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Committee on Energy and Commerce
United States House of Representatives
2125 Rayburn House Office Building
Washington, DC 20515
Attention: David Redl

August 8, 2014

Re: Communications Act Update, Interconnection Agreements

In connection with the Committee's work on updating the Communications Act as it relates to Interconnection Agreements, please find attached Sandvine's September 2013 report, *Exposing the Technical and Commercial Factors Underlying Internet Quality of Experience*. Sandvine makes networking equipment and software that lets service providers: understand network traffic, manage it when the network is congested, create innovative new subscriber services tiers, and guarantee that you are charged properly for them, according to the Internet traffic you use.

The Internet is, amongst many things, a transport mechanism for an end-to-end ecosystem of content delivery amongst participating players. Competing interests must co-operate to deliver acceptable quality. At each interchange between players there is a set of selfish interests and actions which may optimize for one player at the expense of another. Balances are still being sought as the Internet evolves, and these are leading to temporary arbitrage opportunities that may sometimes jeopardize the entire chain.

Quality is affected by a chain of factors, both technical and economic. The location of a quality impairment introduced in the chain is often poorly understood and difficult to measure, and many commonly assume it can only be the access network.

The attached report is a guide to understanding the many interrelated forces that drive Internet quality issues. It examines how content flows from source to consumer, factors that affect the quality of experience of the consumer, and the motivation for decisions relating to those factors. It presents measurements from many networks to demonstrate quality impairments introduced due to both technical and business factors.

This paper also shows how trusted benchmarks such as Speedtest, which seek to 'normalize' experience into simple, objective measures, have accuracy and depth challenges, as well as a tendency to focus subjectively on a single point in the network rather than looking more objectively at the entire data path.

We hope that the understanding that this report brings will help the Committee in its deliberations with respect to potential changes to the Communications Act.

Regards

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Intelligent Broadband Networks

Global Internet Phenomena Spotlight

Exposing the Technical and Commercial Factors Underlying Internet Quality of Experience

SEPTEMBER 2013

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Abstract

The Internet is, amongst many things, a transport mechanism for an end-to-end ecosystem of content delivery amongst participating players. Competing interests also must co-operate to deliver acceptable quality. At each interchange between players there is a set of selfish interests and actions which may optimize for one player at the expense of another. Balances are still being sought as the Internet evolves, and these are leading to temporary arbitrage opportunities that may sometimes jeopardize the entire chain.

Quality is affected by a chain of factors both technical and economic. The location of a quality impairment introduced in the chain is often poorly understood and difficult to measure, and many commonly assume it can only be the access network.

This paper is your guide to understanding the many interrelated forces that drive Internet quality issues. It examines how content flows from source to consumer, factors that affect the quality of experience of the consumer, and the motivation for decisions relating to those factors. It presents measurements from many networks to demonstrate quality impairments introduced due to both technical and commercial factors.

This paper also shows how trusted benchmarks such as Speedtest, which seek to 'normalize' experience into simple, objective measures, have accuracy and depth challenges, as well as a tendency to focus subjectively on a single point in the network rather than looking more objectively at the entire data path.

The best and most consistent quality of experience requires an alignment of business interests and a consistent (and transparent) set of accurate technical measurements at each point in the path.

Executive Summary

The Internet works – its censorship-avoiding, technocracy-driven design and evolution have kept it stable even as architecture and commercial aspects have evolved. However these evolutions are extremely rapid and occur with a momentum that can leave little time to sit back and examine the full breadth of factors and interrelationships that have come to affect Internet quality. To encourage a more complete understanding of the quality issues currently faced by service providers and other stakeholders, it is important to understand how the rapid economic and technical Internet evolution gets ahead of our common understandings, which quickly become false assumptions. Commonly-trusted quality benchmarks fail to deliver a true picture, while economic competition affects service delivery much more than you might think.

Traffic flow is affected by commercial decisions

The 'invisible hand' that guides commercial decisions often causes temporary perturbations to the reliable delivery of good quality which are then corrected through technical means. The cost of video delivery drives economic decisions for content delivery that affect how data flows through the network, with specific high-value interactive activities often overlooked.

As Internet 'quality of service' expectations are driven by entertainment delivery, cost-shifting has temporarily threatened, but not permanently damaged, the ability of over-the-top services to function acceptably. Adaptive streaming video can negatively impact the quality of experience of interactive applications, including web. Internet 'bandwidth' (and cost) is dominated by a small number of players and it is easy to overlook service aspects that represent considerable value for the end user.

Common quality benchmarks are misleading

Benchmarks are overly simplistic, some with significant inaccuracies, and purport to focus on a single spot (the access network) while ignoring other highly impactful impairments in the chain. Serving the overall ecosystem of players well means proper benchmarking with a well-designed experiment that allows sub-segmenting by each independent variable (e.g., segmentation by device, by CDN, by peering, by access, by server, by protocol, etc.). Benchmarks should not focus strictly on 'speed' or 'video' to better account for important applications such as gaming and mobile apps, which are not 'top-10 bandwidth' drivers but are indeed critical consumer applications.

The consequence to quality of service

Incentives to create local optimization, which exacerbate the cost or complexity of other players, exist and are being used. Over time these will work themselves out and a new equilibrium will be found. In the meantime, significant temporary risks exist to the entire ecosystem given the concentration of application bandwidth demand and the central nature of changes to the content serving architectures, with rapid global implications. In the following sections, Sandvine dives deep into the techno-economic factors shaping customer experience to a reveal a more accurate and complete picture of Internet quality of experience.

Contents

Figures

Overview

In "Tussle in Cyberspace: Defining Tomorrow's Internet"[1], Clark et al discuss some of the stakeholders and interests involved in the Internet and how some of these interests conflict, with a focus on the network aspects of this tussle. In this document we expand on that original 'tussle' concept, describing how the Internet interconnection itself and its end-to-end quality chain create additional spots where selfish interests conflict with each other. As roles evolve and the Internet flattens, these interests intersect with the technical nature of how the network works, resulting in quality impairments.

How the Internet is Interconnected

The Internet is a collection of inter-connected private networks. Each of these networks serves a set of roles (and increasingly, serves many roles). Some are consumer access networks (e.g., Comcast, Verizon, and Bell Mobility). These serve the role of an 'onramp', getting consumers first-hop access to any of the other inter-connected networks. Some networks are 'tier-1 IP transit' networks, and these serve the purpose of long-haul interconnection between other networks. Transit networks traditionally have no consumers attached to them - their customers are other networks. Some networks are 'tier-2 aggregation'. These also have other networks as customers and serve as aggregators or intermediaries between tier-1 transit and end -user networks. Some networks are corporate private networks (e.g., Royal Bank of Canada and General Motors). These networks primarily exist to interconnect their own business, but often have outbound connectivity to the Internet. Other networks are 'hosting' networks; these are locations where content providers place their product to make it easily accessible to end-users (e.g., Rackspace, Amazon Web Services). Into this last type of network goes a special type of aggregator called the Content Delivery Network (CDN), which commercially acts to get content as close to the consumer as possible to increase quality and manage the required server CPU & storage capacity.

Increasingly the roles are becoming interchanged – today, tier-1 transit-providers commonly also serve universities, hospitals and end users. Large consumer access providers have built their own backbones. The structure of the Internet is flattening, and this is causing conflict and change. The roles are presented here as distinct, but the reader should assume any commercial entity can be operating in more than one role simultaneously.

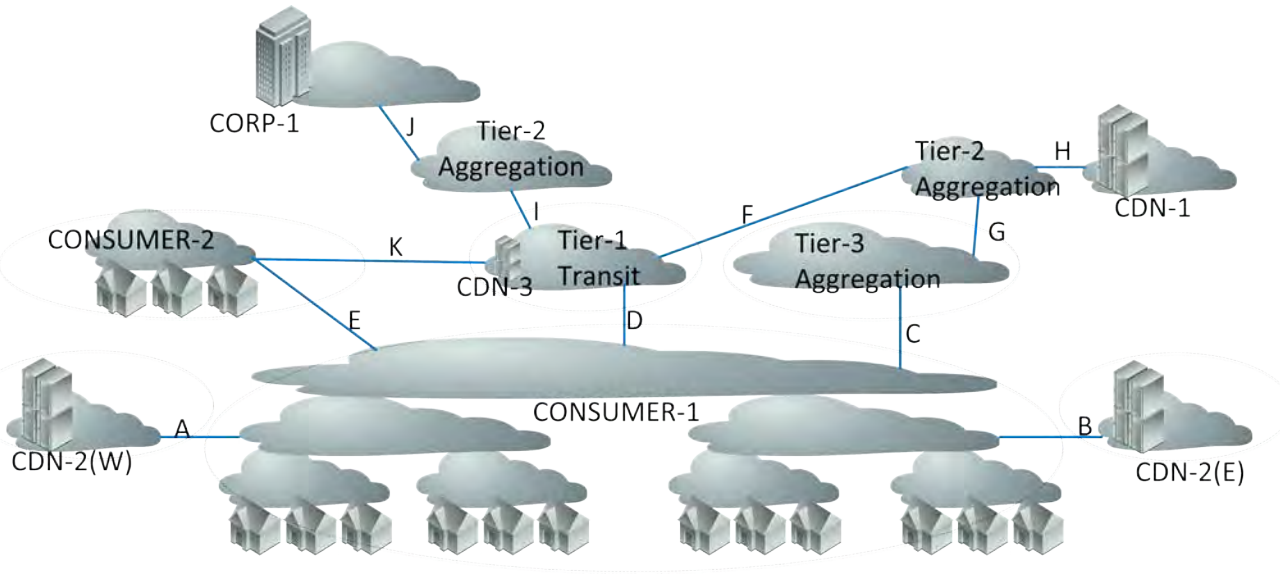


Figure 1 - Stylized network interconnections

Some network providers have vertical integration (e.g., Bell Canada provides consumer access, hosting and corporate services).

1. http://groups.csail.mit.edu/ana/Publications/PubPDFs/Tussle2002.pdf

In general, from each device to each device on the Internet there exist one or more paths. For example, in Figure 1 (which depicts a 'classical' view where there are very distinct roles for each player), CONSUMER-1 can reach CDN-1 via D-F-H, or C-G-H links. This is what makes the Internet special - all hosts are interconnected and reachable. The reality of today's Internet is some of these players play multiple roles as they have expanded into their neighbors' spaces, and this has created 'conflict'.

The mechanisms by which packets choose a specific path are complex. In general, a packet has the destination encoded within it, and at each router it arrives, a local decision is made as to which is the 'best' link to forward it on. The 'best' metric may involve economic cost or technical cost, and may also involve randomness or be based on 'load' (and thus ultimately based on other packets that are unrelated). The decision is also asymmetric in nature - the return path need not have anything in common with the forward path.

Although complex autonomous control systems such as Border Gateway Protocol (BGP)[2] and Open Shortest Path First (OSPF)[3] make these decisions packet by packet, their setup and stability requires considerable communication between the network engineers of the various network-operating organizations, and there are often mailing-lists or user-groups[4] devoted to finding the 'right' person in the 'right' organization to affect the commercial and logistical agreement to peer or inter-connect. In Figure 1, each hand-off between network operators would currently be made autonomously in each direction (packets from CONSUMER-1 to CONSUMER-2 might flow D-K, but from CONSUMER-2 to CONSUMER-1 might flow via E).

Metcalfe's law has pulled companies and people onto the Internet at an exponentially accelerating pace from the earliest days. Even arch-enemy companies that compete want to have their networks interconnected more than they want to be an island. De-peering (where two networks disconnect from each other and thus leave unreachable islands) is the Internet's ultimate punishment, its excommunication.

Considerable technical resources have been expended to create reachability. Challenges abound from all sides: technical (e.g., Network Address Translation), political (e.g., firewalls), and economic (e.g., the digital divide), but the standards have ultimately been largely driven by apolitical technical goals, shepherded by organisations such as the Internet Engineering Task Force (IETF).

Types of network providers

The cost to operate a network is a function of time (e.g., monthly lease costs, employee salaries, and capital amortization) and peak-capacity needs of customers.

Various pricing strategies are used for interconnects between networks, and this gives rise to arbitrage opportunities. Each time data transfers between one network and another there may be an exchange of money, and that flow of money is not end-to-end. It is important to understand how the money flows to understand the 'invisible hand[5]' that guides decisions more efficiently and continually than rules or regulations.

Consumer access network

As a consumer, the most common model is paying your access provider a fixed fee (and optionally some volume overage) for a fixed time of access to anywhere. This in turn places some risk on the access provider since their costs are not fixed, and they respond by oversubscribing the network (selling the same units of bandwidth multiple times). This oversubscription model is very common in parallel technologies (electricity, water, roads) in which not all possible demand can be simultaneously satisfied, but almost all practical demand is satisfied. This in turn creates an efficient network (since a non-oversubscribed network would be idle most of the time). Consumer access networks normally differentiate from each other based on price and speed. An appropriately oversubscribed network can be sold at an inverse-ratio-created lower price.

Many network types are symmetric in capacity, but asymmetric in demand, yielding some latency inefficiency (consumer networks tend to have less upstream demand and hosting networks tend to have less downstream demand). In some technologies this 'ratio' is used to advantage, with asymmetric sharing of spectrum.

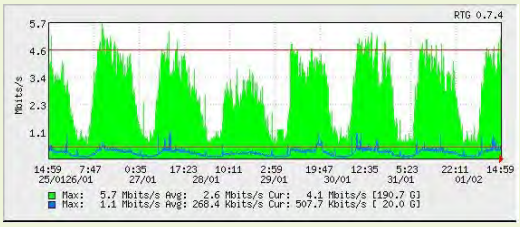
In Sandvine's 1H 2013 Global Internet Phenomena Report, we found that a typical 'ratio' of Down:Up bandwidth demand for North American fixed access was ~6:1 (averaged over a month), and ~8:1 for mobile. But this does vary geographically (e.g., Europe fixed was ~4:1 reflecting the higher proportional use of peer-To-peer file sharing)

2. http://datatracker.ietf.org/wg/idr/charter/
3. http://datatracker.ietf.org/wg/ospf/charter/
4. http://www.nanog.org/
5. http://en.wikipedia.org/wiki/Invisible_hand

Tier-1 IP transit

As a tier-1 IP transit provider, the most common business model is to charge all who interconnect with you a peak-bandwidth price. Normally this is expressed as a 95th percentile[6] of your peak. The median price for several major cities is shown in Figure 2. Transit pricing is very sensitive to location (denser locations with more networks are much cheaper) and volume (purchasing higher volumes offers significant 'economy-of-scale' discounts). Tier-1 IP transit providers normally differentiate based on location, cost, over-subscription, and reach. Tier-1 transit providers do not buy bandwidth from anyone - they are always a seller, and the price paid often-reflects the quality of the connection.

95th percentile billing is used as a good approximation of true cost for both parties (neither side would likely pay for the 100% burst rate).



As the tier-1 IP transit providers also provide end-user access (for example, Level-3 serving consumers in Starbucks[7], Tata Communications providing service to Bank of America[8]), they are able to capture revenue on both sides of the market.

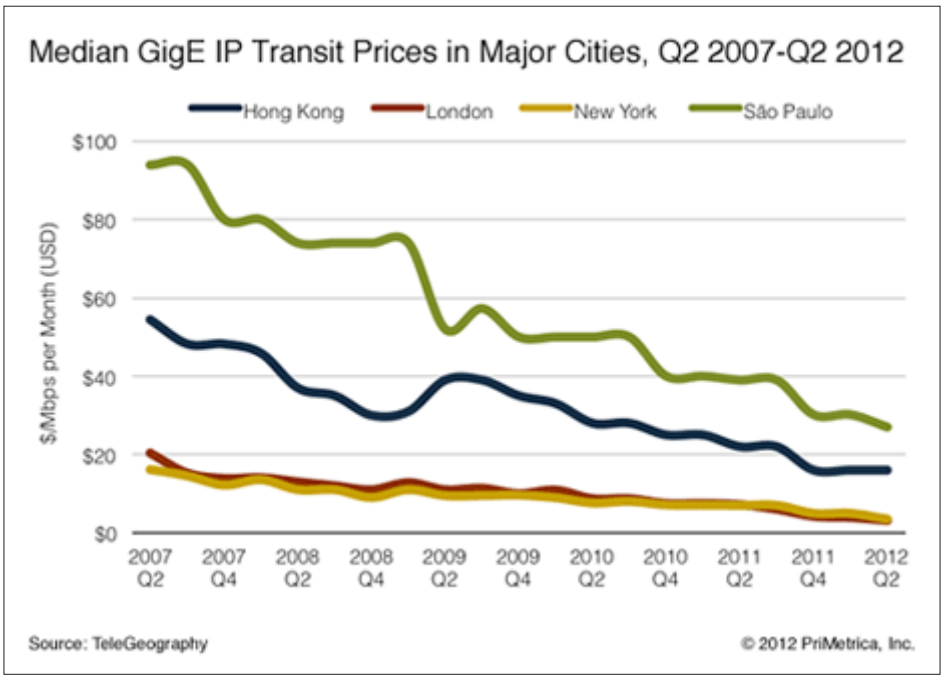


Figure 2 - Media Transit Pricing Major Cities

An example coverage map[9] for a tier-1 transit provider is shown in Figure 3: Example coverage map, Cogent Communications and Figure 4: Example coverage map, Level 3 Communications. From this we can imagine that if we send traffic into Cogent to reach Wyoming or Alberta that it will require going through another aggregator (perhaps a tier-2).

Figure 3 - Example coverage map, Cogent Communications[10]

6. http://en.wikipedia.org/wiki/Burstable_billing
7. http://blog.level3.com/customer-experience/theres-coffee-then-theres-starbucks/
8. http://radar.qrator.net/general/?asnum=4755
9. http://www.cogentco.com/files/images/network/network_map/networkmap_global_large.png
10. http://www.cogentco.com/en/network/network-map

Figure 4 - Example coverage map, Level 3 Communications[11]

To get the best price, it is a very common practice to enter into forward-contracts with transit providers[12] (e.g., purchase a guaranteed amount per month for the next 12 months) in addition to the costs associated with setup (routers, links, etc.). The setup costs are normally amortized over the contract duration.

Tier-1 IP transit has been seeing some large changes in business models. Although formerly it was rare for these operators to peer with their customers' customers (e.g., compete with their own customers), new business opportunities such as Level 3 entering the WiFi market[13], Level 3 entering the CDN market[14], and Tata Communications entering the managed mobile network operator market[15], have created significant friction as existing business relationships were often built around assumptions no longer true (e.g., distance/cost carried, symmetry, etc).

Tier-2 IP transit

Tier-2 IP transit aggregation providers[16] normally charge based on a 95th percentile peak. Bandwidth is normally lightly oversubscribed. These providers normally differentiate on price and geographic reach. In the diagram above, Figure 3: Example coverage map, Cogent Communications, a regional tier-2 network will be used to reach Wyoming, Montana, etc. Depending on the depth of a market, additional tiers of transit may exist although this is becoming rarer as the Internet is becoming flatter (see Internet Traffic Evolution[17], Internet Evolution[18]).

Private peering

Private peering[19] (interconnection between two private networks as shown on link E in Figure 1) is often performed on a fixed-cost (sometimes called settlement-free) basis. In this model, two networks that send roughly the same amount of traffic to each other decide that the value is mutual, and each pay half of the cost of a link between them. This is often done at certain interchange locations (which may be public, e.g., the Toronto Internet Exchange[20]) where each provider has a physical presence and the cost of running a cable is minimal. Peering policies vary widely by company, and are often a mix of technical requirements and commercial requirements.

11. http://maps.level3.com/default
12. http://www.kpn-international.com/scripts/factsheetPopup.asp?factsheetName=IP_Transit_Factsheet.pdf
13. http://blog.level3.com/customer-experience/theres-coffee-then-theres-starbucks/
14. http://blog.level3.com/high-performing-websites/level-3s-cdn-strategy/
15. http://www.tatacommunications.com/news/release-view.asp?d=20130207
16. http://en.wikipedia.org/wiki/Tier_2_network
17. http://www.monkey.org/~labovit/papers/gpf_2011.pdf
18. https://www.internetsociety.org/sites/default/files/brochure.pdf
19. http://en.wikipedia.org/wiki/Peering
20. http://www.torix.ca/

An example peering policy is that of AT&T[21], which has the following high level requirements:

- Speed (due to AT&T scale, they only peer with 10Gbps or greater connections)
- Three or more geographically-diverse points of interconnect (for cost and reliability)
- Cannot be a customer of AT&T and also a settlement-free peer simultaneously
- Ratio must be no more than 2:1 (into AT&T : out of AT&T)
- Must not 'game the system' (forwarding traffic AT&T didn't advertise destination of, reselling peering privilege, etc.)

Hosting providers

Hosting providers normally charge their clients on the basis of monthly volume (GB/month) or on a peak (95th percentile) bandwidth basis. Monthly volume charges do not align perfectly with their cost structure (since their cost is based on peak), but they account for this in their capacity planning and oversubscription modeling. A hosting provider normally has many clients in the same infrastructure, and as a consequence the peaks tend to spread out, lowering this risk.

There is a vast difference in price between the cheapest and the most-expensive hosting (see Figure 5: Rackspace dedicated server pricing at $499/month for 2TB transfer versus Figure 6: GoDaddy hosting pricing at $4.29/month for unlimited transfer). As you might expect, the difference is stark because the products differ in oversubscription and availability, not simply due to profit margins.

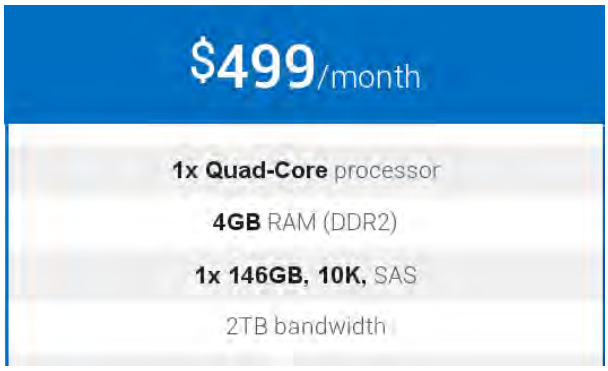


Figure 5 - Rackspace dedicated server pricing [1]

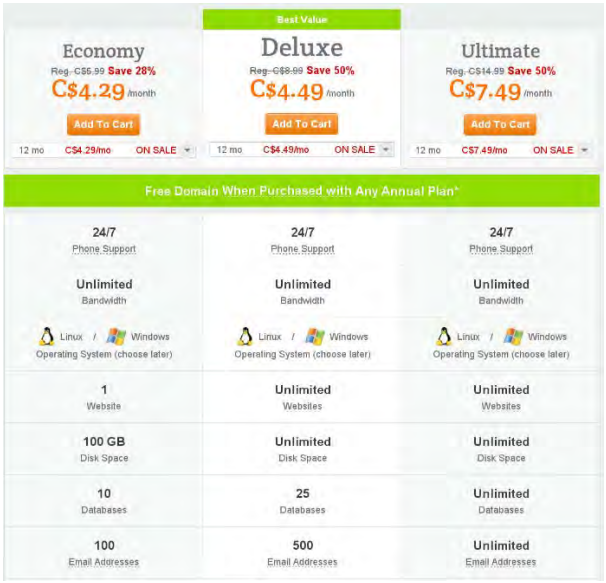


Figure 6 - GoDaddy hosting pricing [2]

This difference in oversubscription manifests itself to the consumer as very different performance. If you have content to host, you will have to make a trade-off between cost and performance when choosing a hosting provider.

21. http://www.corp.att.com/peering/

CDN providers

CDN[22] providers are normally located in hosting providers (or are hosting providers in their own right), and typically charge their clients on a monthly volume-transferred basis (in addition to an amount-stored basis), in addition to features (e.g., SSL support, high-definition video support, analytics, number of points of presence, etc.). CDN providers normally differentiate based on price, reliability, latency, and features. There is a broad spectrum of 'quality' and 'cost' available in the CDN space - examples include Akamai and LimeLight Networks.

Use of a CDN provider may be paired with a hosting provider (e.g., 'web site acceleration' plans). In this model, a content provider purchases 'hosting', and this acts as the master web-site, and CDNs provide transparent caching of it around the globe.

Looking at a CDN that positions itself as a price-leader (such as CDN77, see Figure 7), there is a large difference in bandwidth cost versus its competitors, presumably due to higher oversubscription and fewer distributed servers (leading to higher latency and lower quality).

Very significant changes have occurred in this space as the tier-1 transit providers have moved to also become CDN players.

Level 3 "stores more than 1 billion video files… and every month more than 47PB of video are streamed by Level 3"

Tata operates a CDN that is "integrated with the largest global Tier 1 reach network in the world extending into over 200 countries and territories"

And this in turn has been a source of complaint as the cost of transit is often associated with that 'global reach' rather than 'locally-delivered video'.

In addition other telecommunications firms have moved to form an Open Carrier Exchange for carrier CDN, further muddling the delineation in roles.

Monthly traffic	* EdgeCast	CDN77.com
10 TB	$2 000	$490
100 TB	$20 000	$4500

Monthly traffic	* Akamai	CDN77.com
10 TB	$3 500	$490
100 TB	$35 000	$4500

Figure 7 - CDN77 versus competitor pricing[23] [24]

22. http://en.wikipedia.org/wiki/Content_delivery_network
23. http://www.cdn77.com/akamai-vs-cdn77
24. http://www.cdn77.com/edgecast-vs-cdn77

Looking at one of the industry leaders (see Figure 8: Amazon CloudFront CDN pricing), we can see pricing models for data transfer, and request pricing (in addition to the other Amazon fees that would be needed such as storage and compute capacity).

Regional Data Transfer Out (per GB)

	United States	Europe	Hong Kong, Korea & Singapore	Japan	South America	Australia	India
First 10 TB / month	$0.120	$0.120	$0.190	$0.201	$0.250	$0.190	$0.170
Next 40 TB / month	$0.080	$0.080	$0.140	$0.148	$0.200	$0.140	$0.130
Next 100 TB / month	$0.060	$0.060	$0.120	$0.127	$0.180	$0.120	$0.110
Next 350 TB / month	$0.040	$0.040	$0.100	$0.106	$0.160	$0.100	$0.100
Next 524 TB / month	$0.030	$0.030	$0.080	$0.085	$0.140	$0.095	Contact Us
Next 4 PB / month	$0.025	$0.025	$0.070	$0.075	$0.130	$0.090	Contact Us
Over 5 PB / month	$0.020	$0.020	$0.060	$0.065	$0.125	$0.085	Contact Us

Request Pricing (per 10,000)

	United States	Europe	Hong Kong, Korea & Singapore	Japan	South America	Australia	India
HTTP requests	$0.0075	$0.0090	$0.0090	$0.0095	$0.0160	$0.0090	$0.0090
HTTPS requests	$0.0100	$0.0120	$0.0120	$0.0130	$0.0220	$0.0125	$0.0120

Figure 8 - Amazon CloudFront CDN pricing[25]

The heterogeneity of pricing models, being based on a variety of principles (e.g., peak bandwidth versus monthly volume), creates an arbitrage opportunity.

25. http://aws.amazon.com/cloudfront/

Streaming video paths

Real-time entertainment (including streaming video) is the largest class of Internet traffic (by volume) today. Sandvine's 1H2013 Global Internet Phenomena[26] found that real-time entertainment is 68.2% of the downstream at peak time (see Figure 9). Since a network's capital cost is driven heavily by peak capacity (unused capacity is waste, link cost is driven by peak speed but also by availability: late night users also need it), this means there is significant incentive for all parties to optimize and find efficiencies. But it also means there is significant incentive to move the cost to another party, and there is ample opportunity to do so. With limited exceptions (peak and off-peak pricing to incent night-owls, using time-zones to trade-off transport distance versus server load), moving traffic in time is not an option because, with real-time applications, consumers decide when they want to be entertained. Most of the focus is on reducing the number of links, moving traffic to lower-cost links, arbitrage on pricing models, better video compression, etc.

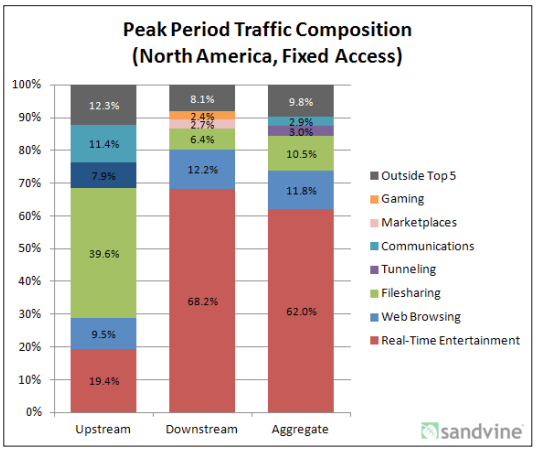


Figure 9 - 1H2013 North America Fixed Access Peak Period

Among these real-time entertainment providers, two notably provide the largest impact on the fixed network: Netflix (at 32% of the peak bandwidth) and YouTube (at 17% of the peak bandwidth)[27]. Together, these two account for almost half the cost (which is based on peak demand) of a consumer network.

Streaming video may flow from source (server) to destination (consumer) in various fashions. Small-volume sites like corporate web sites may directly host their video on their own server. In this case all users worldwide will use the same server and same final path. Large-volume sites might buy service from a single CDN provider, in which case the consumer will be directed to a server selected by the CDN. Mega sites might buy service from multiple CDN providers. This makes for a more complicated choice of both servers and paths. The content aggregator (e.g., Netflix, Hulu) provides the consumer client typically as software (e.g., a mobile or desktop application) and this in turn selects a specific CDN for a specific content/time/location (refer back to Figure 1: Stylized network interconnections to see the impact this will have). The algorithm for CDN selection is proprietary, and may have encoded specific rules depending on the access network used, time of day, client operating system, etc. The CDN then selects the server (from a load-balanced set). As a consequence the content provider has a significant obligation to pick 'the best path' (since their choice comes first) and may steer very significant quantities of data.

In practice, when the user selects a video, the following path-related choices are made:

1. Video content provider selects CDN (based on cost, content availability, load)
2. CDN provider selects server (based on server load)
3. Hop-by-hop path to server is selected (based on network routes) - the more 'peering', the more route options that exist

26. http://www.sandvine.com/news/global_broadband_trends.asp
27. Sandvine 1H2013 Global Internet Phenomena

In Figure 10 a sample network is shown. In this hypothetical network, when the user opens his or her video client, the video provider decides which CDN to use. They may do this to minimize their CDN cost, since one CDN may charge per peak rate, and one per monthly average. This in turn would cause the video provider to select the peak-rate CDN in off-peak time, and the monthly-average CDN in peak time. They may do this based on licensed features – for example, one CDN may charge more to host HD video than another. They may also select based on where they are in their monthly billing cycle if, for example, one CDN has a fixed fee for the first N bytes and a variable free for M bytes afterwards.

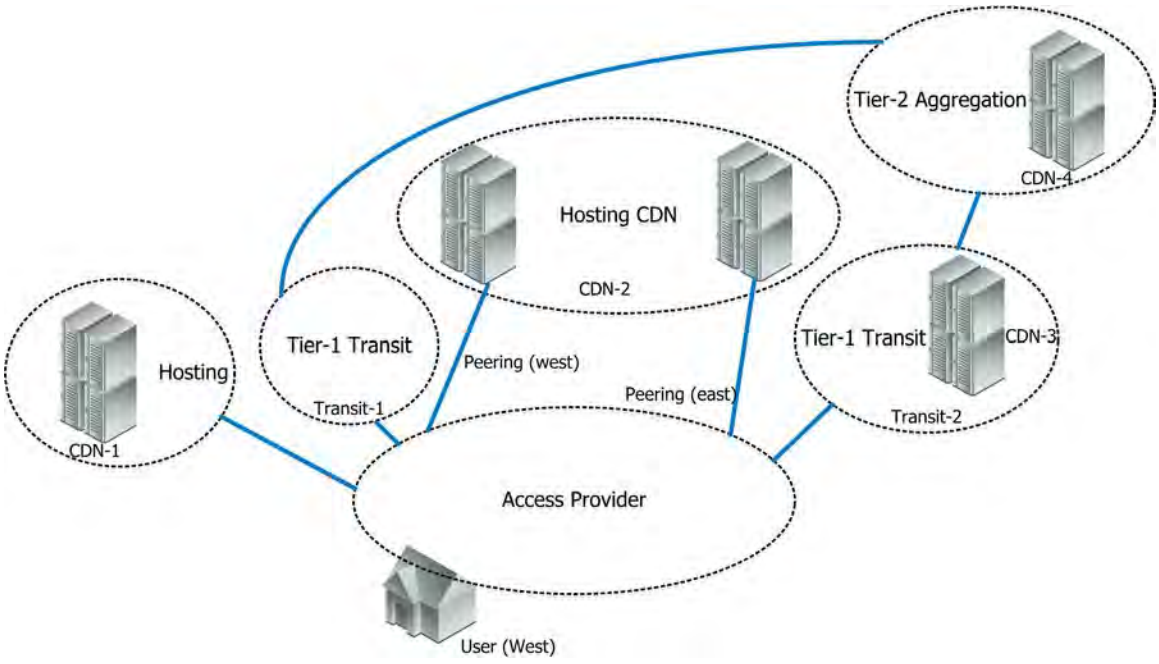


Figure 10 - CDN and path selection

Once the video provider has selected a CDN, the CDN provider now must select a server. In some cases this will have no network impact (e.g., for CDN-1 in the diagram above, all servers will use the same network paths). In other cases this can have large network impacts. The CDN-2 provider above has to make a decision to use the west or east server cluster. If they strictly optimize for server load, they will serve the west-coast users from the east-cost servers during peak time (since the 3-hour time-zone difference will allow them to offset peaks). This would trade-off network cost and latency for server cost. Since the CDN provider is paying the same for the bandwidth in each case, they are likely to choose the longest path and cheapest-server choice. This will in turn move cost from them to the access provider (who must now pay to get the traffic across the country). Given the high difference in price charged by the CDNs, as shown in Figure 10, there certainly is a strong economic incentive.

Once the server is selected, the network selects a path (actually it is selected for each packet individually). For example, if CDN-4 is used, both transit-1 and transit-2 are valid paths for packets. The Access Provider might pay a different amount to transit-1 and transit-2 (as might the tier-2 aggregation network). This selection of path is done using routing metrics exchanged with BGP[28], part of the Inter-Domain Routing protocol family of the Internet Engineering Task Force (IETF[29]).

Bandwidth is normally purchased in advance (e.g., a guarantee of X Mbps for 1 year). Thus a CSP purchasing a supply contract with Hurricane Electric for 1 year to maximise their customers' experience of Netflix may have that contract and the interchange link capital stranded if Netflix switches to prefer Cogent or Level 3.

Looking in more detail at one of the largest video sources on the Internet, Netflix, and their Open Connect CDN, we can see their peering locations[30] from their web site in Figure 11. Given the very large bandwidth demand of Netflix, there is significant network impact when they change peering locations. Changing from one location to another may suddenly leave stranded capacity at the old location (or stranded forward-contracts for bandwidth), and suddenly have inadequate capacity at the new locations. Since the decision is made centrally on the Netflix control servers[31], this can cause an instantaneous world-wide change.

28. http://datatracker.ietf.org/wg/idr/charter/
29. http://www.ietf.org/
30. https://signup.netflix.com/openconnect/locations
31. http://ptt.br/pttforum/6/doc/Netflix-Open-Connect-Network-BR-December-2012-v1.pdf

Open Connect Peering Locations

Private Network Interconnect Sites

City	Provider	Site Identifier
Amsterdam	Telecity	TC2/TC5
Ashburn	Equinix	DC Campus
Atlanta	Telx	56 Marrietta
Chicago	Equinix	CH1/CH2/CH4
Dallas	Equinix	DA1-3
Dublin	Telecity	Data Electric
London	Telecity	Sovereign House
London	Telecity	Harbour Exchange
London	Telehouse	Telehouse North
Los Angeles	Coresite	One Wilshire
Los Angeles	Equinix	LA1
Miami	Terremark	NAP Of The Americas
New York	Equinix	NY9
New York	Telx	111 8th Avenue
New York	Telx	60 Hudson Street
San Jose	Equinix	SV1/SV5
São Paulo	Ahog	Tambore SP2
São Paulo	Global Crossing	Cotia
Seattle	Westin Building	19th Floor FMMR
Stockholm	Telecity	TC1
Stockholm	Telecity	TC2

Peering Exchanges

City	Exchange	IPv4 Address1	IPv4 Address2	IPv6 Address1	IPv6 Address2
Amsterdam	AMS-IX	195.69.146.250	195.69.147.250	2001:7f8:1::a500:2906:1	2001:7f8:1::a500:2906:2
Ashburn	Equinix Internet Exchange	206.223.115.238		2001:504:0:2::2906:1	
Atlanta	Telx Internet Exchange	198.32.132.113		2001:478:132::113	
Chicago	Equinix Internet Exchange	206.223.119.156		2001:504:0:4::2906:1	
Dallas	Equinix Internet Exchange				
London	LINX Juniper LAN	195.66.225.101	195.66.224.6	2001:7f8:4::b5a:1	2001:7f8:4::b5a:2
London	LINX Extreme LAN	195.66.236.6		2001:7f8:4:1::b5a:2	
London	LONAP	193.203.5.229		2001:7f8:17::b5a:1	
Los Angeles	Coresite Any2	206.223.143.215		2001:504:13:0:0:0:0:215	
Miami	NOTA	198.32.125.71		2001:478:124::1071	
New York	Equinix Internet Exchange	198.32.118.176		2001:504:f::2906:1	
New York	Telx Internet Exchange	206.126.115.225		2001:504:17:115::225	
New York	Telehouse NYIIX	198.32.160.90		2001:504:1::a500:2906:1	
San Jose	Equinix Internet Exchange	206.223.116.133		2001:504:0:1::2906:2	
São Paulo	PTTMETRO Exchange	187.16.217.185		2001:12f8::217:185	
Seattle	SIX	206.81.80.222	206.81.80.223	2001:504:16::b5a	2001:504:16::223:0:b5a
Stockholm	NetNod	194.68.123.43	194.68.128.43	2001:7f8:d:ff::43	2001:7f8:d:fe::43

Figure 11 - Open Connect Peering Locations (June 2013)

If we look at the Netflix bandwidth in the São Paulo PTT Metro exchange on the launch of Netflix Open Connect[32] (Figure 12), we can see the instantaneous 'knife-edge' effect.

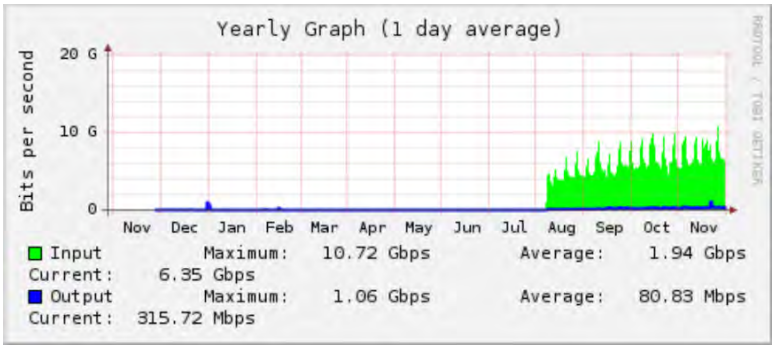


Figure 12 - Open Connect bandwidth in Sao Paolo PTT Metro Exchange

Significant changes in bandwidth are indeed a normal course of business for any video aggregator. If we look at the Netflix use of various CDNs in January and June 2012[33], we can see there was a large shift from the use of Akamai, LimeLight Networks, and Level 3 towards Netflix's own CDN. This in turn caused a tremendous shift in how interconnects between various tier-1 and tier-2 transit and peering links were sized, and may have stranded considerable capital in both the network interconnect locations and hosting servers within the third-party CDNs.

32. http://ptt.br/pttforum/6/doc/Netflix-Open-Connect-Network-BR-December-2012-v1.pdf
33. http://www.deepfield.net/2012/06/first-data-on-changing-netflix-and-cdn-market-share/

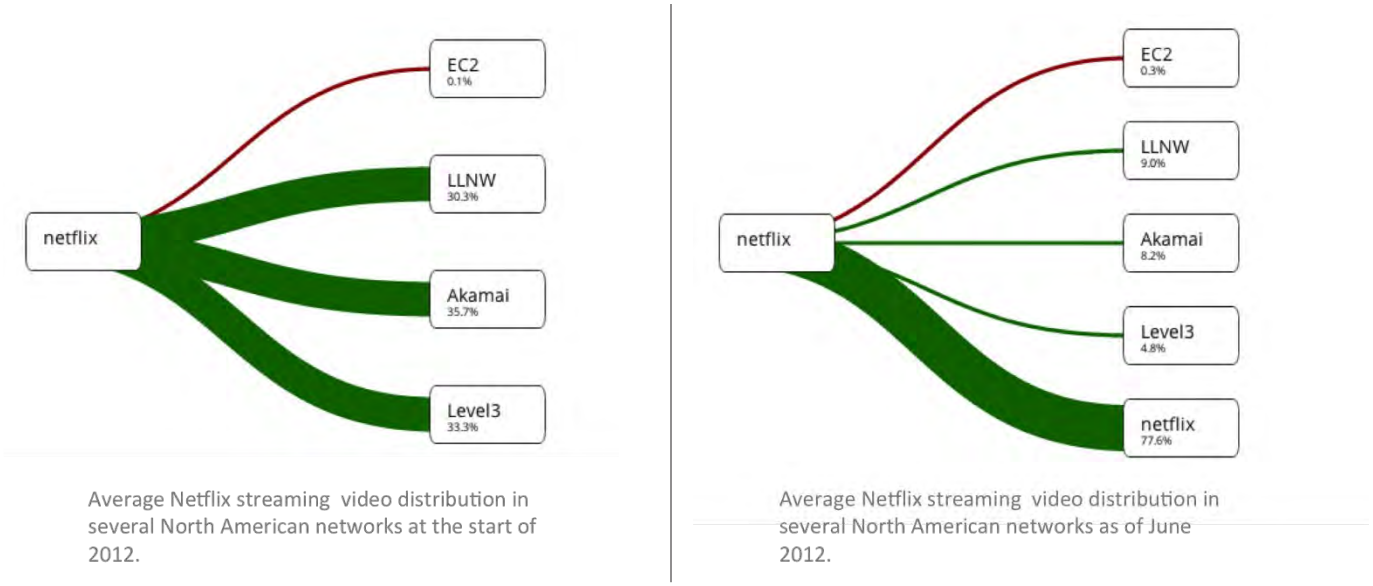


Figure 13 - Netflix CDN shift in 2012

Real interconnect examples

The above examples[34] used stylized 'single-hop'-connected CDNs in a very simple-to-understand fashion. Unfortunately, the Internet is much more complex, with many more players. Interconnection between networks (which are called Autonomous Systems or AS, and named by a number) is done with BGP, and we can see via various 'Looking Glass'[35] systems how different networks view the world.

For example, we can look at how Netflix interconnects with other 'backbone' connections via the Hurricane Electric 'Looking Glass'[36] to see an example of how their network sees Netflix (AS2906) interconnection:

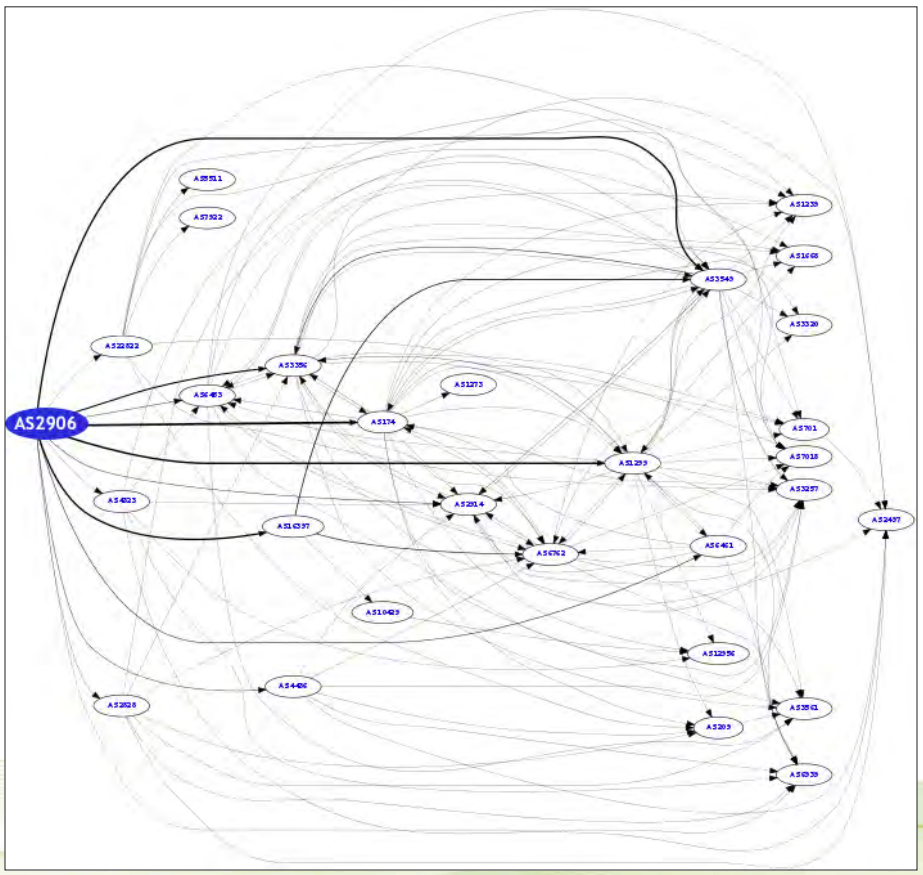


Figure 14 - AS2906 from Hurricane Electric vantage point

34. http://www.deepfield.net/2012/06/first-data-on-changing-netflix-and-cdn-market-share/
35. http://lg.he.net/
36. http://bgp.he.net/AS2906#_graph4

If we look at how Netflix interconnects[37] via Robtex we see an entirely different topology. Since the topology is a function of the decisions of each player along the way, it can change rapidly, a problem known as 'route flapping'[38].

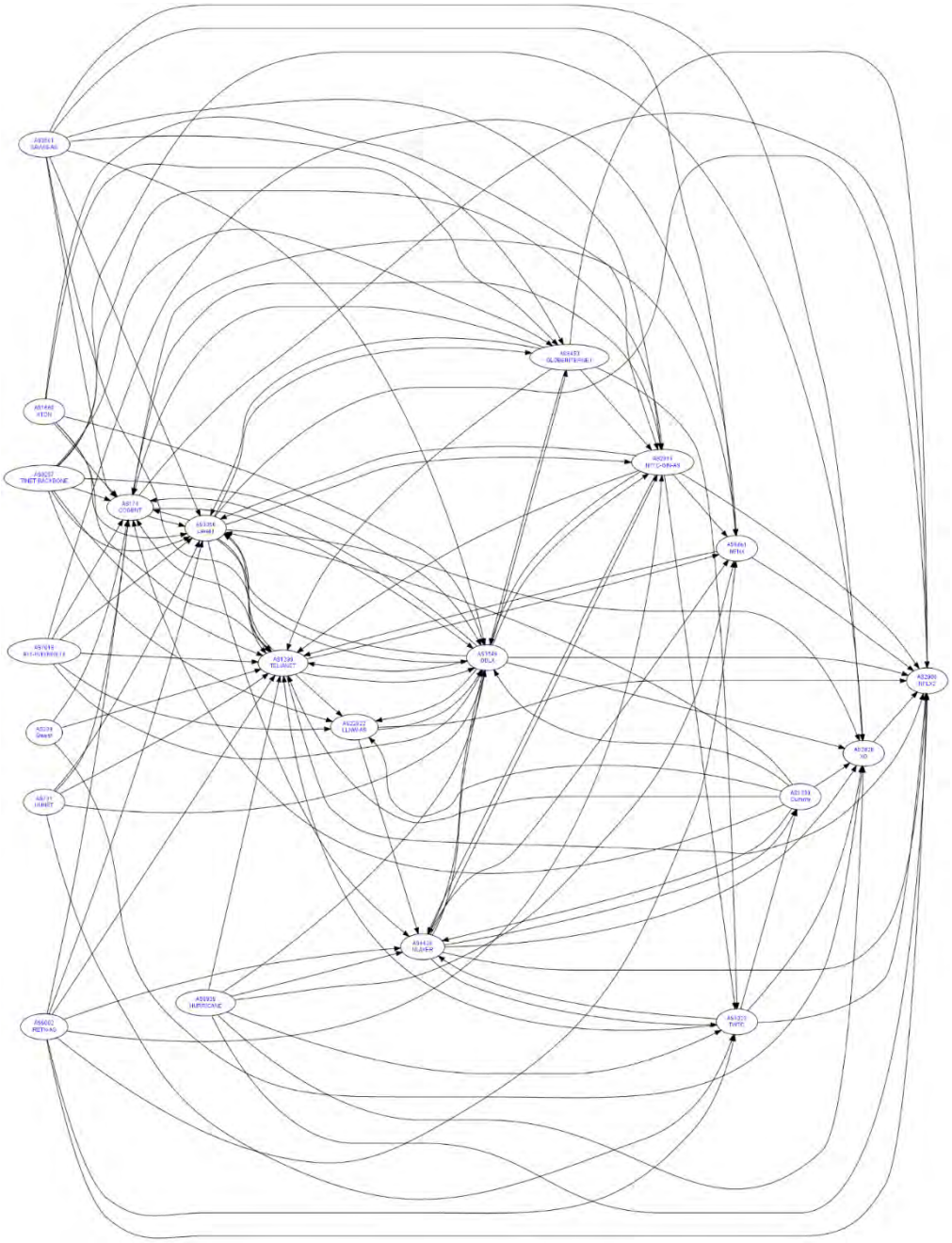


Figure 15 - Netflix Interconnect via Robtex

Due to the complexity of the links involved in the routing, and the hop-by-hop decision making of the network, there is considerable technical risk that a change in one player can have a significant effect on another player.

37. http://as.robtex.com/as2906.html
38. http://en.wikipedia.org/wiki/Route_flapping

Benchmarks

So by now it should be clear that the route a packet takes through the Internet is the result of a complex equation that includes many decisions, both technical and commercial, related to interconnection relationships, hosting, serving, and many other factors, such as BGP, etc. A multitude of players along the chain, all acting rationally in their own best interest, can influence the path of a packet, and in so doing affect the quality of service. In this wildly complex environment, then, how do we find appropriate benchmarks of quality? What (and who) are these benchmarks actually testing?

Demand vs. Capacity

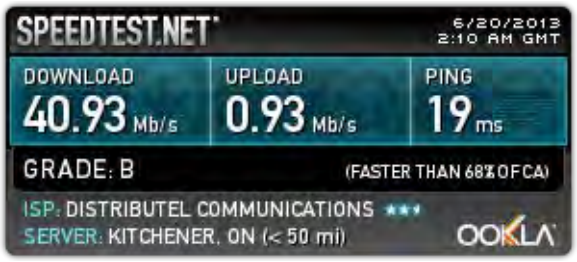
Consumers buy plans advertised as 'up-to' speeds. These represent the theoretical capacity (e.g., how much traffic in some time interval may be transferred under some ideal condition). This is normally based on some provisioned value (e.g., in a DOCSIS cable environment, it is a parameter in the cable-modem, while in a DSL environment it is a parameter in the DSLAM). Thus the ISP knows an amount the user cannot exceed, but has a harder time estimating what they will achieve (due to oversubscription and potential impairments in line quality).

Actual capacity is difficult to measure since it may vary as a function of time (other traffic, weather, etc.). It is also prone to a large set of 'errors' in the measurement process: users may test on WiFi and actually be measuring mostly their in-house network, users may inadvertently have other devices consuming bandwidth during the test, users may not have upgraded their home-router to match the new speed of their connection, etc. In addition, as we will see below, it is challenging to construct an accurate test that can represent the 'typical' and 'peak' performance that might be achieved.

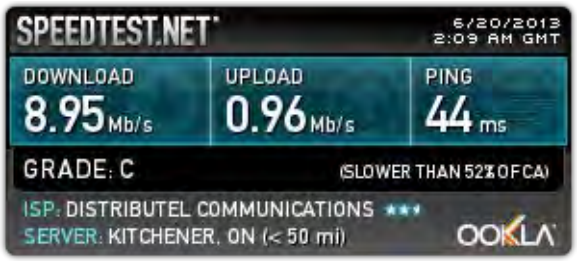
Speedtest

One of the most widely available benchmarks is Ookla's Speedtest.net. But how accurate is this as a benchmark of either 'throughput' in particular, or of 'quality of experience' in general?

If we examine Speedtest in detail (see Figure 16), we see that it normally presents two or more servers to a user as 'suggested' ones (picked based on geographical proximity estimated by the user's IP address). Taking the suggested servers and using them on an otherwise completely idle connection, we find that the two servers consistently give very different results.



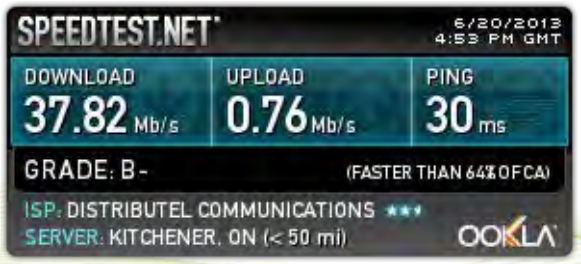
Server A



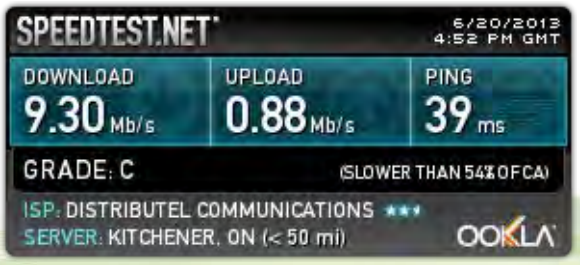
Server B

Figure 16 - Sample Speedtest results off peak

If we run this same test again at a more 'congested time of the day', we see the results are similar:



Server A



Server B

Figure 17 - Sample Speedtest results during congestion period

Note that the network is not the only reason Speedtest has variability. The servers are not identical in setup or configuration. For some higher-speed networks, the TCP connection Speedtest uses does not run long enough to satisfy the Bandwidth-Delay product[39], and as such spends most of its time 'accelerating' without reaching the final speed. In other cases it may be the performance of the server Speedtest runs on, or the server may be improperly tuned. For example, if we look in more detail at the transfer rate of those two Speedtest servers using Wireshark[40] (shown in Figure 18), we can see that the faster server uses a TCP Window Size of 900K, and the slower one uses a TCP Windows Size of 250K. This is a design choice solely of the server operator, and prevents the delivery of higher bandwidth even if available.

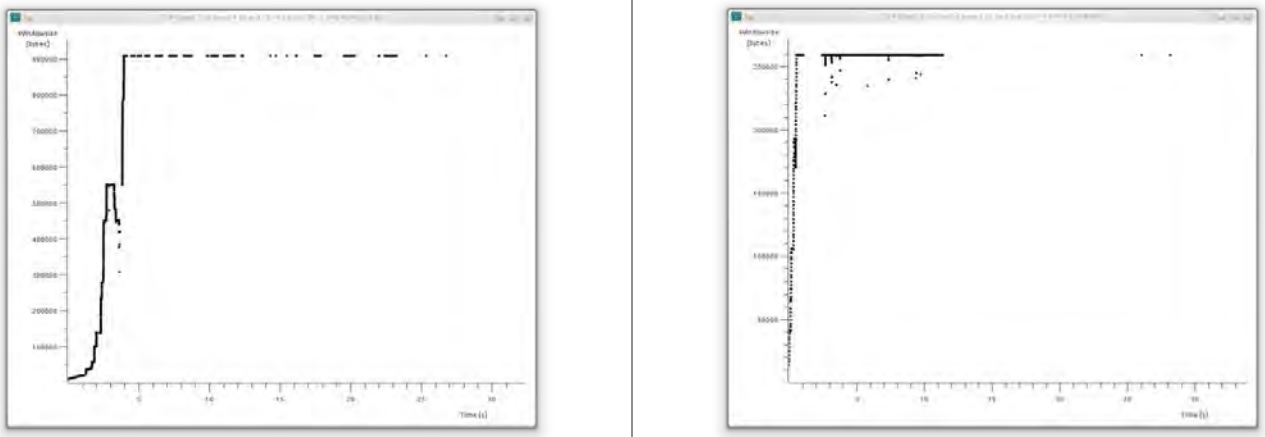


Figure 18 - TCP Window size versus time

If we look at the TCP parameters (Window Size, Window Scale) used by the two servers (by examining the SYN/ACK packet), we can see the first gives us 14480 * 128 == 1853440 bytes. The second gives us 370688 bytes (5792 * 64). What this means is that in an ideal network, one server is prepared to go five times as fast as the other just from its software configuration. And in practice, that is what we achieve. The only way to make the second Speedtest server deliver a faster result is a reconfiguration of it. We are not benchmarking the network, but rather the server!

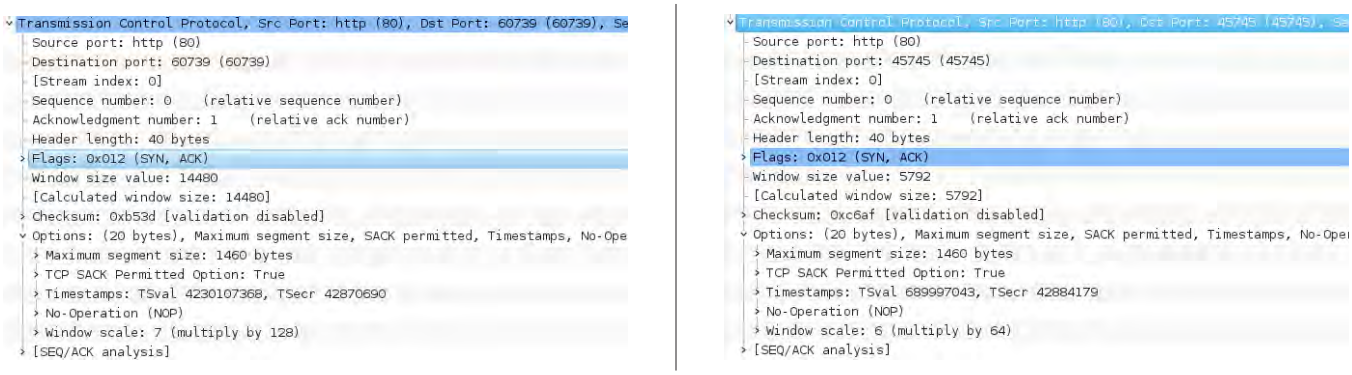


Figure 19 - TCP parameters of Speedtest

Using 'nmap', we can estimate the server operating system, and we see the first one is running Apache/2.2.15 (CentOS) on Linux 2.6.39, and the second is running Apache/2.2.16 (Debian 6) on Linux 2.6.32. Although similar, these are different Linux kernel versions and different Apache (HTTP server) versions. To be a true benchmark, one should try and keep all parameters the same except for the one under test.

39. http://en.wikipedia.org/wiki/Bandwidth-delay_product
40. http://www.wireshark.org/

If we repeat this experiment in other carriers in other geographies, we see a similar effect. For example, in São Paulo, Brazil we can see there is one server, Server A, which is an outlier (~110ms latency and ~20% slower) for the same time and same consumer location.

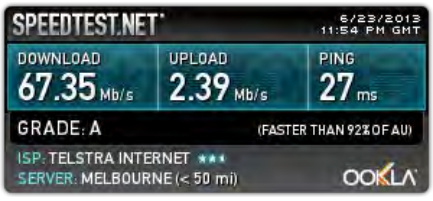
Server A

Server B

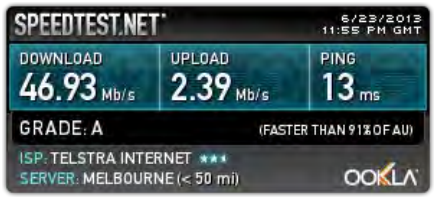
Server C

Figure 20 - Sample Speedtest results, São Paulo, Brazil, one outlier

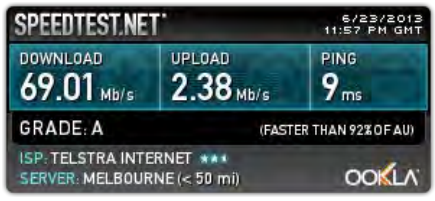
In Melbourne, Australia, we see there is also one server, Server B, which is an outlier, being ~30% slower in bandwidth than the others (interestingly its latency is lower than one of the fast servers suggesting this might be a server issue more than a congestion issue).



Server A



Server B

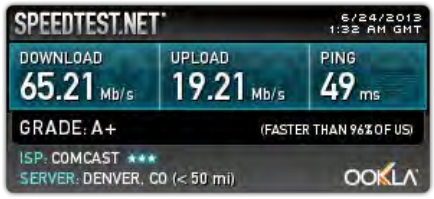


Server C

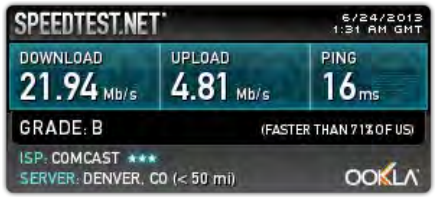
Figure 21 - Sample Speedtest results, Melbourne, Australia, one outlier

In Denver, Colorado, USA, we also see very different results for the same time period.

Server A



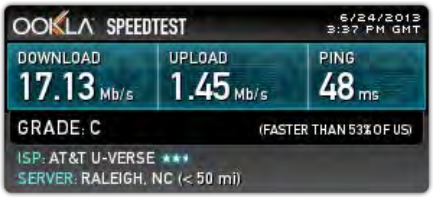
Server B



Server C

Figure 22 - Sample Speedtest results, Denver, Colorado, USA

Elsewhere in the USA, in Raleigh, North Carolina, we see similar results. Interestingly here, the highest latency connection, Server B, also provides the fastest download speed. All servers are very close geographically.



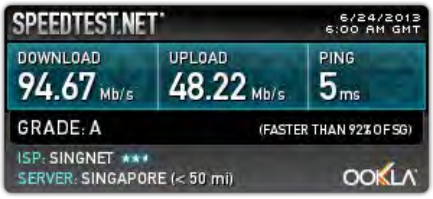
Server A

Server B

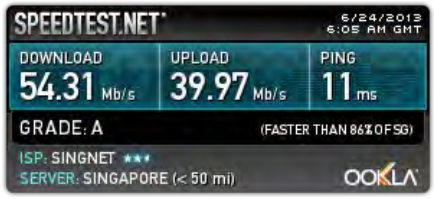
Server C

Figure 23 - Sample Speedtest results, Raleigh, North Carolina, USA

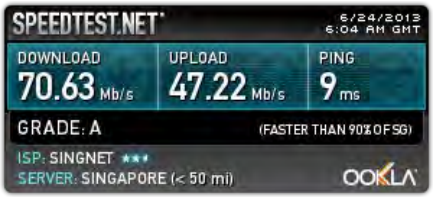
Continuing our look around the world to Singapore, we find an even larger variation. As expected, the latency is very similar for all (all servers are located in the same city in the island-state), but there is a ~2:1 difference between the fastest and slowest results. This is almost certainly due to the “bandwidth-latency-product not running long-enough” issue (the ‘fastest’ Server A is half the latency and two times the download speed of ‘slowest’ Server B, not surprising). This test point was on a fiber-to-the-home (FTTH) connection.



Server A



Server B



Server C

Figure 24 - Sample Speedtest results, Singapore

If we compare the last example with the official government benchmarks[41], we see that one of the servers, Server A, compares favorably with Speedtest (suggesting that there can be a correct benchmark). The end-user was a subscriber of the 100 Mbps service.

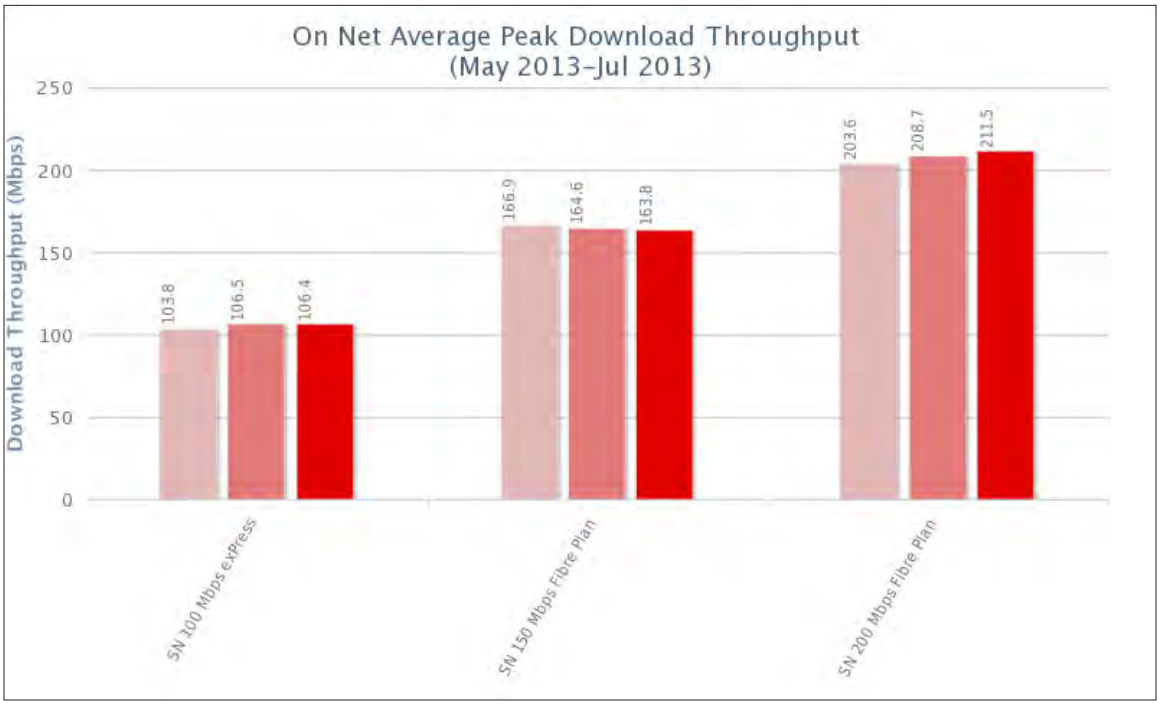


Figure 25 - Singapore Government ISP Benchmark

41. http://www.ida.gov.sg/applications/rbs/chart.html

YouTube benchmark

Although not as widely publicized as Speedtest, YouTube has a 'benchmark'. Unlike Speedtest which seeks to measure 'absolute capacity', YouTube measures 'maximum demand'. That is, it measures the peak rate that you, the user, request of it. If you only watch low-definition video, this will give a lower result. Unlike Netflix, Google (who owns YouTube) provides all bandwidths and resolutions to all users and devices (e.g., all users can try 1080p content).

If we examine the results that I achieve (for the selection of videos viewed in my home on various devices both wired and unwired), we see that I achieve 19.13Mbps of 'demand', and the benchmark for my ISP is 14.0Mbps. My Internet access connection can sustain approximately 35Mbps under ideal circumstances, so this is not a measurement of 'capacity' but rather 'demand'.

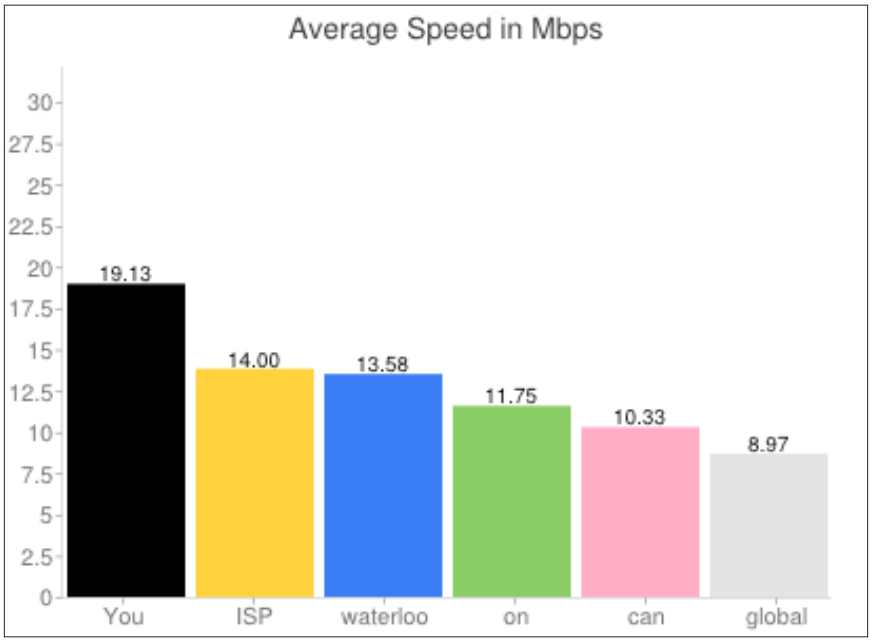


Figure 26 - YouTube my_speed, Waterloo, Ontario, Canada

If we compare the results that YouTube shows (in Figure 26) vs. what I measure on the wire 'instantaneously', we see they compare very closely (the two second peak is ~19-20Mbps in Figure 27).

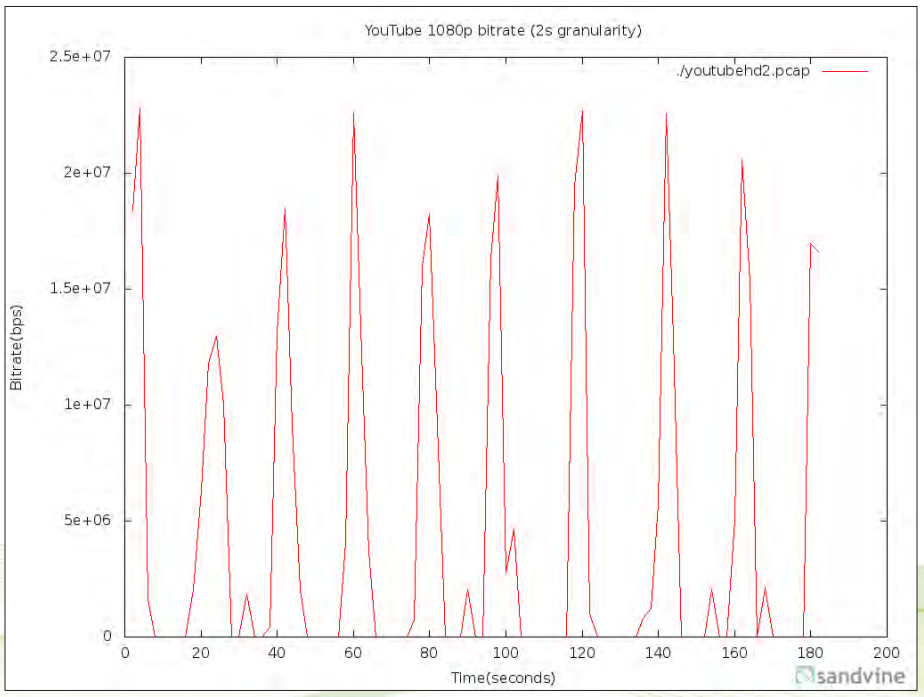


Figure 27 - Instantaneous (two-second) bandwidth, YouTube, Waterloo, Ontario, Canada

From this we can draw the conclusion that Google (YouTube) is measuring 'peak speed' achieved on the 'my_speed' page (even though the average speed of their videos is much less than 19Mbps). We can see from the significant 'peak' and 'trough' of the instantaneous speed graph that YouTube bursts and then halts, effectively 'pulse-width-modulating'. This is very poor for overall network performance but is a trade-off in server efficiency.

Although the web-page fairly accurately reflects the instantaneous demand I place on the network, it will vary significantly from user to user based on their viewing patterns and on their devices. For example, I found a significant uptick in the 'average speed' reported for me after I deployed a Google Chromecast on a 1080p television. This increased the amount of 'high-quality' encoded content I tended to watch, thus driving up my average 'demand'. Other users may be using much older access devices (e.g., the Nintendo Wii) which tend to request lower resolution or rate videos. Are these differences and nuances understood and interpreted correctly by the YouTube benchmark user?

Netflix benchmark

Netflix runs an 'ISP Speed Index[42]' which shows the overall average-demanded speed of their service broken down by ISP. Different factors affect the 'demanded-speed' (device-type mix, peering strategy with Netflix Open Connect, content mix, etc.). The Netflix speed index appears to show 'average video bitrate' rather than 'peak speed' as in YouTube, given that in the same networks where Speedtest shows > 20Mbps and YouTube shows > 15Mbps, Netflix shows ~2-3Mbps.

Figure 28 - Netflix ISP Speed Index, USA

If we examine the chart for the United States, we see the aggregate demand on Google Fiber is the highest (at 3.6Mbps). This can likely be attributed to two factors: those are earlier adopters and thus likely to be technology enthusiasts using the best devices (and thus the most HD), and that Netflix has their Open Connect platform directly peered (and thus has chosen to stream their 1080p 'SuperHD' content). In all cases, the 'average capacity' of the ISP's is greater than the 'speed index' shown, thus we conclude Netflix is showing the aggregate 'demand' on their service rather than the 'capacity' of the access network.

If we contrast the Netflix results with that of the US Government (see Figure 29)[43], which found: "On average, during peak periods DSL-based services delivered download speeds that were 85 percent of advertised speeds, cable-based services delivered 99 percent of advertised speeds…" we see that the Netflix ISP Speed Index is not an accurate measure of capacity.

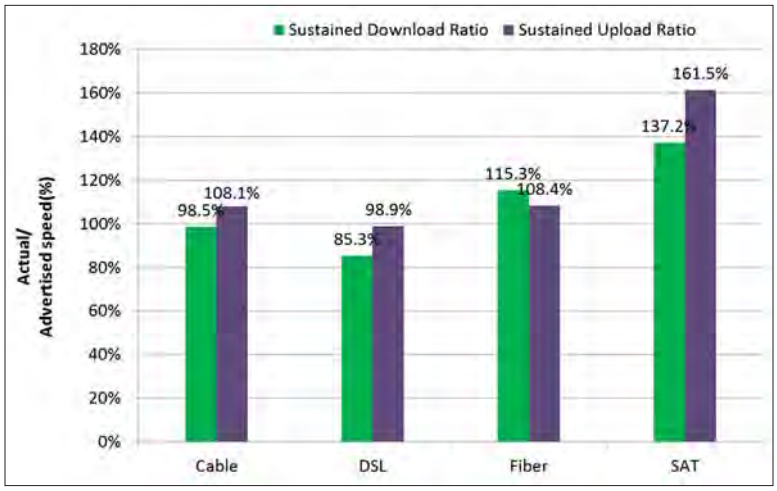


Figure 29 - FCC Measuring Broadband report, Feb 2013

42. http://ispspeedindex.netflix.com/
43. http://www.fcc.gov/measuring-broadband-america/2013/February#Findings

If we examine the actual rate of Netflix (Figure 30: Netflix instantaneous bandwidth) as streamed over a short time interval (five seconds) to get an 'instantaneous' bandwidth measurement, we find that Netflix does a much better job than YouTube at 'burst' pacing. The average bitrate of 'SuperHD' (1080p higher rate) is approximately 12Mbps, while 'standard definition' is approximately 2-3Mbps. From this we conclude that the 'ISP Speed Index' is largely showing the amount of 1080p versus standard definition delivered, and thus is driven by device mix as much as content choice or network peering, but is not reflective of network capacity at all.

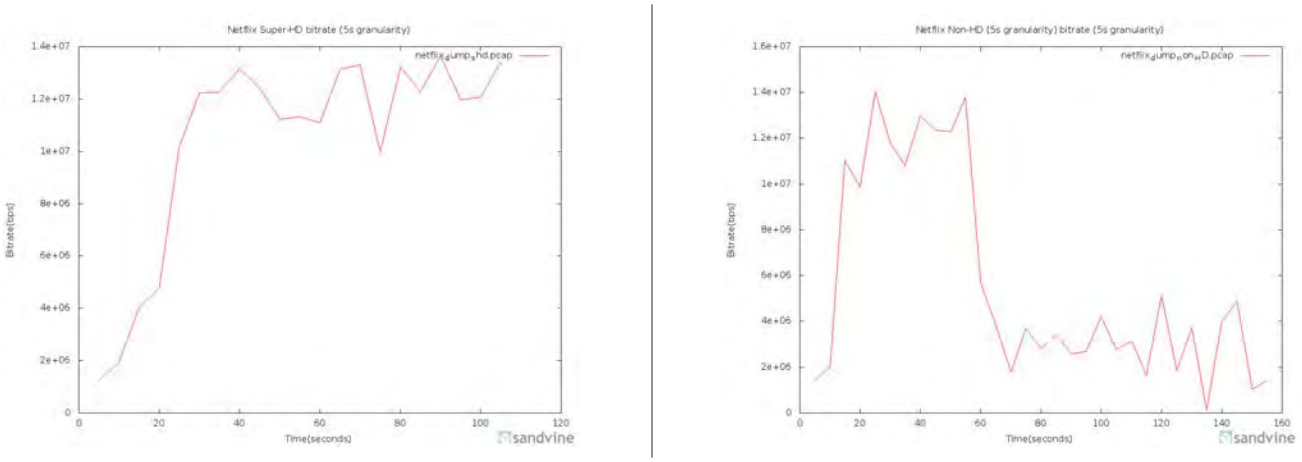


Figure 30 - Netflix instantaneous bandwidth

If we examine another country, Sweden (Figure 31: Netflix ISP Speed Index, Sweden), we see Ownit on top with ~3.1Mbps, which is a FTTHdeployment offering 100Mbps and 1000Mbps connectivity.

To increase the usability of this 'ISP Speed Index', Netflix would need to break out device type and 'allowed' stream speed, allowing the user to compare the relative performance of a 720p video across network operators. Netflix has a vested interest in this index as it is a driver of consumer demand to lower Netflix's cost by forcing consumer ISP's to alter their peering arrangements in Netflix's favor.

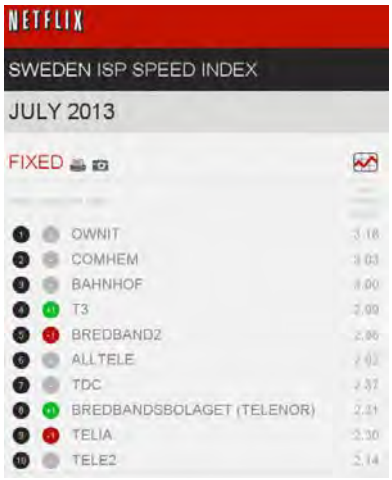


Figure 31 - Netflix ISP Speed Index, Sweden

If we examine the actual achieved bandwidth (broken down by CDN) for an amalgam of operators (taking seven days and plotting all points onto a single day, see Figure 32), we can see a few inconsistencies with the Speed Index. It appears that Netflix runs some 'experiment' with their Open Connect CDN in the early hours of the day. It appears they prefer to serve low-bandwidth content from the Akamai platform (we have observed this to be, for example, Apple iPhone streamed content), significantly pulling down the average. The remaining CDN shows a number in line with the speed index. By our calculation if only 'large-screen' content were included, most of the operators in the USA speed index above would show a number of ~3.0Mbps (e.g., if we excluded content that was specifically selected by device to be lower bitrate).

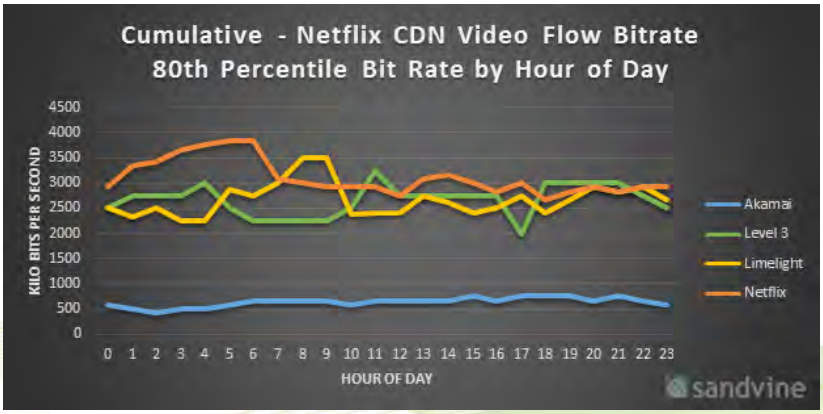


Figure 32 - Netflix bandwidth by CDN

In addition, it appears there is no time-of-day trend through the busy hours in the graph above. Our conclusion from this was that congestion was not a significant barrier to achieving a demanded video bitrate, due to two primary observations. Firstly, congestion typically occurs only during 'peak' times (although not shown, the bandwidth delivered through these networks follows a normal 'curve' of higher demand in the evening). Secondly, during the hours Netflix is achieving their blended-average target bitrate of all videos, other video providers like YouTube, and benchmarks like Speedtest are achieving much higher results). Again, is it broadly understood what this benchmark is actually measuring? Are the results being interpreted properly?

Quality factors end-to-end

The quality of experience of an end-user for a given Internet-delivered application or content is affected by many choices made by many players through the value chain. At a high level this includes the device they use to access it (screen resolution, CPU performance, memory, application and operating system, etc.), the network inside their home (wireless vs. wired, coverage, interference, etc.), the connection from their home to the access provider (RF noise, oversubscription etc.), the backbone of the access provider (oversubscription, latency, etc.), the interconnections from the access provider through the other providers, all the way up through the CDN server choices, the original content quality, and the compression quality selected by the content provider.

From a real-time entertainment standpoint there are two main quality vectors: display quality (what it looks like) and transport quality (how smoothly it delivers). The former is driven by different factors than the latter. Display quality is driven by encoding choices at the content provider, original source material quality, device type, etc. A perfect network of infinite bandwidth cannot make a poorly encoded video look good (or an old TV look new).

Let's examine these in some greater detail. At each hand-off in the chain, different business models may collide which can make an economic-driven effect. And within each span-of-control there are local economics that come into play.

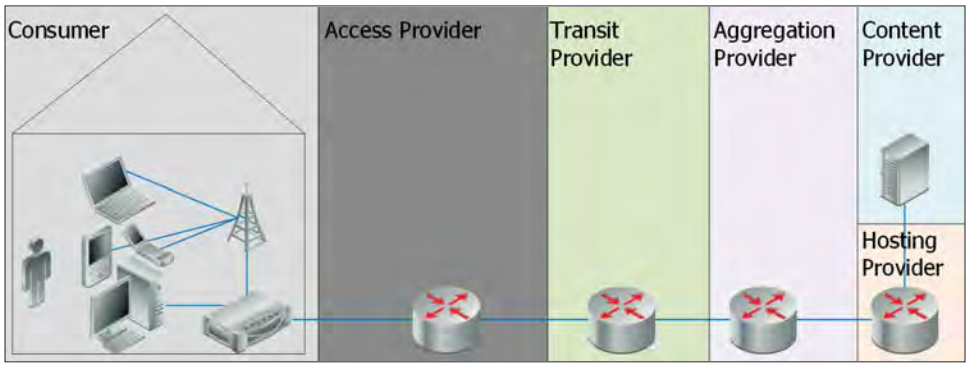


Figure 33 - Simplified delivery chain

Consumer

The consumer has considerable choice with respect to quality. They choose which content to 'buy' (with either their money or their time), voting with their wallet. As a consequence of this choice they govern how important quality is overall (if low quality content delivery sells, there is no incentive to improve).

Consumers choose which devices (smartphones, tablets, laptops, gaming consoles, TV's …) to use, and they select their Internet access package.

The consumer also unwittingly influences quality. For example, some content is not licensed for some devices, or is only licensed in a lower fidelity. For example, Netflix supports[44] 1080p on Android on Texas Instruments OMAP 4, but not on other processors. This is a certification and Digital Rights Management (DRM) limitation, not a performance limitation. In fact, according[45] to Wikipedia, depending on DRM and other rights, select videos are available on some platforms, select resolutions on others. This is a decision entirely made upstream of the network. Nothing in the transport can affect the decision to allow 'SuperHD' on Microsoft Windows 8, but not on Microsoft Windows 7. This decision in turn alters the results of the Netflix 'ISP Speed Index'.

Considerable network problems may occur inside the home. Home wireless networks are not as reliable as wired network and are susceptible to interference from neighbors, from RF emitting devices such as induction motors, cordless phones, and microwaves. From a consumer standpoint the effect on quality of packet loss is the same

44. http://investor.ti.com/releasedetail.cfm?ReleaseID=589023
45. http://en.wikipedia.org/wiki/List_of_Netflix_compatible_devices

regardless of whether the packet is dropped in their home or elsewhere in the network. Another home networking problem plaguing the industry is the life-span of home gateways. Many users forget their 2000-era 802.11B Linksys BEFW11S4 was specified for an optimistic '11Mbps' and have upgraded to substantially higher-speed broadband. Even today wired devices are often Fast Ethernet (100Mbps) which is less than, for example, Comcast's Extreme 105 offering.

As shown by Figure 34, the consumer may be given the choice to select the bitrate (for example, in YouTube, the resolution defaults based on device type, application, and screen resolution, but the user can override). In other cases, some quality levels are unavailable for streaming, and reserved for 'premium' use. A user not remembering to 'increase' the YouTube quality may have a sub-optimal experience (and conversely, incorrectly increasing past the available network or device capacity can also cause problems).

Figure 34 - YouTube user-selectable resolution

Some users override the DNS server provided by their access provider. This can in turn change the selection of the CDN, and dramatically affect the latency or throughput of applications. See "Subscriber Quality of Experience: "DNS, CDNs and the User Experience" Part II of III[46]" for an example of how this affects Facebook (in the example given, the use of OpenDNS adds 37ms to the round-trip time of Facebook packets). This is critical in an era where content companies such as Google are experimenting with UDP[47] to reduce the latency of the TCP setup (which has a minimum of 4 round-trips). This use of UDP in turn has downstream effects on the access providers (who often are forced to use NAT to conserve IPv4 space, which is in turn stateful, which in turn might lead the application developers to introduce keep-alives, which in turn might create signaling load and wasted 'parasitic' bandwidth on the network as well as consuming your battery). There's no free lunch — that ~120ms reduced from each new HTTP connection has an effect on someone.

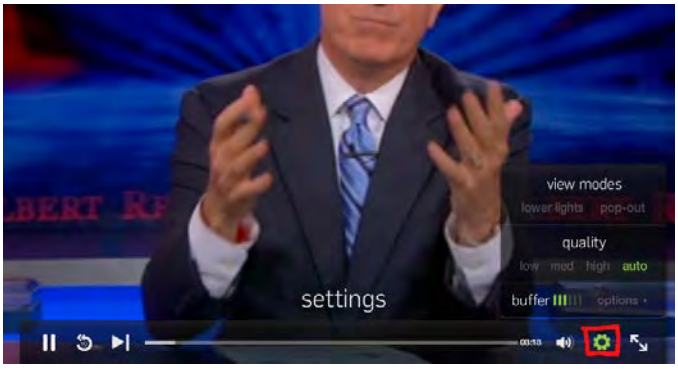


Figure 35 - Hulu Adjustable Quality

Overriding the 'quality' level may result in video that does not deliver properly over the network. For example, on Hulu if you override the 'auto' mode (Figure 35) you may find that the end-to-end network cannot reliably deliver the video, and you may experience stalls. If you do not override this, the adaptive video delivery picks the highest quality in each interval throughout the video life.

Access provider

The access network provider makes Internet connectivity available that is oversubscribed to increase efficiency. For example, a cellular provider operating UMTS or LTE service might achieve 3-4 bits/Hz in ideal operation, and have 10MHz of spectrum. This in turn yields 30-40Mbps of theoretical capacity, and the wireless sector may be shared by 100+ people each with a theoretical 21Mbps downstream connection. This would be an approximate 100:1 oversubscription, which is actually better for the user (the alternative would be that each user would have (30~40)/100 == 330Kbps–400Kbps if it were guaranteed). The downside to oversubscription is that there are 'peaks' during which a user may get less than they need.

Access networks are commonly asymmetric in bandwidth. This is done to optimize radio spectrum (e.g., in a DSL environment, the wire has a fixed bandwidth, but it's in the best interest of the consumer to have ~80% of the spectrum allocated for download and 20% for upload since this matches their usage patterns, see Global Internet Phenomena[48]). This in turn affects some applications (e.g., Dropbox[49]) which use more upstream than the 'norm'.

Some quality affecting factors are access-technology dependent. For example, DSL supports a mode called 'interleaving' which increases reliability at the expense of latency. Wireless networks are susceptible to fluctuations in signal strength (especially indoors) and to network coverage.

46. http://www.betterbroadbandblog.com/2010/02/subscriber-quality-of-experience-%E2%80%9Cdns-cdns-and-the-user-experience%E2%80%9D-part-ii-of-iii/
47. http://en.wikipedia.org/wiki/QUIC
48. http://www.sandvine.com/news/global_broadband_trends.asp
49. https://www.dropbox.com/

Some access providers choose to provide transparent caching of some content. Although the cache introduces some latency, if its 'hit-ratio' is high enough, the overall experience is improved. Different strategies exist for whether to cache 'large-objects' (to reduce bandwidth) or 'small-objects' (to reduce the effects of latency).

In Figure 36, we look at the actual bandwidth (80th percentile) achieved by YouTube for an amalgam of US service providers (both Cable and DSL) for one week (all days overlaid). Consistent across all these operators was a pronounced 'dip' during peak hours, both during 'lunch' time, and during evening peak time.

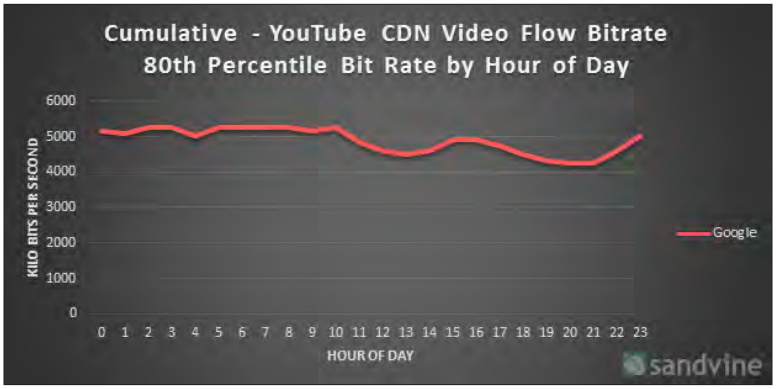


Figure 36 - YouTube video flow bitrate

If we compare this with Hulu and HBO Go during the same time period, for the same set of operators and same locations (Figure 37 and Figure 38), we do not see this dip. From this, we can conclude that access network decisions can provide consistent quality, and it is likely there is an oversubscription in either the Google server farm (where YouTube is hosted), or in the upstream network of Google (since this is from a broad swath of operators it is unlikely they all share common paths to Google).

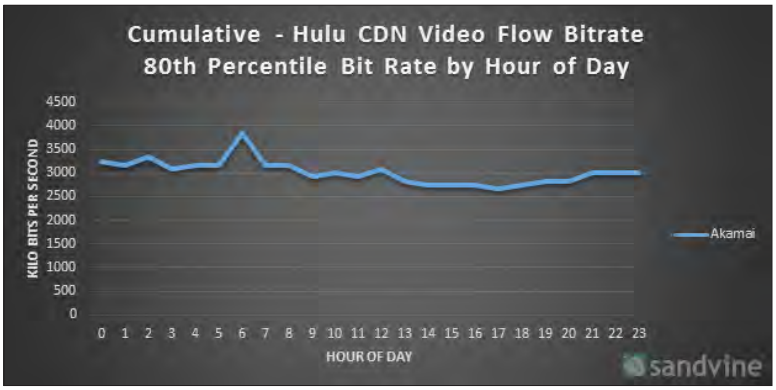


Figure 37 - Hulu video flow bitrate

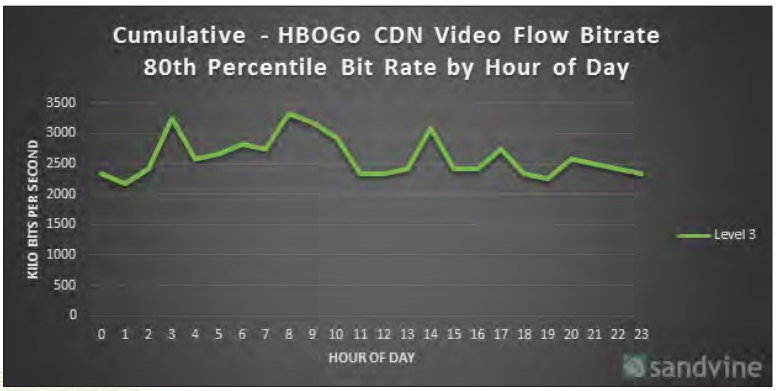


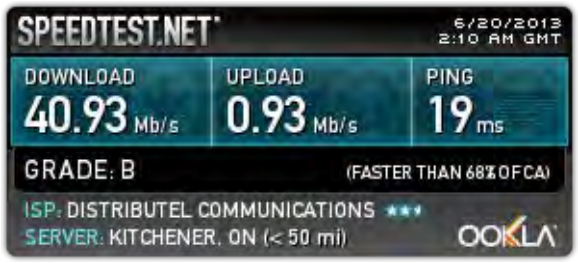
Figure 38 - HBOGo video flow bitrate

The following choices made by access providers affect quality:

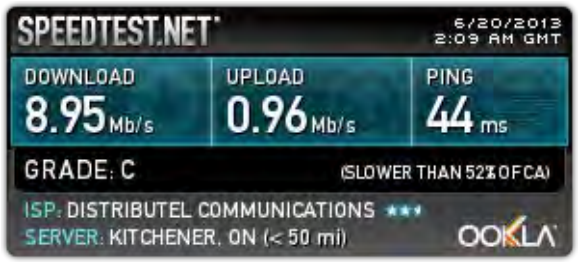
- Ratio of upstream to downstream
- Oversubscription of access
- Oversubscription of core network
- Latency (through interleaving setup, cache setup)
- Peering/upstream interconnection

Aggregation provider

Aggregation providers each have different business strategies for oversubscription. Take as an example two speed tests done within one minute of each other from the same location (Waterloo, Ontario, Canada). Both tests are to Speedtest servers located in Kitchener, Ontario, Canada (they are both actually in the same building). The service plan is a 35Mbps DOCSIS 3 (Cable). The difference in performance is large (32Mbps, ~4:1 difference).



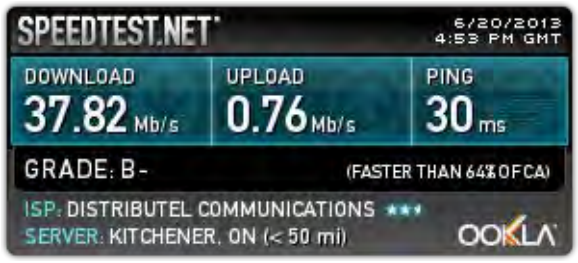
Server A



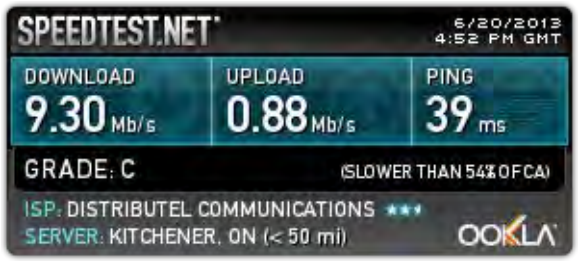
Server B

Figure 39 - Sample Speedtest results off peak

If we run this same test again at a more 'congested time of the day', we see the results are similar:



Server A



Server B

Figure 40 - Sample Speedtest results during congestion period

The conclusion we draw from this is that there is no impairment in the access network - we are getting a rate greater or equal to the contract at two different times of the day. But to two different servers, in adjacent networks, we get dramatically different results. So any impairment present is in the interchange of these networks (or in the test server), not in the access.

If we dig into this result with traceroute[50], we can see this particular variation is a function of the aggregation transit (tier-2 transit) that the access provider uses (as well as the server variation due to TCP window as mentioned in the Benchmarks section above). The path is primarily a function of the IP prefixes announced by upstream providers (since IP uses a destination-based routing technique). In one case the packets are routed ~20km, while in the other case they are routed ~200km (from the same building, to the same building).

```
traceroute to 208.90.99.252 (208.90.99.252), 64 hops max
 1   172.16.0.1 (172.16.0.1) 0.316ms 0.250ms 0.265ms
 2   *  *  *
 3   69.63.254.229 (69.63.254.229) 15.311ms 11.370ms 16.160ms
 4   69.63.249.201 (69.63.249.201) 13.934ms 15.907ms 16.056ms
 5   206.80.255.52 (206.80.255.52) 11.677ms 11.467ms 13.779ms
 6   38.104.158.93 (38.104.158.93) 12.406ms 12.171ms 11.899ms
 7   24.156.159.125 (24.156.159.125) 13.548ms 13.099ms 11.444ms
 8   24.153.7.137 (24.153.7.137) 27.912ms 27.781ms 27.938ms
 9   69.63.249.202 (69.63.249.202) 31.606ms 31.791ms 31.873ms
 10  69.63.252.18 (69.63.252.18) 34.468ms 34.101ms 36.209ms
 11  69.17.128.26 (69.17.128.26) 29.117ms 37.804ms 28.666ms
 12  74.114.73.44 (74.114.73.44) 35.530ms 28.892ms 25.459ms
 13  208.90.99.252 (208.90.99.252) 31.243ms 30.004ms 29.709ms
```

```
traceroute to 199.7.136.40 (199.7.136.40), 64 hops max
 1   172.16.0.1 (172.16.0.1) 0.296ms 0.250ms 0.243ms
 2   *  *  *
 3   69.63.254.229 (69.63.254.229) 13.393ms 12.348ms 15.129ms
 4   69.63.252.210 (69.63.252.210) 13.962ms 11.373ms 11.923ms
 5   206.108.34.78 (206.108.34.78) 12.169ms 11.980ms 13.663ms
 6   74.205.221.16 (74.205.221.16) 13.852ms 14.641ms 14.610ms
 7   208.79.60.225 (208.79.60.225) 15.195ms 15.337ms 16.090ms
 8   208.79.60.218 (208.79.60.218) 19.766ms 15.847ms 15.573ms
 9   64.235.97.70 (64.235.97.70) 15.587ms 16.895ms 15.831ms
 10  199.7.136.254 (199.7.136.254) 15.588ms 17.531ms 17.072ms
 11  199.7.136.40 (199.7.136.40) 16.553ms 16.744ms 16.761ms
```

Figure 41 - Traceroute of two Speedtest servers

Transit provider

A transit provider is intended to be a 'route of last resort' for long-haul interconnection. As such it commands a higher cost to interconnection than other network peers. In recent years some of these providers have discovered that co-locating content by becoming a CDN can create a 2-sided market (they get paid to deliver bandwidth, and the content provider will pay to host content in their CDN). At the same time it potentially reduces costs since the provider only needs to serve the content instead of transiting it through both edges of their network.

Hosting provider

A hosting provider is responsible for keeping the proper number of servers operational, and load-balancing them. There is a trade-off between age of servers and the power they use vs. the capital cost of upgrading them. This can lead to variable performance depending on which server is selected by a load-balancer. The hosting provider may throttle the number of concurrent connections (or bandwidth of connections), and this in turn may be noticeable by the end-user.

Additionally, the hosting provider may use data-center specific equipment (for example, a firewall) which can interfere with the performance of TCP (or the network efficiency). For example, F5, a popular load-balancer, supports a mode[51] where TCP sequence numbers are regenerated and TCP SACK is disabled. SACK is a mode for selective acknowledgement, which increases TCP performance and decreases transmissions for a given throughput.

Content provider

Content encoding quality

Ignoring the question of 'interest' in the content, the content provider makes the first and most crucial choice in the end-to-end system: how to digitize and compress the content? 1080p content takes significantly more resources to store and transmit than 480p, but is viewed as more valuable to the end user. In some cases digital re-mastering may be needed, which is costly.

Additionally, the content provider may choose to make multiple versions available. Some hardware supports H.264 AVC High Profile[52], some devices only Baseline profile. It costs more to encode and store the content twice, but the impact to the network is less when streaming (since equivalent quality will take less bandwidth). To save storage cost, a content provider could encode everything in a lowest-common-denominator (e.g., MPEG-4 Advanced Simple Profile), and just ignore the incremental network cost (since it's a smaller part of their business cost, particularly if they are co-located with a Tier-1 transit provider).

50. https://en.wikipedia.org/wiki/Traceroute
51. http://support.f5.com/kb/en-us/products/big-ip_ltm/manuals/product/ltm_configuration_guide_10_1/ltm_protocol_profiles.html
52. http://en.wikipedia.org/wiki/H.264/MPEG-4_AVC

Content choice access limitations

The content provider can choose who can access what of their content. This is sometimes done as licensing deals with the upstream content creator (for example Hulu content is not available in Canada). Sometimes this is done as licensing deals with the access ISP (for example, Watch ESPN[53] is available only to consumers on the access networks that pay a fee, and there is no method for the individual user to overcome this access restriction).

Content providers may use quality or content restrictions to force economically advantageous relationships. For example, CBS blocked[54] TimeWarner Cable DOCSIS customers from streaming content, despite allowing all other ISP customers access (and regardless of whether those DOCSIS users obtained video programming from TimeWarner or not). Also, for example, Netflix forces[55] consumer ISPs to serve their content via Open Connect[56] before they will allow consumers to access 'Super HD' content (despite there being no technical requirement to do so). In addition, they only allow Super HD on certain devices[57]. These quality decisions are entirely made by Netflix, and cannot be affected by the consumer or any network provider (the normal network path tools of BGP and OSPF discussed above are overridden since the destination IP is selected rather than the path). This can be demonstrated quite simply, as a sophisticated user can use certain sites (e.g., http://tunlr.net/ or unblock-us.com) and can still get Super HD from an ISP not participating in Open Connect. This can be used to show how a given network can deliver higher performance than demonstrated in the Netflix ISP Speed Index (this is commonly misstated even in technical content such as ars technica[58]). It is neither the access network delivering faster content, nor the Open Connect CDN, but rather the Netflix application that is requesting lower quality content explicitly.

> Locking content to a specific CDN by fidelity (HD versus SD) and other restrictions (e.g., geographic restrictions on content availability) is very common. These are not technical restrictions but are instead related to content rights, and to the pricing arbitrage inherent in using more than one CDN (one may charge on peak bandwidth and one may price on monthly average or on number of HD videos views).

Note that if we look back at Figure 1: Stylized network interconnections, we see that a content provider can actually reverse the flow of money with respect to an access provider. In that diagram, CONSUMER-1 ISP will pay to receive CDN-3, but be paid to receive CDN-2. This can be a powerful negotiating ploy.

In Figure 42 we show the bandwidth 80th percentile per CDN for Netflix for an amalgam of multiple operators (both cable and DSL) in the USA over the course of a week (all days overlaid). As we can see, Netflix seems to consistently stream at a lower bitrate than Akamai[59] (serving smartphone screens primarily). In addition, they tend to favor Limelight[60] during off-peak hours.

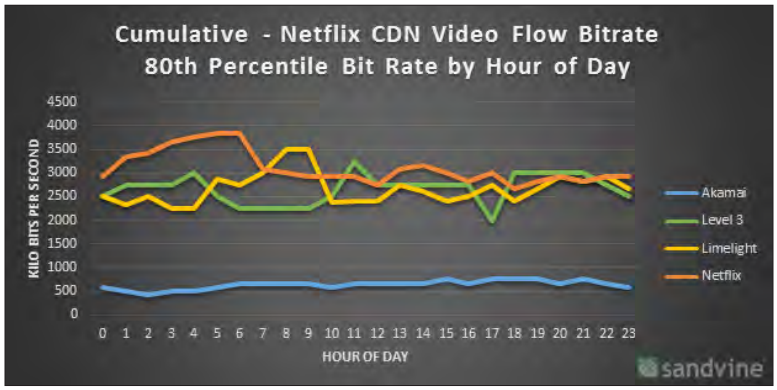


Figure 42 - Netflix bandwidth by CDN by time

53. http://en.wikipedia.org/wiki/ESPN3
54. http://www.multichannel.com/distribution/cbs-blocks-twc-broadband-subs-accessing-full-episodes-online/144786
55. https://signup.netflix.com/superhd
56. https://signup.netflix.com/openconnect/hardware
57. https://support.netflix.com/en/node/8731
58. http://arstechnica.com/information-technology/2013/09/sorry-comcast-and-verizon-customers-rcn-delivers-faster-netflix/
59. http://www.akamai.com/
60. http://www.limelight.com/

Server performance

Streaming servers are more efficient when they do less context-switching. This in turn incents a content provider (either through their hosting provider or their CDN) to burst towards the user and then switch to another user. This 'pulse-width-modulation' bandwidth reduces context switches on the server, and causes no additional bandwidth to be served from the hosting facility. However, when the other end of the stream reaches the consumer, these bursts can cause considerable additional cost to the access provider. In Figure 43, we see Netflix SuperHD streamed to Australia (the measurements are taken in the home). As you can see, the network is either operating at 20Mbps or 0Mbps, meaning the peak-rate needed is 20Mbps. Since the network capital cost is peak-driven, this is much more expensive than maintaining an average speed of ~5-8Mbps which would deliver the same experience to the end user. The higher peak rate for the end user can cause bufferbloat[61] and interfere with other traffic they might be using, such as VoIP.

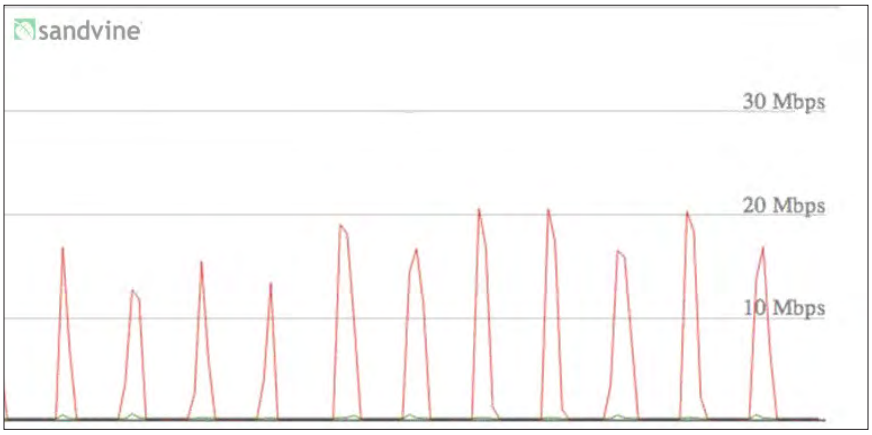


Figure 43 - Netflix delivery, 1 second granularity

Comparing this to the results in Figure 30: Netflix instantaneous bandwidth, which were obtained much closer to the origin server, the variation in 'bursting' is likely due to the longer latency and a control system which becomes unstable with long bandwidth-latency products.

If we look in Figure 44, we can see the same effect with YouTube. In this case a 1080P YouTube video is streamed, and the bandwidth is viewed on a 2 second interval. The average bandwidth needed to deliver this video is ~3-4Mbps, but instead the server has chosen to buffer on/off at a much higher burst speed, doubling the network cost needed to receive the stream (TCP does make it challenging to rate-control).

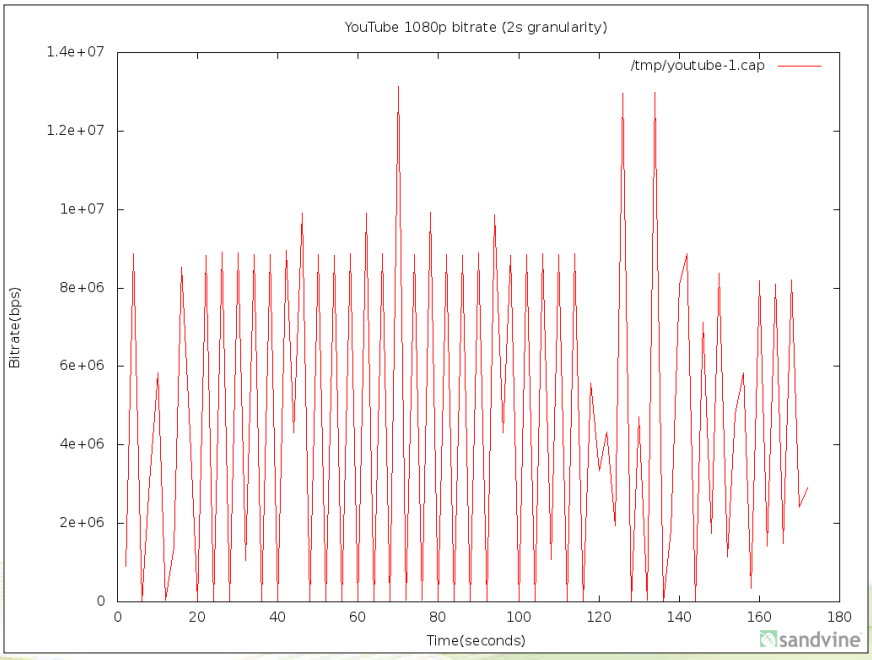


Figure 44 - YouTube bitrate, 2-second granularity

61. http://en.wikipedia.org/wiki/Bufferbloat

Adaptive vs. progressive vs. un-paced

Another overlooked factor of server performance is the algorithm or strategy. Depending on the content type, servers may either use rate control, or just 'as fast as possible'. HTTP (in the web page HTML sense) is normally delivered as rapidly as possible. But streaming content has a 'natural' rate and there is efficiency to be gained in streaming near this rate. Two main strategies exist, 'burst-paced progressive' (a really-large file is sent in spurts but no adaption is made if it is not delivered fast enough), and 'adaptive' (the file is split into chunks and the speed of each chunk governs whether the next one will be delivered at a higher or lower bitrate). YouTube is an example of a 'progressive' download, and Netflix is an example of an 'adaptive' protocol.

But what impact will this 'adaptive' control system have on other Internet traffic? Many different congestion control algorithms all fight with each other on the public Internet. Various generations of TCP have had either no congestion control (original), or use models[62] such as Reno, Tahoe, CUBIC, Vegas, BIC, New Reno, Compound, Westwood, and many others. Each of these behaves differently in the presence of congestion (loss, latency), and in presence of other flows (flow-fairness). In addition, non-TCP transports (UDP[63], LEDBAT[64]), tunneled TCP transports (which prevent the 'loss' signal from being measured), and explicit congestion notification (ECN[65]), all vie for bandwidth with each other.

Most of the TCP variants have in common a concept of 'slow-start' (they ramp to some target rate), and 'loss as a signal' (packet loss indicates they should slow down). As a consequence of these decisions, short-lived TCP sessions are impacted by congestion more than long-lived TCP sessions.

Consider the WWW - a user clicks on a web page and in rapid succession a number of TCP connections are initiated, each transferring a small burst of data and terminating as rapidly as possible. Others have already noted the problems associated with these short-lived sessions and web performance (e.g., SPDY[66], QUIC[67], Microsoft S+M[68], …), and have largely studied them based on congestion and latency, which are not driven by any sort of control system but rather by random user behavior. But, what would happen if a positive feedback loop[69] were introduced? This is exactly what an adaptive video system does – if more bandwidth is available, it takes it. When you mix short-lived TCP flows (carrying HTTP), which spend most of their life in 'slow-start', with adaptive video, the adaptive video will tend to not degrade much and the HTTP will tend to degrade in a pronounced fashion.

TCP has evolved substantially over the years. Researchers have constantly sought ways to make it 'faster' and 'fairer'.

A key part of the TCP algorithm is the 'slow-start', which suggests that a given TCP flow will start off slowly (to avoid instantly creating congestion), and cautiously ramp up in speed linearly, and then, when it finds packet loss (or increased latency in some stacks), exponentially slow down. This algorithm is generally called Additive Increase Multiplicative Decrease (AIMD).[70]

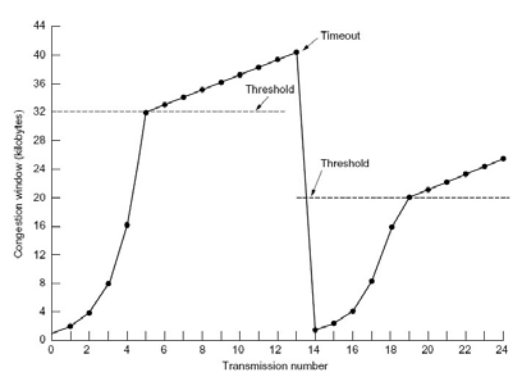


Figure 45 - An example of the Internet congestion algorithm

If we look at this measure in practice, Figure 46 shows the latency (queuing) of the TCP packets for the top web domains (by 'hits') for more than one operator that exhibited some congestion during peak time on the transit and peering. As we can see, during 'busy' hours, there is a variation (approximately 20ms of additional latency is introduced). The assumption is that these top web sites will be well connected and hosted on high-quality servers. This variation in latency will translate into a reduced experience for those users.

62. http://en.wikipedia.org/wiki/TCP_congestion-avoidance_algorithm
63. http://www.ietf.org/rfc/rfc768.txt
64. http://datatracker.ietf.org/wg/ledbat/charter/
65. http://www.ietf.org/rfc/rfc3168.txt
66. http://www.chromium.org/spdy/spdy-whitepaper
67. https://docs.google.com/document/d/1lmL9EF6qKrk7gbazY8bIdvq3Pno2Xj_l_YShP40GLQE/edit
68. http://en.wikipedia.org/wiki/Microsoft_SM
69. http://en.wikipedia.org/wiki/Positive_feedback
70. http://www.site.uottawa.ca/~bochmann/CourseModules/NetworkQoS/TCP-congestion-control.jpg

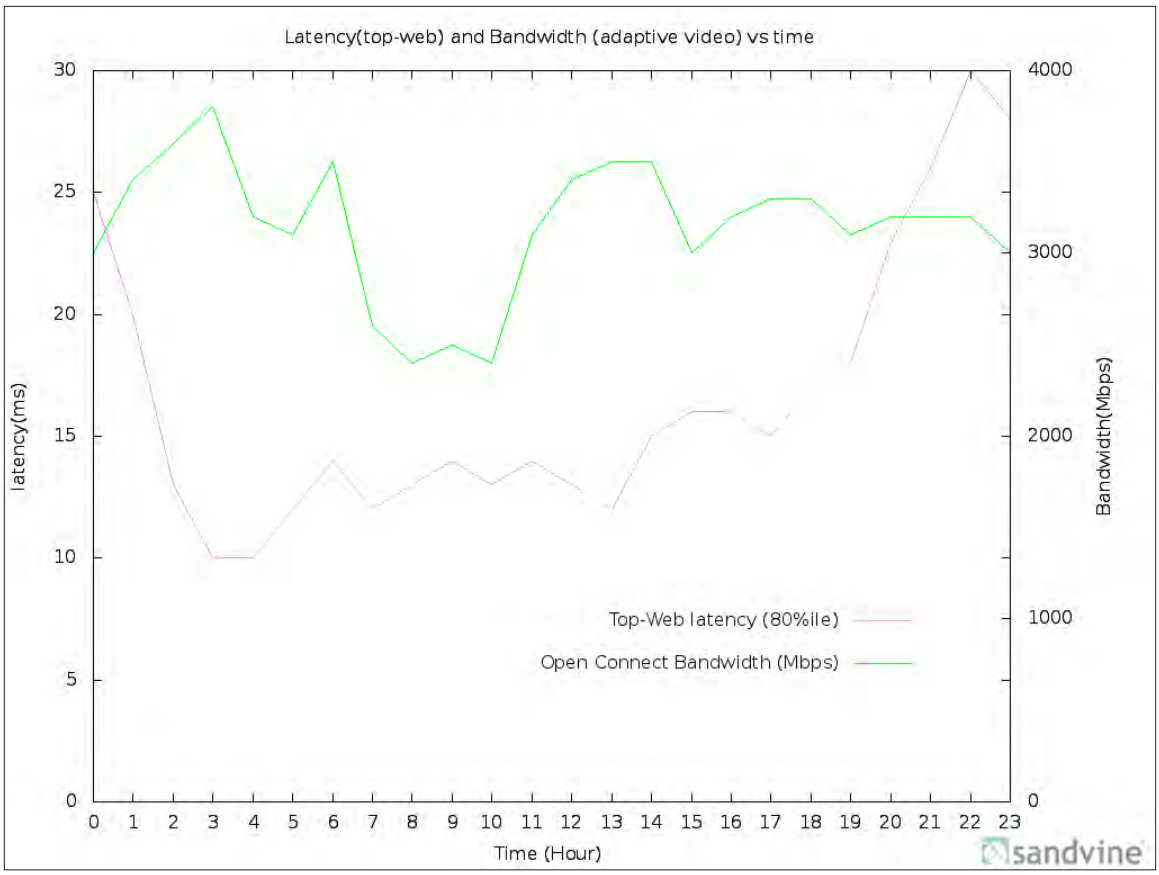


Figure 46 - Internet Latency top 50 HTTP domains with Netflix bandwidth overlaid

In addition, we can see that the Netflix Open Connect-delivered bandwidth, which comes through the same set of connections in these operators as much of the top-N sites, has no material degradation in bandwidth. Of note is the fact that Speedtest and the Netflix ISP SpeedIndex do not reveal this fact – it requires a benchmark that incorporates multiple measurements simultaneously such as that used by Sandvine's Network Analytics. The same 'experiment' in the early hours of the morning is seen in Figure 32: Netflix bandwidth by CDN.

The natural conclusion seems to be that adaptive video may 'push aside' non-adaptive content such as gaming, VoIP, and HTTP due to its longer-lived TCP flows (no material time spent in slow-start) and its adaptive nature (take more bandwidth when available, other flows adapt back using TCP congestion control as a consequence).

Incentives

As we have seen, there are significant incentives for 'selfish' behavior in the Internet: locally optimized but globally "pessimized". This in turn takes advantage of some of the original principles of the Internet (that it was a cooperative and non-commercial network).

Content providers have a balance to strike between quality of delivered product and cost. They are incented to choose lowest cost routes, but may also be incented to select the highest cost routes for other providers in order to force them to peer. See "Creating incentives to peer" in "The Growing Complexity of Internet Interconnection[71].

Tier-1 IP Transit providers have an incentive to increase traffic (since they are always paid for traffic and never pay for it). This may in turn cause them to enter into low-cost or no-cost agreements with large sources of bandwidth (to 'steal' the resulting revenue from their competitors). A Tier-1 IP transit provider would prefer traffic to not privately peer.

Tier-2 IP aggregation providers have a balanced incentive between more traffic out of their network (since they get paid for that) and less traffic into their network (since they pay for that). They also have an incentive to keep oversubscription ratios in line with their business model.

CDN providers have an incentive to lower their cost of entering the network. This in turn causes them to wish to align forces with the Tier-1 IP Transit providers. They have an incentive to minimize server costs, which may in turn cause them to lower their concern for network costs.

CDN providers also have an incentive to lower peak server load at the expense of the network. If we look at Figure 47, we can see the latency (round-trip-time) from a fixed-reference point in the network towards the server for Netflix. The traditional CDN (Akamai, Limelight) show little or no change over the course of the day (implying the data is served from a constant distance). But the Netflix Open Connect CDN has significant variance, and this variance is correlated in time on both coasts, suggesting that there may be cross-continent load-shedding (or, a single source serving all users). In addition the latency is significantly higher to the Open Connect CDN (suggesting it may use different load-balancing or server resource management strategies).

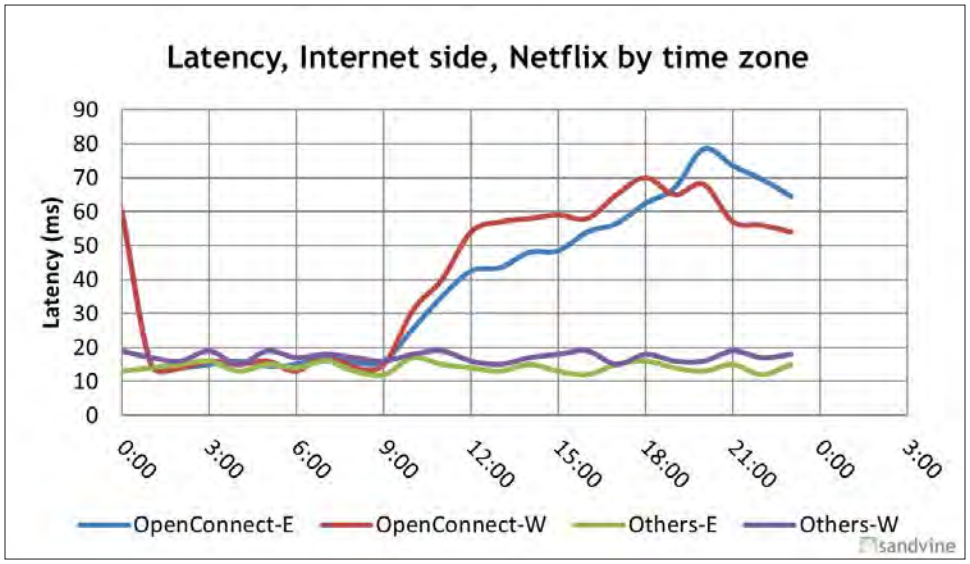


Figure 47 - Netflix latency by location

71. http://www.akamai.com/dl/technical_publications/growing_complexity_of_internet.pdf

How much does this matter?

In the UK the BBC iPlayer has been a significant driver of traffic. In 2008, as a precursor to the current 'Content/CDN/Peering/Transit' wars, the BBC shifted[72] to using Level3 from Akamai. This had the consequence of shifting the iPlayer content from a privately-peered highly-distributed model (Akamai) in which the consumer ISP either paid nothing (being settlement-free peered) or were paid to receive the content, to one in which the largest ISP paid nothing and the smallest ISP paid ~£2-5/Mbps to receive.[73] This change (since Level3 directly connects to the largest, but declines to peer with smaller players) has been a contributing factor in the consolidation of the UK access industry[74]. How much cost are we talking? In 2012 during the Olympics, the BBC served[75] a peak of 700Gbps of throughput (2.8PB of total volume). If the BBC had paid the list price of Amazon's CDN[76] (hypothetically) this would be more than $400,000/day.

In early 2010, Netflix entered into an agreement with Level 3 Communications. As a consequence, Level 3 added 2.9Tbps and doubled its storage[77]. At the New York spot-price for transit at that time ($10/Mbps/month), this would have been $29 million per month of transit bandwidth alone (at the best possible transit price). At the time, Netflix had 19M subscribers. This equates to ~$1.50/month/subscriber of additional cost for the best-possible transit price (in New York). Some operators in the US (Netflix was US-only at this time) would have been ~5 times this cost.

Conclusions

To encourage a more complete understanding of quality issues currently faced by service providers, it is important to understand how the rapid economic and technical Internet evolution gets ahead of our common understandings, which quickly become false assumptions. Commonly-trusted quality benchmarks fail to deliver a true picture, while economic competition affects service delivery much more than we may think.

Cost-efficiency strategies and technical designs driven by economic pressure have temporarily threatened, but not permanently damaged, the ability of over-the-top services to function acceptably. Internet 'bandwidth' (and cost) is dominated by a small number of players and it is easy to overlook service aspects that represent considerable value.

Benchmarks are overly simplistic, some with significant inaccuracies, and purport to focus on a single spot (the access network) while ignoring other highly-impactful impairments in the chain. Benchmarks should not focus strictly on 'speed' or 'video' to better account for important applications such as gaming and mobile apps, which are not 'top-10 bandwidth' drivers but are indeed critical consumer applications.

This paper has shown that incentives to create local optimization, which exacerbate the cost or complexity of other players, exist and are being used. It is clear that significant temporary risks exist to the entire ecosystem given the concentration of application bandwidth demand and the central nature of changes to the content serving architectures, with rapid global implications.

A more complete understanding of the true nature of Internet quality of experience, as presented by this paper, leads to a better awareness of how choices affect consumer experience. This full awareness can only benefit service providers as they navigate the rapidly changing landscape of Internet service delivery.

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72. http://www.bbc.co.uk/blogs/bbcinternet/2008/08/bbc_iplayer_goes_h264.html
73. http://www.telco2.net/blog/2008/08/bbc_iplayer_bandwidth_wars.html
74. http://www.dslreports.com/shownews/UK-ISP-Results-Q1-2012-The-Big-Get-Bigger-119633
75. http://www.bbc.co.uk/blogs/internet/posts/digital_olympics_reach_stream_stats
76. http://aws.amazon.com/s3/pricing/
77. http://www.marketwatch.com/story/level-3-outlines-network-expansion-on-netflix-pact-lvlt-nflx-llnw-akam-2010-11-11

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August 8, 2014

The Honorable Fred Upton
Chairman, Committee on Energy and Commerce
U.S. House of Representatives
2125 Rayburn House Office Building
Washington, DC 20515

The Honorable Greg Walden
Chairman, Subcommittee on Communications and Technology
U.S. House of Representatives
2125 Rayburn House Office Building
Washington, DC 20515

Dear Chairmen Upton and Walden:

Thank you for the opportunity to present Sprint's response to the questions posed in the Committee's "Network Interconnection" white paper. We look forward to continuing to participate in the Committee's ongoing efforts to examine the Communications Act of 1934, as amended. Please don't hesitate to contact me if you have any questions regarding the attached submission.

Sincerely,

Bill Barloon
Vice President, State and Federal Legislative Affairs

cc: Honorable Henry A. Waxman, Ranking Member, Committee on Energy and Commerce; Honorable Anna G. Eshoo, Ranking Member, Subcommittee on Communications and Technology

Attachment

Interconnection is Indispensable to a Competitive Telecommunications Marketplace

August 8, 2014

Interconnection is one of the fundamental principles of the Telecommunications Act and is indispensable to a competitive telecommunications marketplace. This principle will not change as voice networks transition from TDM to IP format. Interconnected all-IP networks offer enormous efficiencies and consumer benefits. Unfortunately, the exchange of voice traffic in IP format remains the exception rather than the rule. In order to realize the benefits of a truly "all-IP" world, Congress and the FCC must ensure that the bedrock interconnection principles embodied under the existing Telecommunications Act and discussed below apply to the exchange of voice traffic in IP format, and take steps to ensure that all carriers, and in particular those with market power, comply with long-standing basic interconnection obligations.

1. In light of the changes in technology and the voice traffic market, what role should Congress and the FCC play in the oversight of interconnection? Is there a role for states?

FCC and Congressional oversight of interconnection remains necessary as the exchange of voice traffic moves from TDM to an IP format. Despite clear guidance from the FCC that interconnection obligations are technology-neutral, many incumbent carriers contend that they are not required to negotiate under Sections 251/252 of the Communications Act for the interconnection and exchange of voice traffic using IP technology. This reluctance to acknowledge a legal obligation to provide interconnection at reasonable cost-based rates is an ominous sign for competitive carriers. Without a legal mechanism to require interconnection on just and reasonable terms, dominant carriers will have both the incentive and ability to undermine or eliminate competition. Therefore, Congress and the FCC must ensure broad national interconnection requirements for IP voice to make it clear that:

- Interconnection for the exchange of voice traffic in IP format ("IP Interconnection") is subject to Sections 251/252 of the Communications Act or its equivalent, and that the dominant incumbent carriers must provide interconnection to competitive carriers at cost-based rates;
- Incumbent carriers must enter into good faith negotiations for IP Interconnection;
- These obligations cannot be circumvented by moving interconnection facilities or capabilities to subsidiaries or affiliates; and
- Unless mutually agreed by the parties, the default network and points of interconnection (POI) for IP voice traffic should be the IP network and POIs used for the exchange of IP data traffic.

Both the FCC and state regulatory bodies have a role to play in expediting the transition from TDM to IP[1] interconnection for voice traffic, and for resolving interconnection disputes between carriers. So long as Sections 251/252 remain the law of the land, state commissions will have a responsibility to arbitrate interconnection issues. Even when interconnection for IP voice traffic is streamlined to occur at a handful of POIs, responsibility for resolving interconnection disputes and implementing national policies can be shared by the FCC and the states.

2. Voice is rapidly becoming an application that transits a variety of network data platforms. How should intermodal competition factor into interconnection mandates? Does voice still require a separate interconnection regime?

The transition of voice traffic to IP platforms will not obviate the need for rules governing the exchange of voice traffic. Although voice traffic can be very efficiently and economically handled over IP networks today, interconnection agreements between incumbent carriers and competing carriers for the exchange of voice traffic in IP format are still very rare. This is largely due to the financial incentives of incumbent carriers to protect their existing TDM voice access revenues and to provide their wireless affiliates with a competitive advantage over wireless carriers that do not have ILEC affiliates. Even with

[1] Communications protocols are moving from circuit-switched TDM to packet-switched IP. Although IP technology is far more efficient and offers superior redundancy and reliability than TDM, many carriers cling to TDM–based arrangements because they are able to impose non-reciprocal access charges for voice traffic in TDM format.

the growth of intermodal competition, the ILECs retain control over tens of millions of retail voice customers, and through their wireless affiliates, hundreds of millions of retail wireless customers.

Competitive carriers have no option but to interconnect with the incumbent carriers, and the incumbents have parlayed their huge market presence and dominant control of local infrastructure into interconnection arrangements that extract maximum financial terms (e.g., the use of TDM-based interconnection facilities and the imposition of TDM-based access rate payments) from wireless and other carriers (in contrast, wireless carriers cannot collect access charges when terminating voice calls). Statutory and regulatory requirements to promote and govern IP interconnection for the exchange of voice traffic clearly remain necessary, and if anything, should be strengthened, not eliminated.

3. How does the evolution of emergency communications beyond the use of traditional voice service impact interconnection mandates?

Measures must be taken to ensure that VoIP customers have access to 911. Public safety measures are as critical for IP-based services as they are for traditional voice service, and service providers should be required to ensure that their subscribers have adequate access to public safety networks no matter what technology is used.

In addition, regulatory oversight will be necessary to ensure communications interoperability between different government public safety entities, and a smooth transition to regional NG911 systems and connections. For public safety systems to function properly, interconnection arrangements between carriers must be in place to ensure that all end users are able to reach the correct Public Safety Answering Point ("PSAP").

4. Ensuring rural call completion has always been a challenge because of the traditionally high access charges for terminating calls to high-cost networks. Does IP interconnection alleviate or exacerbate existing rural call completion challenges?

To the extent that rural call completion problems arise because of traditionally high access charges, the most effective approach would be to directly address those high rates by (1) accelerating the transition to a bill-and-keep regime for all switched access rate elements; and (2) rigorously enforcing IP Interconnection obligations. Expedited elimination of the entire switched access charge regime and

replacement of the outdated network arrangements made under that regime with efficient, reciprocal IP interconnection arrangements at a handful of POIs will sharply reduce the cost of terminating a call, and should accordingly eliminate any incentives to avoid delivery of traffic to any area of the country.

5. Should we analyze interconnection policy differently for best-efforts services and managed services where quality-of-service is a desired feature? If so, what should be the differences in policy between these regimes, and how should communications services be categorized?

It is possible that some applications will require a higher quality of service than other applications, or that some customers will be willing to pay different prices for different grades of service. Interconnection policies should allow such differences. However, certain bedrock principles remain regardless of service regime – interconnection must be available on just and reasonable terms and at cost-based rates; interconnection must be offered on a nondiscriminatory basis; and parties to interconnection agreements must have the right to have disputes addressed by a neutral arbiter.

6. Much of the committee's focus in the #CommActUpdate process has been on technology-neutral solutions. Is a technology-neutral solution to interconnection appropriate and effective to ensure the delivery and exchange of traffic?

Yes, a technology-neutral solution to interconnection is appropriate. Technology no doubt will continue to evolve, and it would be inefficient and unwise to limit bedrock interconnection principles to a particular technology. That said, Congress and the FCC must make it clear that interconnection obligations do explicitly apply to the exchange of voice traffic in IP format.

7. Wireless and Internet providers have long voluntarily interconnected without regulatory intervention. Is this regime adequate to ensure consumer benefit in an all-IP world?

It is a common error to assume that no interconnection obligations apply to wireless carriers and competitive providers because the specific obligations of Section 251(c), which addresses incumbent local exchange carriers, do not apply to these carriers. In reality, however, non-incumbent carriers are governed by the general provisions of Sections 201 and 251(a), and wireless carriers in particular are required to submit to negotiation and arbitration under the provisions of Section 252 upon receipt of a request for interconnection from an incumbent.[2] Carriers without market power, however, generally

[2] 47 C.F.R. § 20.11(e).

have an incentive to reach agreement on a mutually beneficial exchange of traffic. As a result, wireless carriers (particularly those without ILEC affiliates) and Internet providers have indeed been able to successfully negotiate numerous efficient interconnection arrangements without regulatory intervention. Where both parties have approximately equal bargaining power, interconnection agreements can be designed to minimize cost and maximize network efficiencies to the mutual benefit of both parties.

Where bargaining power is uneven, however, regulatory requirements and oversight are necessary to ensure just, reasonable, and non-discriminatory rates, terms and conditions for interconnection. This is the situation surrounding interconnection discussions between incumbent carriers and competitive carriers for the exchange of voice traffic in IP format. As evidenced by the very small number of IP voice interconnection agreements, it is apparent that incumbent carriers remain unwilling to switch from the non-reciprocal compensation, TDM-based network arrangements derived under the switched access regime to fully reciprocal, network-efficient IP-based interconnections for the exchange of voice traffic. To promote greater competition and achieve maximum consumer benefits (lower rates, more advanced features and functions), Congress and the FCC must vigorously promote IP voice interconnection and enforce IP voice interconnection obligations. In short, Congress and the FCC must ensure that an "all-IP" world does in fact include the exchange of voice traffic in IP format.

8. **Is contract law sufficient to manage interconnection agreements between networks? Is there a less onerous regulatory backstop or regime that could achieve the goals of section 251?**

Contract law alone is not sufficient to achieve the goals of section 251. Contract law does not compel or even encourage interconnection negotiations, and history demonstrates that carriers with market power will refuse to negotiate fair agreements unless they are under a regulatory or statutory obligation to do so.[3] For example, the FCC ruled in 2002 that interexchange carriers had no regulatory obligation to compensate wireless carriers for terminating their traffic.[4] The FCC noted, however, that

[3] Although telecommunications technology has changed continually over the last century, the need for regulatory intervention (beginning with the Kingsbury Commitment of 1913) in the face of dominant carrier intransigence remains.

[4] *In the Matter of Petitions of Sprint PCS and AT&T Corp for Declaratory Ruling Regarding CMRS Access Charges,* Declaratory Ruling, WT Docket 01-316 (July 2, 2002).

carriers were still "free to negotiate" contracts covering the exchange of this traffic. To this day, however, no interexchange carrier has agreed to enter into a contract governing the delivery of this traffic and wireline carriers have continued to refuse compensation to wireless carriers for interexchange traffic. There is no reason to believe that a regulatory process will not remain necessary to compel good faith IP voice interconnection negotiations; to establish broad standards for just, reasonable and nondiscriminatory rates, terms and conditions; and to enforce compliance and to address claims of alleged violations of the rules.

STRAND CONSULT

August 8, 2014

Re: Interconnection Whitepaper, Communications Act Update

Dear Chairmen Upton and Walden:

For the last 18 years, I have run an independent company that provides strategic knowledge to mobile operators around the world. My client list includes 170 mobile operators in 100 countries. Our company prepares reports[1] in the areas of in prepaid strategies, MVNOs, value added services, broadband, mobile (OTT) over the top technologies, and solutions to improve deployment of mobile infrastructure, particularly in rural areas.

I have observed the activities of Netflix in the interconnection markets in the US and the countries where it has launched, particularly the Nordic region where I am based. There is no doubt that Netflix is a successful company with more than 50 million customers globally in part because of its value-proposition and innovative use of technology. It is also true that Netflix has transformed itself from a DVD by mail company into the global leader in on-demand streaming video precisely because operators around the world have invested in broadband networks.

Interconnection has come up in the media and in debate because of recent complaints of Netflix about certain commercial transit arrangements. A new MIT-UCSD study "Measuring Internet Congestion: A Preliminary Report" investigates transit and peering links offers the following preliminary conclusions,

> *Congestion at interconnection points does not appear to be widespread. Apart from specific issues such as Netflix traffic, our measurements reveal only occasional points of congestion where ISPs interconnect. We typically see two or three links congested for a given ISP, perhaps for one or two hours a day, which is not surprising in even a well-engineered network, since traffic growth continues in general, and new capacity must be added from time to time as paths become overloaded.*

It is interesting that Netflix has not used any of the many legal means at its disposal to address its alleged problem, but rather, decided to make a public relations campaign by piggybacking on the net neutrality debate opened after the DC Circuit Court struck down net neutrality rules and again as the Federal Communication Commission indicated that it was exploring new rules.

There is nothing wrong with companies being opportunitistic in a market economy, but there is a line between opportunism on one side and manipulation on the other. Unfortuntely, Netflix crosses the line frequently. It is deeply troubling that Netflix, a profitable and growing company, is using the regulatory system to win price controls and other regulatory interventions to ensure a favorable operating environment for its business—at the expense of operators and consumers. I would not be surprised that Netflix uses the US as a testing ground for its dubious tactics to see what works to get favorable conditions and then brings those tactics to its rollout in other countries, cuiting the US case as "evidence" for norms.

I find Netflix complaints of being oppressed and its demands for price controls disingenuous. Netflix audaciously couches its argumentation in the hallowed language of net neutrality while lobbies for self-serving business conditions. These tactics are disgraceful and unscrupulous and disrespect citizens and taxpayers. But Congress should take heart: when companies complain of a lack of competition, this is confirmation that the market is working.

[1] See our reports at http://www.strandconsult.dk/

Netflix's manipulations include its clever use of public relations with speed tests. Netflix speed tests provide an oversimplified, if not misleading, view of network speeds and fail to take account for many factors that impact speed, not the least of which is the user's device. A user's quality of experience will be related to many things, not just average throughput Netflix contends.

Netflix uses these speed tests as a kind of blackmail to force operators to yield to its demands. A particular case was observed in Norway in 2012 with the Netflix launch. Telenor is the largest operator in the country, and it has covered the country with next generation networks along with its proprietary content delivery network (CDN). Bear in mind that at more than 1000 miles, Norway is the longest country in Europe and has one of the harshest climates. So the upfront and continuing costs of infrastructure are considerable.

Netflix had a global agreement with Level3 to ensured the efficient delivery to many countries in the world, but not to Norway. Telenor offered to cache Netflix content in its own network for a standard fee. Netflix countered that Telenor connect to Netflix's nearest exchange, located in Stockholm, Sweden and run by competitor Telia. Netflix claims that OpenConnect is free, but there are real costs for Telenor to connect to an exchange in another country. Routing content for the Norweigian market via Sweden is not an optimal solution for customer experience for Norwegian users. A local solution provides better quality of experience. Telenor declined Netflix's option both for cost reasons and because the formatting employed in Netflix is not optimal for Telenor's network.

Thereafter Netflix threatened to use its speed test to expose Telenor as having a slow network because no CDN solution was employed. Telenor called the practice blackmail and refused to comply. Netflix published the report as promised, and Telenor received a number of negative articles in the press as a result.[2]

If Netflix were an airline, its actions would be similar to selling a ticket to Washington Reagan National Airport but landing instead at Dulles and then expecting Reagan National Airport to pay the passengers' transport cost to the city. It should be observed that Netflix is unique in using these "blackmail" tactics. Operators and content providers around the world exchange traffic with little to no problem and with little regulatory oversight.

In any event, after some time, Netflix and Telenor were able to negotiate an agreement, and it did not require regulatory intervention.

It is true that Netflix invests in content delivery technology to make the delivery of its content more efficient. The fact remains, however, that although Netflix customers may be a small subset of the total number of subscribers on a given network, Netflix service consumes 20-30% of the network's capacity. Whereas it took several years for Netflix to grow to such a level in the US, when Netflix launches in another country, it frequently reaches this high amount almost overnight. This imbalance creates a challenge for operators seeking to manage their networks and to ensure a quality experience for all subscribers.

Netflix proffers that operators should just upgrade overall network capacity, but this imposes an unfair cost to those subscribers who don't use Netflix. Netflix has also suggested that a regulatory price control of zero should be mandated on all transit. This means that operators (and all of their customers, even those that don't subscribe to Netflix) have to absorb the disproportionate cost that Netflix imposes on their network.

[2] http://www.dagensit.no/article2529131.ece, http://www.dagensit.no/article2529667.ece

Not only would price controls upset and distort a competitive market that is working well, it punishes an entire class of innovative companies that provide efficient delivery services, including CDNs, data compression, and cloud delivery. Furthermore, it removes an important competitive differentiator for content providers to compete in content delivery and user experience, not to mention disenfranchising legions of engineers employed at these firms working on these activities. Finally, if interconnection costs are zero, content providers have no incentive to improve the compression of their data. They can continue to offer content in a poorly formatted form.

It is ironic that Netflix would take this position especially because its has used technology intelligently to win its leading place in the market. It might be observed as well that a price control could enshrine Netflix's market position, as no company would both to user better engineering in the transit market to compete with Netflix.

Netflix asserts that people pay for broadband subscriptions because they want to access internet content, but they fail to respect that if there was no network in the first place, there would be no Netflix. Furthermore Netflix, in its international expansion, specifically looks to rollout in locations where there are already high speed networks in place. Though Netflix may assert that a "virtuous circle" is driving traffic and network investment, the fact of the matter is that Netflix chooses countries where operators have already made investments. It goes without saying that Netflix has not announced any expansion in Africa, for example.[3]

Netflix targeted the Nordic region as a place for its rollout for a number of reasons:

1. High broadband penetration;
2. A population with relatively high income and willingness to try video streaming; and
3. Netflix can take advantage of fiscal optimization. By setting up its operation in Luxembourg, it avoids paying the 25% tax in the Nordic counties and instead pays just 3%. This arrangement also lessens Netflix tax burden the US.

Broadband providers build infrastructure that is a vital foundation for the digital society. Broadband providers also employ people in the countries where they work and pay taxes. While the US enjoys the spillover benefits from having its internet companies based in the US, these benefits are not necessarily shared in the foreign countries where these companies operate.

In the Nordic countries, broadband subscribers pay a value added tax of 25% on top of their subscriptions to fund social services. Furthermore, subscribers pay significant media license fees (amounting to hundreds of dollars per year per subscriber) to cover the cost of national language content on top of their broadband subscriptions.

National media companies have certain challenges compared to global Internet companies. Though the BBC may have an international audience, most national media companies create content in a specific language for a specific country. As such, local and national media companies are nearly totally dependent on the local infrastructure to reach their audience. By contrast, global companies such as Google, Facebook, Netflix, and Apple only care about the local infrastructure to the extent that they can earn revenue. They have a business model because another party provides the infrastructure, and the revenue they earn gets favorable tax treatment.

[3] However a number of entrepreneurs and engineers are working on mobile video solutions in emerging countries.

Global content providers are quite different from national media companies. For the most part, global content providers do not pay high taxes (as local media do) nor contribute to the provision of infrastructure in the places they serve. Their interest in the country extends only to the extent that they can profit. They don't have the same mission or obligations as national media companies and telcos.

The net neutrality debate is intertwined with the discussion of how to accelerate the deployment of broadband infrastructure. The questions are how to do it and who should pay. The multi-sided market model says that a variety of arrangements that will evolve based on supply and demand. Net neutrality, on the other hand, says that only consumers and taxpayers should be allowed pay for broadband. Essentially net neutrality creates a legal cartel in which content providers agree to accept the delivery price of zero. Content providers that wish to pay more for improved delivery service, even if it would improve consumer welfare or be a competitive differentiator, are not allowed under such strict rules.

Traffic to popular websites of global Internet companies such as Facebook can exceed the traffic to the top twenty local content providers combined. To be sure, users should have the freedom to access the websites of their choice, but it needs to be recognized that under the current regime, those services that contribute the least financially to the society are able to extract the most benefits. In practice, efforts to build next generation infrastructure, especially taxpayer-funded broadband networks, are frequently justified because of the need for capacity to deliver high-definition video. However this arrangement which disproportionately benefits high bandwidth video providers (e.g. Netflix and YouTube), essentially subsidizes profitable American Internet companies.

The market for interconnection and broadband in the US is one of the most competitive and robust in the world. It has allowed internet companies such as Google, Facebook, and Netflix to grow and internationalize. It is unfortunate that Netflix, a company that has benefitted from the free and open marketplace for interconnection, now attempts to manipulate the regulatory system for its own gain.

The interconnection market as it is today provides incentives not just for the deployment of networks, but for investment in technological solutions to improve the efficiency of data encoding and transport. I urge the US government to resist the temptation to intervene in a market that is working well.

Sincerely,
John Strand
CEO, Strand Consult
Pilestraede 41-43
DK1112 Copenhagen K
Denmark

T-MOBILE USA, INC. RESPONSE TO HOUSE WHITE PAPER ON NETWORK INTERCONNECTION

T-Mobile USA, Inc. ("T-Mobile")[1/] submits the following response to the White Paper released by the House Committee on Energy and Commerce ("Committee") on July 15, 2014, seeking comment on interconnection and peering agreements between communications networks and the role of the government in regulating these agreements, as a part of the Committee's ongoing efforts to reform the Communications Act of 1934, as amended (the "Act").[2/]

I. INTRODUCTION

As the fourth largest wireless carrier in the United States, T-Mobile, including the MetroPCS brand, offers nationwide wireless voice, text, and data services to approximately 50.5 million subscribers and provides products and services through over 70,000 points of distribution.[3/] T-Mobile continues to lead the industry in terms of growth, having added more than one million in total net customer additions over the past five consecutive quarters and having produced the fastest revenue growth in the industry in both total and service revenues.[4/] We also continue to offer the Nation's fastest 4G Long-Term Evolution ("LTE") network and provide the most consistent LTE speeds, even though our customers are using more wireless data

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1/ T-Mobile USA, Inc. is a wholly-owned subsidiary of T-Mobile US, Inc., a publicly traded company.

2/ *See* House Committee on Energy and Commerce, *Network Interconnection* (July 15, 2014) ("White Paper"), *available at* http://energycommerce.house.gov/sites/republicans.energycommerce.house.gov/files/analysis/CommActUpdate/20140715WhitePaper-Interconnection.pdf; *see also* 47 U.S.C. § 151 *et seq.*

3/ *See* T-Mobile News Release, *T-Mobile US Reports Second Quarter 2014 Results, Fastest Growth, Fastest Network, and Best Customer Service in the Industry* (July 31, 2014) ("T-Mobile Q2 2014 Press Release"), *available at* http://newsroom.t-mobile.com/news/t-mobile-us-reports-second-quarter-2014-results.htm.

4/ *See id*.

on average than the major national carriers' customers.[5/] Our 4G LTE network now reaches 235 million people in 325 metropolitan areas and is expected to reach more than 250 million people by the end of this year.[6/]

T-Mobile supports the Committee's continued efforts to modernize the Act and has been an active participant throughout this process.[7/] As T-Mobile explained in prior responses to the Committee, it is particularly important that an updated Communications Act be focused on promoting competition, eliminating barriers, and ensuring access and network interconnection capabilities, regardless of the technology a provider employs.[8/] We therefore recommended that Congress retain the Federal Communications Commission's ("FCC" or Commission") authority to oversee interconnection arrangements among carriers as communications services evolve from traditional telephone technologies to offerings based on Internet Protocol ("IP").[9/] We explained

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5/ *See* T-Mobile News Release, *T-Mobile Transforms the Way Americans Buy Wireless . . . Again* (June 18, 2014), *available at* http://newsroom.t-mobile.com/news/t-mobile-transforms-the-way-americans-buy-wireless-again.htm (reporting that T-Mobile customers use data 61 percent more than Sprint customers, 69 percent more than Verizon customers, and 100 percent more than AT&T customers); *see also* T-Mobile Issues & Insights Blog, *The Un-Carrier Network: Designed Data-Strong* (June 18, 2014), *available at* http://newsroom.t-mobile.com/issues-insights-blog/the-un-carrier-network-designed-data-strong.htm.

6/ *See* T-Mobile Q2 2014 Press Release; *see also* T-Mobile News Release, *T-Mobile Celebrates 1st Anniversary of LTE Rollout By Launching Major Network Upgrade Program* (Mar. 13, 2014), *available at* http://newsroom.t-mobile.com/phoenix.zhtml?c=251624&p=irol-newsArticle&ID=1908666&highlight=.

7/ *See, e.g.*, T-Mobile USA, Inc. Response to House White Paper on Modernizing the Communications Act (filed Jan. 31, 2014) ("T-Mobile White Paper #1 Comments"), *available at* http://energycommerce.house.gov/sites/republicans.energycommerce.house.gov/files/analysis/CommActUpdate/WP1_Responses_91-100.pdf; T-Mobile USA, Inc. Response to House White Paper on Modernizing U.S. Spectrum Policy (filed Apr. 25, 2014) ("T-Mobile White Paper #2 Comments"), *available at* http://energycommerce.house.gov/sites/republicans.energycommerce.house.gov/files/analysis/CommActUpdate/WP2_Responses_43-58.pdf; T-Mobile USA, Inc. Response to House White Paper on Competition Policy and Role of the FCC (filed June 13, 2014) ("T-Mobile White Paper #3 Comments"), *available at* http://energycommerce.house.gov/sites/republicans.energycommerce.house.gov/files/analysis/CommActUpdate/WP3_Responses_64-84.pdf.

8/ *See* T-Mobile White Paper #1 Comments at 3.

9/ *See id.* at 6-7.

that one reason Commission oversight of interconnection arrangements will remain necessary is the control that incumbent local exchange carriers ("ILECs") exercise over tens of thousands of legacy points of interconnection ("POIs"), creating bottlenecks for access to IP networks. We therefore suggested that the Commission have regulatory authority to adopt *ex-ante* rules, rather than undertake *ex-post* enforcement actions, to remedy these distortions and encourage arms-length negotiations.[10/]

An orderly industry transition to IP networks holds the potential for enormous benefits, including greater efficiencies for carriers and new and better competitive services for consumers. T-Mobile therefore supports continued Commission authority over *all* interconnection obligations. Because of changes in technology, those obligations may differ from what they are today and certainly should not be unbounded. Nevertheless, the interconnection framework should continue to include the type of flexible regulatory backstop that exists today to ensure that all providers can effectively and efficiently send customer traffic to each other. A statutory scheme that provides the FCC with the ability to impose appropriate limited regulatory requirements in the face of changing technology remains necessary to support providers' ability to interconnect in the face of potential bottleneck facilities or wholesale market power. That authority is particularly important to maintain an interconnection framework for voice communications as the IP transition occurs. The Act's provisions giving the FCC authority over interconnection should also continue to be technology neutral.

10/ *See* T-Mobile White Paper #3 Comments at 5-6.

II. INTERCONNECTION REQUIREMENTS COUPLED WITH A REGULATORY BACKSTOP CONTINUE TO BE NECESSARY

A. Any Interconnection Scheme Should Include a Regulatory Backstop.

Recognizing changes in technology, the White Paper seeks comment on whether the current interconnection framework is adequate in an all-IP world.[11/] The White Paper also requests comment on whether contract law is sufficient to manage interconnection agreements between networks.[12/] Alternatively, it asks whether there is a less onerous regulatory backstop or regime that could achieve the goals of Section 251.

FCC Chairman Wheeler has observed that communications policy is guided by what he calls the "Network Compact," the basic rights of consumers and the basic obligations of network operators.[13/] One of the elements of the Network Compact is interconnection. As he noted, interconnection obligations historically created an "identifiable, singular, end-to-end path for communications."[14/] The proliferation of different technological platforms has amplified the need for the FCC to have the authority to ensure that providers do not impede the utility of end-to-end communications.

The current statutory and regulatory regime has been important in ensuring that carriers have the ability to interconnect on a reasonable and non-discriminatory basis. Section 251 of the Act subjects all carriers to a general duty to interconnect directly or indirectly with the facilities and equipment of other carriers.[15/] Because of their unique role in the communications

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11/ *See* White Paper at 3 (Question 7).

12/ *See id.* (Question 8).

13/ *See* Prepared Remarks of FCC Chairman Tom Wheeler, The Ohio State University, Columbus, Ohio, at 5 (Dec. 2, 2013), *available at* https://apps.fcc.gov/edocs_public/attachmatch/DOC-324476A1.pdf.

14/ *Id.*

15/ *See* 47 U.S.C. § 251(a)(1) ("Each telecommunications carrier has the duty . . . to interconnect directly or indirectly with the facilities and equipment of other telecommunications carriers.").

ecosystem and market, it also subjects local exchange carriers ("LECs") to certain rate regulations and ILECs to additional obligations, including the duty to negotiate interconnection agreements in good faith.[16/]

While interconnection among wireless carriers and Internet backbone providers has historically been less regulated – and generally conducted pursuant to contractual arrangements – under this regime,[17/] the nature of communications is changing.[18/] An increasing percentage of consumers no longer rely on landline communications at all.[19/] And the wireless service providers on whom they rely offer various voice, video, and data services over their networks.[20/] IP traffic is quickly supplanting other means as the way many traditional forms of communications are provided. Although the Act's interconnection provisions are directed at traditional carrier-to-carrier relationships, traffic is no longer carried exclusively among and between those entities. Congress should therefore ensure that the Act continues to include interconnection obligations that may be applied flexibly to new technologies.

16/ *See id.* § 251(b), (c); *see also id.* § 252 (providing for arbitration of interconnection agreements involving ILECs). The White Paper appears to understate the role that the Act plays today in ensuring interconnection. It asserts that "[t]raditional public-switched telephone network carriers must abide by the Title II regulations regarding interconnection." White Paper at 2. However, it is not only "traditional" carriers that are subject to Title II; all carries have Title II obligations. Similarly, while it is true that "[w]ireless networks interconnect through commercial agreements between carriers . . .", the regulatory backstop of Section 251 in particular and Title II of the Act in general governs those commercial agreements. *See id.* Those obligations should continue to exist in an IP environment.

17/ *See* White Paper at 2, 3.

18/ *See id.* at 1. Nevertheless, as noted above, wireless carriers' contractual negotiations are backstopped by Section 251 in particular and Title II in general today, and should continue to be backstopped that way in the future.

19/ *See* T-Mobile White Paper #1 Comments at 2; T-Mobile White Paper #3 Comments at 7-8.

20/ *See* White Paper at 1.

While T-Mobile generally supports light touch regulation,[21/] contract law is not sufficient to manage IP interconnection between networks. Some networks, such as those controlled by LECs, will continue to play a unique role because of their historical position as monopoly providers. Non-LECs may also exercise wholesale market power requiring Commission oversight to ensure seamless communications on a nationwide basis. As T-Mobile has pointed out to the Commission, it has been exceedingly difficult to, for example, negotiate IP interconnection agreements with ILECs on reasonable terms and conditions.[22/] ILECs today control tens of thousands of legacy POIs that are deep in the ILEC network (*e.g.*, local wire centers).[23/] This legacy interconnection architecture and competitive reality allows ILECs to exercise wholesale market power and impose excessive and discriminatory transport and tandem switching costs, as well as trunking and facility charges, on competitors seeking access to their networks and facilities.[24/]

To remedy this competitive distortion, Congress must ensure that current interconnection obligations remain in place so that ILECs are required to negotiate IP-to-IP interconnections in good faith, as they are currently required to do for other interconnection arrangements under Section 251.[25/] The Act must also continue to apply to other providers in order for consumers to be assured that they can continue to communicate with others. The Commission should likewise

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21/ *See, e.g.*, T-Mobile White Paper #1 Comments at 5; T-Mobile White Paper #3 Comments at 3, 9-10.

22/ *See* Comments of T-Mobile USA, Inc., GN Docket No. 13-5, at 2 (filed July 8, 2013) ("T-Mobile Transition Trials Comments"); Reply Comments of T-Mobile USA, Inc., GN Docket No. 13-5, at 9-10 (filed Aug. 7, 2013) ("T-Mobile Transition Trials Reply Comments").

23/ *See* Comments of T-Mobile USA, Inc., GN Docket No. 12-353, at 9 (filed Jan. 28, 2013) ("T-Mobile AT&T/NTCA Petition Comments"); T-Mobile White Paper #3 Comments at 5.

24/ *See* T-Mobile AT&T/NTCA Petition Comments at 10.

25/ *See* Comments of T-Mobile US, Inc., WT Docket No. 13-135, at 24 (filed June 17, 2013) ("T-Mobile Wireless Competition Comments"); T-Mobile AT&T/NTCA Petition Comments at 11; T-Mobile Transition Trials Comments at 8-9; T-Mobile Transition Trials Reply Comments at 10-11.

continue to be able to clarify that "good faith" negotiations cannot occur where providers are required to, for instance, sign non-disclosure agreements, pay to build deep within a network, or exchange IP traffic with affiliates, which often impose unreasonable charges to exchange or convert traffic.[26/] Further, Congress must retain the Commission's ability to impose non-discrimination obligations to ensure that providers do not favor their own affiliates over competitors.[27/] While these obligations have typically arisen in the ILEC context, the Act should continue to provide the Commission with a backstop against these behaviors by any provider.

In conjunction with a "good faith" negotiation requirement, the Act should continue to provide the Commission with the ability to impose a regulatory mechanism for resolving disputes where IP interconnection negotiations reach an impasse, as Section 252 of the Act currently provides.[28/] Unless providers have access to a neutral arbiter and standards for dispute resolution are established, negotiations could skew in favor of providers with bottleneck facilities or wholesale market power and could potentially drag on for long periods of time.

B. Interconnection Rules Are Essential for Voice Communications As the IP Transition Occurs.

The White Paper points out that voice is rapidly becoming an application across a variety of network platforms and asks whether voice interconnection still requires a separate regulatory regime.[29/] The need for the Commission to continue to have authority over interconnection is particularly critical for voice communications as the IP transition occurs. As the Commission

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26/ *See* T-Mobile AT&T/NTCA Petition Comments at 8-9.

27/ *See id.* at 13; Reply Comments of T-Mobile USA, Inc., GN Docket No. 12-353, at 7 (filed Feb. 25, 2013) ("T-Mobile AT&T/NTCA Petition Reply Comments"). Moreover, carriers, including ILECs should not be able to hide behind affiliates to avoid interconnection obligations. The obligations should apply to any entity providing a relevant service.

28/ *See* T-Mobile AT&T/NTCA Petition Comments at 11-12.

29/ *See* White Paper at 3 (Question 2).

has recognized, the ability for consumers to use voice calling to, for example, reach emergency responders using 911 is vital to protecting and promoting the safety of life and property.[30/] The Commission has therefore adopted specific 911 requirements for voice communications across various technologies,[31/] even when such services are transmitted using IP.[32/] Not only must providers of voice communications over IP networks transmit all 911 calls, but they are also required to transmit the telephone number and location of the calling party to the appropriate Public Safety Answering Point ("PSAP"), designated statewide default answering point, or other appropriate local emergency authority.[33/] Interconnection arrangements are important to ensure that those voice calls will reach the PSAP. Therefore, the Act should continue to impose basic interconnection obligations so that providers can meet these requirements.[34/]

Requiring interconnection obligations for voice communications can also help meet other important goals. For instance, rural traffic and call completion may suffer in the absence of IP interconnection obligations. Under current network architectures, ILEC facilities generally

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30/ *See IP-Enabled Services; E911 Requirements for IP-Enabled Service Providers*, First Report and Order and Notice of Proposed Rulemaking, 20 FCC Rcd. 10245, ¶¶ 3-4 (2005) ("*VoIP Order*").

31/ *See* 47 C.F.R. § 20.18 (requiring commercial mobile radio service providers to deliver all wireless 911 calls to the appropriate Public Safety Answering Point ("PSAP") – or a designated answering point where no PSAP has been identified – to deliver the calling party's telephone number and location information to the PSAP).

32/ *See VoIP Order* ¶¶ 1-2; 47 C.F.R. § 9.5.

33/ *See* 47 C.F.R. § 9.5(b)(2).

34/ *See* T-Mobile AT&T/NTCA Petition Comments at 14 (discussing the need to access ILECs' 911 facilities); T-Mobile Transition Trials Reply Comments at 4. The Commission has recently acted to ensure that PSAPs are capable of receiving 911 messages transmitted via text. *See Facilitating the Deployment of Text-to-911 and Other Next Generation 911 Applications; Framework for Next Generation 911 Deployment*, Policy Statement and Second Further Notice of Proposed Rulemaking, PS Docket No. 11-153, PS Docket No. 10-255, FCC 14-6 (rel. Jan. 31, 2014); *see also Facilitating the Deployment of Text-to-911 and Other Next Generation 911 Applications; Framework for Next Generation 911 Deployment*, Further Notice of Proposed Rulemaking, 26 FCC Rcd. 15659 (2012). This recent action and the continued convergence of technology highlight why it may be necessary to expand interconnection obligations beyond traditional voice communications.

provide the only indirect, cost-effective transit route to many rural customers.[35/] The IP networks deployed by ILECs, however, are "closed" – meaning packets are not allowed across POIs unless authorized by the ILEC – providing ILECs with control over critical chokepoint facilities.[36/] Without appropriate legal safeguards, ILECs will be able to leverage their IP facilities and extort unreasonable and anticompetitive terms and conditions from those who want to interconnect with their IP networks. Other providers will either have to accept these unfair circumstances or find alternative routes, both of which could result in higher rates for rural consumers and impact innovative and new services.

III. THE ACT SHOULD PERMIT THE COMMISSION TO IMPOSE INTERCONNECTION OBLIGATIONS REGARDLESS OF THE TECHNOLOGY PLATFORM

Consistent with previous white papers, the Committee asks whether a technology-neutral solution to interconnection is appropriate and effective to ensure the delivery and exchange of traffic.[37/] As T-Mobile has previously stated, the Act should be as technology-neutral as possible, taking into consideration differences only where necessary.[38/] Indeed, the Commission has acknowledged that the obligation to negotiate interconnection in good faith "does not depend upon the network technology underlying the interconnection."[39/] Congress should likewise recognize that the Act currently provides and should continue to provide that flexibility with

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35/ *See* T-Mobile AT&T/NTCA Petition Comments at 10.

36/ *See id*.

37/ *See* White Paper at 3 (Question 6).

38/ *See, e.g.*, T-Mobile White Paper #1 Comments at 3-4.

39/ T-Mobile AT&T/NTCA Petition Comments at 11 (citing *Connect America Fund, et al.*, Report and Order and Further Notice of Proposed Rulemaking, 26 FCC Rcd. 17663, ¶ 1011 (2011)); *see also* T-Mobile AT&T/NTCA Petition Comments at 14-15.

respect to interconnection.[40/] While IP is the platform to which technology is now migrating, there may be others in the future, all of which should be subject to an interconnection obligation regulatory backstop where technically feasible.

In addition, the Commission should be able to continue to rely on the Act to ensure that existing facilities and technologies are not used as an excuse to make interconnection more difficult in the presence of changing technology. For example, the Act should continue to allow the FCC to prohibit providers from insisting on unnecessarily converting traffic from one format to another.[41/] ILECs in particular often force other providers to exchange traffic in a time-division multiplexed ("TDM") format to accommodate their legacy technologies even where both providers can carry and deliver traffic in an IP format.[42/] Providers insist on such conversions because clear ground rules exist regarding interconnection rights and compensation requirements for legacy networks, but not for IP networks.[43/] These conversions, however, are inefficient and can be anticompetitive. As the White Paper observes, IP traffic "usually transits the most efficient pathway to its destination."[44/] Moreover, such conversions often result in the loss of certain features or functionality of IP-based services, which negatively impacts

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40/ *See* T-Mobile Transition Trials Reply Comments at 10 (suggesting that IP interconnection should be covered by the Act to the same extent as any other form of interconnection).

41/ *See* T-Mobile AT&T/NTCA Petition Reply Comments at 6 (explaining that ILECs insist on TDM interconnections even where they or their affiliates have deployed IP voice interconnection facilities); Comments of T-Mobile USA, Inc., GN Docket No. 13-5, *et al.*, at 5 (filed Mar. 31, 2014) ("T-Mobile AT&T Trials Comments").

42/ *See* T-Mobile AT&T/NTCA Petition Reply Comments at 5-7.

43/ *See id.* at 7.

44/ White Paper at 2.

consumers.[45/] The Act should continue to provide the Commission with authority to require that all providers accept any request to exchange voice in an IP-traffic format.[46/]

Similarly, the Commission should be able to continue to ensure that existing POIs are not used as the bases for future POIs. As noted above, ILECs today control competitive access to their networks and facilities through the tens of thousands of legacy POIs that they maintain.[47/] Requiring providers to deliver IP traffic to the enormous number of POIs used in ILECs' networks is not only inefficient, but also costly to the connecting providers, which ultimately increases costs for consumers.[48/] Service providers should instead be required to exchange IP traffic at only a handful of regional POIs.[49/] These regional POIs for IP interconnection would ideally be located at Internet exchange points, unless carriers agree to alternative locations.[50/] Data is already exchanged at these points,[51/] and adding IP voice traffic to such transport circuits and POI exchanges would not pose a significant burden.

The Commission should also retain the authority to require that traffic exchanged and terminated at these regional POIs occur under a bill-and-keep regime that applies to transport and tandem switching charges.[52/] As T-Mobile has explained to the FCC, failure to include all

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45/ *See* T-Mobile AT&T Trials Comments at 5.

46/ *See* T-Mobile AT&T/NTCA Petition Comments at 5.

47/ *See id.* at 9; T-Mobile White Paper #3 Comments at 5.

48/ *See* T-Mobile AT&T/NTCA Petition Reply Comments at 4.

49/ *See* T-Mobile AT&T/NTCA Petition Comments at 5; T-Mobile AT&T/NTCA Petition Reply Comments at 4; T-Mobile Wireless Competition Comments at 23.

50/ *See* T-Mobile AT&T/NTCA Petition Reply Comments at 2, 5.

51/ *See id.* at 5.

52/ *See* T-Mobile Wireless Competition Comments at 24.

transport and tandem switching rates in the transition to bill-and-keep will result in arbitrage.[53/] As providers shift costs from end office termination services to transport and tandem switching elements, transport and tandem switching rates become an *ad hoc* intercarrier compensation recovery fund to make up for reduced termination charges.[54/] In order to deter such behavior, Congress should ensure that the Commission continues to have the regulatory tools it needs to require ILECs and other carriers to originate and terminate traffic on a bill-and-keep basis, which in turn will encourage them to transition to more efficient IP networks.[55/]

T-Mobile recognizes that preserving an interconnection scheme that will remain robust as technology advances is complicated. T-Mobile therefore suggests that Congress support limited trials of voice traffic exchanges in an IP format consistent with its proposals above.[56/] Because the provision of IP services and the exchange of IP traffic have already been proved viable from a *technological* perspective,[57/] the Commission should test how it can best implement its authority to develop an appropriate interconnection *regulatory* framework so that all carriers exchange traffic on reasonable terms and conditions.

IV. CONCLUSION

T-Mobile supports congressional review of existing regulations to ensure that they reflect the current and future needs of consumers and carriers as networks transition to IP. The

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53/ *See* T-Mobile AT&T/NTCA Petition Comments at 7; Reply Comments of T-Mobile USA, Inc., WC Docket No. 10-90, *et al*., at 8-9 (filed Mar. 30, 2012) ("T-Mobile Transformation FNPRM Reply Comments").

54/ *See* T-Mobile Transformation FNPRM Reply Comments at 8-9; T-Mobile Wireless Competition Comments at 24.

55/ *See* T-Mobile AT&T/NTCA Petition Comments at 6 (noting that wireless carriers like T-Mobile have been originating and terminating traffic on a bill-and-keep basis for decades and have developed a more efficient network as a result).

56/ *See id*. at 17-18; T-Mobile Wireless Competition Comments at 23-24; T-Mobile Transition Trials Reply Comments at 5.

57/ *See* T-Mobile AT&T/NTCA Petition Reply Comments at 10-11.

functionality and safeguards needed for high-quality voice transmissions will not simply spring into existence once the all-IP network is deployed. Congress must therefore ensure that the Act continues to contain pro-competitive interconnection policies and confers authority to the FCC to intervene where industry participants control bottleneck facilities or exercise wholesale market power, regardless of the technology used.

August 8, 2014

The Honorable Fred Upton
Chairman
Energy and Commerce Committee
U.S. House of Representatives
2183 Rayburn House Office Building
Washington, DC 20515

The Honorable Greg Walden
Chairman
Communications and Technology Subcommittee
Energy and Commerce Committee
U.S. House of Representatives
2182 Rayburn House Office Building
Washington, DC 20515

Re: Response to Communications Act Update White Paper #4

Dear Chairman Upton and Chairman Walden,

TechFreedom[1] and the International Center for Law and Economics (ICLE)[2] respectfully submit the following comments and attached appendices in response to the Committee's fourth white paper[3] in its examination of how communications law can be rationalized to address the 21st century communications landscape.

The Telecommunications Act of 1996 has been outdated since the moment it was signed into law, and we applaud the Committee for taking up the task of bringing it up to date. The Act's

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[3] http://energycommerce.house.gov/sites/republicans.energycommerce.house.gov/files/analysis/CommActUpdate/20140715WhitePaper-Interconnection.pdf.

siloed approach reflects the assumptions of the pre-Internet era, and is completely out of sync with the market it now governs. The sooner it is replaced with a technologically neutral act focused on how regulated conduct affects consumer welfare, the better, as we argued in our earlier comments in this ongoing inquiry.[4]

As the Committee recognized in its fourth white paper, interconnection issues are nothing new, and have been a part of communications law in America since before the 1934 Communications Act was enacted. However, interconnection and peering in the digital age are significantly different than their analog (TDM) counterparts. Data traffic utilizing the TCP/IP networking protocols does not require a direct connection from one endpoint to another, and can be broken down into multiple different pieces that travel over and across the network (in the form of packets) toward their destination via multiple different routes simultaneously.

These advancements in networking technologies make data traffic much more robust, since it can be actively routed to reduce congestion, avoid network infrastructure outages, and even minimize transit costs by finding the cheapest route from endpoint to endpoint—all things that would have been difficult or even impossible to do with circuit-switched TDM traffic. Additionally, substituting packet-routers for local switches has greatly reduced the number of interconnection points needed to connect all users to one another, down to around just a dozen for IP traffic, as compared with the hundreds or even thousands needed to manage TDM traffic.

Simply put, in most cases, the transit market provides an effective alternative to direct interconnection. So even if a broadband provider refused to deal with an edge provider, the edge provider still has a variety of options for getting its traffic to the subscribers of that broadband provider. So long as the transit market is competitive and it is not technologically possible (and cost-effective) for a broadband provider to discriminate among sources of traffic coming from transit providers (in real time), it is unlikely that a refusal to interconnect (or a breakdown in interconnection negotiations) will actually harm consumers.

The available data supports the conclusion that the transit market is highly competitive. In fact, transit prices have plunged from $1200 per mbps in 1998 to $0.94 in 2014 (a factor of 1297x).[5] These prices act as a ceiling on direct interconnection prices, and the transit market checks whatever power might theoretically exist by virtue of a broadband provider's supposed "terminating access monopoly."

While the risk of under-regulating in the IP-based interconnection market is low, the risk of *over-regulating* is high. Unnecessary intervention risks foreclosing pro-competitive practices and thus reducing consumer welfare. For example, setting prices at zero for interconnection could reduce the incentive for ISPs to supply capacity, harming consumers who would, ironically, get

[4] http://energycommerce.house.gov/sites/republicans.energycommerce.house.gov/files/analysis/CommActUpdate/WP3_Responses_64-84.pdf#page=49.

[5] William B. Norton, The Internet Peering Playbook 33 (2013); *see also* http://drpeering.net/white-papers/Internet-Transit-Pricing-Historical-And-Projected.php.

slower access to favorite content.[6] Meanwhile, existing antitrust laws can address any remaining anticompetitive practices—but consumers are simply extremely unlikely to be harmed in so a competitive marketplace.[7]

Any consideration of a legislative framework for addressing interconnection should begin by re-examining the Digital Age Communications Act (DACA) proposed by a working group of telecom experts and academics from across the political spectrum.[8] Assembled in 2005 by The Progress & Freedom Foundation, the group produced S. 2113, which Sen. Jim DeMint introduced in 2006.[9] In general, DACA would have made the FCC work more like the Federal Trade Commission: before regulating, the agency would have to show market power and harm to competition.[10] But with respect to interconnection, the FCC would only have to show

> practices that pose a substantial and non-transitory risk to consumer welfare by materially and substantially impeding the interconnection of public communications facilities and services in circumstances in which the Commission determines that marketplace competition is not sufficient adequately to protect consumer welfare, providing that in making any such determination the Commission must consider whether requiring interconnection will affect adversely investment in facilities and innovation in services.[11]

In other words, DACA gave the FCC *greater* discretion over interconnection (than elsewhere) by dropping the market power requirement.[12] Nonetheless DACA's interconnection regulations wisely maintain the Act's fundamental restraint and consumer focus by requiring the FCC to

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[6] Geoffrey Manne, *Understanding Net(flix) Neutrality*, DetroitNews Opinions and Editorials (June 24, 2014), *available at* http://www.detroitnews.com/article/20140624/OPINION01/306240007/Understanding-Net-flix-Neutrality, *attached as* Appendix D.

[7] *See* Hal J. Singer, *Mandatory Interconnection: Should the FCC Serve as Internet Traffic Cop?* 3-4, Progressive Policy Institute (May 2014), *available at* http://www.progressivepolicy.org/wp-content/uploads/2014/05/2014.05-Singer_Mandatory-Interconnection_Should-the-FCC-Serve-as-Internet-Traffic-Cop.pdf (arguing that in light of the evidence it would be a "stretch to defend an interconnection obligation as a means to address monopoly.").

[8] *See* Progress & Freedom Found., *Digital Age Communications Act: Proposal of the Regulatory Framework Working Group* (June 2005) [*DACA Report*], *attached as* Appendix A.

[9] *See* http://thomas.loc.gov/cgi-bin/query/z?c112:S.2113.IS:/

[10] DACA Report, at 3 ("the Working Group concluded that regulation in the digital age should be based, almost exclusively, on competition law principles drawn from antitrust law and economics. Regulation should respond to instances of abuse of market power, which are more than transitory in nature, and regulation should address such instances of abuse as they occur.").

[11] *Id.* at 36.

[12] *Id.*

show that a failure to interconnect substantially harmed consumer welfare *and* that markets would not solve the problem before regulating.[13]

By grounding the FCC's approach to interconnection in sound economics, with a presumption against mandatory interconnection, DACA provides a model for how to address interconnection concerns going forward — and not just on an ex post basis.[14]

We urge the Committee to carefully consider the bipartisan consensus of DACA as it studies the issue of interconnection. If anything, DACA's standard may even have set the analytical bar too low for justifying intervention in interconnection negotiations. The subsequent nine years have shown no problem that needs fixing in this market. But if there is a problem, an approach grounded in economic rigor remains the best way to ensure that regulatory intervention does not inadvertently harm consumers. And DACA remains the best starting point for drafting such aspects of a rewrite of our sorely outdated telecom laws.

We attach, for the Committee's benefit, the following articles:

- **Appendix A**: Progress & Freedom Found., *Digital Age Communications Act: Proposal of the Regulatory Framework Working Group* (June 2005): Landmark bipartisan working group proposal to reform the Communications Act
- **Appendix B**: Raymond L. Gifford, *The Continuing Case for Serious Communications Law Reform*, (Mercatus Center Working Paper No. 11-44, Nov. 2011): Summarizes DACA and provides a fresh perspective on communications reform
- **Appendix C**: A Statement of the DACA Regulatory Framework Working Group, The Digital Age Communications Act's Regulatory Framework and Net Neutrality (2006): Brief discussion of the DACA approach, and how it would ameliorate Net Neutrality concerns
- **Appendix D**: Geoffrey Manne, *Understanding Net(flix) Neutrality*, DetroitNews Opinions and Editorials (June 24, 2014): Op-ed explaining the economics of interconnection as it relates to Netflix and Comcast's agreement and distinguishing interconnection from net neutrality.

We remain eager to assist the Committee in its work and look forward to seeing draft legislative language soon.

/s/Berin Szoka, TechFreedom
/s/Geoffrey Manne, ICLE
/s/Tom Struble, TechFreedom
/s/Ben Sperry, ICLE

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[13] *See id.*; *see also* A Statement of the DACA Regulatory Framework Working Group, The Digital Age Communications Act's Regulatory Framework and Net Neutrality 3 (2006) [DACA Working Group Statement], *attached as* Appendix C.

[14] Raymond L. Gifford, *The Continuing Case for Serious Communications Law Reform* 5 (Mercatus Center Working Paper No. 11-44, Nov. 2011), *attached as* Appendix B (citing DACA Report, at 18-19).

Digital Age Communications Act

Proposal of the Regulatory Framework Working Group

Release 1.0

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June 2005

A DIGITAL AGE COMMUNICATIONS ACT

A Proposal for a New Regulatory Framework

Release 1.0

Introduction and Summary

Technological and marketplace developments have forced a re-thinking of the premises of communications regulation. Advances in transmission technologies (both wireless and wireline), in computerized switching, and in the creation of digital content have fundamentally altered the marketplace. Innovative digital services and broadband networks are radically changing the frontier of the possible, bringing new competitors into the marketplace. The combination of new technologies and increased marketplace competition across all communications sectors means more communications power to individuals and businesses.

The digitalization of transmission and content has had two long-anticipated but now increasingly recognized effects. Communications services long associated with only one transmission technology are now provided over many. The growing success of voice-over-Internet-protocol telephony is only the most recent and extreme example: broadband platforms can provide the full range of communications services, from voice, to data, to video. Moreover, digitalization is creating increased competition among carriers previously isolated to single services. Those companies previously known as "cable television" companies are providing voice services to residential customers; those previously known as "telephone companies" are deploying fiber to provide their own "triple play" of voice, video, and high-speed data services. And satellite providers, cell phone companies, and other new entrants are providing increasing competition in many traditionally monopolized markets, while potential new entrants, such as wide-area wireless and power companies, lurk on the sidelines as future competitors.

These developments challenge the fundamental underpinnings of communications regulation. The 1934 Communications Act and its predecessors were principally concerned about control of monopoly power in an era in which, in most markets, only a single provider offered service. The Telecommunications Act of 1996 recognized competition in many markets, and it lifted legal barriers to the entry of new players in telecommunications markets. But the 1996 Act, itself only an amendment to the 1934 Act, had as its principal focus the control of monopoly power in local telecommunications markets. And under both laws – and thus the law as it stands today – specific regulatory treatment is based on the techno-functional characteristics of the services those carriers are providing.

The current regime is often referred to as a "silo" or "smokestack" regime: a distinct set of regulations attach to a service once it is classified under one service definition or another.

The development of competition eliminates the need for laws designed to limit monopoly power, and, in particular, laws that presume – as both the telephony and cable television titles of the current Communications Act largely do – that all providers of certain kinds of services have dominant market power. The 1934 Act set as its goal making available "to all the people of the United States . . . a rapid, efficient, Nation-wide, and world wide wire and radio communications service,"[1] and the importance of communications services cannot be denied. But most essential goods and services in this country are effectively provided by competitive markets.

Similarly, the current regulatory scheme – where the type of regulation to which a network is subject depends upon the technical or functional characteristics of the service that the network offers – no longer makes sense when digital technologies mean that almost any type of network can provide almost any kind of service. Worse, the uncertainty fostered by the existing outdated technology-based regulatory categories both delays entry and innovation and creates the opportunity for political gaming by companies intent on using regulation as a barrier to competition.

Recognizing these developments, many have called for a re-write of the Communications Act, and it is in service of these calls that The Progress and Freedom Foundation has organized the Digital Age Communications Act project. The principal work of the project is being undertaken by five working groups.[2] As its name implies, the charge of this Regulatory Framework Working Group was to propose a statutory framework model that could respond to the changed environment.[3] As this report details, the Working Group considered a wide-range

[1] 47 U.S.C. § 151.

[2] The Working Groups are: Regulatory Framework; Federal/State Framework; Universal Service/Social Policy; Spectrum; and Institutional Reform. Each of these groups will be issuing their draft proposals in the weeks and months to come. Of course, there are obvious interrelationships among the work of the groups, so that they should not be viewed in isolation. For example, while the Regulatory Framework proposal presented here in some sense represents a completely new regulatory model at the federal level, it does not explicitly address issues of federal-state relations, such a preemption of state and local regulation. These issues will be addressed by the Federal-State working group. Similarly, the work of all of the other groups may well affect the recommendations to be offered by the Institutional Reform group, which will report last. Ultimately, the intent is that the proposals of each group fit together in an integrated way that forms the basis for conceiving major parts of a new Digital Age Communications Act. Even with the reports of all of the groups, however, it is not the project's intent or purpose to address every issue that is addressed in the current Act or that could or should be addressed in imagining a new one.

[3] By design, the Regulatory Framework Working Group is composed of a diverse group of individuals from academia and think tanks with a variety of perspectives. The draft model legislative proposal and the accompanying report represent a consensus view of the working group. It should be understood that not all members of the group necessarily support all aspects

of statutory models, from the elimination of sector-specific regulation, leaving only antitrust to police telecommunications markets, to prior modes of deregulating network industries, to some of the current proposals for legislative action.

There is merit to each of the proposals we considered. Some of the proposals considered, such as the IP Migration Model that would eliminate public utility-style regulation of broadband services, might present attractive compromises between the current model and the more far-reaching and comprehensive reform model proposed here. But the Working Group concluded that regulation in the digital age should be based, almost exclusively, on competition law principles drawn from antitrust law and economics. Regulation should respond to instances of abuse of market power, which are more than transitory in nature, and regulation should address such instances of abuse as they occur. The regulator would act principally through adjudication, responding as antitrust authorities do, to correct abuses as they occur, largely eliminating the elaborate web of rules and regulations that has grown up under the existing statute.

The Working Group translated this basic conclusion to proposed language for a new statute. The essential statutory language borrows heavily from the Federal Trade Commission Act. The FTC acts principally under the antitrust laws, and principally through adjudication, the two core attributes of a new regulatory regime for communications. Thus, at the outset the model act declares that it is the policy of the United States that the FCC's "decisions should be based on jurisprudential principles grounded in market-oriented competition analysis such as those commonly employed by the Federal Trade Commission and the United States Department of Justice in enforcing the Federal Trade Commission Act and the antitrust laws of the United States." It also declares that it is the policy of the United States that "economic regulation of communications markets should be presumed unnecessary absent circumstances that demonstrate the existence of a threat of abuse of market power that poses a substantial and non-transitory risk to consumer welfare." The FTC does, however, have authority to act to prevent violations of the law, and it possesses limited rulemaking authority. These powers, still hinged to antitrust reasoning, are also found in the new statute.

The Working Group's new regulatory framework, however, does take an additional step to ensure that the nation's communications systems remain integrated: that the essential interconnectivity of communications is preserved.

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of the legislative proposal or endorse all of the language of the report. By the same token, the model legislative language and the report represent the work product of the group's members in their individual capacities and the views expressed should not necessarily be attributed to the institutions with which the group's members are affiliated.

The new regulatory framework permits the Federal Communications Commission to order the interconnection of communications networks, in situations in which markets are not adequately providing interconnection and in which the denial of interconnection would substantially harm consumer welfare. The justification for the interconnection authority is two-fold. First, although communications markets are increasingly becoming competitive, in some important access markets competition is likely to be among a relatively small number of access providers. This, coupled with the network effects that inhere in communications markets, means that the strategic denial of interconnection may be a rational competitive strategy – and that private benefits from the denial of interconnection may not align with total social welfare. Second, the economic and non-economic benefits of an integrated communications network, for commerce, for education, and for individual fulfillment, are fundamental. The interconnection authority aims to preserve the integrity of communications networks without a heavy-handed regulatory structure covering all aspects of these increasingly dynamic markets.

Finally, the Working Group appreciates that any shift to a new regulatory paradigm, especially one as significant as the one proposed here, is likely to involve some transitional and timing issues that must be resolved. In some instances, it may not be feasible or advisable to "flash cut" legacy regulation. While acknowledging the existence of such transitional issues, they are not treated in this proposal and report. The Working Group wants the focus to be on the substance of the recommendation for a much different regulatory framework than the present one. Moreover, many of the transitional issues that may need to be addressed will not become apparent until at least some of the succeeding groups report. It makes more sense to focus on transitional issues at a later date.

How We Got Here: The Premises of the 1934 and 1996 Acts

The Communications Act of 1934 and its predecessors were modeled on the economic regulation of railroads pioneered by the Interstate Commerce Act of 1887. Under this model, common carriers (meaning telephone companies) were required to provide service to all customers on a nondiscriminatory basis and set just and reasonable prices (and practices).[4] Carriers could not enter service without regulatory approval, which the Federal Communications Commission could grant (or deny) based on the "public convenience and necessity."[5] Carriers were required to file tariffs, setting forth all of the rates and practices for their services, and the Federal Communications Commission reviewed these tariffs for compliance with the statute's requirement that the terms of service be "just and reasonable".[6]

This extensive regulation was thought necessary to control the monopoly power of telecommunications companies, and in particular the integrated Bell

[4] 47 U.S.C. §§ 201, 202.
[5] 47 U.S.C. § 214(a).
[6] 47 U.S.C. §§ 203(a), 205.

System, and to stabilize the provision of common carrier communications services.[7] Notably, although it opposed elements of the 1934 Act, AT&T was not opposed in principle to regulation which would confirm its monopoly position; other independent telephone companies agreed.[8] Before passage of the 1934 Act, local telecommunications had, in many places, been provided by competing companies, but many considered that competition ruinous. In any event, the Bell System dominated the markets, and the 1934 Act codified a scheme of public-utility regulation premised on the assumption of natural monopoly.

The premise of natural monopoly regulation was sorely tested in the 1970s and 1980s in several realms. New computing services were developed, which expanded the horizon of communications services. While these services were initially dependent, to at least some degree, on communications common carriers for their use, the computer processing components could be provided on a more competitive basis. Competition also developed in long-distance markets, as microwave technology and increasing traffic densities re-wrote the economics of that market. Communications services provided via satellite also became more common.

These developments prompted radical changes in regulation. The Federal Communications Commission began its long-standing policy of attempting to keep new, potentially competitive services outside the scope of public utility regulation, and its *Computer II* framework, adopted in 1980, defined the computer-based "enhanced services" outside of the Act.[9] As a legacy of that decision, under the Telecommunications Act of 1996 most providers of Internet network services are now classified as "information services" providers and are largely exempt from regulation, while most providers of voice services remain subject to the public utility regulation of Title II by virtue of being defined as

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[7] *See, e.g.*, Southwestern Bell Corp. v. FCC, 43 F.3d 1515, 1518 (D.C. Cir. 1995) ("In 1934, when Congress enacted the Communications Act and created the FCC, AT & T held a virtual monopoly over the Nation's telephone service. The regulatory scheme Congress devised in title II meant to respond to that situation, to ensure competition among interstate common carriers and reasonable rates for consumers."). Professors Joseph D. Kearney and Thomas W. Merrill make the point that the Interstate Commerce Act and the Acts on which it was modeled were not solely designed to limit monopoly, and, indeed, in some cases (such as trucking and airlines), the common carrier regulatory model was expressly adopted to control (i.e., to limit) competition. *See* Joseph D. Kearney & Thomas W. Merrill, *The Great Transformation of Regulated Industries Law*, 98 Colum. L. Rev. 1323, 1332-33 (1998); James B. Speta, *A Common Carrier Approach to Internet Interconnection*, 54 Fed. Comm. L.J. 225 (2002).

[8] *See generally* Glen O. Robinson, *The Federal Communications Act: An Essay on Origins and Regulatory Purpose*, in A Legislative History of the Communications Act of 1934, at 1, 6-7 (Max D. Paglin ed., 1989); Kenneth A. Cox & William J. Byrnes, *The Common Carrier Provisions – A Product of Evolutionary Development*, in A Legislative History of the Communications Act of 1934, at 25, 28-30 (Max D. Paglin ed., 1989).

[9] See First Computer Inquiry, 65 F.C.C.2d 808 (1977); Second Computer Inquiry, 77 F.C.C.2d 384 (1980), *recon*., 84 F.C.C.2d 50 (1981), *further recon.,* 88 F.C.C.2d 512 (1981), *aff'd sub nom.* Computer and Communications Industry Ass'n v. FCC, 693 F. 2d 198 (D.C. Cir. 1982) *cert. denied*, 461 U.S. 938 (1983).

providers of "telecommunications services".[10] This definitional construct was useful in not regulating newly emerging services in a narrowband world when "data" services were more readily separable from "voice" services; in an increasingly digital broadband world, however, it creates regulatory competitive imbalances among competing services.

More wrenching to the telecommunications industry, but also a result of developing competition, was the break up of the Bell System, effected by consent decree after the government's antitrust case.[11] The structural separation of local and long-distance markets was premised on the local exchange's natural monopoly characteristics. As the District Court put it, the Bell operating companies' control over local networks gave them the "ability and incentive" to leverage their power into long-distance markets. The divestiture facilitated competition in long-distance. But it also introduced an access charge system to compensate local telephone companies for the use of their local lines to originate and terminate long distance traffic. This system continued the subsidies that long-distance service had long provided to local and to universal service programs. Despite substantial reforms by the FCC, the access charge regime continues to treat different types of traffic differently based solely on the type of provider, for example by subjecting "long-distance" telephone calls from traditional carriers differently from terminating traffic delivered to the public exchange by newer Voice-over-Internet Protocol companies. This is so even though the two types of traffic are largely indistinguishable both from a consumer's perspective and in terms of costs imposed on the local telephone network.

In the years following the consent decree, technological and market developments continued. In urban centers, competitive access providers installed new facilities, bypassing the incumbent local exchange carriers' access facilities. Cellular service became more widespread and cheaper, as digital technology increased system carrying capacity and the FCC made spectrum available for personal communications services. And, at the tail end of the period, some cable companies (which had, since the 1970s, been expected to

[10] Under the 1996 Act "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 sent and received." 47 U.S.C. § 153(43). An "information service" is "the offering of a capability for generating, acquiring, storing, transforming, processing, retrieving, utilizing, or making available information via telecommunications…but does not include any use of any such capability for the management, control, or operation of a telecommunications system or the management of a telecommunications service." 47 U.S.C. § 153(20). In the *Brand X* case, of course, the Ninth Circuit rejected the FCC's decision to treat cable modem services as "information services," holding instead that, at least in part, they must be "telecommunications services" and subject to the requirements of Title II. *See Brand X Internet Servs. v. FCC*, 345 F.3d 1120 (9th Cir. 2003), *cert. granted.* The Supreme Court's decision in the case is expected shortly.

[11] *See* United States v. American Tel. & Tel. Corp., 552 F. Supp. 131 (D.D.C. 1982), *aff'd sub nom*., Maryland v. United States, 460 U.S. 1001 (1983).

compete with telephone companies) finally began early moves into voice services.

At the same time that communications technology was so rapidly progressing, a paradigm shift was occurring in the way many approached the law of industrial organization. Antitrust was increasingly influenced by rigorous economic thinking that identified consumer welfare as the touchstone by which practices should be judged legal or illegal, and the increasing sophistication of economic analysis allowed better legal analysis. To some extent, economics began the process (not yet completed) of antitrust's eliminating its own silos, under which economically similar practices were judged by different standards.[12] Moreover, command and control regulation was increasingly questioned, both for the costs that it imposed directly[13] and for the opportunities it created for incumbents (and others) to use the regulatory system in anticompetitive ways.[14]

All of these developments – combined with the Bell Companies' chafing under the AT&T Consent Decree's line of business restrictions – set the stage for the Telecommunications Act of 1996. At the most general level, the 1996 Act embraced competition and less regulation of communications markets as first principles. In the 1996 Act's preamble, Congress described the Act's purpose to "promote competition and reduce regulation in order to secure lower prices and higher quality services for American telecommunications consumers and encourage rapid deployment of new telecommunications technologies."[15] The central House Report declared that the legislation "reflects the Committee's belief that more competition, rather than more regulation, will benefit all consumers."[16] Overall, "[t]he hope underlying much of the Telecommunications Act of 1996 [was] that sufficient competition will develop in local telecommunications that this area of the industry will witness a transformation similar to the one that occurred in the long-distance segment over the [previous] twenty-five years."[17]

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[12] *See generally, e.g.*, Fred S. McChesney, *Talking 'Bout My Generation: Competition for and in the Field of Antitrust*, 52 Emory L.J. 1401 (2003) (discussing the changes in antitrust over the past 30 years).

[13] The canonical citation is Richard A. Posner, *Taxation by Regulation*, 2 Bell J. Econ. 22 (1971).

[14] *E.g.*, Roger G. Noll & Bruce M. Owen, The Political Economy of Deregulation: Interest Groups in the Regulatory Process 155 (1983) ("regulation tends to create new special interests whose survival depends on its continuation"); Paul L. Joskow & Roger G. Noll, *The Bell Doctrine: Applications in Telecommunications, Electricity, and Other Network Industries*, 51 Stan. L. Rev. 1249, 1252 (1999) ("[R]egulation must accord rights of participation and policy review to anyone substantially affected by its policies, which invites strategies and tactics that, at best, retard the competitive process and, with depressing frequency, invite cartelization.").

[15] Telecommunications Act of 1996, Pub. L. No. 104-104, 110 Stat. 56, 56 (preamble).

[16] H.R. Rep. No. 104-240, at 50 (1996), *reprinted in* 1996 U.S.C.C.A.N. 10, 14.

[17] Joseph D. Kearney, *Will the FCC Go the Way of the ICC?*, 71 U. Colo. L. Rev. 1153, 1178 (2000); *see also* Howard A. Shelanski & J. Gregory Sidak, *Antitrust Divestiture in Network Industries*, 68 U. Chi. L. Rev. 1, 91 (2001) ("The [Bell] break up is now widely acknowledged to have unleashed powerful forces of competition in long-distance telephone markets; to have induced policy makers to recognize (in the Telecommunications Act of 1996) that not even local telephone service is subject to natural monopoly.").

The Act's pro-competition, deregulatory bent is revealed in many of its provisions. Most importantly, the Act preempted any state or local law that would "prohibit or have the effect of prohibiting the ability of any entity to provide any interstate or intrastate telecommunications service."[18] The Act also repealed provisions that prevented entities from crossing service boundaries, such as telephone company provision of video services; and the Act gave the FCC the authority to dismantle all of Title II by "forbearing" from applying any statutory provision that competition had rendered unnecessary in the public interest.[19]

The 1996 Act, however, did not stop at eliminating legal barriers to competition. Based on the view that elements of the local market might remain natural monopolies[20] – or at least on the view that, in order to be competitive, new entrants would need to build their own facilities gradually[21] – the Act also included the (now) highly controversial local unbundling provisions.[22] As implemented by the FCC, these provisions required the incumbent local exchange carriers to share elements of their local networks at low rates, by renting loops or switching or other elements to new competitors. As one commentator put it, the FCC rules required the incumbents to "cooperate, against their interests and for little if any profit, with those very competitors" who sought to take away their customers.[23]

Without here revisiting all of the controversies surrounding the unbundling rules, the FCC's implementation of those rules, and the frequent trips to the appellate courts (largely unsuccessful for the FCC because in each instance the courts held the agency's unbundling requirements too expansive), two uncontroversial things can be said. First, the unbundling provisions provoked substantial litigation and therefore marketplace uncertainty, as neither the incumbents nor potential entrants could predict with certainty the economic terms on which they would be operating in local telecommunications markets. Second, the unbundling provisions, because they applied only to the incumbent local telephone companies, created a imbalance in regulatory treatment between the telephone companies and other entrants into broadband services, most notably the cable companies. While some have defended that different regulatory

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[18] 47 U.S.C. § 253(a).
[19] 47 U.S.C. § 160(a).
[20] *See, e.g.*, Thomas W. Krattenmaker, *The Telecommunications Act of 1996*, 29 Conn. L. Rev. 123, 158-59 (1996) (explaining that the unbundling provisions were included in the law because "[i]t is most likely that running a telecommunications wire to the home is a natural monopoly and so one ought to concentrate on regulating that monopoly or mitigating its ill effects").
[21] *See, e.g.*, Douglas Lichtman & Randal C. Picker, *Entry Policy in Local Telecommunications: Iowa Utilities and Verizon*, 2002 Sup. Ct. Rev. 41, 51-52 (arguing that unbundling rules are merely transitional, to enable a competitor to enter an economic or advertising market while gradually building facilities; or, in other words, transitional rules to help overcome the incumbency advantage).
[22] 47 U.S.C. §§ 251, 252.
[23] Howard A. Shelanski, *A Comment on Competition and Controversy in Local Telecommunications*, 50 Hastings L.J. 1617, 1621 (1999).

treatment,[24] as a long-term proposition such differences clearly affect investment opportunities and create market imbalances.

More generally, as the differential treatment of cable and telephone broadband infrastructure highlights, in the 1996 Act, "Congress . . . legislated with all eyes firmly fixed on the rear view mirror."[25] The Act did acknowledge the Internet, for one of its major titles addressed the issue of indecency on the Internet, and other of its provisions insulated on-line service providers from defamation liability and required the FCC to take affirmative steps to make advanced telecommunications services available to all Americans.

But while its sponsors' rhetoric often appealed to the coming competition of firms across traditional service boundaries, the 1996 Act itself did only very little to account for the convergence of communications platforms and the proliferation of broadband. As John Duffy and Monroe Price have noted: In the 1996 Act, "we see an institution bold in word, but incremental in deed. . . . Indeed, though members of Congress began writing the Telecommunications Act of 1996 prophesying coming 'convergence,' they may now look back on their work with an appreciation of Maitland's famous sentiment: 'The forms of action we have buried, but they still rule us from their graves.' For, despite the congressional requiems, much of the Act retains the categorical approach of the past, and true regulatory convergence must await another day."[26]

The continuation of public utility regulation and of service-based regulatory uncertainty has substantial costs, which are recognized in the increasing calls for a re-write of the current statute. The complaints are widespread, and only two recent examples are the conclusions of Jerry Ellig, who estimates that the non-spectrum costs of current FCC regulation exceed $37 billion annually,[27] and the conclusion of Thomas Hazlett and others that current regulation had "contribute[d] to the pronounced long-lived telecommunications slump" by causing a loss of capital spending of "more than $20 billion for incumbent operators and an additional $2 billion to $3.5 billion for competitive entrants."[28] It is hard to quantify these regulatory costs as a whole, for some of them are attributable not to the general structure of the law (i.e., its reliance on

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[24] William P. Rogerson, *The Regulation of Broadband Telecommunications, the Principle of Regulating Narrowly Defined Input Bottlenecks, and Incentives for Investment and Innovation*, 2000 U. Chi. Legal F. 119.

[25] John D. Podesta, Jr., *Unplanned Obsolescence: The Telecommunications Act of 1996 Meets the Internet*, 45 DePaul L. Rev. 1093, 1109 (1996) ("The battles fought in this legislation were conceived of and framed prior to the phenomenal growth in the Net and especially the advent of the World Wide Web, the graphical subnetwork on the Internet.").

[26] Monroe E. Price & John F. Duffy, *Technological Change and Doctrinal Persistence: Telecommunications Reform in Congress and the Courts*, 97 Colum. L. Rev. 976, 977, 978-79 (1997).

[27] Jerry Ellig, *Costs and Consequences of Federal Telecommunications and Broadband Regulations*, Mercatus Center Working Paper (Feb. 2005).

[28] Thomas W. Hazlett, et al., *Sending the Right Signals: Promoting Competition Through Telecommunications Reform* (Sept. 22, 2004).

technological and service categories) but rather are linked to particular policies, each of which can and has been the subject of extensive debate.[29] But the continuation of regulatory silos and the needless uncertainties created by the current regulatory regime do have serious costs.

Potential Models for a New Statute

The Working Group undertook to draft a new regulatory framework as part of a Digital Age Communications Act that would respond to these dual challenges: the greater emergence of competition in all telecommunications markets, and the deployment of digital broadband platforms that allow true cross-platform competition.

These two challenges necessarily require telecommunications law to move beyond traditional public utility regulation to consider new models. At the most general level, the Working Group considered three principles incontestable; these principles flow from the need of the new law to address competition and convergence. First, the new regime must be based on technology- and provider-neutral regulatory criteria. Regulatory asymmetry begets competitive asymmetry, and creates the incentive and the opportunity for regulatory gaming of markets through competition before agencies instead of in markets.

Second, the new regime must be premised on legal principles drawn largely from competition law. The 1996 Act does recognize competition, in that it allows the FCC to dismantle the common carrier regime when and if it affirmatively finds that competition renders regulation no longer in the public interest.[30] But current and likely future marketplace developments demand a statutory structure with the opposite burden of proof – one that makes regulation dependent upon a finding of lack of competition. Instead of a significant body of *ex ante* rules dictating the structure and operation of communications markets, regulation should proceed much more modestly and largely through *ex post* remedies directed to proven abuses of market position.

Finally, the regulatory structure ought to pursue non-economic regulatory goals with as light a touch as possible, and, preferably, apart from the structure of economic regulation created by the statute. The statutory model proposed here, therefore, does not include explicit reference to matters such as universal service; those are the domain of a separate Working Group.

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[29] For example, some have attributed the much greater broadband deployment, and its consequent economic benefits, in Japan and South Korea to local loop unbundling policies. *See, e.g.*, Thomas Bleha, *Down to the Wire*, Foreign Affairs, May/June 2005. Loop unbundling has not, of course, had such success in the United States, and there are other explanations for the success of broadband deployment in these two countries in particular. *See, e.g.*, James B. Speta, *Policy Levers in Korean Broadband*, 4 J. Korean Law 1-18 (2004); Philip J. Weiser, *Telecommunications Policy Unplugged*, Foreign Affairs (forthcoming 2005) (critiquing Bleha).

[30] 47 U.S.C. § 160(a), (b).

The Working Group's final proposal, contained in the next section, grew out of its consideration of five models of regulation, each of which met the foregoing three criteria.

- An antitrust model, in which telecommunications markets would be subject only to the restrictions of antitrust law, eliminating sector-specific regulation entirely.

- A model based on the earlier deregulation of the railroads, which retained only a limited area of public-utility rate regulation and only in those instances in which a railroad exhibited "market dominance."

- A "layers" model, which substitutes for the service-based approach of the current statute an approach based on technical characteristics of the underlying, multi-purpose networks used to provide those services.

- An "IP-migration" model, which, instead of replacing the current Act wholesale, would create a new regulatory category for IP-networks with a much lighter form of regulation than the current common carrier model of Title II.

- A model based on the "new regulatory framework" adopted by the European Union in 2002, which brought most communications services under a single umbrella and which based regulation largely on the competition guidelines adopted by the European Commission.

Before turning to the Working Group's proposal, this section briefly describes each of these five models and some of the reasons they were considered as plausible candidates for a new regulatory framework. (The reasons they were not adopted will come later.)

The Antitrust Model

An antitrust model for the governance of telecommunications would eliminate sector-specific regulation, leaving only the background rules of antitrust to police instances of market abuse (as defined by the antitrust laws). Antitrust and public utility regulation share the goal of protecting consumers from the harms of monopoly, but antitrust does so by ensuring that competitive markets operate free from collusion and free from the abuse of or illicit acquisition of monopoly power. Public utility regulation presumes that competitive markets do not exist, and seeks through command and control to simulate the result of competitive markets by forcing the provision of service and the lowering of prices.

Thus, the antitrust model most appropriately captures the development of competition in telecommunications markets. Moreover, an antitrust model provides the best response to the problems of sector-specific regulation. The antitrust laws are laws of general jurisdiction, and a government enforcement

action generally must be proved before a court of law. An antitrust model therefore minimizes the possibilities of public choice, in which an agency seeks to perpetuate its mission by continuing regulation of a particular industry or in which incumbents capture a regulator to prevent new competitors from emerging. Even the Federal Trade Commission, which has a broader brief under its enabling statute than the Department of Justice does under the antitrust laws, proceeds largely through a complaint process that seeks *ex post* remedies to extant market problems.

The Railroad Model

The Working Group also looked to the precedent of railroad deregulation, because both the industries and the transition to competition share much in common. The railroad and telecommunications sectors are both "network industries," in that both are in the business of connecting a set of geographic points to one another and providing transport among them. In the case of railroads, the goods happen to be coal, grain, and other tangible items. In communications, the "goods" transported are messages and other information. Both industries largely own their own networks, unlike some network businesses such as trucking and maritime shipping, where the infrastructure is largely owned by the government, or is unowned. And, as is typical of networks, the marginal cost of using the network is relatively low compared to the fixed costs.[31]

As a result, the public policy issues regarding these industries have been quite similar. In fact, the telephone industry was initially regulated by the Interstate Commerce Commission, which also regulated the railroads. Firms in both industries have been regulated as common carriers, with rates broadly regulated on a "just and reasonable" basis.[32]

In the 1960s and 1970s, however, railroads began to suffer under steadily increasing inter-modal competition from trucking, airline, and water carriers, as well as from private automobiles. Several major railroad bankruptcies occurred, requiring in the instance of the Penn Central a substantial government bailout. Deregulation, which permitted railroads to abandon money-losing routes and which relaxed regulatory restrictions, began in the 1970s.[33]

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[31] The analogy of course is not perfect, for technological change in communications has been much more rapid than in railroading and because some communications technologies (such as wireless) do not exhibit the same severe economies of scale.

[32] *See generally* Kearney & Merrill, *supra* note 7, at 1330-40.

[33] *See* General Accounting Office, "Railroad Regulation: Economic and Financial Impacts of the Staggers Rail Act of 1980," GAO/RCED-90-80 (May 1990); *see also* Curtis Grimm & Clifford Winston, *Competition in the Deregulated Railroad Industry: Sources, Effects, and Policy Issues*, *in* Deregulation of Network Industries: What's Next 41, 41 (Sam Peltzman & Clifford Winston eds., 2000) ("The railroad industry is perhaps the only U.S. industry that has been, or ever will be, deregulated because of its poor financial performance under regulation."). A good summary of the statutes leading up to the 1980 Staggers Act, each of which took a step towards deregulation, in Frank J. Dooley & William E. Thoms, Railroad Law A Decade After Deregulation 1-13 (1994).

In the Staggers Act of 1980,[34] Congress took deregulation of the railroads to its logical conclusion, providing rail carriers freedom to set their own rates if they lacked "market dominance,"[35] defined as "an absence of effective competition from other rail carriers or modes of transportation for the transportation to which the rate applies."[36] The Act also created two safe harbors, providing that a railroad would not have market dominance if the complaining shipper and the railroad had entered into a private contract or if the railroad charged a rate lower than 180 percent of its variable cost.[37]

The Staggers Act reforms were a dramatic success. The railroads recovered financially – with return on investment averaging 4.9 percent during the 1980s as opposed to 2.5 percent during the 1970s. At the same time, service to shippers improved, and rates actually fell – by about 22 percent by 1987.[38]

Fifteen years after the Staggers Act, and 108 years after the Interstate Commerce Act, the ICC was abolished by Congress and replaced by a newly-created "Surface Transportation Board."[39] The new agency has three members instead of five and is formally within the Department of Transportation.[40]

In recent years, the STB – like the FCC – has struggled with the question of when and how carriers can be required to make their networks available to others. Unlike telecommunications carriers, however, there is no general requirement that railroads provide access. Instead, the need and justification for such access is weighed on a case-by-case basis. Specifically, the STB is authorized to order three types of access: 1) an alternative through route, meaning a railroad must carry traffic from the shipper to a competing carrier, 2) "reciprocal shipping," where a carrier handles cars of a competing carrier, and 3) "terminal trackage rights," meaning the railroad must allow another carrier's trains and crews to operate over its tracks.[41] As the name implies, however, terminal trackage rights can be granted only for terminals and a reasonable distance around them, and not for the entirety of a carrier's network.

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[34] Pub. L. No. 96-448, 94 Stat. 1895 (1980).
[35] 49 U.S.C. § 10701(c).
[36] 49 U.S.C. § 10707(a).
[37] 49 U.S.C. §§ 10707(d), 10709(c).
[38] Clifford Winston , et al, The Economic Effects of Surface Freight Deregulation 13 (1990) ("Deregulation appears to have changed both carrier and shipper behavior as policymakers intended. Carriers have taken significant steps to improve the efficiency of their operations and to set rates that are more responsive to competitive market conditions."); Wesley W. Wilson, *Market-Specific Effects of Rail Deregulation*, 42 J. Indus. Econ. 1, 20 (1994) ("While differences exist across commodities (especially in the early periods of deregulation), the effect of deregulation on prices has generally been to lower them.").
[39] ICC Termination Act of 1995, Pub. L. No. 104-88, 109 Stat. 803.
[40] *See* 49 U.S.C. § 701.
[41] 49 U.S.C. § 11103.

The STB is authorized to order through shipping if it finds it in the public interest, and reciprocal shipping or trackage rights if it also finds it to be "practicable."[42] STB's regulations limit use of any mandated access to cases where a carrier has actually used its market power to extract unreasonable terms or render inadequate service.[43]

At the same time, as common carriers, a railroad can be required to interchange traffic from other carriers if the railroad does not itself serve the origin point of the shipment. For instance, suppose a shipper needs to send freight from point A to point C, via point B. If a railroad only serves part of the route – say, B to C – then it can be required to interchange the shipment with another railroad. If it does serve the whole route, however, shippers cannot force a railroad to take interchange traffic mid-way, even if that provides competition for a portion of an otherwise "bottleneck" route.[44]

The "Layers" Model

The *Layers Model* of regulation is largely a response to the current scheme's reliance on technological and service-based classifications as discussed in the previous section. Various forms of the model have been the subject of discussion in telecommunications policy circles for five years or more,[45] and a particular form and interpretation of the *Layers Model* has recently been advocated by MCI.[46] At its core, the *Layers Model* is a horizontal regulatory model based on the premise that telecommunications regulatory boundaries should focus on the network characteristics of modern broadband networks, rather than the outdated definitions of the 1934 Act.[47] According to Joshua Mindel and Douglas Sicker, "The aim of the Layered Model is to provide a consistent and modular approach to telecommunications policy that reflects the reality of network design, market power, and business arrangements."[48]

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[42] 49 U.S.C. § 11103(a)(1).

[43] *See* Midtec Paper Corp. v. U.S., 857 F.2d 1487 (D.C. Cir. 1988).

[44] *See, e.g.,* Central Power & Light Co. v. Southern Pac. Co., 2 S.T.B. 235 (1997), *aff'd*, MidAmerican Energy Co. v. STB, 169 F.3d 1099 (8th Cir. 1999).

[45] One of the earliest uses of the engineering concept of a layered network in legal policy circles was Douglas C. Sicker, Joshua L. Mindel, & C. Cooper, The Internet Interconnection Conundrum (unpublished FCC working paper 1999). *See also* Kevin Werbach, *A Layered Model for Internet Policy*, 1 J. Telecom. & High Tech L. 37, 58-64 (2002); Lawrence B. Solum & Minn Chung, *The Layers Principle: Internet Architecture and the Law*, 79 Notre Dame L. Rev. 815 (2004).

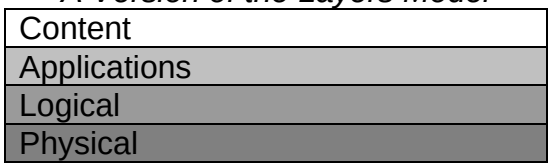
[46] Richard S. Whitt, *A Horizontal Leap Forward: Formulating a New Communications Public Policy Framework Based On The Network Layers Model*, 56 Fed. Comm. L.J. 587 (2004).

[47] Joshua L. Mindel & Douglas C. Sicker, "Comparative View of a Layered Model for U.S. Telecom Policy." Working Paper, 2004, p. 4; *see also* Douglas C. Sicker & Joshua L. Mindel, *Refinements of a Layered Model For Telecommunications Policy*, 1 J. Telecomm. & High Tech. L. 69 (2002).

[48] *See* Mindel & Sicker (2004), *supra* note 46, at 8.

The basic structure is illustrated in Figure 2 and drives off of the current network model for provisioning service over the Internet and the Transmission Control Protocol/Internet Protocol ("TCP/IP") stack. While this oversimplifies matters to a certain degree, the physical layer constitutes the wires and switches (and/or transmitters and receivers) used to send and receive signals; the logical layer consists of TCP/IP and other protocols and systems that organize and manage the routing functions of the network; the applications layer include the specific programs and functionalities used by end-users; and the content layer represents the webpages, text, and video that are inputs and outputs of the applications running over the network.

A Version of the Layers Model



The *Layers Model* offers the prospect for improvement over the current classification of telecommunications services by focusing on the underlying components and functionality of the technical services supplied rather than discrete products and services themselves. To the extent that this segmentation is based on current and (possibly) future network architectures and topologies, it removes yesteryear's overhang of legacy service classifications in the evolving IP world. Thus, a layers model of regulation could improve the modularity, technology neutrality, and provider neutrality of communications laws.

The IP-Migration Model

The IP-Migration Model defines a new regulatory construct based on providers' moving their services onto IP network protocols. This model has a number of similar precedents, including a "safe harbor" proposal discussed in policy circles in the mid-1990s, a petition for forbearance filed by SBC Communications, Inc., the Advanced Internet Communications Services Bill proposed by Representatives Boucher and Stearns in 2004, and a proposal advanced by former FCC Chairman Michael Powell in a number of venues.[49]

Although these proposals differ in some details, they have in common the creation of a new regulatory scheme for networks using the Internet Protocol and for the services provided by and over those networks.[50] This new regulatory

[49] *See* Petition of SBC Communications, Inc. for Forbearance from the Application of Title II Common Carrier Regulation to IP Platform Services, Memorandum Opinion and Order, FCC No. 05-95 (May 5, 2005); Advanced Internet Communications Services Act of 2004, H.R. 4747 (108th Cong.); Remarks of FCC Chairman Michael Powell at Silicon Flatirons Conference, University of Colorado, Feb. 14, 2005.

[50] For example, in its petition for forbearance, recently rejected by the FCC, SBC defined "IP Platform Services" as "those services that enable any customer to send or receive communications in IP format over an IP platform, and the IP platforms on which those services

scheme will exempt IP networks and services from all economic regulation, or will substantially limit the agency's powers of economic regulation.[51] Social regulation, such as universal and emergency services, might continue to apply, however.

The IP-Migration model meets the goal of eliminating heavy-handed public utility regulation for broadband services, by adopting a lighter form of regulation for these new services. IP-Migration also partially advances the goal of infrastructure-neutrality. Unlike the current Act, it does not distinguish among IP networks, but regulates all IP networks, whether twisted-pair, coaxial copper, fiber optic, or wireless, under the same model.

The IP-Migration model has the further benefit – which may be its most important advantage – of easing the transition (at least as a legislative matter) from the current regulatory framework, which has been with us for the past 70 years, to a new framework. An IP-Migration model avoids some difficult questions concerning the treatment of legacy services, such as local regulation of cable television networks and rate regulation of plain old voice services. An IP-migration model might also provide some incentive for the deployment of new IP-networks and the conversion of older networks to IP-networks, by allowing carriers that deploy or upgrade networks to receive lighter regulatory treatment.

The EU Model

Over the past 18 years,[52] Europe has moved in the direction of privatizing formerly state-owned telecommunications companies, eliminating market entry barriers, and harmonizing Member-State law.[53] Of particular interest to the Working Group, the March 2002 "New Regulatory Framework" adopts competition law-based reasoning for regulation of communications markets – with the ultimate goal of the elimination of sector-specific regulation.[54] Prior to

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are provided." *See* Petition of SBC Communications, Inc. for Forbearance from the Application of Title II Common Carrier Regulation to IP Platform Services, Memorandum Opinion and Order, FCC No. 05-95, at ¶ 2 (May 5, 2005). The FCC rejected the SBC petition on the ground that it was not clear that the Title II regulations applied to such IP networks and services in any event (although the FCC did not, of course, hold that those regulations did not apply) and on the ground that SBC's petition was not sufficiently specific.

[51] For example, the Stearns/Boucher bill, the Advanced Internet Communications Services Act of 2004, H.R. 4747 (108th Congress), provided that neither the states nor the FCC "may regulate the rates, charges, terms or conditions for, or entry into, or exit from, the provision of, any advanced Internet communications services."

[52] Towards a Dynamic European Economy: Green Paper on the Development of the Common Market for Telecommunications Services and Equipment, COM(87) 290 (July 30, 1987).

[53] For background on this effort, see generally European Commission, Toward a New Framework for Electronic Communications Infrastructure and Associated Services, COM(539) (Nov. 1999); Pierre LaRouche, *A Closer Look at Some Assumptions Underlying EC Regulation of Electronic Communications*, 3 J. Network Indus. 129 (2002).

[54] Directive 2002/21 of March 7, 2002, on a Common Regulatory Framework for Electronic Communications Networks and Services, O.J. 2002 L108/33 ("Framework Directive").

the Framework Directive, European law subjected any market participant with over 25% market share to mandatory access and unbundling rules.[55] The Framework Directive, by contrast, premises most regulation upon an affirmative finding that an entity has "significant market power."[56] And the prescribed approach to determining significant market power has the elements of market definition (by considering demand and supply substitutability) and of ability to raise price through restricting output without incurring significant loss of sales or revenues that echo the U.S. merger guidelines and antitrust economics generally.[57]

The Framework Directive initially sweeps within its grasp all "electronic communications networks" and "electronic communications services," which include all systems and services "convey[ing] signals by wire, by radio, by optical or by other electromagnetic means, including satellite networks, fixed (circuit- and packet-switched, including Internet) and mobile terrestrial networks."[58]

The European approach emphasizes the need for a minimum of regulation even where bottlenecks are not yet in evidence. The Access Directive makes clear that all public communications networks must interconnect with one another, and all access providers must interconnect with other networks in order to ensure the provision of a single, interoperable network.[59] These obligations (on the part of networks and access providers) and this regulatory power (granted to Member State national regulatory authorities) are not dependent on a finding of significant market power in a particular market.[60]

Apart from the mandatory interconnection and access obligations just described, the EU framework provides that national regulatory authorities may, in general, regulate only in those markets in which a company has significant market power.[61] Importantly, the process for finding significant market power is cabined by a consultation process with the European Commission. The

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[55] *See* Council Directive 92/44/EEC of 5 June 1992 on The Application of Open Network Provision to Leased Lines, 1992 O.J. L 165/27, Article 2(3); Directive 97/33/EC of the European Parliament and of the Council of 30 June 1997 on Interconnection in Telecommunications With Regard to Ensuring Universal Service and Interoperability Through Application of the Principles of Open Network Provision (ONP), 1997 O.J. L 199/32, Article 4(3); Directive 98/10/EC of the European Parliament and of the Council of 26 February 1998 on The Application of Open Network Provision to Voice Telephony and on Universal Service for Telecommunications in a Competitive Environment, 1998 O.J. L 101/24, Article 2(2)(I).

[56] Framework Directive, Article 14(2).

[57] *See generally id*.; European Commission, Guidelines on Market Analysis and the Calculation of Significant Market Power under the Community Regulatory Framework for Electronic Communications Networks and Services, 2002 O.J. C 165/6 (July 11, 2002); Jens-Daniel Braun & Ralf Capito, *The Framework Directive*, in EC Competition and Telecommunications Law 309, 312-13 (C. Koenig, et al. eds., 2003).

[58] Framework Directive, art. 2(a).

[59] Access Directive, art. 4(1), 5(1).

[60] *Id*.

[61] Framework Directive, art. 8; *see* Access Directive, art. 8(2), (3).

Framework Directive specifically incorporates competition law guidelines of the Commission;[62] the Commission makes an initial determination of market definition, identifying those markets into which NRAs should make an inquiry into market power;[63] and each NRA must give notice to the Commission of its tentative findings of significant market power, as well as any proposals to regulate in the absence of significant market power.[64]

Under the EU Framework, a finding of significant market power permits the regulator (at the Member State level) to employ all of the traditional tools of public utility regulation, including transparency and tariffing rules, nondiscrimination requirements, accounting separation, access rules, wholesale and retail price control, and cost accounting.[65] Although the Access Directive advises that the regulator should choose the lightest degree of regulation necessary to control market power, the directive does not actually limit the regulators' discretion.[66]

THE PROPOSAL: AN FTC ACT MODEL

The Working Group has adopted a proposal largely based on the Federal Trade Commission Act, and it is therefore largely an antitrust model.[67] The Working Group believes that competition law and economics provides the only sound basis for addressing communications markets in the future, as those markets become more competitive. The general framework of competition law overcomes the techno-functional silos created by current communications law, and it makes clear that protection of consumer welfare is the paramount goal of communications policy. Just as important, competition law makes clear that private markets are to be relied upon to protect consumer welfare, except where private actors have the power to distort those markets.

The Working Group's proposal nevertheless differs from a pure antitrust model in three regards. First, the proposal maintains the Federal Communications Commission as a sector-specific regulator. Second, the proposal imports the general "unfair competition standard" from the FTC Act as the principal substantive standard for FCC action. This standard, while based upon the antitrust laws, does allow the FTC some leeway to take action to prevent incipient violations of the antitrust laws. Third, the proposal allows the FCC to order the interconnection of public networks without a finding of an abuse

[62] Framework Directive, para. 27.
[63] *Id*. art. 15.
[64] *Id*. art. 7; *see also* Access Directive, art. 8(3).
[65] Access Directive, arts. 9-13. *See generally* Richard A. Crawley, *The New Approach to Economic Regulation in the Electronic Communications Sector in Europe: The Application of Regulatory Remedies*, 5 J. Network Indus. 3 (2004); Martin Cave, *Remedies for Broadband Services*, 5 J. Network Indus. 23 (2004).
[66] *Id*. art. 12-13.
[67] 15 U.S.C. § 41 *et seq.*

of significant market power, although the proposal does require a finding that markets are not adequately assuring interconnection.

As a whole, the proposal maintains the lightest possible sector-specific regulation. Retaining the sector-specific regulator and allowing the regulator to take action to maintain interconnection are based on the particular characteristics thought likely to prevail in communications markets for at least some time. Although communications markets are becoming increasingly competitive, they continue to be characterized by network effects. In network markets with only a few competitors, the denial of interconnection might be a strategy by which one player attempts to win the entire market. More importantly, in some circumstances, the total economic welfare gain from ordering interconnection may justify regulatory intervention. Given the substantial non-economic benefits from maintaining an integrated public communications service, the Working Group believes it is important to permit the FCC to order interconnection in circumstances in which the market is not adequately providing interconnection.

This section describes the FTC Act in brief and then describes the manner in which the Working Group proposes that the FTC Act model be translated and modified in a new Digital Age Communications Act. At the end, this section discusses some additional reasons that the Working Group did not adopt other of the particular models considered.

The FTC Act

The Federal Trade Commission was created to improve antitrust enforcement, by providing "the steady supervision of a permanent administrative agency."[68] The Federal Trade Commission Act forbids methods of "unfair competition" and "unfair or deceptive acts" affecting commerce. The Act empowers the FTC to prevent such practices and to seek redress for consumers who are affected by illegal acts.[69] The FTC also has authority under the Clayton Act to prevent and eliminate unlawful tying contracts, corporate mergers and acquisitions, and interlocking directorates.[70] The jurisdictional core of the FTC's authority is contained in Section 5(b) of the Act:

> Whenever the Commission shall have reason to believe that any such person, partnership, or corporation has been or is using any unfair method of competition or unfair or deceptive act or practice in or affecting commerce, and if it shall appear to the Commission that a proceeding by it in respect thereof would be to the interest of the public, it shall issue and serve upon such person, partnership, or corporation a complaint stating its

[68] Robert Cushman, The Problem of Independent Regulatory Commissions, in Report of the United States President's Committee on Administrative Management in the Federal Government 211 (1937).
[69] 15 U.S.C. § 45.
[70] 15 U.S.C. §§ 12-27.

> charges in that respect and containing a notice of a hearing upon a day and at a place therein fixed at least thirty days after the service of said complaint….[71]
>
> The FTC describes its authority as follows:
>
> [T]he Commission is empowered, among other things, to (a) prevent unfair methods of competition, and unfair or deceptive acts or practices in or affecting commerce; (b) seek monetary redress and other relief for conduct injurious to consumers; (c) prescribe trade regulation rules defining with specificity acts or practices that are unfair or deceptive, and establishing requirements designed to prevent such acts or practices; (d) conduct investigations relating to the organization, business, practices, and management of entities engaged in commerce; and (e) make reports and legislative recommendations to Congress.[72]

Thus, the FTC has both investigative and enforcement powers, as well as rulemaking authority to define prohibited acts. And, as the Supreme Court recognized in the *Brown Shoe* case, the FTC's authority extends to violations of the antitrust laws and to practices that are incipient to such violations.[73]

On the investigative side, the FTC has a broad investigative authority, including subpoena power to specific questions for the purpose of obtaining information about any matters under investigation.[74] It has authority to require "annual or special…reports or answers in writing, business, conduct, practices, management, and relation to other corporations, partnerships, and individuals" of the entities to whom the inquiry is addressed."[75] The FTC also possesses a research bureau, issues research reports, and hosts conferences on issues of competition policy.

The FTC's enforcement authority is both administrative and civil. The FTC can proceed through an adjudicatory process, prosecuting and remedying instances of "unfair competition" pursuant to its so-called "section 3" authority. The FTC must prove its case before an administrative law judge, and the FTC itself possesses a quasi-appellate authority over ALJ decisions, which ultimately are appealable to the U.S. courts of appeals. For unfair or deceptive trade practices, the FTC has rulemaking authority "to define with specificity acts or practices which are unfair or deceptive acts or practices in or affecting commerce" within the meaning of Section 5(a)(1) of the Act.

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[71] 15 U.S.C. § 45(b).
[72] Available at http://www.ftc.gov/ogc/stat1.htm.
[73] 384 U.S. at 320-22.
[74] 15 U.S.C. §§ 46, 49, and 57b-1.
[75] 15 U.S.C. § 46(b).

The FTC can also bring cases in federal district courts under the Clayton Act[76] to enforce its provisions.[77]

The FTC Act Model Modified For Communications Regulation

In adapting the FTC Act to the communications realm, the findings of the proposed DACA affirm that "competition in a dynamic communications marketplace is the most effective means for protecting consumers and enhancing the consumer welfare of all the people of the United States, in terms of achieving the optimum mix of price, quality, and consumer choice." § 1(a)(1). As a result, the DACA declares that it is the policy of the United States that "economic regulation of communications markets should be presumed unnecessary absent circumstances that demonstrate the existence of a threat of abuse of significant market power that poses a substantial and non-transitory risk to consumer welfare." § 1(b)(2).

The wholesale replacement of the current model of regulation based on vague standards such as the "public interest" and "just and reasonable" with the well-established "unfair competition" standard of the FTC simultaneously codifies a presumption that regulation is unnecessary to protect consumers and provides tools that can adequately address competition problems that arise in communications markets. "Antitrust doctrine is supple enough, and its commitment to economic rationality strong enough, to take in stride the competitive issues presented by the new economy."[78] More importantly, the use of antitrust reasoning ensures that errors are more likely to be errors of non-regulation, correctable by market forces.[79] "[T]he economic system corrects monopoly more readily than it corrects [regulatory] errors."[80]

Retaining Sector-Specific Regulation

The proposed DACA deviates from a pure antitrust model most significantly by retaining a sector-specific regulator, although of course it is an agency with a much more circumscribed regulatory mandate. The "FCC" is retained, however, both to promote uniformity in increasingly national communications markets and to develop a body of expertise necessary to supervise interconnection or other competition matters in communications

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[76] The FTC also possesses authority under the Robinson-Patman Act, an antitrust statute that broadly purports to outlaw most price differentiation. See 15 U.S.C. §§ 13a-13f. Because of its probable deleterious effects on economic activity, it has fallen into desuetude.

[77] The FCC also has Clayton Act § 7 authority, but prefers to evaluate mergers under the more capacious and less-rigorous "public interest" standard. 47 U.S.C. § 314.

[78] Richard A. Posner, *Antitrust in the New Economy*, 68 Antitrust L.J.. 925, 925 (2001).

[79] Fred S. McChesney, *supra* note 12, at 1412 ("The cost of Type II errors (failing to penalize anticompetitive contracts and practices) will be low, as long as barriers to entering markets plagued by suspected anticompetition are also low. As prices rise because of anticompetitive contracts or practices, new entrants emerge to alleviate or even eradicate the problem.").

[80] Frank Easterbrook, *The Limits of Antitrust*, 63 Tex. L. Rev. 1, 15 (1984).

markets.[81] The FCC will "employ a reactive, antitrust-like model of regulation for the emerging broadband market, which faces no price regulation and has the potential for rival platforms to compete vigorously with one another. . . . [T]his model would allow parties to develop their own business relationships as they saw fit, subject only to an after-the-fact scrutiny of discriminatory conduct alleged to lack a redeeming efficiency justification."[82]

A sector-specific regulator has several advantages over traditional antitrust. The common law process of antitrust depends upon the development of facts on a case-by-case basis, through the adversary process. As Stephen Breyer has noted, "[c]ourts have difficulty investigating underlying circumstances – particularly changes in circumstances – because they depend upon a record, produced through an adversarial process, for their information."[83] And pure antitrust enforcement requires time to produce a uniform rule, incorporating proceedings in both trial and appellate courts, perhaps in multiple jurisdictions.

More importantly, the Supreme Court has recently expressed doubt that antitrust law and generalist antitrust courts are able to resolve the sorts of disputes most likely to occur in broadband markets. In *Verizon Communications, Inc. v. Law Offices of Curtis V. Trinko, LLP*, the Court noted that, in telecommunications markets, remedies for refusal to grant access to networks or facilities "will ordinarily require continuing supervision of a highly detailed decree," and that "an antitrust court is unlikely to be an effective day-to-day enforcer of these detailed sharing obligations."[84]

Of course, the Federal Trade Commission itself has nationwide adjudicatory jurisdiction, which promotes uniformity, and the FTC has investigatory authority as well as adjudicatory authority that could be used to develop relevant expertise. The Working Group did consider giving the FTC express jurisdiction over communications markets, eliminating sector-specific

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[81] A separate working group is focusing on institutional reform, including proposals to modify the structure of the FCC by, for example, converting it to an executive branch agency. The use of the term "FCC" here is meant to refer only to the sector-specific regulator, however it is ultimately constituted. Moreover, other Working Groups may identify other tasks for the agency, such as resolving interference disputes or administering universal service programs. This is not intended to be a comprehensive list.

[82] Philip J. Weiser, *Toward a Next Generation Regulatory Strategy*, 35 Loy. U. Chi. L.J. 41, 66 (2003). Weiser was describing the manner in which the FCC could accomplish this end through its Title I authority, but the intent of the new statute is the same: to bring all of the various communications service providers under a symmetrical, market-oriented regime, one in which regulation does not depend on service classifications tied to techno-functional constructs.

[83] Stephen Breyer, *Regulation and Deregulation in the United States: Airlines, Telecommunications and Antitrust*, in Deregulation or Re-regulation 45 (Giandomenico Majone ed., 1990).

[84] 540 U.S. 398, 415 (2004). For a discussion of the problem of antitrust courts setting access or interconnection prices, see generally Philip J. Weiser, Goldwasser, *The Telecom Act, and Reflections on Antitrust Remedies*, 55 Admin. L.J. 1519 (2003); James B. Speta, *Antitrust and Local Competition under the Telecommunications Act*, 71 Antitrust L.J. 99 (2003).

regulation. The FTC currently acts under the antitrust laws, and discontinuing the FCC entirely would have emphasized the break with regulation founded on the "public interest." Such an option might also decrease public choice concerns, as an agency with more general jurisdiction would shift to other concerns if telecommunications markets presented no particular competition problems, while a sector-specific regulator might continue regulating a sector to continue its own mission.

Despite these concerns, the Working Group chose to maintain sectoral regulation under some form of specialized agency like the Federal Communications Commission. Consideration of regulatory issues relating to communications markets is likely to benefit from the presence of a specialized body of technologists and economists to address both economic and non-economic issues described here (and by other Working Groups). Richard Posner's conclusion that antitrust doctrine is supple enough to accommodate the new economy[85] was tempered by his concern that traditional antitrust institutions are not,[86] and one of his recommendations was the development of additional, specialized expertise in government.[87] Nevertheless, it is hoped that the limits imposed on FCC actions, especially the significant limits on rulemaking actions, will ensure that the agency stays within the banks of a narrow stream of regulation.

One of the most important of these limits is contained in section 3(a) of the proposed Act, which in its general terms imports the FTC Act's unfair competition standard. The draft DACA further defines "unfair competition" as "practices that present a threat of abuse of significant and non-transitory market power as determined by the Commission consistent with the application of jurisprudential principles grounded in market-oriented competition analysis such as those commonly employed by the Federal Trade Commission and the United States Department of Justice in enforcing the Federal Trade Commission Act and the antitrust laws of the United States." § 3(a). The explicit reference to the antitrust laws is meant to cabin the agency's discretion, directing it to draw on already-established doctrines, and to give courts reviewing its actions more certain guideposts.

Agency Jurisdiction

The FCC is given regulatory jurisdiction over all electronic communications networks and services. This possibly may be an expansion of the FCC's current jurisdiction over common carrier telecommunications service,

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[85] *See supra* note 79.

[86] *Id*. at 925 ("The real problem lies on the institutional side: the enforcement agencies and the courts do not have adequate technical resources, and do not move fast enough, to cope effectively with a very complex business sector that changes very rapidly.").

[87] *Id*. at 940 (recommending that the Antitrust Division and the FTC hire more computer scientists and engineers to better understand new economy antitrust problems).

spectrum, and cable services (depending on the extent to which courts sanction the FCC's not infrequent attempts to use its Title I powers to reach more broadly).[88] The Working Group considered this choice difficult, because it conflicts with its general desire, warranted by competition in the marketplace, of more definitively ensuring a decrease in the scope of regulation. In particular, the Working Group strongly considered limiting the scope of the FCC's authority to common carrier or otherwise public networks, leaving private networks and other services to the general antitrust authorities (as they currently are). To a great extent, this issue mirrored the Working Group's discussions over whether to retain a sector-specific regulator in any form. As noted above, the Working Group concluded that some form of sector-specific regulatory oversight was justified. Once that decision was made, technological and competitive neutrality seemed to require a broader brief for the agency. Indeed, Eli Noam has concluded that competition will present a substantial challenge to the traditional notion of common carriage, such that "common carriage will erode over time, and [any] hybrid co-existence will not be stable."[89] Any gross division of regulation applicable to common carriers versus private carriers threatens to continue the fundamental regulatory apartheid of the current system. Moreover, the Working Group believes that substantive limits on the agency's exercise of its authority, coupled with increased reliance by the agency on *ex post* actions, should limit that agency's regulatory activity.

Interconnection Authority

The general unfair competition standard, which as just described imports standards of competition law, is supplemented in the draft statute by a further definition that permits the FCC to remedy denials of interconnection. This alternative states that unfair competition includes,

> "with respect to interconnection, practices that pose a substantial and non-transitory risk to consumer welfare by materially and substantially impeding the interconnection of public communications facilities and services in circumstances in which the Commission determines that marketplace competition is not sufficient adequately to protect consumer welfare, provided that in making any such determination the Commission must consider whether requiring interconnection will affect adversely investment in facilities and innovation in services."

§ 3(b).

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[88] For a recent attempt of the Commission to use its Title I authority in an expansive regulatory way, see American Library Ass'n v. FCC, 406 F.3d 689 (D.C. Cir. 2005) (FCC's regulations requiring that digital television receivers and other devices capable of receiving DTV signals to include technology allowing them to recognize a "broadcast flag" are beyond agency's Title I authority).

[89] Eli M. Noam, *Will Universal Service and Common Carriage Survive the Telecommunications Act of 1996*, 97 Colum. L. Rev. 955, 970 (1997).

This interconnection provision is somewhat broader than the general unfair competition standard delineated in section 3(a) (which is discussed in the prior section). Section 3(a) both focuses on an abuse of market power ("the threat of abuse of significant and non-transitory market power") and directly imports antitrust precedents. By contrast, section 3(b) permits the agency to find a denial of interconnection to be "unfair competition" if such practice "pose[s] a substantial and non-transitory risk to consumer welfare." This section does *not*, however, impose a general interconnection mandate, although the Working Group considered models that would have created such a mandate or would have adopted a stronger default rule for interconnection.[90] This proposal limits the agency's action to situations in which it finds "that marketplace competition is not sufficient adequately to protect consumer welfare" and it instructs that "the Commission must consider whether requiring interconnection will affect adversely investment in facilities and innovation in services." And, of course, the "consumer welfare" touchstone makes clear that the protection of consumers, and not of competitors, is the statute's goal.

The Working Group considers this broader interconnection section to be warranted for three reasons. First, as previously noted, the Supreme Court's *Trinko* decision leaves substantial uncertainty about the extent to which interconnection could be ordered under an antitrust-based unfair competition standard. Although in earlier antitrust cases such as *Otter Tail* and *Terminal Railroad* the Court had approved the equivalent of an interconnection remedy,[91] the *Trinko* Court limited both cases to a narrower ambit, stating that they stood only for a (possible) rule that parties dealing with others might be required to deal with all on a non-discriminatory basis.[92]

Second, denial of interconnection can, in some circumstances, be a rational economic strategy, and social welfare can be improved by ordering interconnection. Indeed, the early years of the Internet have already seen "significant clashes among Internet carriers and businesses [that] are actually conflicts of interconnection – either over the threshold question of whether interconnection will be allowed or over the terms and conditions of interconnection."[93]

Communications markets are network markets, where the value of the network or service can depend, often quite strongly, on the number of other

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[90] *See, e.g.*, id. (advocating an interconnection mandate).

[91] *See* United States v. Terminal R.R. Ass'n, 224 U.S. 383 (1912); Otter Tail Power Co. v. United States, 410 U.S. 366 (1972); *see also* Weiser, *supra* note 85, at 1422-25 (discussing how, in these cases, the antitrust courts referred the difficult pricing questions to regulatory agencies that had jurisdiction).

[92] *Trinko*, 540 U.S. at 409.

[93] James B. Speta, *A Common Carrier Approach to Internet Interconnection*, 54 Fed. Comm. L.J. 225, 229 (2002) (discussing Internet backbone peering disputes, the open access debate, the IM interoperability debate, and the debate concerning compensation for Internet bound telephone calls as interconnection debates).

consumers who are on the same network or use the same service. As a result, network markets can be "tippy," such that a single network, service, or standard can dominate the market.[94] In such networks, consumers can benefit greatly from interconnection of networks; but carriers may deny interconnection in order to try to win the entire market. In such circumstances, interconnection requirements can enhance total welfare. The potential downside, however, is, as always, regulation's own inefficiencies. Michael Katz and Carl Shapiro have summarized the tradeoffs, and their summary is worth setting out at length.

> "There are several reasons to expect equilibrium in systems markets to diverge from the social optimum: (1) due to economies of scale and product differentiation, these markets are often characterized by oligopoly or monopolistic competition, not perfect competition; (2) due to the importance of R&D and innovation, together with the high chance of tipping, these markets are often characterized by (temporary) monopolies; and (3) the network effects discussed above may indeed be network externalities, not internalized in any market transaction.
>
> "Since market outcomes may be inefficient, it is theoretically possible for government intervention to improve market performance. But there are several issues that must be addressed before concluding that government intervention is warranted in practice.
>
> "First, the extent of the market inefficiency is unclear, once recognition is given to the many private institutions that arise to achieve coordination and internalize externalities. As discussed throughout this paper, there are many possible responses of systems markets to these problems that involve no government intervention whatsoever.
>
> "Second, there is the question of whether the government would have incentives to improve matters. One plausible hypothesis is that the government will act to serve the current generation of producers and users, while acting to block or impose inefficiently high costs on an emerging technology. . . .
>
> "Third, even if policy-makers try to maximize total surplus, they may lack the information needed to do so. . . ."[95]

The proposed statute is designed to take into account all of these considerations. The FCC's authority to order interconnection is limited to

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[94] On network effects generally, see, for example, Michael L. Katz & Carl Shapiro, *Network Externalities, Competition, and Compatibility*, 75 Am. Econ. Rev. 424 (1985); Joseph Farrell & Garth Saloner, *Standardization, Compatibility, and Innovation*, 16 Rand J. Econ. 70 (1985); Carl Shapiro, *Exclusivity in Network Industries*, 7 Geo. Mason L. Rev. 673 (1999).

[95] Michael L. Katz & Carl Shapiro, *System Competition and Network Effects*, 8 J. Econ. Persp. 93, 112-13 (1994).

circumstances in which the denial of interconnection substantially harms consumer welfare. And the agency must find that the market (including such private mechanisms as industry and standard settings organizations) is not providing interconnection (and, to repeat, that such lack is harming consumer welfare). And the agency is required to consider whether any interconnection it orders would decrease incentives to deploy new infrastructure and services. In addition, to ensure that the agency does not create an onerous web of *ex ante* interconnection requirements, the statute also limits the agency's rulemaking authority in other regards (on which more shortly).

Third, the value of an unfragmented communications network extends beyond the economic. Americans rely on their integrated communications system for personal communication, for education, for news, and for free expression. Broadband networks are increasingly a means of facilitating democratic self-government. This non-economic value provides a reason to give the regulator somewhat broader authority to consider whether interconnection should be ordered, given that there is an economic justification for granting such authority as well.

Two notes concerning other terms used in the interconnection section are appropriate. The interconnection obligation is limited to "public" networks, although that term is not defined in the statute. The Working Group was unanimous in the view that the Commission's authority to order interconnection would not extend to private networks. Under the current Title II, of course, only common carrier services – i.e., those offered without discrimination to the public or a segment of the public – are within the FCC's jurisdiction.[96] There was some sentiment in the Working Group to try to further limit the interconnection requirement to certain "fundamental" services, such as voice, or to state that the FCC could only order interconnection if the network or service was already relied upon by a substantial portion of the public.[97] This would further limit the interconnection requirement to those areas where consumer welfare would be most at risk and where the non-economic aspects of communications services would be weightiest. But the Working Group ultimately eschewed such language in favor of the more general limitation ("public") in order to avoid codifying the sorts of metaphysical technological and service distinctions that have rendered the current Act obsolete.[98] The Working Group also opted for the word "public" as opposed to a "common carrier" definition to avoid carrying over Title II concepts – which apply today only to certain technologies and which are

[96] *See* 47 U.S.C. § 153(10) (defining common carrier as "any person engaged as a common carrier for hire"); Southwestern Bell Tel. Co. v. FCC, 19 F.3d 1475, 1480 (D.C. Cir. 1994); NARUC v. FCC, 525 F.2d 630, 640-41 (D.C. Cir. 1976).

[97] One member of the Working Group forcefully argued that the *only* interconnection requirement should be one that required all networks to interconnect voice traffic carried by any other network.

[98] See Randolph J. May, "The Metaphysics of VoIP," CNET News.Com, January 5, 2004, *available at* http://news.com.com/The+metaphysics+of+VoIP/2010-7352_3-5134896.html ("Much of the debate before federal and state regulatory authorities on whether and how VoIP should be regulated is going to be downright metaphysical.");

associated with much broader regulatory authority -- to the current regime. In those limited circumstances in which the Commission decides to exercise this authority, it should have the ability to reach all appropriate networks in a competitively neutral manner.

The statute also does not further define the term "interconnection." This term is already used in the Communications Act,[99] and the Working Group believes that precedents under the current Act can readily be translated to broadband networks. The model will change, for interconnection of telephone networks was mainly an issue of physical interconnection while interconnection of broadband networks may require the interoperability of certain logical services necessary to the transport functions of the networks, but the Commission can address these matters as necessary.[100] The Working Group considered using a somewhat broader phrase – "interconnection and interoperability" – but rejected the use of the term interoperability both because it seemed unnecessary to cover essential interconnection and because it too much suggested a requirement that might be extended to applications and content providers.

In this regard, the interconnection requirement is not a "network neutrality" requirement as that phrase is often used.[101] Network neutrality requires infrastructure providers to treat all applications equally, thereby interfering with carriers' ability to provide differential quality of service, which may be beneficial to customers. By contrast, Commission actions under the interconnection authority will generally be directed to cooperation with co-carriers, not with customers. The idea of an interconnection authority is much more "horizontal" than net neutrality.[102] Network neutrality also limits carriers' ability to pursue new business models, by limiting their ability to price discriminate and capture upstream revenues.[103] And, in all events, a network neutrality rule would grant significantly greater, and significantly less well-defined, powers to the Commission, which the Working Group believes is inconsistent with developing competition in broadband markets. The Commission's general "unfair

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[99] 47 U.S.C. § 201(a) (requiring interconnection upon Commission order), § 251(a)(1) (requiring all telecommunications carriers to interconnect).

[100] One example from telephony that fits this model is the Commission's order creating the 800-number databases and requiring the signaling and database interconnection necessary to enable 800-number portability. *See* Competition in the Interstate Interexchange Marketplace, *Report and Order*, 6 F.C.C.R. 6880, paras. 16-51 (1991). In the broadband area, the agency could, if necessary to protect consumer welfare, address logical layer standards or the coordination with databases.

[101] *See* Timothy Wu, *Network Neutrality, Broadband Discrimination*, 2 J. Telecomm. & High Tech L. 141 (2003).

[102] The two ideas have some commonality, and Eli Noam has proposed an interconnection rule that requires a carrier not to discriminate among the customers of the carriers to which a given carrier interconnects. *See* Noam, *supra* note 90. The Working Group does not endorse this specific proposal, but notes that it maintains substantially greater flexibility than does a network neutrality rule.

[103] *See* James B. Speta, *The Vertical Dimension of Cable Open Access*, 71 Colo. L. Rev. 975, 994-95 (2000).

competition" authority will be sufficient to address vertical practices where such practices harm competition.

Agency Adjudication and Rulemaking Authority

The antitrust model adopted in the DACA presumes that the Commission will generally act through adjudication, addressing unfair competition problems on a case-by-case basis *ex post*. Primary reliance on adjudication ensures that the Commission acts on well-developed facts, and it ensures that new entrants do not confront an extensive web of regulations that limits their entry or options. Adjudication presents questions in a narrower focus, and the proposed DACA adopts time limits for the Commission's deciding adjudications. In both ways, adjudication is superior to the kind of overly broad, open-ended rulemaking proceedings that sometimes have lingered at the Commission for quite extended periods. Case-by-case adjudication may also reduce log rolling and compromises that have a natural tendency to ratchet up regulation in expansive rulemakings in which many issues are in play simultaneously.[104]

The DACA gives the Commission the power to entertain private complaints, and the Commission's remedial powers under the DACA will be significantly greater. The FTC has the power to seek recovery of damages for violations of its orders and for certain private injuries,[105] and the Commission should be empowered to award significant damages in appropriate cases. Indeed, the lack of adequate *ex post* remedial authority is yet another reason the current FCC has tended to adopt detailed *ex ante* rules and conditions.[106]

Despite the preference for adjudication, the FTC has rulemaking authority to define methods of unfair competition, and the DACA gives the FCC similar rulemaking authority. § 5(a). The DACA, however, imposes some additional limits on the Commission's rulemaking authority. The Commission is enjoined to make rules only where it finds, by "clear and convincing evidence," that such rules are necessary. § 5(a)(2). This higher evidentiary standard of proof, which is directed to the Commission, codifies the preference for adjudication over rulemakings and a preference for rigorous analysis. Additionally, echoing the substantive standards of section 3, the Commission is required to find that "marketplace competition is not sufficient adequately to protect consumer welfare" and that the injury to consumers is both "substantial" and "not avoidable by consumers themselves." *Id*. Even more importantly, the Commission is directed to consider any effect that the rules themselves may have on competition. *Id*.

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[104] See Randolph J. May, *New Rules for New Tech*, Legal Times, March 29, 2004, at 70.
[105] 15 U.S.C. §§ 45(m), 57b(b).
[106] The details of the Commission's remedial authority are a point of contact with the Institutional Reform Working Group and are still under discussion.

The Commission's rulemaking authority is further cabined by requiring the sunset of each rule five years after it is adopted. § 5(a)(3). The Commission may renew a rule only if it makes an affirmative finding, after notice and comment proceedings, that current evidence again makes a "clear and convincing" showing that the rule is necessary to protect consumers. *Id*. This sunset provision will help ensure that rules do not become stale in the face of changing technology and marketplace dynamics. In his seminal work on regulatory reform, Stephen Breyer called for the additional use of sunset provisions, but worried that a legislature facing a sunset "may well simply reenact the old program automatically," without doing the serious work of considering its necessity.[107] This proposal avoids that possibility, by providing that FCC rules become void unless the Commission, in a new proceeding based on current evidence, finds that the rules continue to be necessary to protect consumer welfare.

Despite these limitations, the Working Group acknowledges that some might find the rulemaking authority too broad. The FTC Act permits the Commission to act to prevent instances of unfair competition, and this authority is reflected in the DACA. Most notably, section 3(a) defines unfair competition to include "*threats* of abuse" of market power, and section 5(a)(1) states that "[r]ules under this section may include requirements prescribed for the purpose of preventing" unfair competition. The FTC has used this prophylactic authority relatively sparingly (at least in the modern era), and the Working Group believes that the FCC will follow that precedent. The use of competition law as the basis for the FCC's substantive rulemaking authority will itself limit the scope of rulemaking as well.

In both adjudicatory and rulemaking proceedings, the Working Group expects that the Commission will use alternative dispute mechanisms such as mediation whenever possible and that the Commission will engage private and market mechanisms, such as standards-setting bodies.[108]

Merger Authority

Dual review of mergers in communications markets, by the FCC and the antitrust authorities, has been the subject of substantial, powerful criticism.[109] Even though the FCC has, in recent years, assumed the role of a follow-on reviewer, deferring more to the process undertaken by the antitrust authorities, the FCC's vague "public interest" authority over mergers has both required a

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[107] Stephen Breyer, Regulation and its Reform 365 (1982).

[108] *Compare* Philip J. Weiser, *Internet Governance, Standard Setting, and Self-Regulation*, 28 N. Ky. L. Rev. 822 (2001) (discussing the interaction between the FCC and private standards setting bodies).

[109] See generally Donald J. Russell & Sherri Lynn Wolson, *Dual Antitrust Review of Telecommunications Mergers by the Department of Justice and the Federal Communications Commission*, 11 Geo. Mason L. Rev. 143 (2002); Rachel E. Barkow & Peter W. Huber, *A Tale of Two Agencies: A Comparative Analysis of FCC and DOJ Review of Telecommunications Mergers*, 2000 U. Chi. L. Forum 29.

separate proceeding and, because of its indeterminate nature, permitted the Commission to impose conditions that are unrelated to any competitive impacts unique to the merger.[110]

The new regulatory framework cabins the FCC's authority over mergers quite substantially. Review under the Hart-Scott-Rodino Act would continue, with the Department of Justice or the Federal Trade Commission taking the lead. The FCC's authority to review the merger would be limited to ensuring that the merger does not create any violation of the Communications Act or an FCC rule, and it would not review the merger under the same (or different) antitrust standards applied by the competition agencies.

Additional Reasons for Rejecting Other Models

The FTC Act model adopts some of the elements of the other models considered by the Working Group. Each of these models uses antitrust analysis, to a greater or lesser extent, and the railroad and EU models expressly give the regulatory agency somewhat greater authority to order interconnection of networks. This paper concludes with a few additional observations on the Layers and the IP-Migration models, two models which the Working Group did not adopt but which are the subject of substantial current discussion.

First, the Working Group did not adopt the Layers Model for several reasons. Most fundamentally, nothing in the concept of layers provides any help in deciding *how* to regulate any particular layer. As a network engineering concept, layers may be a useful tool for thinking through some regulatory issues. But the marketplace position of services, not the particular layer with which a service may be most closely identified must drive the application (or not) of regulation. As a telling example of this, the MCI version of the model seems to presume that owners of physical layer infrastructure will possess significant market power and that such market power will necessarily be leveraged into other layers, impeding competition at the application and content layers.[111] The DACA, by contrast, requires a *showing* of significant market power prior to the imposition of regulation. And, it recognizes that current competition law and economics provides substantial reason to think that leveraging will not occur.[112]

The suggestion of increased attention to the physical layer, in concert with the idea that regulation should not cross layers would also suggests a return to the "quarantine" policies of yesteryear that resulted in limited choices for consumers and supra-competitive prices -- the antithesis of competition.

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[110] See Randolph J. May, *Telecom Merger Review-Reform the Process*, National Law Journal, May 30, 2005, at 27.

[111] *See* Whitt*, supra* note 47, at 647-48.

[112] *See* Joseph Farrell & Philip J. Weiser, *Modularity, Vertical Integration, and Open Access Policies: Towards a Convergence of Antitrust and Regulation in the Internet Age*, 17 Harv. J.L. & Tech. (2003).

Moreover, to the extent these quarantines exist, it raises the question as to whether this model is necessarily technology/provider-neutral in practice.

The prospect of a "quarantine" in the physical layer also appears to discount the importance of scope economies and those associated with vertical integration, and it ignores the manner in which IP-based services are actually being provided. "Far from being antithetical to innovation and competition, however, vertical integration can play a vital role in ensuring the development of a more robust broadband marketplace."[113] It is increasingly the case that, to manage quality of service and to introduce new features, carriers are "reaching up the protocol stack" to integrate physical and logical services together with applications. These sorts of innovations can only benefit consumers in the long run.

Indeed, as network and applications providers increasingly integrate the functions provided at various layers of the network, any approach that keys regulation to a particular function's layer will itself fail the test of technological and competitive neutrality. In sum, the layers approach does not itself provide a rationale for a particular kind of regulation. To the extent, however, that regulation is keyed to a layer, it loses the advantage that it claims over the current, vertical silo approach.

Second, the Working Group did not adopt an IP-Migration model because that model simply continues the technological, service-based distinctions of the current Act. And, again, nothing in the IP-Migration model describes the level of regulation to which IP-based networks and services should be subjected. The Working Group's proposal is fully consistent with the premise of the IP-Migration model that new services should be subject to lighter regulation. But the Working Group's proposal recognizes that competition from new networks should also decrease the regulation faced by legacy networks. By limiting the lesser regulation to IP-networks, the migration model introduces a new distortion and continues to violate competitive neutrality. For example, the IP-Migration model does not eliminate competitive imbalance between the treatment of traditional voice and VoIP.

Although most advanced networks today rely on the IP protocols for at least part of their operations, IP may or may not be the network technology of the future. As explained, any technology-based service distinction runs the risk of soon becoming outdated. Even if an IP-Migration model is able to accelerate the transition to IP networks (which, of course, is already well underway), the model may retard the transition to the next generation, by retaining the uncertainty that new technologies and services face under the current system.

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[113] Adam Thierer, *Pipe Dreams: Why "Dumb Pipe" Models Make for Poor Public Policy*, in Free Ride: Deficiencies of the MCI Layers Policy Model and the Need for Principles that Encourage Competition in the New IP World 22 (New Millennium Research Council 2004).

MODEL PROPOSED LEGISLATIVE LANGUAGE

The Digital Age Communications Act

(NOTE: This sets out the key substantive provisions of the Working Group's proposal. The Working Group has given some attention to more routine issues, such as the Commission's mode of operation and the procedures for seeking judicial review of its decisions. But such provisions are not the heart of the proposal, so for purposes of focusing on the most fundamental changes proposed, only the key provisions are reproduced here.)

Title I—REGULATORY FRAMEWORK

Section 1: Findings

(a) FINDINGS. The Congress finds the following:

(1) that in 1996, Congress enacted and the President signed into law the Telecommunications Act of 1996, which Congress intended to be pro-competitive and deregulatory, and which was intended to provide a framework to facilitate the continuing transition to more competitive communications markets from less competitive markets;

(2) that since the enactment and implementation of the Telecommunications Act of 1996, rapid advances in technology and marketplace developments have further increased the existence of competition in all communications markets and the likelihood of the continuing existence and increasing intensity of competition;

(3) that competition in a dynamic communications marketplace is the most effective and efficient means for protecting consumers and enhancing the consumer welfare of all the people of the United States in terms of achieving the optimum mix of price, quality, and consumer choice; and

(4) that regulation that is not necessary to protect consumers and enhance consumer welfare deters investment in new and advanced communications facilities and the development of new services and applications.

(b) POLICY. In light of the findings in subsection (a), it is the policy of the United States:

(1) to promote the widespread availability of communications services for all Americans in order to assure that the American people have access to a diversity of information sources necessary for democratic government, and to promote the integrity, reliability, and efficiency of communications facilities in a manner consistent with the

encouragement of investment in advanced communications networks and innovation in communications services and applications;

(2) that economic regulation of communications markets should be presumed unnecessary absent circumstances that demonstrate the existence of a threat of abuse of significant market power that poses a substantial and non-transitory risk to consumer welfare; and

(3) in order to ensure that the actions of the Federal Communications Commission are consistent with the findings in subsection (a), and to effectuate the deregulatory policy declared in this subsection (b), the agency's decisions should be based on jurisprudential principles grounded in market-oriented competition analysis such as those commonly employed by the Federal Trade Commission and the United States Department of Justice in enforcing the Federal Trade Commission Act and the antitrust laws of the United States.

Section 2: Definitions

(a) "Electronic communications network" means transmission systems and, where applicable, switching or routing equipment and other facilities which permit the conveyance of signals by wire, by radio, by optical or by other electromagnetic means, over satellite, cable, or other facilities, whether fixed or mobile, to the extent that they are used for the purpose of transmitting signals, irrespective of the type of information conveyed.

(b) "Electronic communications service" means a service normally provided for remuneration which consists wholly or mainly in the conveyance of signals on electronic communications networks.

(c) "Antitrust Acts" means the Act entitled "An Act to protect trade and commerce against unlawful restraints and monopolies", approved July 2, 1890; also sections 73 to 76, inclusive, of an Act entitled "An Act to reduce taxation, to provide revenue for the Government, and for other purposes", approved August 27, 1894; also the Act entitled "An Act to amend sections 73 and 76 of the Act of August 27, 1894, entitled 'An Act to reduce taxation, to provide revenue for the Government, and for other purposes' ", approved February 12, 1913; and also the Act entitled "An Act to supplement existing laws against unlawful restraints and monopolies, and for other purposes", approved October 15, 1914.

Section 3: Unfair Methods of Competition Unlawful

Unfair methods of competition in or affecting electronic communications networks and electronic communications services, and unfair or deceptive practices in or affecting

electronic communications networks and electronic communications services, are hereby declared unlawful.

For purposes of this act, unfair methods of competition means:

(a) practices that present a threat of abuse of significant and non-transitory market power as determined by the Commission consistent with the application of jurisprudential principles grounded in market-oriented competition analysis such as those commonly employed by the Federal Trade Commission and the United States Department of Justice in enforcing the Federal Trade Commission Act and the antitrust laws of the United States; and

(b) with respect to interconnection, practices that pose a substantial and non-transitory risk to consumer welfare by materially and substantially impeding the interconnection of public communications facilities and services in circumstances in which the Commission determines that marketplace competition is not sufficient adequately to protect consumer welfare, providing that in making any such determination the Commission must consider whether requiring interconnection will affect adversely investment in facilities and innovation in services.

Section 5: Rulemaking Authority

(a) Authority of Commission To Prescribe Rules

(1) The Commission may prescribe rules which define with specificity acts or practices which are unfair methods of competition or unfair or deceptive acts or practices (within the meaning of section 3 of this Act). Rules under this section may include requirements prescribed for the purpose of preventing such methods, acts, or practices.

(2) The Commission shall have no authority under this section to prescribe rules that declare unlawful an act or practice on the grounds that such act or practice is unfair unless the Commission determines, based on a showing of clear and convincing evidence presented in the rulemaking proceeding, that marketplace competition is not sufficient adequately to protect consumer welfare and that such act or practice causes or is likely to cause substantial injury to consumers and is not avoidable by consumers themselves and not outweighed by countervailing benefits to consumers or to competition.

(4) Any rule promulgated pursuant to subsection (1) above shall terminate automatically by operation of law five years from the date it became effective unless the Commission, in a proceeding in which the public is

afforded notice and an opportunity to comment, makes an affirmative determination, based on a showing of clear and convincing evidence presented in such proceeding, that the rule continues to be necessary because marketplace competition is not sufficient adequately to protect consumers from substantial injury which is not avoidable by consumers themselves and not outweighed by countervailing benefits to consumers or to competition.

Section 6. Complaint Actions

(a) The Commission shall have authority to hear complaints from any party injured by an act of unfair competition and to award damages for any violation found.

Section 7. Time Limits on Commission Action

(a) Whenever an application of any kind is filed with the commission and is accompanied by the applicant's supporting testimony or a detailed summary thereof, together with exhibits, if any, the commission shall issue its decision on such application no later than one hundred twenty days after the application is deemed complete as prescribed by rules promulgated by the commission. If the commission finds that additional time is required, it may, by separate order, extend the time for decision by an additional period not to exceed ninety days.

(b) In the case of any application not accompanied by prefiled testimony and exhibits, the commission shall issue its decision no later than two hundred ten days after the application is deemed complete as prescribed by the commission's rules.

(c) The time limits specified in subsections (a) and (b) of this section may be waived by the applicant and, if so waived, shall not be binding on the commission.

(d) The commission, in particular cases, under extraordinary conditions and after notice and a hearing at which the existence of such conditions is established, may extend the time limits specified in subsections (a) and (b) of this section for a period not to exceed an additional ninety days.

Section 8. Additional Powers of Commission

The Commission shall also have power –

(a) Investigation of persons or entities

To gather and compile information concerning, and to investigate from time to time the organization, business, conduct, or practices of any person or entity

engaged in or whose business affects the operation of electronic communications networks.

(b) Reports of persons or entities

To require, by general or special orders, persons or entities who own or operate electronic communications networks, or any class or them, or any of them, respectively, to file with the Commission in such form as the Commission may prescribe annual or special, or both annual or special, reports or answers in writing to specific questions, furnishing to the Commission such information as it may require as to the organization, business, conduct, or practices of such persons or entities in writing. Such reports and answers shall be made under oath, or otherwise, as the Commission may prescribe, and shall be filed with the Commission within such reasonable period as the Commission may prescribe, unless additional time be granted in any case by the Commission.

(c) Publication of reports

To make public from time to time such portions of the information obtained by it hereunder as are in the public interest; and to make annual and special reports to the Congress and to submit therewith recommendations for additional legislation; and to provide for the publication of its reports and decisions in such form and manner as may be best adapted for public information and use: Provided, That the Commission shall not have any authority to make public any trade secret or any commercial or financial information which is obtained from any person and which is privileged or confidential, except that the Commission may disclose such information to officers and employees of appropriate Federal law enforcement agencies or to any officer or employee of any State law enforcement agency upon the prior certification of an officer of any such Federal or State law enforcement agency that such information will be maintained in confidence and will be used only for official law enforcement purposes.

Title II---REFORM OF THE PROCESS FOR THE TRANSFER OR ASSIGNMENT OF PERMITS, LICENSES, OR CERTIFICATES

Section 1: Findings

(a) FINDINGS: The Congress finds the following:

(1) The process by which the Federal Communications Commission currently reviews, and imposes conditions upon, the transfer or assignment of permits, licenses, or certificates in the context of a merger, or other conveyance of corporate control, is in need of reform.

(2) Currently, the Federal Communications Commission's review of telecommunications industry mergers often results in undue delay and

introduces uncertainty into the marketplace because of the unpredictability of that review under the nonspecific public interest standard and, furthermore, the agency has invoked its authority pursuant to the nonspecific public interest standard to allow it to impose terms and conditions on the assignment and transfer of permits, licenses, or certificates unrelated to any competitive impacts of the proposed transaction before the Commission.

(3) The Department of Justice and the Federal Trade Commission have extensive institutional expertise in analyzing issues relating to industry concentration and its effects on competition.

(4) It is inefficient, burdensome, and costly to the federal government and to the private sector, and unnecessary for the protection of consumers from injury or for the enhancement of consumer welfare, for the Federal Communications Commission in a review of a transfer or assignment of licenses to duplicate the work performed by the Department of Justice or the Federal Trade Commission these agencies review a merger or acquisition.

(5) The Federal Communications Commission should only deny, and should impose only those conditions on, the transfer or assignment of permits, licenses, or certificates as is necessary to ensure that applicants for such transfer and assignment authority are in compliance with existing Commission rules and regulations.

Section 2: Modification of Authority to Deny or Condition Licenses

(a) LIMITATIONS ON FCC AUTHORITY- In any proceeding to approve an application to assign or transfer control of a license, permit, or certificate, the Commission--

(1) may not deny such application unless--

(A) the assignment or transfer of control will result in a violation of the Communications Act or the Commission's rules and regulations in effect on the date such application is received by the Commission; and

(B) such violation cannot be cured by the conditional approval of the assignment or transfer of control pursuant to the provisions of paragraph (2);

(2) may not condition approval of such application except to the extent necessary to--

(A) ensure that the assignee or transferee is in compliance with all Commission rules and regulations in effect on the date of such approval; or

(B) permit the orderly disposition of assets to comply with such rules and regulations; and

(3) shall complete all action on any such application within 90 days after the date of receipt by the Commission of the application, unless the applicant requests an extension.

Section 3: Effective Date

(a) IN GENERAL- Section 2 shall apply with respect to any application for a transfer of a permit, license, or permit that is pending on, or submitted to the Federal Communications Commission on or after, the date of enactment of this Act.

(b) DEADLINES FOR PENDING APPLICATIONS- With respect to any such application pending before the Federal Communications Commission for more than 30 days as of the date of enactment of this Act, the Commission shall complete all action on any such application within 60 days after such date of enactment, unless the applicant requests an extension.

The Digital Age Communications Act Project Advisory Committee Members

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* The Advisory Committee was established to provide a broad and diverse source of experience and expertise to the project. The Committee's members do not necessarily endorse the proposals contained in this paper or in any papers issued subsequently by the working groups, and the positions of the Working Groups should not be attributed to them by virtue of their Advisory Committee membership.

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No. 11-44
November 2011

WORKING PAPER

THE CONTINUING CASE FOR SERIOUS COMMUNICATIONS LAW REFORM

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The Continuing Case for Serious Communications Law Reform

Raymond L. Gifford

Communications law reform is like Brigadoon. It appears periodically, presents a gauzy vision of a better, more logical and sensible communications world, and then recedes into the mists, only to reappear again after a suitable interval. Lacking a book and lyrics by Lerner and Loewe, communications law reform might not make for quite as compelling a revival as Brigadoon, but it continues to reappear as a topic for the FCC chairman,[1] think tanks,[2] and Congress to discuss,[3] even if it gets sent into hibernation by more pressing topics like mergers, net neutrality, or the latest indecent utterance or image broadcast on the airwaves. Nevertheless, a high-level consensus exists between progressive and free-market groups, the regulators and the regulated, that we need *some* reformation of the FCC and communications law, even if there is not agreement on the substantive details. If reform is not going to disappear again into the mists, then substantive proposals need to be brought forward, or, in the case of this paper, dusted off.

FCC reform has again pushed its way onto the stage, though perhaps not center stage. The House Commerce Committee, led by Communications and Technology Subcommittee Chairman Greg Walden, is proposing reforms at the FCC: more rigor and time limits in its processes, the use of cost–benefit analyses, and the curtailing of duplicative merger reviews with "voluntary" commitments. Despite these proposals, the current discussion surrounding reform accepts many of the legacy categories, methods, and assumptions of 1934 telecommunications law.

While FCC reform is necessary and salutary—even in the smaller ways currently being discussed—a more fundamental rethinking of the institutional and normative standards of communications law remains compelling. Technological change continues apace; appetite for wireless spectrum remains voracious and unable to keep up with consumer demand; universal service remains focused on subsidizing rural telephony; and the FCC continues to be tasked with incompatible statutory goals based on backward-looking technological categories. If the Telecommunications Act of 1996, itself an amendment to the Communications Act of 1934, was immediately rendered obsolete by the Internet,[4] then 15 years on from that last revision, it surely remains ripe to reorient a communications law premised on monopoly and scarcity. Both the progressive left and

[1] Federal Communications Commission, "Statement from FCC Chairman Julius Genachowski on the Executive Order on Regulatory Reform and Independent Agencies," news release, July 11, 2011, http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-308340A1.pdf.
[2] See Reforming the FCC, a joint project of Public Knowledge and Silicon Flatirons, http://fcc-reform.org.
[3] Representative Greg Walden, chairman of the Subcommittee on Communications and Technology of the House Energy and Commerce Committee, is the latest to initiate legislation on FCC reform. See Walden, "FCC Needs Reform, Accountability," September 18, 2011, http://walden.house.gov/index.cfm?sectionid=94&sectiontree=8,94&itemid=747.
[4] See Robert C. Atkinson, "Telecom Regulation For The 21st Century: Avoiding Gridlock, Adapting to Change," *Journal on Telecommunications and High Technology Law* 4, no. 2 (2006): 379, 403; John D. Podesta, Jr., "Unplanned Obsolescence: The Telecommunications Act of 1996 Meets the Internet," *DePaul Law Review* 45 (1996): 1093, 1109.

free-market writers criticize the FCC for corporatism, for enabling rent-seeking, and for standardless "public interest" decision making. With this bipartisan agreement added to the mix, the imperative for bipartisan communications law reform becomes all the more compelling.

But imperatives for communications reform do not need to start from scratch. Indeed, current reform can profitably build from earlier efforts. Specifically, in 2005, the Digital Age Communications Act (DACA) working group published five separate reports on discrete communications law topics.[5] The DACA project gathered more than 50 leading communications policy scholars, including lawyers, academic economists, think tank analysts, and technologists, to craft model regulations in five major policy areas. The working group also strove for ideological balance by including free market and libertarian analysts, although a majority of working group members served in Democratic-led administrations. While each individual did not have to agree with every recommendation, the reports' goal was consensus on a better model than currently existed.

The working group published collaborative reports intended to guide regulators and legislators in their efforts to reform communications laws. Those reports resulted in a recommended model for communications law and became embodied in the Digital Age Communications Act of 2005.[6] Although never implemented, DACA provides a good start for communications reform six years from its introduction.

To reintroduce DACA into the communications law reform discussion, this paper proceeds in three parts. First, it considers whether communications should be treated as a separate species of law rather than be handled under property, contract, and tort law. Second, the paper describes the DACA project, its composition, and its purpose and discusses and summarizes the DACA recommendations. Third, it looks at the issues DACA did not address and offers a DACA-like solution.[7]

I. Does Communications Need a Separate Law?

A threshold question for reformers is: Why treat communications law as a separate area of law?[8]

More than a decade ago, Peter Huber advocated communications law reforms in his book *Law and Disorder in Cyberspace*. The book's subtitle gives its essential thesis:

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[5] Progress and Freedom Foundation, "Digital Age Communications Act," http://www.pff.org/daca/.
[6] *Digital Age Communications Act of 2005*, S. 2113, 109th Cong., 2005, http://www.govtrack.us/congress/bill.xpd?bill=s109-2113.
[7] The original DACA recommendations emerged from working group consensus reports. Any suggestions here are the author's own and have not been vetted through the DACA working group process.
[8] A succinct presentation of this question comes from Judge Easterbrook in "Cyberspace and the Law of the Horse," *University of Chicago Law Forum* 207 (1996). Judge Easterbrook cautions against legal innovations for the special case of the Internet, arguing instead that legal norms of property and contract will better allow the emergent order of the Internet to take shape.

Abolish the FCC and Let Common Law Rule the Telecosm.[9] Huber argues that problems with communications law arose from its treatment as a discrete area of law. This treatment allows special interests to predominate, he states. He further argues that general common law, combined with antitrust law as an expression of the common law of unfair competition, would be much more effective at promoting the rule of law, competition, and consumer welfare in telecommunications. Huber also indicts the FCC based on its inglorious history of thwarting competition and innovation and protecting monopoly. After all, it did take an antitrust case to break up the AT&T telephone monopoly. Why, then, Huber asks, persist with a special-sector regulator like the FCC, when general laws and general courts can perform just as well, if not better, and without the public choice hazards?

A pure common law approach had great appeal to many DACA working group participants, and it retains strong normative and institutional advantages over an agency specially focused on communications law. For those concerned with "agency capture" (for which there is ample historical evidence), a general common-law approach solves the public choice problems endemic to a single-focus administrative agency. In the end, the technical expertise arguments and practical political impediments to abolishing the FCC won out as a consensus position among DACA members, and DACA rejected abolishing the FCC and letting general law take over the communications sector. However, as a baseline set of assumptions against which to evaluate reform proposals, common law norms of adjudication, case-by-case decision-making, and judicial rigor remained valued goals for the working group.

First, DACA noted that general antitrust law depends on case-by-case, fact-based adjudication, where general rules take time to emerge, particularly across multiple jurisdictions. Because communications networks are national, indeed, global, the need for rule uniformity calls for a national regulator. The absence of a federal common law further exacerbates the problem to the extent that state and federal laws would both have a separate track of "emergent" rules for communications.[10] In addition, Balkanized legal rules would impede the scale of communications networks. If each state's common law, plus federal antitrust law, had some rule to offer governing communications networks, the result would likely be laws that hampered communications innovation rather than enabling it.

Next, DACA endorsed a sector-specific regulator because the regulation of communications networks would take ongoing supervision and expertise, which courts of general jurisdiction are not suited to do. As the Supreme Court noted, access to networks and facilities "will ordinarily require continuing supervision of a highly detailed decree," and "an antitrust court is unlikely to be an effective day-to-day enforcer of these detailed sharing obligations."[11] It judged that a specialized regulator, with expertise in the

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[9] Peter Huber, *Law and Disorder in Cyberspace: Abolish the FCC and Let Common Law Rule the Telecosm* (New York: Oxford University Press, 1997). Nomenclature surely has changed since Huber wrote his book. "Telecosm" and "cyberspace," neologisms then, sound quaint and outdated today.
[10] *Erie v. Tompkins*, 304 U.S. 64 (1938).
[11] *Verizon Communications, Inc. v. Law Offices of Curtis J. Trinko*, 540 U.S. 398, 415 (2004).

technical details, capabilities, and potential of communications networks, would be superior to either an agency or court of general jurisdiction. It comes down to a prudential judgment whether this expertise and need for national uniformity outweigh the hazards of rent-seeking and agency capture.

Finally, the DACA working group's endorsement of a sector-specific regulator is premised on the judgment that economic regulation and social policies like universal service are inextricable, and that Congress will, for the foreseeable future, treat them together. The DACA model seeks to separate the economic regulatory issues from the social policy issues and seeks to create a single regulatory governance structure to promote both economic welfare and social policy goals, but with more straightforward and transparent regulatory mechanisms.

In the end, the DACA working group opted for a rewritten communications law. The proposed new law was intended to minimize some hazards of a sector-specific legal regime through increased use of *ex post*, adjudicatory-type mechanisms. The DACA working group's consensus judgment was that the benefits of a single, national regulatory regime outweighed its all-too-well-known costs.

II. DACA as a Model for Communications Law Reform

The DACA model for communications law reform consists of five discrete reports issued in 2005 and 2006. The reports address the following topics:

1. regulatory framework
2. universal service
3. spectrum reform
4. federal–state jurisdiction
5. institutional/agency reform

Since DACA's issuance, spectrum reform remains crucial, and universal service reform is timely given [1]FCC activity in just this past month. Other topics, notably the federal–state jurisdictional split, have diminished in importance. State regulatory issues have grown senescent and federal–state struggles over jurisdiction and regulatory priority have receded. Nevertheless, the reports cover the main topics that still need to be addressed in communications reform, and the DACA model remains a consensus of some of the best minds in communications law and policy. While any given choice of the DACA working group can be disputed, the group's judgments represent a model for Congress as it looks to broadly supported principles for communications law reform.

a. Framework

DACA's regulatory framework is its centerpiece recommendation and its most overarching purpose. The DACA working group adopted a proposal largely based on the Federal Trade Commission Act. This model embraces antitrust-focused thinking and centers on the idea that "competition law and economics provides the only sound basis for addressing communications markets in the future, as those markets become more

competitive."[12] The DACA model does away with the persistent technological silos of "telecommunications," "cable," "wireless," and so forth. Instead, it opts for the antitrust-derived standard of consumer welfare and embraces competitive markets as the first protection of that welfare.

The DACA working group did not embrace a pure antitrust model, however, because of concerns specific to the communications market:

> The Working Group's proposal nevertheless differs from a pure antitrust model in three regards. First, the proposal maintains the Federal Communications Commission as a sector-specific regulator. Second, the proposal imports the general "unfair competition standard" from the FTC Act as the principal substantive standard for FCC action. This standard, while based upon the antitrust laws, does allow the FTC some leeway to take action to prevent incipient violations of the antitrust laws. Third, the proposal allows the FCC to order the interconnection of public networks without a finding of an abuse of significant market power, although the proposal does require a finding that markets are not adequately assuring interconnection.[13]

The operative DACA statutory standards forbid "unfair competition" and "unfair or deceptive acts" affecting commerce. Under the FTC Act model, the regulator retains its investigative and enforcement powers, and DACA supports this model.[14] In addition, DACA's "unfair competition" model would import the understanding of that standard worked out through the FTC's adjudications and litigation. The working group agreed with Judge Posner that "antitrust doctrine is supple enough, and its commitment to economic rationality strong enough, to take in stride the competitive issues presented by the new economy."[15]

In adopting an FTC model, the DACA working group also generally preferred the FTC's reactive, *ex post* adjudicatory model over the current FCC's prophylactic *ex ante* rulemaking, with enforcement as an afterthought. Accordingly, under a DACA regulatory framework, the core regulatory functions would be administrative adjudications. The "new FCC" would retain limited rulemaking authority, but that authority would be tethered to "unfair competition" principles, not the more open-ended "public interest." The breadth of "unfair competition" concerned some working group members, such that DACA explicates the standard as:

> practices that present a threat of abuse of significant and non-transitory market power as determined by the Commission consistent with the application of jurisprudential principles grounded in market-oriented competition analysis such

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[12] Randolph J. May and James B. Speta, *Digital Age Communications Act: Proposal of the Regulatory Framework Working Group, Release 1.0* (Washington, DC: Progress and Freedom Foundation, June 2005), 18, http://www.pff.org/issues-pubs/other/050617regframework.pdf.
[13] Ibid., 19–20.
[14] See 15 U.S.C. § 45(b).
[15] Richard A. Posner, "Antitrust in the New Economy," *Antitrust Law Journal* 68 (2001): 925.

as those commonly employed by the Federal Trade Commission and the United States Department of Justice in enforcing the Federal Trade Commission Act and the antitrust laws of the United States.[16]

While section 3(a) of DACA constrains the FTC unfair competition standard, section 3(b) offers expanded regulatory supervision over interconnection. The working group concluded that denial of interconnection presented a uniquely important and powerful leverage point in communications networks, and hence specified supervisory regulatory authority over interconnection. The working group did not flat out require blanket interconnection, however, recognizing that consumer welfare harms from denial of interconnection had to be balanced by potential adverse affects on facility investment and innovation. The gist of the DACA recommendation is that interconnection still retains special regulatory scrutiny, but the commission would retain discretion over whether denial of interconnection would negatively affect consumer welfare.[17]

Along with the FTC act's antitrust thrust, the DACA model also prefers *post hoc* adjudication over the current FCC's rulemaking. Under DACA, the agency would have authority to entertain private complaints and would have enhanced remedial authority to award damages, where appropriate. Rulemaking authority would still be present under DACA, but would require "clear and convincing evidence" before the agency acts. DACA codifies a preference for *ex post* adjudication, but still allows the agency to act when marketplace competition breaks down.

The DACA model thus changes both the normative legal standard and the institutional focus of communications law. The legal standard—unfair competition—remains broad but is anchored in antitrust consumer welfare. Instead of rulemaking, institutional change prefers adjudication, which the working group identified as increasing rigor, reducing error, and reflecting the predominance of market competition in the communications arena.

To be sure, these antitrust-like standards have their detractors. On one side, opponents point to the negative social utility of much antitrust action and to antitrust's susceptibility to the same rent-seeking the FCC is so easily convicted of.[18] On the other side, the progressive view finds antitrust too constrained to satisfy the desired regulatory scope of FCC action. The FCC's own Open Internet Order rejects any antitrust-like limits on the Commission's regulation of the Internet.[19] DACA constitutes the mean between

[16] DACA §3(a).
[17] The working group endorsed the conclusions of Michael Katz and Carl Shapiro that interconnection and denial of it raises special concerns in "systems markets." The working group also heeded Katz and Shapiro's caution about information problems and status quo protection. See Michael L. Katz and Carl Shapiro, "Network Externalities, Competition and Compatibility," *American Economic Review* 75 (1985): 525.
[18] See for example, Tom W. Bell, "The Common Law in Cyberspace," *Michigan Law Review* 97 (1999): 1746, 1753–57; see generally, Fred McChesney and William Shugart II, eds., *The Causes and Consequences of Antitrust: The Public-Choice Perspective* (Chicago: University of Chicago Press, 1995).
[19] See Federal Communications Commission, *In the Matter of Preserving Open Internet Broadband Industry Practices,* GN Docket 09-191, WC Docket 07-52, 78, December 23, 2010, 45–46.

these two extremes. In itself, this position does not recommend DACA as the preferred normative policy, but it does give a basis for a broad political consensus about legal norms. Because DACA is meant to be a practical, politically viable reform model, it allows those more detailed normative legal fights to be carried into the reformed agency.[20]

b. Universal Service

Universal service is both a central goal of U.S. telecommunications policy and a primary impediment to competition and rational pricing in communications service. Since AT&T President Theodore Vail proclaimed in 1907, "One Policy, One System, Universal Service," the concept of universally available communications service at comparable prices has been at the core of communications law and policy. In practice, this policy has meant that some consumers subsidize others; some services subsidize others; and some places subsidize others. Because the cost of building and maintaining communications networks varies greatly with geography and population density, the universal service policy has required communications regulators to create a price and taxation system to roughly equalize services and prices. This system has introduced grave pricing distortions and has encouraged uneconomic entry into some markets as well as business models premised on price arbitrage rather than consumer benefit.

The DACA working group conceded the political reality and vitality of universal service. Like the Telecommunications Act of 1996, DACA seeks to make universal service policy more transparent, economical, and efficient. The universal service working group opened its deliberations with three questions. First, what should universal service policy accomplish? Second, how should universal service policy be funded? Finally, how should universal service be distributed? These are the perennial questions of universal service, but the answers must be adapted from the world of communications monopoly to that of competitive free markets, and from that of landline telecommunications to one of wired and wireless broadband.

DACA answered the first question—what is universal service for?—by proposing a universal service policy motivated by "securing affordable basic electronic communication services for low-income households and households located in high cost areas, with transparent, easy-to-administer distribution and contribution mechanisms that are economically efficient and competitively neutral.[21] The supported service under DACA is called "basic electronic communications services" to reflect neutrality about what the service is and how it is delivered and to allow for advances in what is

[20] For instance, the DACA working group issued a statement on how net neutrality would be handled under the framework; see Randolph J. May and James B. Speta, *The Digital Age Communications Act's Regulatory Framework and Network Neutrality* (Washington, DC: Progress and Freedom Foundation, 2006), http://www.pff.org/issues-pubs/communications/other/031707dacastmt.pdf. As this statement makes clear, DACA would contemplate hearing complaints in the vein of net neutrality concerns, but would evaluate them through a rigorous hearing process focusing on consumer welfare effects.

[21] Randolph J. May and James B. Speta, *Digital Age Communications Act: Proposal of the Universal Service Working Group, Release 2.0* (Washington, DC: Progress and Freedom Foundation, December 2005), 2, http://www.pff.org/issues-pubs/books/051207daca-usf-2.0.pdf.

considered "basic service." The standard for basic service is meant to be emergent and not tied to a specific technology, device, or platform.

The DACA proposal has three key features to encourage innovation and experimentation within and between the states on how to best maximize access and use of "basic electronic communications services." It caps the overall size of the federal Universal Service Fund (USF). It distributes funds through performance-based block grants that encourage state governments to experiment with alternative subsidy mechanisms. Finally, it finances the USF primarily by a "numbers tax" on consumers and businesses.[22]

The FCC would continue to oversee the USF and would still collect contributions for the fund. However, instead of directly transferring federal funds to communications providers, the federal government would allocate them to whatever entity—public utility commission or otherwise—the state legislatures appoint to administer the federal program. In managing the USF, the state administrator would have to comply with federal guidelines, but would have broad discretion to create different models and forms of universal service support. DACA's block grant program would set forth broad federal goals, and within those goals states would be free to use the universal service grants as they saw fit. States could experiment with plans as disparate as traditional support of specific carriers, service vouchers to eligible consumers, or reverse auctions between providers. States would still be accountable to federal standards and surely would be susceptible to local public choice pressures. But the working group believed that the local public choice hazards would be outweighed by the value of experimentation with metrics that reward least-cost support and by incentives to achieve universal service performance metrics.

On the support side, the working group believed that a numbers-based assessment mechanism would be the least distortive and most broad based of the universal service support mechanisms. In assessing the different options for a contribution mechanism, the working group discussed a connections-based tax (based on non-linear taxes on a per-connection basis); a usage tax, and finally a numbers-based tax. The working group opted for a pure numbers-based tax levied on all telephone numbers. The consensus was that the numbers-based tax would be technologically neutral and be levied on the least elastic service: access. This system would best meet the economic criteria of optimal tax policy.

The universal service working group was skeptical of continuing a communications-focused subsidy policy. The preferred economic path for universal service policy would be general taxation and funding from general governmental revenues. This path would be the least distortive and most politically accountable. Nevertheless, communications law discussions inevitably center on untangling the long tentacles of universal service policy in current communications pricing. It is difficult to

[22] A numbers tax would assess a tax on each assigned telephone number to raise revenue for the Universal Service Fund.

imagine how universal service policy would not be a continuing central concern of whatever communications reform was proposed.[23]

c. Spectrum

Efficient allocation and use of the electromagnetic spectrum has been an acute challenge for communications regulation since the advent of the Federal Radio Commission in 1927. The central problem is a classic question of property law: "interference." One party's transmissions interfere with those of another party in the same (or a neighboring) geographic area and/or spectrum band. Historically, spectrum has been treated as a national resource managed centrally by the FCC. In practice, this has meant that the FCC allocated spectrum (a) to specific uses—e.g., broadcast radio or television; (b) by defining service parameters—e.g., transmitter power; (c) by assigning licenses to specific parties for transmitting over specific frequency bands at specific locations; and (d) by enforcing its allocations, service rules, and assignments.

Transfers under this command-and-control model can only happen with FCC permission. In practice, this means inordinate delays, costs, and burdens for spectrum to be efficiently utilized. To be sure, the FCC has taken steps toward a more market-based approach to spectrum allocation. But reform has been slow, and progress only partial. The economics literature is nearly unanimous in stating that property rights in spectrum are superior to the current licensing scheme,[24] and that spectrum allocation should take place through auctions that put its use in the hands of the entity that values it the most. The DACA spectrum working group, while considering alternatives, concluded that "there is no serious contender for a system that can be expected to perform as well or better" than a property-based system of spectrum allocation.[25]

The DACA working group described the property right in spectrum as follows:

> The property right would be defined in terms of the right to transmit over a specified spectrum band and geographic area (and during a specified time period) subject to: (1) an out-of-band emission limit; (2) an in-band power limit (because receivers in adjacent bands may be affected by in-band power even if out-of-band emissions are zero, or . . . there may be other in-band licensees); and (3) a field-strength limit for out-of-area emissions. The out-of-band and out-of-area emissions limits would be defined at the band and geographic boundaries, respectively.[26]

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[23] Federal Communications Commission, "Statement of Chairman Julius Genachowski re: Connect America Fund, WC Docket No. 10-90," news release, October 27, 2011, http://transition.fcc.gov/Daily_Releases/Daily_Business/2011/db1027/DOC-310695A2.pdf.

[24] The pioneering work here is from Ronald Coase, who in 1959 argued for property rights in spectrum. Coase, "The Federal Communications Commission," *Journal of Law & Economics* 2, no. 1 (1959). This paper is also the first place his famous Coase theorem appeared.

[25] Thomas M. Lenard and Lawrence J. White, *Digital Age Communications Act: Report from the Working Group on New Spectrum Policy, Release 1.0* (Washington, DC: Progress and Freedom Foundation, 2006), 3, http://www.pff.org/issues-pubs/books/060309dacaspectrum1.0.pdf.

[26] Ibid., 7–8.

The working group identified a property rights system as best adapting to new or unforeseen uses of spectrum. Further, property rights enable bargains between spectrum owners who value a given band or use. The working group rejected a wholesale commons model for spectrum, concluding that the conditions of a surfeit of spectrum did not apply, and noting that the regulatory supervision a commons model would require would exceed even that of the command-and-control inheritance. The spectrum working group retained a healthy respect for, and place for, unlicensed uses.

Of course, the transition between the current system and a property system is a large part of the problem, and the reason that the FCC—which, to its credit, has generally championed auctions and market-based spectrum mechanisms—has not decreed an immediately open market for spectrum. The FCC gave away much of the spectrum currently in use. To allow these users to simply resell what was conceived as a "public resource" would result in tremendous windfalls. Other users purchased portions of the spectrum at auction and operate it under an FCC license. Because the various allocations cover different uses and different permutations of a more complete property right, the working group offered a transition framework. To accomplish the transition, the DACA proposal treats spectrum differently based on how and where the current license was obtained. There are three broad classes of spectrum:

1. Spectrum that is exhaustively, exclusively (or with well-specified priority rights), and relatively flexibly licensed, with licenses purchased at auction (e.g., the personal communication services [PCS] licenses). This class mostly already operates under a market-driven regime. Under the DACA proposal, it would acquire formal property rights; other than that, it would be largely unaffected.
2. Spectrum encumbered by current use constraints, either on the nature of the service offered or on the time and scale of the service offering. This spectrum may have been licensed by auction or by other mechanisms, and may be exclusively or nonexclusively licensed (e.g., time-shared under a "listen-before-talk" requirement). The key feature is that the current licensee has less complete property rights than will attach to spectrum in the future under a market-based, fully allocated rights regime. Generally, spectrum in these bands is not exhaustively licensed; instead, these licenses give the users the right to operate certain equipment in defined frequencies and geographic areas at defined power levels.
3. Unassigned spectrum, including white spaces—the unused and unencumbered portions of spectrum licensed under category 2.

The transition options discussed below apply to the second and third classes.[27] Each option establishes property rights immediately, but the configurations of those rights differ based on distributional and transaction-cost concerns.

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[27] Ibid., 11.

The DACA working group endorsed a "spectrum registry" akin to a clerk and recorder's office for real property. The registry would facilitate spectrum transactions and help buyers and sellers to identify one another. The registry's overall purpose would be to lower transaction and negotiation costs. The public could view who owns what spectrum and under what parameters and power limits. The public could then negotiate more optimal uses or powers or address interference concerns.

Once regulators established spectrum property rights, regulators' operative role would be to enforce those rights or to provide a forum for that enforcement. Accordingly, DACA turns to the law of trespass for its adjudicatory standard over spectrum rights. The law of trespass would govern respective uses of spectrum—interference questions, for instance, would be cast as trespass claims. Institutionally, these rights could then be adjudicated, whether by courts of general jurisdiction or through a reconstituted FCC with administrative adjudicatory processes. Because of the specialized and ethereal nature of spectrum, specialized FCC administrative courts might make the most sense, according to DACA.

The end goal of spectrum reform would be more spectrum, better utilized, in the hands of those who value it most. The working group strongly endorsed a property system to achieve this goal, using any practical accommodations necessary to effectuate that transition.

d. State–Federal Relations

Traditionally, the state–federal regulatory authority has been conceived as "separate and dual." States had jurisdiction over local monopoly telephony, and the federal government regulated interstate networks, wireless service, and broadcast issues. The DACA recommendation continues the trend toward greater federalization, and even raises traditional issues of local control like franchising to the statewide level. The DACA working group discussions of state–federal relations were fraught with competing claims and strong views about traditional regulatory prerogatives. Today, that controversy has largely subsided.

The DACA working group's recommendations reflected that the overall structure and direction of communications regulation is federal. The need for a unitary regulatory framework, the belief that that communications policy should be a subset of general competition policy, and the concern over avoiding patchwork regulation and spillover effects from state regulation all pointed toward communications policy being a federal matter with limited state jurisdiction.

DACA proposed delegating to states and localities the authority to promote public safety and homeland security and to manage public rights-of-way, subject to federal law and a prohibition on effects that spill over state boundaries. DACA favored granting states the discretion to impose streamlined certification requirements. State fees for access to rights-of-way would be limited to the costs of such access.

In short, the working group endorsed a carefully circumscribed role for states and localities going forward in communications law. It recommended eliminating rate regulation, except under narrow circumstances. States would continue to be empowered to deter and remediate fraudulent activities such as slamming and cramming, but they could not engage in economic regulation under the guise of consumer protection.[28] While the working group at the time allowed states to retain a basic local service rate, even that rate regulation, in the time since DACA issued its reports, has begun to wane on a state-by-state basis. Hence, a "current" version of DACA might eliminate basic local service rate regulation in all instances save clear monopoly provision of communications services. Finally, states would retain supervision of alternative dispute-resolution procedures and other processes for solving consumer fraud problems.

A self-conscious commitment to an integrated regulatory framework would best promote sound communications policymaking, the working group found. Under such a model, states and localities would be permitted to regulate only within federally authorized spheres. This authority involves both an explicit delegation of authority—as exists, for example, under the 1996 Act's interconnection agreement regime—and a tolerance (through a "savings clause") for states to act in ways that do not affect other states and that are "not inconsistent" with federal regulatory policy.

e. Institutional Reform

DACA's institutional reform recommendations cannot be separated from the regulatory framework discussion. The framework envisions a competition policy agency focused on adjudication, not rulemaking. To complement this legal standard, the Institutional Reform Group recommended that a split agency model be adopted as the institutional mechanism for executing the regulatory functions proposed under DACA. In practice, a split agency model would mean that a multimember agency similar to the present FCC would be responsible largely for conducting the adjudications envisioned under the new statute, and a single executive branch official would be vested with the authority to conduct the more limited rulemaking proceedings envisioned by the new act as a means of establishing policy. The working group thought that the split-agency model would better serve the twin goals of political accountability for administrative policymaking through rulemaking while achieving efficient, effective, and sound decision-making through adjudicatory rigor.

The agency split would proceed as follows. Rulemaking authority for the agency would be vested in a single official located in the executive branch. The adjudication function (the principal form of agency action under DACA) would remain the FCC's role in its current multi-member form. The reformed commission would focus on a function within the traditional competence of multi-member panels—applying established principles to specific facts and circumstances during the adjudication of particular cases.

[28] "Slamming" and "cramming" involve the fraudulent actions of communications carriers to switch a subscriber's communications carrier (slamming) and add unauthorized charges to communications bills (cramming). Both are instances of consumer fraud.

Spectrum functions—registry supervision and the conduct of options—would be in the hands of the single executive branch administrator. In essence, DACA's institutional setup could be viewed as transferring the rulemaking/policy decisions over the current National Telecommunications and Information Administration, with the FCC remaining an adjudicatory body. The FCC, sitting in its adjudicatory capacity, would also make certain policy, but the primary rulemaking role would now be split off to a politically accountable executive branch official. Because the DACA FTC model reduces regulation through rulemaking, this institutional structure would still keep a large regulatory nexus at the FCC, but the executive branch would make the broader policy calls in rulemaking.

The institutional structure of communications law should be considered as important as the substantive legal standards. A broad antitrust standard in the hands of a lawless agency disinclined to rigor would accomplish little. That same standard in a more self-consciously adjudicatory and law-abiding agency would be better than current practices.

III. What Is Missing?

DACA did not presume to encompass every topic in communications law. Media law and ownership constitute the most glaring omissions. DACA also sidestepped content-regulation issues and public safety communications and networks. In addition, circumstances may have overtaken some of DACA's recommendations, illustrating how even a self-consciously forward-looking regulatory plan can mistake what the future will hold. For instance, federal–state issues appeared central to the working group in 2005–2006. Now, those issues seem largely worked out, with the states stepping aside for a national regulatory model.

Because it is styled as a law of general applicability within the communications sphere, DACA should be able to encompass issues like media ownership. An "unfair competition" standard with an antitrust pedigree would apply to media ownership and concentration issues. This standard would not satisfy those who are concerned about media ownership and concentration issues. Nevertheless, it would require a rigor and level of proof that are currently lacking from media ownership debates. Congress could add social policy objectives relating to media ownership, subject to constitutional constraints. Nevertheless, a DACA model for media ownership would begin with a strong presumption that the standards of general applicability from the FTC Act and the institutional method of adjudication would be the preferred lenses through which to view media issues.

Content issues do not fit neatly into the DACA framework. Competition policy law does little to regulate speech, particularly in a fecund media environment. While First Amendment law might be on the way to making specialized administrative regulation of content obsolete, DACA in its outlook and aims would not encompass a content regulation regime. The DACA response, if there were one, to proposals for content

regulation would likely leave such regulation to other agencies or to Congress rather than to the specialized competition policy agency that DACA contemplates.

Conclusion

Communications law reform remains a perennial topic because the categories, aims, and institutions of the 1934 and 1996 telecommunications laws are ill-suited to current technological and market reality. The "digital broadband migration," a term coined in 2000 by then-FCC Chairman Michael Powell, has continued apace, and law must be updated to reflect the technological reality. DACA thoroughly considered many models and standards for communications regulation, and a bipartisan group of scholars and analysts agreed on consensus outcomes. If Congress takes up communications reform on a wholesale basis, it can start with DACA as a roadmap to thinking about reform.

The Digital Age Communications Act's Regulatory Framework and Network Neutrality

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A Statement of the DACA Regulatory Framework Working Group*

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One of the hottest issues in the current telecommunications reform debate is the discussion of "Network Neutrality," which generally refers to a nondiscrimination mandate for all broadband Internet networks similar to the common-carrier rule that applied to traditional telecommunications services in a monopolistic era. Most of the legislative proposals for telecom reform include a Network Neutrality rule,[1] and the FCC in 2005 issued a policy statement in which it backed a version of Net Neutrality principles.[2] The exception to this trend is Senator Jim DeMint's "Digital Age Communications Act."[3]

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* The views expressed here are the views of the DACA Regulatory Framework Working Group and may not necessarily reflect those of The Progress and Freedom Foundation, its Board, or its staff. This statement is adapted from remarks delivered by James B. Speta at the March 9, 2006 Digital Age Communications Act Conference in Washington, DC.

[1] The most recent bill to be introduced is S. 2360, Senator Ron Wyden's "Internet Non-Discrimination Act of 2006." This bill provides that a network operator shall not "interfere with, block, degrade, alter, modify, impair, or change any bits, content, application or service transmitted over the network of such operator." And it also provides that "a network operator shall…offer just, reasonable, and non-discriminatory rates, terms, and conditions" for all its broadband services.

[2] Appropriate Framework for Broadband Access to the Internet over Wireline Facilities, FCC 05-151, CC Docket No. 02-33, September 23, 2005.

[3] S. 2113, Digital Age Communications Act, December 15, 2005. S. 2113 embodies the proposals released by The Progress and Freedom Foundation's Digital Age Communications Act ("DACA") Regulatory Framework, Federal-State Relations, and Universal Service Working Groups.

Senator DeMint's bill echoes much of the position taken by the DACA Regulatory Framework Working Group.[4] This release explains the general structure of the DACA proposal, and explains why it provides a better framework for dealing with Network Neutrality issues. In brief, DACA adopts an "unfair competition" standard which is based on competition law and economics and which is robust enough to deal with truly anticompetitive instances of exclusion on the Internet, but without prejudging business practices that may spur investment and deployment of new facilities and services. DACA's case-by-case approach to Network Neutrality is superior, because it avoids thickets of ex ante rules while maintaining the availability of ex post relief.

The DACA Regulatory Framework In General

The DACA framework is designed to respond to two well-known and, in our view, largely incontestable developments. First, communications markets are increasingly competitive. Although that competition is not perfect and does not mirror the stylized markets of microeconomics textbooks with very large number of competitors, technological developments have increased – and are likely to continue to increase – competition in communications. Second, those same technological developments mean that service-based regulatory categories – one kind of regulation for telecommunications carriers, another for information services, and another for cable services – are no longer sustainable.[5]

The DACA is a technologically neutral regulatory paradigm, in that the Federal Communications Commission is given the same regulatory authority over all electronic

[4] *See* Proposal of the Regulatory Framework Working Group, Digital Age Communications Act (Rel. 1.0, June 2005) (available at http://www.pff.org/daca).
[5] *See, e.g.*, Randolph J. May, *Why Stovepipe Regulation No Longer Works: An Essay on the Need for a New Market-Oriented Communications Poilicy*, 58 FED. Com. L. J. 103 (2006).

communications networks. That regulatory authority is two-fold. The agency's principal authority is to punish and prevent "unfair methods of competition," which is a phrase intentionally borrowed from the Federal Trade Commission Act. The core idea is to punish and prevent practices that violate competition law principles (or that potentially would do so). Thus, DACA charges the agency to condemn "practices that present a threat of abuse of significant and non-transitory market power" consistent with market-oriented competition principles.[6]

Beyond the general incorporation of competition law principles, DACA also states that it is an unfair method of competition to substantially impede the interconnection of public communications facilities and services in circumstances in which the denial of interconnection causes substantial harm to consumer welfare. This "interconnection authority" is not necessarily dependent on traditional antitrust doctrine. Given the result of the *Trinko* case[7] and the importance of interconnection in communications markets, the DACA provides separate authority for the FCC to order interconnection. But this authority, under DACA, must still be linked to a theory of consumer welfare.[8] It is important to recognize that net neutrality is linked to the welfare of independent content and applications providers, but not to a sound theory of consumer or aggregate welfare. Even the most nuanced versions of network neutrality limit a network's ability to charge an application that imposes comparatively high costs on a network accordingly, leaving the network to recover at least some of those costs through subscription prices paid by consumers. Net neutrality thus risks being regressive:

[6] DACA § 4(a).
[7] *Verizon Communs., Inc. v. Law Offices of Curtis V. Trinko, LLP*, 540 U.S. 398 (2004).
[8] DACA § 4(b).

relatively low use consumers within a service tier may end up subsidizing those consumers whose use imposes relatively high costs on the network.

A last, general point about DACA: the regulatory framework is expressly tilted towards resolving competition problems that arise through adjudication and *ex post* remedies. The agency is still given rulemaking authority, although it must meet a higher evidentiary burden before promulgating rules. But the statute contemplates, and we prefer, the agency to act not through the development of a thicket of rules, but through case-by-case considerations.

Net Neutrality Claims Under the DACA Framework

Although there is some – indeed, it is fair to say, much – disagreement about how a network neutrality rule would operate in practice, such a rule is essentially an attempt to impose on the Internet the sort of nondiscrimination rule that traditional common carrier regulation has long imposed on telephone companies. The supposed point of network neutrality is to ensure access for applications and content providers, against the alleged incentives that network providers might have to deny or degrade access to certain unaffiliated content and services.

DACA proposes to handle these issues without the necessity of a specific rule, and without the need for a blanket rule that tries to anticipate every imaginable harm, and which would present opportunities for regulatory litigation. Antitrust law and economics has a well-developed body of learning about acts of vertical foreclosure – which is what denials of access would be.[9] Network neutrality may be a new label, but it is just a specific example of a more general competition issue with which there is over a century

[9] For one excellent summary of the economics as applied to Internet access, *see* Joseph Farrell & Philip J. Weiser, *Modularity, Vertical Integration, and Open Access Policies: Towards a Convergence of Antitrust and Regulation in the Internet Age*, 17 Harv. J.L. & Tech. 85, 117-18 (2003).

of enforcement experience and accumulated knowledge. Antitrust analysis takes into account the possibility of foreclosure, but also looks on a case-by-case basis for justified or efficient business arrangements. Competitive markets often involve legitimate price and service discrimination, and network owners often are pursuing legitimate technological or business objectives in particular cases. The "unfair competition" prohibition in DACA provides sufficient authority for the FCC to condemn and prevent anticompetitive violations of network neutrality. Indeed, DACA goes beyond antitrust law by giving the FCC authority to regulate vertical interconnection where necessary to protect consumers. For Congress to legislate such interconnection in advance of actual market experience to justify its necessity risks economic harm to consumers and producers—harm that has not been adequately considered in the case for network neutrality. An ex ante approach to actual harm, backed by the FCC's proposed authority under DACA, provides a more targeted approach to real harms. To take only the most famous case to date of a Network Neutrality complaint, the Madison River foreclosure of a competing VoIP provider,[10] antitrust analysis would handle this as a classic monopoly maintenance scenario. At the same time, DACA's case-by-case approach preserves the space companies need to develop new network facilities and services and to enter into new business arrangements.

In addition, DACA's interconnection authority would also achieve a substantial amount of the same openness that network neutrality proponents claim to be seeking. In particular, net neutrality would allow applications and content providers to reach users of all interconnected carriers, so long as they are able to reach a negotiated agreement with some carrier. The necessity of one negotiated agreement is an important check on

[10] In the Matter of Madison River Communications, LLC, 20 F.C.C. Rcd. 4295 (2005).

regulatory opportunism, however. It channels efforts at entry into the marketplace and away from litigation at the FCC.

Conclusion

Given that DACA has the analytic power and the regulatory tools necessary to handle truly anticompetitive network neutrality issues, institutional design becomes all important. And the institutional design of the DACA framework and the way that it would handle net neutrality issues comes back to its fundamental premises. One of DACA's fundamental premises is that, given developing competition, an extensive web of *ex ante* rules would have unintended consequences that would harm consumers and likely stifle markets. DACA is also premised on the view that infrastructure providers will act, in general, to promote applications and services that consumers want. Consumers do not purchase bandwidth for its own sake; they buy connections if those connections provide services and applications that consumers want.[11]

And so, if the evidence supports the requisite conditions – that the markets will be reasonably competitive, that the risks of truly anticompetitive actions are reasonably small, and that antitrust-based competition analysis is powerful enough to address it when it happens – then DACA is the right framework through which to address net neutrality.

[11] For this argument, *see, e.g.*, James B. Speta, *Handicapping the Race for the Last Mile?: A Critique of Open Access Rules for Broadband Platforms*, 17 Yale. J. on Reg. 39 (2000).

JUNE 24, 2014 AT 1:00 AM

Understanding Net(flix) Neutrality

GEOFF MANNE 0 COMMENTS

Netflix CEO Reed Hastings has muddied the average consumer's understanding of Net Neutrality. (Paul Sakuma / AP)

If you happen to own a computer, television or other streaming device, you've probably heard that Netflix recently reached an agreement with Comcast to streamline the delivery of Netflix's videos to Comcast customers.

You've probably also heard that the chairman of the FCC has circulated new "net neutrality" rules to govern how traffic moves across the so-called "last-mile" connection between an ISP and your home.

What do these have to do with each other? The short answer is, nothing, but you wouldn't know that from listening to Netflix's CEO Reed Hastings.

The Netflix-Comcast agreement deals with something known as interconnection — how big content providers transmit their huge files over the Internet's backbone in order to get to Comcast (and other ISP) last-mile facilities in the first place. Net neutrality deals with how traffic is handled once it arrives at the last mile, and whether it makes sense for certain traffic to receive priority treatment once it gets there.

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Big content providers have always had to pay someone to manage delivery of their shows, movies and services. Typically these companies use specialized services called “content delivery networks” (CDNs) to manage this traffic as it travels from the provider to the ISP, which then moves it over its last miles to individual customers and screens. CDNs often build significant infrastructure of their own to improve speeds, and content providers (including Netflix) have always paid for this.

A company like Netflix can also connect to ISPs directly to cut out the middleman. Companies like Google, Microsoft, Amazon and others do just this, paying for network “ports” that enable them to manage their own traffic and offload their massive data streams directly, instead of paying a third party to handle it.

Netflix’s videos take up as much as 30 percent of all Internet bandwidth in the U.S., creating longstanding traffic management problems for the company that have been costly to address. Netflix had used a number of CDN middlemen to deliver its traffic, but ran into problems when it overloaded one CDN, Cogent, who didn’t want to pay for the extra infrastructure needed to offload the additional content.

So Netflix chose to interconnect directly with Comcast, which had already invested heavily in the infrastructure to handle large volumes of content. Netflix reportedly saved a ton of cash in cutting out the middleman, and increased its speeds by 65 percent.

Net neutrality, on the other hand, addresses the issue of discrimination on the last-mile networks owned by Comcast and other ISPs. In essence, it seeks to prohibit unfair treatment of unaffiliated content traveling within an ISP’s network. Under the new proposed rules, according to reports, if an ISP decides to provide premium speeds to Netflix over its last-mile facility, it can’t deny that same quality of service to Netflix’s competitors.

But if the issues of interconnection and net neutrality are entirely different, why did Netflix’s Hastings take to the airwaves to complain that the interconnection deal with Comcast — one that he initiated and over which he stands to save money — amounts to an unfair “toll” on Netflix that threatens net neutrality?

Apparently, Mr. Hastings figured he could confuse longstanding, widely accepted interconnection practices with the debate over net neutrality, hoping politicians and regulators who favor net neutrality might help him get a free pass on interconnection costs.

But free to whom? *Someone* has to pay for the infrastructure needed to

handle Netflix's traffic.

That Netflix would prefer not to pay for delivery of its content isn't surprising. But net neutrality regulations don't — and shouldn't — have anything to do with it.

Geoff Manne is executive director of the International Center for Law & Economics.

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Telecommunication Industry Association Comments regarding House Energy & Commerce Committee's Interconnection White Paper

1. In light of the changes in technology and the voice traffic market, what role should Congress and the FCC play in the oversight of interconnection? Is there a role for states?

As a matter of basic technology, the once-useful distinction between circuit / message switching and data processing is no longer relevant in a broadband world where all communications traffic is delivered via Internet Protocol. These technology changes undermine many of the assumptions underpinning interconnection practices. As a result, services going forward will likely look more like "information services" than "telecommunications services," at least as those terms were envisioned in 1996. Regulation should be consistent with this change.

A modern Communications Act should be re-built to address unifying purpose of achieving universal, reliable, and affordable access to broadband without undue subsidization. In doing so, Congress should recognize the success that a light-touch regulatory model has had in enabling advanced value-added services.

As the whitepaper notes, modern IP-based networks interconnect at a small number of peering locations in the United States, compared to the hundreds or thousands of points of interconnection of the public switched telephone network. The policy issues related to this transition are best addressed at a national level.

Whether through explicit communications policy or as a result of anti-trust law, the exchange of traffic among providers will continue to be the subject of legal oversight. Consequently, reliance on the FCC for policy guidance and oversight certainly has the advantage of continuing to marketplace guidance compared to the judicial nature of anti-trust enforcement.

2. Voice is rapidly becoming an application that transits a variety of network data platforms. How should intermodal competition factor into interconnection mandates? Does voice still require a separate interconnection regime?

The definitions of markets should reflect the increasing competitiveness of telecommunications markets across services and technologies. Such a holistic market analysis will also permit a reevaluation of the extent to which legacy regulation is still required, particularly when such regulation is imposed on only some of the competitors.

Beyond voice communications, the FCC has an important public interest role to play in ensuring that all Americans have access to broadband. Indeed, Congress should articulate and consolidate – perhaps in one title or section of the Act – all of the *specific* public interest objectives it seeks to achieve. These could include, for example:

- Universal high speed broadband service to homes, libraries, and schools;
- Availability of broadband services in public spaces such as roadways or parks, and for public purposes;

- Reliable emergency communications for services such as 9-1-1, and for public safety responders, the realization of the full potential of a nationwide public safety broadband network; and,
- Accessibility for those with disabilities.

3. How does the evolution of emergency communications beyond the use of traditional voice service impact interconnection mandates?

Reliable public safety remains a critical policy objective for the FCC. The Commission's public safety policy changes to services, such as text-to-9-1-1 and location accuracy, reflect the increased use of mobile communications by consumers. However, the incorporation of data information into emergency communications is limited more by the resources of public safety answering points available to use the information effectively than by interconnection challenges.

4. Ensuring rural call completion has always been a challenge because of the traditionally high access charges for terminating calls to high-cost networks. Does IP interconnection alleviate or exacerbate existing rural call completion challenges?

To the extent that broadband networks are "less distance sensitive" than legacy networks, IP interconnection should reduce rural call completion challenges. This underscores the need for continuing investment in rural broadband.

5. Should we analyze interconnection policy differently for best-efforts services and managed services where quality-of-service is a desired feature? If so, what should be the differences in policy between these regimes, and how should communications services be categorized?

The FCC's regulatory authority should be connected directly to achieving the specific end-user objectives set forth by Congress. Intermediary regulations – whether imposed by the agency or by statute – should be closely scrutinized. For example, the current Act's mandates regarding provider-to-provider issues, such as interconnection, need to be re-evaluated in the context of the IP transition, since the nature of technology means that such regulations lag behind business models and changes in consumer demand.

The FCC's role should be to regulate with a light touch, much as it presently does in the information services space. The Commission should intervene only in cases where there is demonstrable evidence to show a disruption to the ecosystem, in which industry can continue to innovate, consumers are protected, and Congress' specific user-facing objectives are achieved. Indeed, the initial response to the D.C. Circuit's recent decision from Internet service providers was to express their continued commitment to maintaining an open Internet. Market forces should be allowed to operate more smoothly in responding to changes in content delivery models, including the establishment of more transparent and efficient secondary markets.

Regulation should be limited to advancing specific Communication policy objectives, such as universality and connectivity. Rules should be technology neutral, and not change with the protocol being used or based on service level agreements.

6. Much of the committee's focus in the #CommActUpdate process has been on technology-neutral solutions. Is a technology-neutral solution to interconnection appropriate and effective to ensure the delivery and exchange of traffic?

- *See answer to question 8*

7. Wireless and Internet providers have long been voluntarily interconnected without regulatory intervention. Is this regime adequate to ensure consumer benefit in an all- IP world?

Multiple technologies and their associated business platforms directly challenge each other in the marketplace in a manner not fully contemplated at the time of the 1996 Act. In addition, over-the-top services compete against stand-alone services, and service providers offer "triple-play" and "quad-play" packages. Policies should be updated to reflect this reality.

Multi-technology, multi-layer, multi-architecture "Heterogeneous Networks" (HetNets) are a significant development providing for more competitive alternatives and efficiencies. These technologies are also breaking down barriers between networks.

8. Is contract law sufficient to manage interconnection agreements between networks? Is there a less onerous regulatory backstop or regime that could achieve the goals of section 251?

Again, as the whitepaper appropriately notes, modern IP-based networks interconnect at a small number of peering locations in the United States, compared to the thousands of points of interconnection of the public switched telephone network. These legacy interconnection points are subject to legal traffic exchange requirements under Section 251 of the Communications Act.

The transition to an all-IP network will require a reexamination of the extent of these requirements. A key challenge will be determining how the number of exchange points can be reduced, while still preserving competition.

Preserving telecommunications competition, while also allowing for a natural reduction in the number of point for traffic exchange as a result with central office closures is a critical policy challenge for telecommunication policymakers.

August 8, 2014

U.S. House of Representatives
Energy and Commerce Committee
2125 Rayburn House Office Building
Washington, D.C. 20515

Re: Response to #CommActUpdate White Paper on Interconnection

Comments by Steven Titch, Technology Policy Analyst
Affiliations: R Street Institute, Heartland Institute, Reason Foundation

There has been much discussion on interconnection policy as Congress re-examines the Telecommunications Act of 1996 while the Federal Communications Commission (FCC) simultaneously evaluates reclassification of Internet service providers (ISPs), namely the large telephone and cable companies, under Title II of the Act. This would of course allow the FCC much more regulatory authority over their businesses.

But despite the constant conflation of Title II and "network neutrality" with interconnection, the fact is that the market is thriving due to a lack of regulation and the ability for interconnection deals to develop organically.

Title II reclassification is the latest tactic on the part of a coalition of corporations and organizations to create network neutrality regulations for Internet Service Providers (ISPs) and gain greater control over the market. Advocates say such a policy is needed to keep the Internet open and assure unencumbered access to all legal applications, content and web sites.

Unfortunately, a network neutrality policy would likely accomplish the exact opposite.

Network neutrality would allow the federal government to regulate the network interconnection and the transmission of Internet data. It would impose obligations and prohibitions on major service providers that own the networks that connect homes and businesses to the Internet as well as interconnect with networks owned by partners and competitors. It would dictate the technology and software that phone companies, cable companies and other Internet service providers could develop, purchase and use in their network. It would limit the quality choices they could offer their customers and networking partners. It would lead to a host of unintended consequences, the most immediate and likely being a slow, congested Internet with little or none of the utility for the multimedia applications for which it has become associated.

Activists are particularly interested in preventing ISPs from managing, partitioning or optimizing any traffic, either of their own accord or for a fee. If given the force of law, such a rule would hold serious consequences, for it would impose limits on how service providers can use their networks to improve the quality, reliability, prioritization and management of data and applications as they move across their facilities. It should be noted that current FCC Chairman Thomas Wheeler and his immediate predecessor, Julius Genachowski, while sympathetic to the network neutrality concept, both expressed misgivings about Title II reclassification.

Network neutrality proponents nonetheless say reclassification is needed because the phone and cable companies control most consumer connections to the Internet. As an example, they point to Comcast, the nation's largest cable company, which in October 2007 confirmed reports that it was intentionally slowing down the rate that voluminous video files using the BitTorrent protocol were being transferred. Although an Associated Press headline reported that Comcast was "blocking" P2P applications, the truth was more complex.[1] BitTorrent software is designed to set up as many simultaneous connections as possible between the user's PC and BitTorrent's file sharing site (the more connections, the faster the transmission). To keep BitTorrent users from flooding the network, especially at peak times, Comcast introduced software that limited the number of simultaneous connections the BitTorrent software could set up, arguing that it was protecting the quality of service for the overwhelming majority of its customers who did not use BitTorrent.

When the FCC sought to fine Comcast for doing so, the D.C. Court of Appeals ruled against the Commission, saying that it did not have the power to impose the regulation under Comcast's classification under the Telecom Act. Hence, the push for reclassification.

The Comcast action, juxtaposed with the reality that P2P protocols such as the BitTorrent protocol are designed to consume as much bandwidth as is available, sharpened the debate about what the unintended consequences of network neutrality might be. If network neutrality were enacted as bills are currently written, service providers would not be able to take technical countermeasures that would balance bandwidth consumption. Conversely, they would not be allowed to offer content providers such as Netflix, which on a given evening accounts for 35 percent of Internet traffic, priority transmission at a higher price. Netflix already has contracts with Level 3, major Internet backbone provider, to handle its traffic. It's conceivable that all three parties—Netflix, Level 3 and a local ISP—might agree that such an interconnection arrangement would greatly improve video delivery while reducing network congestion for users of other applications. Badly implemented policy would prevent it.

As such, network neutrality enforcement would add an unprecedented level of government interference in the way Internet applications work, and would dramatically influence the extent to which sophisticated transmission mechanisms within the Internet could be used to facilitate future Web applications such as telemedicine and distance learning, as well as entertainment and e-commerce.

Network neutrality proponents state that without neutrality under Title II, service providers will be able to create high-speed "toll" lanes on the Internet, and relegate those without deep pockets to some sort of "slow" lane. These suppositions, however, are presented with no evidence. Today the Internet reaches the customer at speeds as high as 100 or more megabits per second (Mb/s), hardly pokey by any measure. In 2005, the norm was 4 Mb/s, and last year 15 Mb/s was the norm, while prices have remained stable. All this has come about without mandated network neutrality.

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[1] Peter Svensson, "Comcast Blocks Some Internet Traffic," *Associated Press*, Oct. 19, 2007, available at http://www.breitbart.com/article.php?id=D8SCEBLG0&show_article=1.

As justification for Title II reclassification, supporters cite the historical definition of network owners as "common carriers," a status which they say obligates them to treat all data the same. But the "common carrier" rationale no longer holds. True, only a few years ago, telecom networks were neutral common carriers by default, but then two things changed. First, the Internet and broadband together enabled an unlimited number of parties to use the network to deliver diverse content, applications and services. Second, network technology evolved to the point where service providers could manage and prioritize data in their networks in ways that could add greater value.

Although neutrality proponents routinely compare telecom networks to utilities like electricity and water, the concept of the "value-add" is a critical distinction in telecom. The common carrier argument sees only a raw data stream crossing the network. It's a clever twist, because it's easy to comprehend data—all those ones and zeroes—flowing to homes much like electricity and water. But the analogy ends there. Consumers don't use their Internet connections to receive a stream of digits; they use them to find, purchase and exchange data in the form of *processed information*, be it a simple e-mail or a high-definition movie.

Network neutrality mistakenly assumes that service providers deliver commoditized data when, in fact, they deliver packaged information products that have been created and crafted by numerous parties.

Processed information, as opposed to raw data, can take many forms, and can be valued using any number of measures. To the user, therefore, the Internet as a delivery mechanism is inherently commercial and non-neutral. As a party to an information-based transaction, the consumer implicitly accepts that the enterprises that have invested in the creation, processing, transmission, presentation and sale of that information are entitled to compensation.

Network neutrality would lock service providers out of the process. It would prohibit the companies that build, own and operate the nation's broadband networks from taking any strategic role in the management and optimization of information products that use their facilities. It would do so at the detriment of everyone who depends on a high-performance Internet. Network neutrality would pre-empt the development of an entire class of optional, but valuable, products, features and services that would make for a better network. For example, any application that has life or death implications and calls for real-time communication—say a remote home-based health monitoring system linked to emergency alarms at a hospital, would benefit from, and perhaps require, transmission prioritization.

In fact, the capability to do so already exists. Hospital networks, which use the very same IP protocol as the Internet, can and do prioritize traffic. So do many other business and organizations that do business over the Internet.

Peer-to-peer content delivery networks, routinely used by Netflix, Google, and the major media companies, are important to understand because they demonstrate the existence of a legitimate and thriving market for content and applications prioritization. Companies such as Akamai Technologies, Kontiki and Mirror Image Internet provide technology for accelerating the delivery content and business processes online as demand warrants. Large content and

application providers purchase their technology and services to make their Web sites function better. In essence, these companies create tight-knit server networks within the larger Internet that partition off these bandwidth-rich, error-sensitive applications—exactly the type of service that reclassification proponents excoriate ISPs for proposing.

This is not trivial to the debate. Remember, the basic premise for interconnection regulation, network neutrality and overall Title II reclassification is that the Internet, by nature, is neutral and that allowing service providers to monetize their ability to optimize applications somehow corrupts its essential nature. That Akamai and companies like it have made a successful business out of content and applications optimization is just another fact that belies this assertion. The market—businesses and consumers—has consistently responded positively to any improvement in the management and the delivery of Internet applications. It validates the argument that broadband providers should be compensated for the extra cost of managing the transmission of profitable applications that move through their networks.

The fact is, the Internet is not, and never has been, neutral. Neither Title II reclassification nor stand-alone rules limiting interconnection arrangements or applications optimization will make it so. All it will do is place legal limits on the quality and performance of Web-based services. Neither federal and state legislators, nor FCC commissioners, will serve the users or Internet economy if they go out of their way to remove an entire group of companies from the information value chain.

Enlightened policy will accept that service providers are not in the monopoly position they were in years past. When viewed alongside the titans Google, Apple, Amazon and Netflix, service providers are part of a larger information supply chain in which there exists a balance of market power between content providers and network service providers. Neither group is in a position to exploit the other, or the consumer. A policy that allows the law of supply and demand to develop for interconnection and bandwidth optimization is the best way of preserving the open Internet, driving down costs, and delivering the promised benefits of a robust Internet to consumers everywhere.

USTELECOM
THE BROADBAND ASSOCIATION

INTERCONNECTION IN TODAY'S VIBRANT COMMUNICATIONS MARKETPLACE

INTRODUCTION

The United States Telecom Association ("USTelecom") thanks the Committee on Energy and Commerce ("the Committee") for the opportunity to share its views on modernizing the nation's communications laws. The Committee is to be commended for its comprehensive efforts to study how these laws should be modernized to ensure sensible public policy for a dynamic communications marketplace and to preserve the communications sector's role as a critical driver of economic growth and job creation in the United States.

In this regard, we applaud the Committee for recognizing the importance of interconnection policy to all aspects of communications. Interconnection between and among networks is what makes global communications possible. It is what makes networks useful. It is essential to ensuring the continuing ability of end users to choose from among the wide array of options for communications services and service providers currently available. Indeed, the Internet – which is at the center of the seismic competitive and technological changes that have occurred since the passage of the Telecommunications Act of 1996 ("96 Act") – would not exist without interconnection. The Internet is, by definition, a network of interconnected networks. So, the issue for policymakers should not be *whether* to assure interconnection among networks, but *how best* to assure that interconnection is preserved and advanced in ways that are most efficient, economical, effective, and responsive to innovation and rapid technological change. In undertaking this analysis, it is important to note that the Internet – this network of interconnected networks – developed and is currently flourishing without a government-prescribed interconnection mandate or a government-sanctioned interconnection framework. The same is true for wireless services. In today's highly competitive communications marketplace, providers have strong incentives to ensure efficient and effective network interconnection arrangements. If subscribers cannot communicate where and when they want, they will find another provider or alternative technology that can meet their communications needs.

USTelecom is the nation's oldest and largest association for providers of wired communications for which interconnection is essential. Although it originally represented traditional voice telephone companies, the overwhelming majority of its members today offer broadband communications as well. The association represents a broad array of companies, ranging from some of the largest employers in the U.S. to some of the smallest cooperatives and family-owned telecom businesses in rural America. Our members use a wide variety of technologies and platforms to provide voice, video, and data services to residential customers, small businesses, large corporations, and governments at all levels. The networks built and managed by USTelecom members have been, and will continue to be, critical to the nation's

ongoing communications revolution. And, each of these networks – large and small – relies upon interconnection in order to provide quality services.

As the Committee recognizes in its white paper, the current interconnection framework is almost two decades old. The objective of that framework was to facilitate the ability of new competitors to enter the local voice market and thereby loosen the grip of incumbent local exchange carriers ("ILECs") that historically held a government-sanctioned monopoly in that market. Congress's objective has been accomplished, although not necessarily in the manner intended. Increasingly, consumers are demonstrating that they consider wireless services, broadband-enabled Voice over Internet Protocol ("VoIP") offerings, and a host of other communications alternatives, many of which Congress could not have envisioned when it enacted the '96 Act, to be competitive with, and fully substitutable for, traditional circuit switched services. As a result, regulatory mandates governing interconnection that apply only to legacy services have no place in forward-looking 21st century communications policy. Congress should seek to advance new policies that treat functionally equivalent services in symmetrical ways, and afford both consumers and network operators with a common set of expectations and business standards without regard to the technology or platform used.

In USTelecom's view, these goals can be best accomplished through a transition from a legacy silo to a functionally equivalent service market-based approach to interconnection that includes a reasonable period to allow businesses and the legacy marketplace to adjust, along with provisions for policies aimed at protecting consumers and preventing anticompetitive behavior.

NEW TECHNOLOGIES AND CONSUMER CHOICES HAVE ALTERED THE COMMUNICATIONS LANDSCAPE

As USTelecom has explained previously, the communications marketplace in the U.S. has changed drastically since passage of the '96 Act. Consumers increasingly are opting for wireless, interconnected VoIP, and other modes of communication that rely upon vibrant broadband networks. For example, the number of voice subscribers served by wireless carriers grew from 1 million subscribers in 1992 to 306 million subscribers in 2013. Furthermore, according to the Federal Communications Commission ("FCC"), 34 percent of all wireline connections were served by VoIP in 2013. The tectonic shift in the means by which consumers communicate is further underscored by the Centers for Disease Control, which estimates that almost 41 percent of U.S. households use wireless service exclusively as of late 2013.

Indeed, consumers increasingly are abandoning voice services altogether. Many consumers opt to communicate via email, text messaging, instant messaging, and social networks. All of these applications are accessible over wireless networks or fixed and mobile broadband platforms. There are 6 billion text messages sent and received every day, while 58 percent of Americans communicate via social networking sites. Congress could hardly have envisioned this evolution in communications when it passed the '96 Act, which underscores the difficulty – if not the folly – of regulation trying to keep pace with technology.

In fact, the '96 Act was focused on traditional voice services, and Congress did not anticipate the growth of broadband-enabled services and the extent to which IP networks would

displace circuit switched telephone networks. U.S. IP traffic in 2012 was 13.1 exabytes per month, which is the equivalent of 3 billion DVDs. In 2012, the U.S. generated three hundred sixty times more IP traffic than it generated in the year 2000, eight thousand times more than 1996, and twelve and a half million times more than 1990. Furthermore, Cisco projects that in the period from 2012 to 2017, U.S. IP traffic will nearly triple to 37.1 exabytes per month.

To accommodate their increased usage, customers are demanding faster broadband speeds. Wired broadband services routinely are able to achieve download speeds between 25 and 100 Mbps, while mobile broadband services increasingly can provide download speeds between 6 and 10 Mbps. Gigabit fiber networks are expanding rapidly to homes and businesses. And, mobile broadband speeds are only expected to increase as network operators upgrade to 4G/LTE networks and seamlessly integrate Wi-Fi into their networks, while broadband providers build out fiber to thousands of cell sites across the country. The White House Office of Science and Technology Policy reported that, in the fourth quarter of 2012, broadband speeds in the United States were the fastest when compared to similar countries. According to the FCC's own data, the number of connections with downstream speeds of at least 10 Mbps increased by 188 percent between June 2012 and June 2013.

TODAY'S MARKETPLACE PROVIDES AMPLE INCENTIVES FOR IP-INTERCONNECTION

With the competitive consequences of failing to interconnect so severe, ample incentives exist for interconnection. Such incentives are clear from the experiences in the wireless industry and the evolution of the Internet – markets not subject to the '96 Act interconnection framework or any government-mandated interconnection regime.

In 1992, the wireless industry had 10 million customers and was a duopoly by virtue of FCC rules in effect at the time that allowed no more than two facilities-based carriers per market. More than 30 years later, with four national wireless carriers and a host of regional providers, the total number of wireless subscriber connections today (336 million) exceeds the total U.S. population (316 million). Wireless carriers have been able to interconnect their networks – and to reach agreement on mutually acceptable rates, terms, and conditions for interconnection – even though wireless-to-wireless interconnection is not and never has been subject to the negotiation and arbitration provisions of the '96 Act.

Likewise, the Internet backbone – which consists of interconnected high-capacity, long-haul transmission networks – has flourished in the absence of regulation. At its simplest, backbone providers typically enter into two types of interconnection arrangements that provide for the exchange of IP traffic: "peering" arrangements and "transit" arrangements. Typically, when two backbone providers anticipate they will derive roughly equal benefits from exchanging traffic, the providers will enter into a peering arrangement under which the providers agree to accept and deliver traffic without charge. In other cases, where the exchange of traffic is likely to be unequal, providers will enter into transit arrangements whereby the backbone provider performs delivery services for a fee. Importantly, both peering arrangements and transit arrangements are privately negotiated and have never been subject to regulation or mandated interconnection requirements. Indeed, the FCC has summarized the state of the Internet

backbone as follows: "[I]nterconnection between Internet backbone providers has never been subject to direct government regulation, and settlement-free peering and degradation-free transit arrangements have thrived."

Today, there are thousands of IP networks interconnected to provide access for all users to reach each other and the Internet. These networks include a broad array of facilities, from local access networks, to national and regional Internet backbone facilities, to Content Distribution Networks ("CDNs"), to edge provider facilities. This complex and competitive IP-interconnection system has relied on market forces to grow. According to recent reports, there are tens of thousands of private interconnection agreements between various IP networks. In fact, many IP interconnection agreements do not involve a formal written contract. They are often entered into between networks in the common course of business with little haggling or fuss.

A provider must interconnect with the various networks that comprise the Internet in order to attract and retain broadband customers. A consumer who cannot reach particular Internet sites or communicate in the manner he or she wants will find another provider. As broadband investment has flourished, cable, DSL, fiber, mobile, and even satellite networks have expanded rapidly throughout the country, creating new sources of competition and giving consumers more choices for broadband services. While not every consumer has a choice of multiple broadband providers, the vast majority do. For fixed broadband service, the FCC estimates that 92 percent of households have access to two or more providers offering broadband with speeds of at least 10 Mbps downstream and 1.5 Mbps upstream. When wireless broadband service is taken into account, the FCC estimates that 98 percent of households have access to two or more providers offering broadband with speeds of at least 10 Mbps downstream and 1.5 Mbps upstream (and 91 percent of households have a choice among three or more broadband providers).

Consumers do not hesitate to change broadband providers, particularly when it means lower prices or faster download speeds, as evidenced by the annualized churn rates between 28.8 percent and 36 percent experienced by some broadband providers. Studies indicate that consumers find changing providers to be relatively easy. Indeed, switching is now so commonplace—and the market so competitive—that broadband providers routinely target offers to competitors' customers and boast in their advertisements about the ease of changing service providers.

Competition in the marketplace has driven and will continue to drive interconnection. Investment in international Internet backbone facilities has resulted in decreased prices for international Internet connectivity in many countries, including the U.S. Additional interconnection points are being built throughout the country, in turn shortening transit distances. Similarly, in many U.S. markets, the price for Internet connectivity has decreased due to more capacity in the marketplace, despite the rapid increase in bandwidth demand spurred by video and other bandwidth-heavy content. Internet networks are evolving to meet the demands of consumers. For example, new networks like CDNs are emerging, and hubs where multiple Internet service providers connect (called IXPs) are becoming more common. As consumers expect to be able to communicate anywhere and at any time, there are multiple pathways to

connect an IP-based device to the Internet. IP interconnection will continue to be driven by consumer demand, and such demand – not government regulation – will promote innovation and competition in IP services.

TECHNOLOGY AND COMPETITION HAVE CHANGED THE INTERCONNECTION PARADIGM

Under the interconnection framework set forth in the '96 Act, a competitive local exchange carrier ("CLEC") seeking to enter the local voice market makes a request for interconnection to the ILEC. The parties are required to negotiate the terms of an interconnection agreement. Under the Act, interconnection mandates reflect network technology and economics from the 1980s and earlier (before widespread fiber and digital switch deployment), including mandates that interconnection be available on a local basis in hundreds of local access and transport areas ("LATAs") across the country. In the event such negotiations are unsuccessful, either party can petition the state public service commission to arbitrate any disputed issues. Interconnection agreements that are either voluntarily negotiated or arbitrated must be submitted for approval by commissions *state-by-state*, after which another CLEC may opt into the approved agreement.

This framework may have been appropriate given the existence of the ILEC as a monopoly provider in the local voice market. However, as discussed above, much of the competition that has evolved since the '96 Act is not subject to this framework. Furthermore, as the white paper rightly notes, "[t]he historic, 'natural' monopoly that justified special rules to govern ILECs has faded in the years since 1996."

A prescriptive interconnection regime is ill-suited to the IP world. Many of the issues related to IP interconnection – including differences between the network and application layers and the need for quality of service levels – are highly technical in nature. The resolution of these issues is best left to network engineers, not federal or state regulators.

Furthermore, given the national and international reach of IP networks, state involvement in overseeing IP interconnection is anachronistic. Traditional telecommunications regulation has been predicated on the historical dichotomy between intrastate and interstate services – a dichotomy that does not exist in the IP world – and is built upon other historical voice concepts that are now outdated. These include the requirement that a CLEC could designate a single point of interconnection within a LATA where traffic would be exchanged with the ILEC. However, as the white paper recognizes, IP services require fewer interconnection points than traditional voice services. This is because there is no need for a dedicated physical connection to carry a call all the way to the terminating party on an IP network. Two IP networks can directly interconnect, or they can interconnect through intermediaries, utilizing one or two interconnection points across the entire country. Under these circumstances, having 50 state public service commissions decide the location of a limited number of IP interconnection points would be highly inefficient, leading to higher costs and less innovation.

As IP networks increasingly displace the Public Switched Telephone Network ("PSTN"), it is imperative that Congress acknowledge and embrace the market forces that have

facilitated IP interconnection to date. This goal can best be accomplished by ensuring that any new communications law promotes efficient and economic interconnection, which requires that communications platforms not be subject to different standards or requirements for interconnection. Disparate treatment of one communications platform would be as equally counterproductive as an overly prescriptive interconnection regime across all platforms; both approaches would create disincentives for investment and innovation.

The federal government has a role in promoting interconnection in an IP world. However, that role should entail case-by-case adjudication of interconnection disputes based on well-established competition standards under federal antitrust law (*e.g.,* unreasonable refusals to deal), rather than *ex ante* prescriptive interconnection mandates. The federal government also should ensure a reasonable transition mechanism from legacy mandates to protect consumers as the country's communications infrastructure migrates from the PSTN to an all-IP environment.

CONCLUSION

As applied to the commercial relationships between networks that comprise the Internet, the lessons generally to be drawn from the economic and regulatory literature were ably summarized by Hal J. Singer in a May 2014 policy brief published by the Progressive Policy Institute titled *Mandatory Interconnection: Should the FCC Serve as Internet Traffic Cop?* After summarizing various arguments for and against mandatory interconnection, Singer concluded, "It is a mistake to presume that regulator-driven interconnection arrangements are always more efficient than commercial ones, particularly when regulators have no way of knowing what solutions are most efficient."

Any future legislation must take into account the dramatic changes in competition, technology, and consumer preferences that have occurred in the communications sector since the passage of the '96 Act. Congress can best do so by recognizing the marketplace incentives for efficient and economic IP interconnection, refraining from a prescriptive interconnection regime, setting a reasonable transition period to a market-based approach, and establishing policies aimed at protecting consumers and preserving competition regardless of the technology used or the platform that is employed in the delivery of communications services.

August 8, 2014

Network Interconnection

Verizon welcomes this opportunity to comment on the fourth in a series of white papers regarding the Committee on Energy and Commerce's efforts to modernize the laws governing the communications and technology sectors. As Congress considers a framework for a 21st Century broadband world that barely resembles the communications landscape that existed even as recently as 1996, Congress should move away from prescriptive regulatory models designed for a bygone era that discourage innovation and investment. Instead Congress should adopt a technology-neutral approach that relies primarily on consumer choice, competition, and effective multi-stakeholder processes. In the context of network interconnection, the Committee has the benefit of a real world experiment with two very different approaches to interconnection that have existed in parallel for many years: the prescriptive regulatory model governing traditional voice interconnection and the commercially negotiated approach for Internet interconnection. The prescriptive legacy rules that govern interconnection for traditional voice services already have proven to be anachronisms in today's marketplace, and they have been a constant source of inefficiencies and arbitrage that the Federal Communications Commission (FCC) has spent years trying to ameliorate. The Internet approach – with minimal regulatory involvement – has proven itself a platform for steady investment and innovation. Consumers have remained connected, even as this flexible approach has proven itself sufficiently nimble to evolve with the Internet. Congress should embrace the successful Internet interconnection model and apply it to all traffic exchanged in IP format, including voice traffic.

1. The legacy interconnection model that produced arbitrage, inefficiencies, and other conflict has no place in today's dramatically changed marketplace.

As the Committee knows, the communications marketplace has "changed dramatically" since Congress adopted the Telecommunications Act of 1996. Where there once was monopoly, there is now robust competition and consumer choice. Until the 1990s, to talk with someone outside of your presence, you had to use a phone line provided by an incumbent local exchange carrier (LEC) to call a fixed location that you hoped would be in the vicinity of the person you wanted to talk to. Now customers can choose whether to call a person -- not just a location -- using a wired or wireless device, including phones, computers, tablets and video game consoles. The services may be provided by companies that traditionally were telephone companies, cable

companies, or software companies and may have existed for decades or been formed just last year. And if customers don't want to talk, they can send a text, or an e-mail, or a tweet, or a Facebook message. Customers regularly have access to, and switch back and forth between, these many ways of communicating, and they no longer rely on just one option.

The regulatory framework – including the 1996 Act's interconnection framework – is outdated and has been overtaken by a fundamental revolution that has reshaped the way in which customers communicate. That 1996 interconnection framework, which was designed to replace the traditional local telephone monopolies that once existed, created special rules that singled out the incumbent LECs. Whereas the 1996 Act permitted other carriers to interconnect either directly or indirectly, Section 251 of the 1996 Act required incumbent LECs to interconnect directly with new entrants at artificially low regulated rates to exchange traditional, circuit-switched traffic. The Act also required incumbent LECs to submit disputes to state commissions for arbitration if negotiation failed, which led to each state public utility commission establishing its own interconnection rules and encouraged companies to seek regulatory advantages from the states. This fragmented and cumbersome approach often resulted in inefficiencies and arbitrage. The 1996 Act and the FCC adopted principles and rules to guide those negotiations and state arbitrations, which by design favored the competitive LECs in order to promote new entry as quickly as possible by reducing economic barriers to entry for the new competitors. These new rules – which were thought to make sense in the context of opening the local exchange market because of the incumbent LECs' historic monopoly – were layered upon existing mandatory interconnection requirements that existed for all carriers and the associated tariffed access-charge regime, which governed the compensation that long-distance carriers paid to local exchange carriers when they exchanged long-distance voice traffic.

Under the legacy regulated interconnection regime, each state public utilities commission was charged with developing its own intercarrier compensation rates, and, in conjunction with the FCC, the states administered a highly complex system of explicit and implicit subsidies. Implicit subsidies in particular are problematic because they opaquely force consumers to pay other carriers' network costs. The FCC has found the legacy intercarrier compensation system based on implicit subsidies "is fundamentally in tension with and a deterrent to deployment of all IP networks."[1] The legacy system's balkanized approach, which produced myriad interconnection regulations and intercarrier rates for different types of phone calls, and the mandate for incumbent LECs to interconnect directly at regulated rates, created incentives for arbitrage and gamesmanship as competition took hold in the industry.

Concerns about the negative consequences of the outdated 1996 interconnection regime are not just theoretical. Rather, the FCC and state regulators have been addressing problems arising from this regime continuously for over 15 years. In one of the earlier examples of post-1996 arbitrage, carriers took advantage of compensation rules that required direct interconnection at non-economic rates and targeted customers like dial-up Internet Service Providers (ISPs) that

primarily or exclusively received traffic. Carriers since have engaged in access stimulation, or traffic pumping, in which carriers artificially inflated their traffic volumes to increase intercarrier compensation payments. In another arbitrage scheme, known as phantom traffic, carriers have removed or masked call identifying information to frustrate intercarrier billing. Because the regime created incentives and opportunities to game the system, it produced endless disputes between carriers. Further, both the resulting lack of certainty and predictability, and the requirement that incumbent LECs interconnect directly at artificially low rates, impeded investment. In addition, the legacy system was laden with implicit subsidies by which companies subsidized competitors, although wireless and other companies competed largely without those subsidies. At the end of the day, consumers were harmed by a system that impeded investment in IP networks and by "paying more on their wireless and long distance bills than they should in the form of hidden, inefficient charges."[2]

The legacy Section 251 regime is based on the assumption that direct interconnection between a new-entrant competitive LEC and the incumbent LEC was needed in order for the new entrants to compete. That's simply not the case in today's world. As discussed below, in the Internet space, while some networks interconnect directly, others interconnect indirectly through third-party networks. In general, there are many different paths to reaching any particular Internet network and the end users served by it. Because of the wide availability of connection points and the Internet's architecture, there is little possibility that a network would be disconnected from the Internet, even if it were unable to reach agreement on interconnection terms with one or more networks. The same principles easily could apply to IP-based voice traffic to ensure that voice calls reach their destinations. In fact indirect interconnection and exchange of traffic is widely used today for voice calls in order to achieve redundancy, diversity, and capacity management. Companies will interconnect, directly or indirectly, because interconnectivity increases the value of their networks, and indirect interconnection will help ensure that networks that carry voice traffic are always fully interconnected.

2. The flexible and tremendously successful Internet interconnection model demonstrates that commercial agreements effectively ensure efficient interconnection.

Compare this failed system with the tremendously successful story of the Internet. The Internet developed through purely voluntary commercially negotiated agreements that interconnect a series of individual networks owned and operated by many different entities, without a regulatory mandate. Those agreements may contain different terms, depending on the various networks' needs, but each assumes a perceived equitable value exchange between the interconnecting parties.

Throughout the Internet's history, content providers and their service providers have relied on commercially negotiated agreements with backbone operators who themselves make arrangements with other backbone providers, and traffic carried between Internet endpoints often

transits multiple backbone networks. The commercial agreements between networks might create "peering" relationships, in which networks interconnect directly and exchange traffic, or "transit" relationships, in which one provider agrees to ensure that another provider's traffic will reach its destination, even if it must travel over the networks of additional *other* providers. If each network receives equal value from the mere fact of interconnection, the parties may agree to exchange traffic on a settlement-free basis to avoid the hassles and burdens that billing each other for roughly even traffic flows would create. By contrast, if one network receives greater value from interconnection, then that network will compensate the other network.

The Internet meets consumer demands efficiently, in large part because it has developed without regulation. The commercial arrangements that underlie and self-regulate the Internet enable it to adapt quickly to market changes and innovations, and technology changes, to best fit consumer needs and evolving demands. The Internet interconnection experience demonstrates that negotiated commercial agreements are the most effective way to ensure efficient interconnection arrangements and efficient network deployment. These negotiated, commercial agreements have been tremendously successful, and they have fueled the rapid growth in the Internet's capacity. They have created a flexible framework for networks to evolve in order to address new demands quickly.

For example, players in the Internet ecosystem have created new and innovative interconnection arrangements in response to changes in end users' demands. Commercial interconnection agreements have evolved to facilitate new arrangements, like content delivery networks (CDNs), to meet the growing demand for video traffic.

As new business models have arisen, the Internet itself has shifted from a hierarchical network featuring large Internet backbones interconnecting with smaller backbones and (ultimately) the ISPs serving content providers and end users into a much more complex network in which providers interconnect in a multitude of ways.

The flexibility inherent in these commercial agreements permits parties to handle issues as they arise, and the Internet works well as a result. The need for flexibility – and the complexity of this sector – has increased over time as many companies assume multiple roles in the Internet ecosystem. The diversity of roles and interconnection options has become critical to the Internet's functioning – without them, the Internet might still be optimized for text-based news sites and blogs rather than for streaming massive volumes of high-definition content.

Moreover, even amidst burgeoning complexity, this system has functioned smoothly, and traffic has reached its destination. But the robust ecosystem we enjoy today would not exist if policymakers had adopted a regulatory approach to Internet interconnection rather than the market-driven approach it chose.

3. Policymakers should continue the decades-old light-touch regulatory approach to Internet and IP-based interconnection, whether for data or voice.

Regulatory history amply demonstrates that, especially in industries marked by rapid technological change, rules based on static assumptions about technology and markets quickly become obsolete—and worse, can lead to unintended negative consequences, including stifling investment and innovation. Policymakers "are often wrong both in their predictions of how the market will develop and in their judgments of what regulatory measures will best promote consumer welfare."[3] To their credit, policymakers of both parties have pursued a light-touch approach to regulating data and the Internet over the last two decades, which has fostered high levels of innovation, investment, and competition.

By contrast, a regime centered on inflexible rules would undercut the innovation and investment that characterize today's Internet. Government-imposed rules regarding interconnection can lead to economic and technological inefficiencies. New government rules would be less likely to fully take advantage of advanced technologies and network configurations, inadvertently resulting in more costly interconnections that impose unnecessary costs on consumers. And the negative consequences would be especially harmful to consumers and competition if applied in the context of mobile wireless services.

Presented with two options – one the heavily regulatory model for legacy voice that slowed investment and generated endless disputes, the other the flexible light-touch approach that relied on commercial agreements and fostered the tremendous success of the Internet – policymakers should have an obvious choice as they consider how to regulate interconnection prospectively. Choose the model that works. The nation's decades-long commitment to flexible Internet regulation has been a resounding success, and it promises to continue to create an environment in which voice and data communications flow seamlessly and deliver high-quality services to consumers.

4. Providers already are interconnecting in IP format to exchange voice traffic without a regulatory mandate.

While the number of traditional circuit-switched telephone lines in service has been declining for years and account now for only a small percentage of all lines used for voice service, the number of VoIP subscriptions has been increasing. And wireless providers – which have become the primary or sole voice service for many customers – also are moving to IP-based technologies. As more and more customers adopt innovative IP-based services, it will make more and more sense for providers to exchange voice traffic – which in any event will be only a small percentage of the overall set of IP-enabled traffic – in a manner very similar to how they exchange Internet traffic. Negotiated commercial agreements are the most effective way to ensure efficient IP interconnection arrangements, whether for voice or data service. Commercial agreements allow providers to negotiate network configurations that best accommodate their

underlying networks. The best way for two parties to obtain a mutually beneficial IP interconnection arrangement is for them to negotiate, actually taking the time to work through the technical and operational challenges.

These types of arrangements already are occurring. Although the idea of "long-distance" traffic is going by the wayside with the evolution of the communications marketplace to all-distance services, communications providers have exchanged long-distance traffic in IP format for a long time. This made sense, because those providers transported their own traffic in IP format, and it was more efficient to exchange the traffic in IP format rather than converting it to a legacy protocol simply for the exchange. Similarly, wireless traffic now in many instances is transported and exchanged between providers in IP format. As more and more end users adopt VoIP services, and more and more traffic can travel end-to-end in IP format without needing a protocol conversion to reach a customer that has not adopted VoIP, then providers' existing incentives to interconnect in IP format for voice services will increase.

In fact, Verizon already is doing this because it makes business sense. IP interconnection offers considerable efficiencies to providers and benefits to consumers in the form of new features that all-IP transmission makes possible. Vonage has said its IP agreement with Verizon will allow "Verizon and Vonage customers to enjoy the quality of service and cost benefits that come from the IP exchange of traffic."[4] That's why Verizon recently has entered into eight agreements for the exchange of voice traffic in IP format between its incumbent LEC entities and other providers, and three similar agreements between Verizon Wireless and other providers. We are negotiating others and expect more will follow.

The historic monopoly conditions that led to the legacy interconnection arrangements embodied in the 1996 Act no longer exist. In the innovative new world of IP networks, there are no incumbents. Everyone is a new entrant, and there is vibrant competition. And because there are no incumbent networks or providers, there is no good reason to regulate one set of companies differently than the others. The largest VOIP providers are companies that didn't exist when the 1996 Act was written, and no company has market power when it comes to IP interconnection. The prospective regulatory framework must take that into account and recognize that companies will enter into commercial interconnection arrangements because their natural business incentives will drive them there. We have 20 years of experience that demonstrates that marketplace participants have sufficient business incentives to reach commercial agreements.

5. The commercial Internet interconnection model provides the necessary flexibility for providers to adapt to marketplace changes and resolve disputes quickly.

While the Internet interconnection model has been successful, there have been occasional disputes, as there are in any competitive market made up of hundreds of players and thousands of agreements. But the providers involved have been able to work out those disputes quickly and through ordinary commercial means, without protracted regulatory proceedings. These disputes

were resolved without regulatory involvement precisely because the flexible light-touch regulatory framework encourages providers to negotiate mutually beneficial interconnection arrangements. And, notably, these isolated disputes generally all have involved the same scenario: formerly balanced traffic exchange that has greatly increased in asymmetry and volume, altering the original value exchange the parties had agreed to. While online video and similar applications can generate these high volumes and asymmetry, voice communications generally do not. Voice traffic is relatively balanced, and the volume of voice traffic being added to IP networks is a tiny fraction of the traffic already on those networks, which are governed by commercial agreements. There is no reason to think these issues would arise in the voice context.

Simply put, the Internet marketplace has proven capable of working through issues as they arise, without a regulatory mandate to do so, and it is critical that providers retain the flexibility to do so. In 1996, no policymakers anticipated or predicted the swift rise of online video and other high-volume traffic, and if they had enacted statutes and interconnection regulations that did not allow Internet providers to adapt quickly to marketplace changes, the results for the Internet and its users could have been devastating.

So, too, it will be difficult – if not impossible – to predict what new arrangements will arise to serve consumers' and providers' needs *going forward*, as usage patterns, content offerings, and capacity levels continue to evolve. Under these circumstances, statutes and regulations that restrict or dictate the scope of permissible interconnection arrangements or their rates, terms, and conditions would undercut consumer interests and distort and impede the Internet's ability to serve consumers' ever-changing needs.

6. Any government backstop must be federal, limited in scope, and available only if and when market forces fail to resolve disputes

Even so, some have said a regulatory backstop is needed to ensure that companies negotiate in good faith and enter into IP interconnection agreements so that no one is cut off from the Internet. Interconnection is fundamental to functioning Internet ecosystem, and Internet networks are more valuable by virtue of being interconnected. Rural companies and others have had no problems interconnecting with other Internet networks. Companies have options to interconnect indirectly or directly with one another. And, as a threshold matter, existing legal protections, including the FCC's transparency rule and generally applicable antitrust and consumer protection laws, as well as multi-stakeholder groups, already provide an effective backstop to prevent and address future issues that could emerge.

Given its success, there should be a strong presumption that the Internet interconnection model works and that commercial agreements will form the basis of network interconnection, whether for voice or data. Technology trends have fortunately allowed us to work ourselves out of the arbitrage-ridden legacy interconnection model, as voice service is already transitioning to IP-based interconnection arrangements through commercially negotiated agreements, and that

will continue. To adopt a policy framework other than one that relies primarily on the hugely successful model of Internet interconnection would be a profound mistake, and the burden of proof to demonstrate why for the first time we should introduce heavy-handed regulation into IP interconnection should be extremely high.

Still, given the paramount importance of interconnection, policymakers may want to consider adopting a limited government backstop as a safety value that would only kick in if and when marketplace competition is not sufficient to adequately protect consumers. To ensure that no one is left behind, some form of a government backstop may be appropriate in those rare instances where commercial negotiations, coupled with generally applicable antitrust and consumer protection laws, fail to prevent demonstrable harm to competition or consumers. Any backstop would have to be highly targeted, apply only to substantial and non-transitory risks of harm, and should not result in a new regulatory construct that discourages investment and innovation or invites arbitrage and regulatory gamesmanship in place of negotiations. Congress should authorize an agency to intervene only after it has found that competition would not solve the problem. And when weighing whether to intervene, government should consider whether indirect interconnection options are available and whether its intervention would impede investment in network facilities and innovation in services. Any backstop must be flexible enough to encourage experimentation and innovation, while protecting consumers and competition.

Whatever government backstop results, if any, must be federal in nature, and it must not resemble Section 251's heavily regulatory model. A single commercial IP interconnection agreement can govern the exchange of VoIP traffic within and between all of the states uniformly and efficiently. Heightened oversight along legacy regulatory lines — potentially by more than 50 different regulatory regimes — would lead to myriad disputes and would result in technical interconnection details being resolved at a glacial pace not by engineers and other experts but by more than 50 different state public utility commissions applying disparate views of what is and is not appropriate. In fact, the mere possibility that legacy rules could be applied to these arrangements already is deterring commercial negotiations.

Furthermore, legacy voice interconnection, including Section 251's mandatory direct interconnection by incumbent LECs at artificially low rates, was intertwined with a complex system of implicit subsidies that created competitive distortions and harmed consumers by requiring them to pay to support other carriers' network costs. As those implicit subsidies fade away, there may well be instances where the transition to commercial IP-based interconnection arrangements upset certain companies' longstanding business models, including some rural providers. These are important and real concerns that policymakers must address. The FCC has recognized these companies' concerns and need for support in its 2011 order reforming intercarrier compensation and universal service. But the need for support is a financial issue, not a network issue. Policymakers should not conflate the two. Instead, policymakers should address

legitimate needs for financial support in the context of modernizing universal service policy. They should not allow financial concerns to drive decision-making on the optimal interconnection policy framework to meet changing consumer demands. In the 1996 Act, Congress directed the FCC to make universal support explicit.[5] To the extent support is needed as part of the move to IP interconnection, that support too should be explicit. Whatever steps Congress now takes with respect to support should start from where the FCC left off in its 2011 reform order and should include only explicit subsidies, not implicit.

The Committee also notes the evolution of emergency communications and asks how it may affect interconnection. Like with universal service, regulators will continue to play an important role ensuring that public safety including E911 and NG911 concerns are addressed. Government will continue to administer a public-safety regime to protect the public as voice and data communications converge and voice more and more becomes an application.

Conclusion

The Committee recognizes that the rapid changes in the communications industry warrant a reexamination of the nation's communications laws so that they are more suited for the 21st Century broadband-based communications landscape. Flexibility to respond to consumer demand and competitive forces should underpin Congress's approach to competition policy generally and network interconnection specifically. A framework that relies on commercially negotiated agreements and avoids prescriptive regulations, like the framework that fostered the Internet, would provide that flexibility and encourage innovation and investment.

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[1] *Connect America Fund, et al.*, Report and Order and Further Notice of Proposed Rulemaking, 26 FCC Rcd 17663, ¶ 648 (2011).

[2] *Id.* ¶ 9.

[3] Jonathan E. Neuchterlein & Philip J. Weiser, Digital Crossroads: American Telecommunications Policy in the Internet Age (2005), at 428.

[4] Comments of Vonage Holdings Corp., *Numbering Policies for Modern Communications*, WC Docket 13-97; *et al.*, at 2-3 (March 4, 2014).

[5] 47 U.S.C. § 254(e).

Advocates for Rural Broadband
Mark M. Gailey
President
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Response of WTA – Advocates for Rural Broadband
to the House Energy and Commerce Committee's
White Paper on Network Interconnection

August 8, 2014

In its White Paper on Network Interconnection, the House Energy and Commerce Committee (Committee) requests public comment on several issues regarding interconnection and peering agreements between communications networks and the role of government in regulating these agreements.

WTA – Advocates for Rural Broadband (WTA) is a national trade association representing more than 250 small rural telecommunications providers that serve some of the most remote, difficult and expensive-to-reach areas of the country and that are providers of last resort to those residing there. Most WTA members serve fewer than 3,000 access lines in the aggregate, and fewer than 500 access lines per exchange. Whereas WTA members were predominately providers of traditional voice services over copper networks during the early 1990's when the Telecommunications Act of 1996 was being debated and enacted, they have more recently been evolving into providers of increasingly higher-capacity broadband data, video and voice services over hybrid fiber/copper networks, and are also in the midst of converting from Time Division Multiplexing (TDM) to Internet Protocol (IP) technology.

In its response to the Committee's initial White Paper on Modernizing the Communications Act, WTA emphasized that the Committee should keep in mind the following three key points: (1) the communications industry and technology have changed over the decades, yet many of the principles underlying current law remain sound; (2) rural areas of our country served by WTA's members have different market dynamics than more suburban and urban areas and continue to

need regulatory structures tailored to these unique circumstances; and (3) federal universal service policies for areas served by rural local exchange carriers (RLECs) have helped to ensure that consumers living in high-cost rural areas receive services reasonably comparable in quality and price to those in more densely populated areas. WTA reiterates the validity and importance of these three principles and emphasizes that nothing it states herein with respect to the Committee's questions regarding IP interconnection is intended to modify or reduce the primacy of these principles.

Statement of WTA's Position on Internet Protocol Interconnection

For WTA members, the most pressing current and long-term network interconnection issue is their ability to obtain and maintain the IP interconnection and middle mile arrangements necessary to provide their rural customers with quality and affordable access to Internet content, applications and services.

Since 1996, Sections 251 and 252 of the Communications Act have been remarkably successful in enabling a growing variety of telecommunications carriers to connect directly and indirectly with each other and with the Public Switched Telecommunications Network as a whole. Whereas the transition to a competitive telecommunications industry could have left many people unable to communicate with their relatives, friends and business associates for long periods of time, the negotiation, arbitration, interconnection and pricing provisions of Sections 251 and 252 kept such disruptions to a minimum and limited their duration and extent.

WTA believes that Sections 251 and 252 apply to the interconnection of IP networks as well as TDM networks. In particular, Internet backbone and transport providers (including middle mile transport providers, whether or not they employ special access services) meet the definition of "telecommunications carriers" in that they offer for a fee directly to the public or classes thereof, transmission services for information of the users' own choosing between or among points specified by the users without change in the form or content of the information. Whether or not the Congress and the FCC determine to subject some or all retail Internet access services to Title II common carrier regulation, they should make it clear that the Internet backbone providers and

transport providers that connect service providers to the emerging Public Broadband Network are telecommunications carriers subject to Title II of the Act, particularly Sections 251 and 252.

WTA is aware that others within the industry argue that Sections 251 and 252 do not apply to IP interconnection. This interpretation disregards the actual operations of Internet backbone and transport providers, as well as the clear purposes of Sections 1, 2 and 201 of the Communications Act to establish and maintain a nationwide public communications network (whether a switched telecommunications network or a broadband network) that is available to all Americans on a just and reasonable basis. Moreover, it poses real and substantial dangers that the Internet will become the exclusive or near-exclusive domain of large peering entities, and that RLECs and other smaller broadband service providers and their customers will be unable to obtain sufficient and affordable access to all of the information, services and people that should be available to all Americans over the public network. WTA members are concerned that, in the absence of Section 251 and 252 protections, they will not be allowed to connect to the Internet at the closest technically feasible point, but will be required instead to pay for transporting the traffic of their customers to distant urban hubs. For many WTA members, this could mean being required to pay substantially more than they do today for the transport of the traffic to and from their rural customers over hundreds or thousands of miles. WTA members are also concerned that they will be unable to obtain middle mile transport of sufficient quality and capacity to meet the latency needs of their customers as well as the FCC's latency standards, or that such middle mile transport will become so expensive that significant numbers of their rural customers will be unable to afford Internet access service. In fact, in the absence of Section 251 and 252 protections, many WTA members fear that they are so small relative to most Internet backbone and transport providers that they may be unable to get the larger providers even to participate in *bona fide* negotiations to establish reasonable interconnection and transport arrangements with them.

WTA members have been, and remain, focused upon showing their rural customers the services they can access and the benefits they can obtain from adopting broadband service. To continue their progress toward the rapidly approaching IP world, WTA members and other small carriers need just and reasonable IP interconnection and middle mile transport arrangements so that they

can offer their rural customers broadband services and rates that are reasonably comparable to those available in urban and suburban areas.

Responses to the Committee's Specific Questions

1. In light of the changes in technology and the voice traffic market, what role should Congress and the FCC play in the oversight of interconnection? Is there a role for the states?

There is still a critical role for Congress and the FCC to play in ensuring that all Americans in all parts of the nation have just, reasonable and reasonably comparable access to the emerging Public Broadband Network. The Section 251/252 process encourages this important goal via voluntary agreements among private carriers and service providers without the need for federal or state intervention. However, if certain larger carriers refuse to negotiate interconnection arrangements with smaller entities and/or attempt to use their superior bargaining power to impose onerous terms and conditions for such arrangements, the backstop of Section 251/252 or a substantially equivalent process is necessary to level the playing field and to facilitate or impose via arbitration more equitable arrangements. Whereas most Internet backbone and middle mile transport providers operate on an interstate basis, state commissions played a very valuable and useful role in conducting Section 251/252 arbitrations of interstate and intrastate issues. State commissions are more familiar with local situations and are better able to resolve in timely fashion the more limited number of proceedings likely to arise in a single state than the FCC could do if it were required to resolve disputes arising in all of the states and territories.

2. Voice is rapidly becoming an application that transits a variety of network data platforms. How should intermodal competition factor into interconnection mandates? Does voice still require a separate interconnection regime?

In an IP world, voice traffic is composed of bits, bytes and packets just like data and video traffic. At the same time, congestion and latency problems can degrade voice calls to the point where they become unacceptable and generate consumer complaints. At some future date, there may be a satisfactory technical solution to the problem. However, at present, Congress should

maintain a separate interconnection regime or standards for voice traffic to ensure that voice services maintain at least a minimally acceptable level of quality and security.

3. How does the evolution of emergency communications beyond the use of traditional voice service impact interconnection mandates?

Congress should encourage the research and development of new and enhanced IP emergency communications services. However, with respect to both future and current emergency communications, the critical factors appear to be that: (1) each emergency call be delivered to the appropriate Public Safety Answering Point ("PSAP") so that it can be directed to the proper first responder(s); (2) each emergency call be delivered as rapidly and reliably as possible; and (3) the calling party's location be readily and accurately ascertainable. With traditional voice calls (and especially before wireline-wireless local number portability), 911 calling was a relatively simple and accurate process. With wireless calling, 911 calls became more difficult, but most of the problems have been resolved. With Voice over IP calling and the possibility of IP interconnection in distant cities hundreds or thousands of miles away, the speed, accuracy and reliability of emergency communications become much more complicated. Congress will need to examine and monitor these critical public safety issues very closely. In the absence of effective technical solutions, Congress and/or the FCC may need to require IP backbone and middle mile network designs that entail many more Internet nodes and points of interconnection so that emergency calls need travel only minimal distances with minimal opportunities for delay, degradation and/or misdirection.

4. Ensuring rural call completion has always been a challenge because of the traditionally high access charges for terminating calls to high-cost networks. Does IP interconnection alleviate or exacerbate existing rural call completion challenges?

Whereas access charges and reciprocal compensation are being reduced toward bill-and-keep ($0 in most cases) for both the traditional Public Switched Telecommunications Network and the evolving Public Broadband Network, the implementation of IP interconnection may not eliminate the rural call completion problem. An IP interconnection regime is still likely to entail charges for middle mile and other transport and transit by the carriers that operate the facilities that deliver traffic to rural areas. To the extent that these middle mile, transport and transit

charges will be higher for traffic going to certain rural areas, some service providers may continue to try to block or drop calls to such rural areas.

5. Should we analyze interconnection policy differently for best-efforts services and managed services where quality-of-service is a desired feature? If so, what should be the differences in policy between these regimes, and how should communications services be categorized?

Various levels of service quality require differing priorities, and this is likely to impact interconnection policies and regimes. Whereas Congress and the FCC need to monitor developments in this area, it would appear premature to adopt specific legislation or rules while best-efforts, managed and other levels of service are still developing, and while there is likely to be significant uncertainty and reasonable differences of opinion regarding the appropriate regulatory mechanism.

6. Much of the Committee's focus in the #CommActUpdate process has been on technology-neutral solutions. Is a technology-neutral solution to interconnection appropriate and effective to ensure the delivery and exchange of traffic?

Yes, it appears that all IP traffic is comprised of bits, bytes and packets, and that it needs to go through the Internet backbone and middle mile transport networks whether it originates or terminates as wireline, wireless, cable television or satellite traffic.

7. Wireless and Internet providers have long voluntarily interconnected without regulatory intervention. Is this regime adequate to ensure consumer benefit in an all-IP world?

As indicated on pages 2 and 3 above, WTA has serious concerns that, without Section 251 and 252 procedures or equivalent protections, rural telephone companies and other small carriers will not be allowed to connect to the Internet at the closest technically feasible point, but will be required instead to pay for transporting the traffic of their customers to distant urban hubs. WTA is also concerned that its members and other small rural carriers will be unable to obtain middle mile transport of sufficient quality and capacity to meet the latency needs of their customers as well as the FCC's latency standards, or that such middle mile transport will become so expensive that significant numbers of their rural customers will be unable to afford Internet access service.

There is a long history of reluctance on the part of large wireline and wireless carriers to negotiate interconnection and other business arrangements with individual rural telephone companies. From WTA's perspective, keeping in mind that some of WTA's member companies provide wireless service, voluntarily wireless interconnection arrangements have not always worked out smoothly without regulatory intervention, but rather that many small wireless carriers have had an increasingly difficult time obtaining reasonably priced roaming arrangements, and in some cases, any roaming arrangements at all with some of the large national wireless carriers.

8. Is contract law sufficient to manage interconnection agreements between networks? Is there a less onerous regulatory backstop or regime that could achieve the goals of section 251?

No, contract law will not be sufficient to obtain and enforce equitable interconnection agreements between large carriers and small carriers if certain large carriers refuse to negotiate with smaller carriers, or if they use their superior resources and bargaining power to impose one-sided rates, terms and conditions upon the smaller entities. A Section 251/252 regime imposed upon backbone providers and middle mile transport and transit providers should be sufficient to allow broadband service providers of all sizes and types to provide their customers with quality and affordable access to the Internet and other advanced services. The proposed Section 251/252 approach to interconnection does not require Title II common carrier regulation of retail broadband transmission services.

Conclusion

WTA reiterates that the most pressing current and long-term network interconnection issue for its members and other rural carriers is their ability to obtain and maintain the IP interconnection and middle mile arrangements necessary to provide their rural customers with quality and affordable access to broadband content, applications and services. The current Section 251/252 procedures, or their functional equivalent, are needed to ensure that large carriers will negotiate just and reasonable interconnection and middle mile arrangements with smaller carriers so that all Americans can obtain quality, affordable and reasonably comparable access to the emerging

Public Broadband Network. Such an approach does not require extensive and expensive regulation of retail broadband services but rather can be limited to backbone and middle mile transport providers.

13865 Sunrise Valley Drive
Herndon VA 20171

August 8, 2014

The Honorable Fred Upton
Chairman
Committee on Energy and Commerce
House of Representatives
Washington, DC 20515

The Honorable Henry Waxman
Ranking Member
Committee on Energy and Commerce
House of Representatives
Washington, DC 20515

The Honorable Greg Walden
Chairman
Communications and Technology Subcommittee
Committee on Energy and Commerce
House of Representatives
Washington, DC 20515

The Honorable Anna Eshoo
Ranking Member
Communications and Technology Subcommittee
Committee on Energy and Commerce
House of Representatives
Washington, DC 20515

Dear Chairmen Upton and Walden, Ranking Members Waxman and Eshoo:

XO Communications (XO) appreciates the opportunity to provide feedback to the Committee as it contemplates whether changes to the Communications Act of 1934 (Act) as amended are warranted. Directly serving business and wholesale customers exclusively, XO has been a leading innovator in the telecommunications space for nearly two decades – including adopting the use of Internet Protocol (IP)-enabled voice communications inside its network 2001, that led to the launch of its retail IP Flex product in 2005 which attained over one million Voice over Internet Protocol (VoIP) users by 2010. As the first carrier to provide 100 Gigabit backhaul coast to coast (in 2012), a leading provider of unified communications services, and also a Tier I peer, XO is uniquely positioned to comment on network interconnection for the exchange of voice and data traffic.

Interconnection is vital to the functioning of networks, with government-mandated requirements dating back nearly a century. Today, managed IP-enabled communications,[1] the public Internet, and wireless and traditional wireline calls may all be transmitted over separately owned and operated networks of different providers serving disparate points across the country. In order for all of those different customers to be served, the network providers rely on interconnection, with much of this activity overseen by federal and state regulators. The need for oversight to ensure our public interest objectives are met will continue, especially as more networks are deployed and more services offered. Simply put, without a functioning interconnection regime, the "network of networks" serving America today will fail to work.

[1] The public Internet is just one of many IP-based networks. The public Internet is distinct from IP-based networks that are used for managed services, such as managed IP voice and IP video. These managed services are Quality of Service (QoS) based services. The networks assign prioritization markers in the packets and other network configuration parameters to ensure end-to-end QoS, which customers pay for and demand. By contrast, the public Internet is purely a "best efforts" network. Thus, two types of traffic may both use IP technology and even use the same physical facilities but do not share the same interconnection arrangement.

The Importance of Interconnection

Two decades ago, when competitive telecommunications carriers, such as the predecessors of XO, first entered the market to provide circuit-switched telephone service, they needed to interconnect with the existing monopoly telephone local exchange carriers so that any consumer could place a call to anywhere on the Public Switched Telephone Network (PSTN). However, since there was no economic incentive for these incumbents to enter into reasonable interconnection arrangements with prospective competitors, the Congress and Federal Communications Commission (FCC) imposed technology neutral legal requirements obligating interconnection on reasonable and non-discriminatory terms. Absent this interconnection regime, it is unlikely competition would have advanced to where it is today.

Government oversight of the obligation to interconnect networks is still essential. The incumbents continue to control the most widespread connections to end users (whether those users are the incumbent's own retail customers or retail customers of the incumbent's wholesale customers), especially in the large business and enterprise markets, and are the primary competitors XO faces in the geographic and product markets XO serves. Consequently, the incumbents have incentives to use their market power to curb or otherwise degrade interconnection with competitors. Given that competitors are at the forefront in deploying IP technologies, any such degradation in turn slows the expansion of IP-based communications.

IP Communications and the Internet

XO has extensive experience with IP-based technologies and transmissions – both with its managed IP voice services and the "best efforts" public Internet. Use of IP technology allows for the routing of packets that enables internetworking, something critical for the public Internet, but a function whose benefit is by no means limited to the public Internet.

Furthermore, the same network connections (copper and fiber) that have carried traditional voice traffic for decades also support both types of IP traffic – by virtue of investments in the modern, innovative network switching equipment, not by a wholesale rewiring of America. In essence, the same physical facilities can support various types of logical networks, using individual inner paths within the facilities and separately interconnected to other networks. Thus, to conflate the Internet and the managed IP networks carrying IP-based services would be incorrect because of the distinct Quality of Service (QoS) prioritization provided over managed IP networks, as discussed below. Similarly, because the traffic over these networks is not comingled, one should not confuse Internet peering with managed IP interconnection.

Evolution of Voice Services

Over the past twenty years, there has been an increasing amount of voice traffic carried in whole or in part using IP technology. In order to provide the QoS demanded particularly by business customers, IP-based networks that carry managed IP voice require end-to-end prioritization – functionality beyond the pure distribution of packets – for real-time two-way (or multiple-way) high-fidelity communications. The public Internet, as currently operated, cannot provide such prioritization.

Prioritization is managed on a provider-specific, bilateral basis. So, if high-quality IP voice is being provided – as businesses and enterprises demand – it is being provided using private, managed IP networks. The need to ensure QoS for managed IP voice isn't unique to XO. AT&T provides its U-verse Voice service "over AT&T's world-class managed network and not the public Internet."[2] Verizon acknowledges that "…the service is not the same as the services you get with a little Internet adapter for your modem and phone, and it does not ever touch the public Internet."[3] In other words, even the largest incumbents have highlighted that managed IP voice is distinct from and does not run over the public Internet.

So while a broadband connection is necessary for both facilities-based managed and over-the-top VoIP service riding the public Internet, the managed IP voice service, with its call quality guarantees, is transmitted wholly separate from public Internet traffic. That separation is critical because it eliminates the effects of packet loss on real time, two way communications – a syndrome to which callers are exceedingly sensitive and which is expected to be minimal during any business grade quality call.

Peering Is a Type of Interconnection

Two of the predominant types of IP-based interconnection today facilitate the exchange of very different types of IP-based traffic: managed IP voice traffic and so-called "best efforts" Internet traffic (including over-the-top VoIP). Today, XO has interconnection arrangements of both types with multiple providers. However, managed IP voice interconnection and Internet peering arrangements, even if between the same two carriers, connect two different pairs of network paths at the point of interconnection. None of XO's peering arrangements for the exchange of public Internet traffic is used to exchange traffic for managed IP voice or other managed IP-based services. Users and carriers typically do not expect Internet traffic to have the same quality as managed IP voice.

A Forward-Looking Communications Policy

There is no question that the telecommunications industry is moving to all-IP networks; however, the industry is not moving to a convergence where all communications traverse the public Internet. As long as the public Internet continues to operate on a "best efforts" basis, managed IP-based communications – such as managed IP voice – will remain distinct for the indefinite future, primarily because of the need to support and maintain QoS, particularly in the business market. However, XO's experience with IP-based interconnection for managed IP voice traffic has been mixed. While XO has sought and entered into IP interconnection arrangements for managed IP voice traffic with a variety of carriers, not all carriers that XO has approached to establish managed IP interconnection arrangements have been willing to enter into such arrangements. In light of similar industry-wide issues, the FCC must clearly direct all carriers to provide managed IP interconnection under the Act.

[2] Paragraph 1, Retrieved August 4, 2014:
http://www.att.com/media/en_US/swf/uverse_center/uverse/downloads/att_home_alarm.pdf

[3] Paragraph 1, Retrieved August 4, 2014:
http://newscenter2.verizon.com/press-releases/verizon/2010/fios-digital-voice-heres.html

Direct connection to the private managed IP networks of other voice carriers is preferable to indirect connection and would result in less loss of data and better quality for the voice call.

The Committee should underscore the need for robust interconnection and government oversight where necessary to ensure public interest objectives are achieved, including by implementing and enforcing the technology neutral interconnection principles delineated in the Act. Ensuring the widespread availability of the most efficient form of interconnection will enable those providing IP-based connections to offer their subscribers the benefits of IP transmission all the way to the handoff – resulting in lower overhead, a more robust QoS, and a broad suite of features. In addition, there are no costs of conversion for a carrier offering IP-based services and using managed IP transport within its network when interconnection is in IP. On the other hand, where a carrier that offers IP-based services is forced to exchange traffic with other carriers in a different format, such as Time-Division Multiplexing (TDM), the carrier must maintain burdensome and unnecessary overhead in engineering design, network planning, mediation and billing, and potentially maintain duplicative interconnected circuits with either the other carrier's end office switch and/or tandem switch, all of which increase costs, decrease quality and curb innovation.

Summary

As the nation's networks grow and evolve, clear interconnection policy is and will continue to be critical, and government oversight is necessary to ensure public interest objectives are achieved. This includes addressing the market power and other advantages that large incumbents enjoy today, which result from their extensive networks built over decades of protected monopoly status and which will persist in the future as the transition from the legacy technologies to IP-based technologies continues. Accordingly, for the public communications network to work, all carriers will need a properly functioning, IP-based interconnection regime with clear rules and oversight.

Sincerely,

Patrick Thompson
Director, Legislative Affairs
XO Communications

Center for Technology, Innovation and Competition

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COMMENTS OF CHRISTOPHER S. YOO ON "NETWORK INTERCONNECTION"

John H. Chestnut Professor of Law, Communication, and Computer & Information Science and Founding Director, Center for Technology, Innovation and Competition, University of Pennsylvania

Before the Committee on Energy and Commerce of the U.S. House of Representatives

August 8, 2014

Thank you to the members of the House Energy and Commerce Committee for initiating the process of updating our nation's communications laws. This Committee's leadership in this area on these issues and should provide important benefits to the entire country. Per the most recent white paper, I am offering my thoughts on network interconnection.

Peering and Transit

The basic approach to interconnection has undergone a sea change over the past two decades. In the traditional voice network, interconnection was highly regulated. The situation is quite different for modern data networks based on the Internet protocol. Interconnection in the Internet is unregulated and is governed by arms-length, bilateral negotiations between various network operators.

ISPs operators enter into contracts to exchange traffic originating or terminating on other networks. Typically, the originating ISP is the only one to receive direct payment from end users. Because the terminating ISPs also incur costs, the traditional rule was that the originating ISP would make what is known as a *transit* payment to compensate the terminating ISP for the costs it incurs delivering the traffic sent by the originating ISPs customers. This is quite similar

to the sending-party-pays regime that characterized interconnection in the traditional telephone network.

Internet interconnection evolved beyond this simple transit-based regime of sending-party pays. If traffic is roughly symmetrical, ISPs can reduce costs by foregoing monitoring and billing for the exchange of traffic and instead calling it a wash, a practice commonly known as settlement-free *peering*. Such arrangements make economic sense only if the traffic exchanged is symmetrical. If traffic becomes out of ratio, peering contracts typically call for transit-style payments. Thus, although peering is often misrepresented as zero-price interconnection, it is more properly regarded as a form of barter and is conditional on an even exchange of volume.

Consider what would happen if one of the parties to a peering contract suddenly increased the amount of traffic that it was handing off to the other party for termination. The terminating ISP would have to incur significant costs to terminate the traffic. Certainly, the originating ISP would like the terminating ISP to bear all of the costs of doing so. Conversely, the terminating ISP would like the originating ISP to pay for the costs, as required by the typical peering contract. Both parties benefit from delivering greater value to the end users. The usual solution would be for both parties to bear part of the costs.

Indeed, this is exactly what appears to be occurring in the recent interconnection agreement between Comcast and Netflix. Netflix has been a spectacular success, growing to roughly one-third of all primetime Internet traffic in the U.S. Like any for-profit company, it would prefer it if the ISPs bore as much of the burden of the additional costs of carrying this traffic as possible. Indeed, that is the gist of its Open Connect program, which requires ISPs to terminate Netflix traffic for free. Some ISPs have embraced Open Connect. Others have resisted. All of this is a natural part of healthy bargaining process. As in the typical case, both

sides reached an interconnection agreement that divides the costs. The terms represent nothing more than a garden-variety bargain over price that characterizes every arms-length economic transaction.

The Comcast-Netflix interconnection agreement appears to be nothing more than a typical case of such bargaining. The agreement reduces Comcast's costs. The impact on Netflix is ambiguous: while it now must pay Comcast to terminate its traffic, it no longer needs to pay the third-party ISP on which it previously relied to reach Comcast in a classic case of efficiencies through cutting out the middleman. Although some have suggested that this might lead to a net reduction in Netflix's costs, that information is confidential and cannot be verified. In any event, interconnection represent a trivial revenue stream for Comcast and a tiny portion of Netflix's cost structure, which is dominated by program acquisition costs, which means that the transaction is unlikely to have any material effect.[1] Moreover, cutting out the middleman has allowed Netflix to enjoy faster service as well as service-level guarantees from Comcast.

Although some have suggested that the government should regulate to equalize the terms under which traffic passes through the Internet, it is hard to see how this could be accomplished. The Internet consists of over 30,000 separate networks interconnected through arms-length, bilateral interconnection agreements. As a result, the length of the paths and the amount paid as traffic passes through the network varies widely from packet to packet. Given this heterogeneity, interconnection disputes are best left to individualized bargaining rather than be straitjacketed by price regulation.

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[1] Dan Rayburn, *Here's How the Comcast & Netflix Deal Is Structured, with Data & Numbers*, STREAMING MEDIA BLOG, Feb. 27, 2014, http://blog.streamingmedia.com/2014/02/heres-comcast-netflix-deal-structured-numbers.html.

The Changing Internet Architecture

Pricing flexibility is also justified by key differences in the network architecture. The telephone network typically followed a hierarchical structure in which there was only one way to connect two endpoints. The result was that failure to reach agreement on an interconnection agreement effectively disconnected part of the network.

The situation is quite different in the Internet. Much like the phone system, the original Internet architecture was quite hierarchical, with Tier 3 Internet service providers (ISPs) typically connecting to a single Tier 2 ISP, which in turn connected to a single Tier 1 ISP. As I detail in my article, *Innovations in the Internet's Architecture that Challenge the Status Quo* (attached), practices such as multihoming and secondary peering have made the network much less hierarchical and now provide multiple paths between endpoints. The result is that failure to reach an agreement typically does not disconnect any part of network. Moreover, the presence of multiple paths limits the bargaining leverage that any network may exercise against any other network.

Consider Comcast, whose interconnection policies have been the focus of considerable scrutiny in recent months. Comcast maintains 40 settlement-free peering relationships and over 8,000 transit relationships. That means that edge providers will always have some way to reach Comcast customers even if they are unable to reach a direct interconnection agreement. The only bargaining advantage that Comcast would enjoy is the different between the direct interconnection terms and the cost of Netflix's next-best interconnection option. Indeed, Netflix may be able to route into another one of Comcast's peering arrangements if it is willing to pay a small amount of transit to reach that network. And transit prices have been dropping precipitously for the past several years.

The Economics of Two-Sided Markets

The economics of two-sided markets provides another reason that the federal government should avoid regulating interconnection. Conventional economics has long recognized the existence of "network economic effects," which cause a network to increase in value as the number of users connected to it increases. To use a classic example, the value of a telephone network to consumers is thus determined by more than just the price charged and the services provided, as is the case with most goods. It also depends on the number of other subscribers connected to the network. The more people you can reach through the network, the more valuable it becomes.

The telephone system is an example of a one-sided market, in that the value to any particular caller is determined in no small part by the number of similarly situated callers. When a market is two sided, instead of bringing together a single class of similarly situated users, networks bring together two completely different classes of users. In those cases, the value is determined not by the number of users of the same class, but rather the number of users of the other class. To put it in terms of a concrete example, consider the economics of broadcast television, which generates revenue from advertisers based on the number viewers the industry can deliver. The value of the network for advertisers is not determined by the number of other advertisers. Instead, the value of the network increases with the number of a different class of network participants (i.e., television viewers).

The economics of two-sided markets indicate that it may be socially beneficial for content and application providers to subsidize the prices paid by end users. The fact that the Internet has become increasingly dominated by advertising revenue paid to content and application providers rather than network providers makes this particularly likely to be true. An

advertiser's willingness to pay for an ad on any particular website depends on the number of end users viewing that website. Under these circumstances, the optimal solution may be for the website owner to subsidize the total number of end users by making payments to the network provider to help defray their costs of connection. The costs of subsidizing more users would be more than offset by the additional revenue generated by the fact that advertisers can now reach more potential customers.

These revenue-side pressures are reinforced by cost-side considerations. The cost of connecting content and application providers to the Internet is quite low, typically only requiring a single high-speed line to a small number of business locations. The cost of connecting end users to the Internet is much higher, requiring the wiring and upgrading of equipment in entire neighborhoods. In an industry in which the primary revenue is flowing to content and application providers and the costs involved in connecting content and application providers are much smaller than the costs of connecting end users, one would expect some cash to flow from content and application providers to those who are providing connections to end users.[2]

These dynamics are again well illustrated by broadcast television. In many ways, broadcast television and the Internet are analogous. The movie studios that create television programs play a similar role to content and application providers. Television networks aggregate programs and deliver them nationally in much the same manner as server-side network providers and backbone providers. Local broadcast stations provide last-mile connectivity that is quite similar to the role played by DSL and cable modem providers. In addition, the revenue structure is quite comparable, in that television networks receive advertising revenue in much the same

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[2] *See* Peyman Faratin et al., *The Growing Complexity of Internet Interconnection*, 72 COMM. & STRATEGIES 51, 58-59 (2008).

manner as content and application providers. Furthermore, the cost structure is somewhat similar in that connecting individual homes is much more costly than distributing programming nationally.

For decades, the standard business arrangement has been for television networks to subsidize the operations of local broadcast stations by paying them to be members of their television networks. The industry's revenue and cost structure make such arrangements quite logical. The cost of paying these broadcast stations to affiliate with a network is more than offset by the increase in advertising revenue made possible by the fact that the network is now able to reach a larger audience. Broadcast television thus represents a prime example of when firms operating on one side of the market find it economically beneficial to subsidize end users on the other side of the market.

Furthermore, the magnitude of the affiliation fees that the networks pay to broadcast stations is anything but uniform. The precise amount paid varies with the relative strength of the network and the relative strength of the broadcast station. Stronger broadcast stations receive more, while weaker ones receive less. Equally interesting is the fact that in recent years, the cash flow has begun to vary in its direction as well as magnitude, with weaker stations having to pay rather than be paid to be part of the television network. The dynamic nature of this pricing regime benefits consumers by providing incentives for networks to invest in better quality programming and by providing an incentive for stations to provide better carriage. All of this counsels against imposing sending-party-pays or any particular pricing regime on the network.

The two-sided market analysis also reveals the problems with the claim that allowing network providers to charge content and application providers for premium services would force consumers to pay twice. As a general matter, pricing flexibility makes it easier for network

providers to recover the costs of building additional bandwidth. Left to their own devices, network providers would set prices designed to maximize the revenue generated by each side of the market. So long as competitive entry is sufficiently feasible to prevent network providers from simply pocketing the extra returns, facilitating network providers' ability to generate revenue from one side of the market will reduce the proportion of the fixed costs that the network provider will have to recover from the other side of the market. Thus granting network providers pricing flexibility with respect to content and application providers should reduce the economic burden borne by end users.

Paid interconnection also promotes fairness by placing the cost of increasing the available bandwidth on the customers who are creating the need to do so. If Comcast and Netflix did not have a paid interconnection agreement, Comcast would have to recover the cost of expanding its capacity by raising the price charged to all of its customers, regardless of whether or not they are Netflix users. Having Netflix pay part of this cost places the burden on those responsible for creating these costs.

Increasing the cost of building networks also increases the breakeven number of customers needed to cover the costs of expanding infrastructure, which in turn threatens to worsen the digital divide.

The Risks of Setting Interconnection Prices Incorrectly

Pricing flexibility is the standard mechanism by which our society rewards socially beneficial behavior and reallocates resources. This process of equilibration works well so long as entry barriers are relatively low and inputs are relatively mobile. These conditions are easily met with respect to content and applications, which are already very competitive and unprotected by entry barriers (and therefore likely to remain that way). Connectivity in the core of the

network is also quite competitive and open to entry. The upsurge in interest in fiber prompted by the success of Google Fiber as well as the rapid deployment of LTE has enhanced competition in the last mile as well.

Regulating interconnection prices would stifle this mechanism. Consider if one interconnection price were set too low. Traffic would flow towards that network to take advantage of the low prices, at which point that network would become congested. Under normal circumstances, the network would raise prices until it brought demand back into balance with the available supply in the short run and would begin investing in additional capacity in the long run. If this price were subject to rate regulation, however, the network could not adjust its price in this manner, which would cause this portion of the network to be permanently congested. Moreover, the inability to earn any additional revenue would provide the network with no incentive to expand its capacity to meet the demand.

All of these considerations underscore why the current approach permitting pricing flexibility has served the Internet so well. It is hard to see the justification for deviating from the approach that has proven and is still proving so successful.

INNOVATIONS IN THE INTERNET'S ARCHITECTURE THAT CHALLENGE THE STATUS QUO

CHRISTOPHER S. YOO*

INTRODUCTION

Despite having received sustained attention from both policymakers and academic commentators for the past several years, network neutrality shows no signs of retreating from the forefront of the policy debate. It has remained a central focus for Congress,[1] the Federal Communications Commission (FCC),[2] and both presidential candidates during the last election.[3] As President, Barack Obama has effectively ensured that network neutrality will remain at the top of the policy agenda by including provisions in the stimulus package requiring that the FCC

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1. *See The Internet Freedom Preservation Act of 2008: Hearing on H.R. 5353 Before the Subcomm. on Telecomm. and the Internet of the H. Comm. on Energy & Commerce*, 110th Cong. (2008); *Net Neutrality and Free Speech on the Internet: Hearing Before the Task Force on Competition Policy and Antitrust Laws of the H. Comm. on the Judiciary*, 110th Cong. (2008).

2. *See* Formal Complaint of Free Press and Public Knowledge Against Comcast Corp. for Secretly Degrading Peer-to-Peer Applications, *Memorandum Opinion & Order*, 23 FCC Rcd. 13,028 (2008); *En Banc Hearing on Broadband Network Management Practices Before the FCC* (Feb. 25, 2008), http://www.fcc.gov/realaudio/mt022508v.ram.

3. *See* Lee Gomes, *Debugging Obama-McCain*, FORBES, Oct. 13, 2008, at 72.

formulate a national broadband plan and through requiring that grants made by the National Telecommunications and Information Administration comply with the network neutrality principles articulated by the FCC in 2005.[4]

Although pinning down a precise definition of network neutrality has proven elusive,[5] the most common position appears to be that network providers should route traffic without regard to the source or content of the packets, the application with which the packets are associated, or the sender's willingness to pay. In the words of leading network neutrality proponent Lawrence Lessig, "Net neutrality means simply that all like Internet content must be treated alike and move at the same speed over the network."[6]

Some commentators have questioned whether this description of network neutrality represents an accurate description of the Internet's past.[7] Indeed, it would be surprising if any two similar packets would be treated exactly alike when traveling through a network consisting of more than thirty thousand autonomous systems that each determine their terms of interconnection through arms-length negotiations. There are, however, some systematic changes in the architecture of the Internet that have largely been overlooked by both commentators and policymakers. These changes are largely the result of network providers' attempts to reduce cost, manage congestion, and maintain quality of service.

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4. American Recovery and Reinvestment Act of 2009, Pub. L. No. 111-5, § 6001(j)–(k), 123 Stat. 115, 515–16.

5. *See* Rachelle B. Chong, *The 31 Flavors of Net Neutrality: A Policymaker's View*, 12 INTELL. PROP. L. BULL. 147, 151–55 (2008) (identifying five distinct versions of network neutrality); Eli Noam, *A Third Way for Net Neutrality*, FIN. TIMES, Aug. 29, 2006, http://www.ft.com/cms/s/2/acf14410-3776-11db-bc01-0000779e2340.html (identifying seven distinct versions of network neutrality).

6. *See, e.g.*, Lawrence Lessig & Robert W. McChesney, *No Tolls on the Internet*, WASH. POST, June 8, 2006, at A23.

7. *See, e.g.*, Robert W. Hahn & Robert E. Litan, *Portioning Bit by Bit: The Myth of Network Neutrality and the Threat to Internet Innovation*, MILKEN INST. REV., 1st Qtr. 2007, at 28, 31–33; Jonathan E. Nuechterlein, *Antitrust Oversight of an Antitrust Dispute: An Institutional Perspective on the Net Neutrality Debate*, 7 J. ON TELECOMM. & HIGH TECH. L. 19, 36–37 (2009); Douglas A. Hass, Comment, *The Never-Was-Neutral Net and Why Informed End Users Can End the Net Neutrality Debates*, 22 BERKELEY TECH. L.J. 1565, 1576–77 (2007); Kai Zhu, Note, *Bringing Neutrality to Network Neutrality*, 22 BERKELEY TECH. L.J. 615, 634–36 (2007); Michael Grebb, *Neutral Net? Who Are You Kidding?*, WIRED, May 31, 2006, http://www.wired.com/news/technology/internet/0,71012-0.html; ANDREA RENDA, I OWN THE PIPE, YOU CALL THE TUNE: THE NET NEUTRALITY DEBATE AND ITS (IR)RELEVANCE FOR EUROPE 9-11 (2008), *available at* http://shop.ceps.eu/downfree.php?item_id=1755; Craig McTaggart, *Was the Internet Ever Neutral?*, 34 RES. CONF. ON COMM'N, INFO. & INTERNET POL'Y 1, 4–14 (2006), *available at* http://web.si.umich.edu/tprc/papers/2006/593/mctaggart-tprc06rev.pdf; David Clark, Written Statement to the En Banc Public Hearing on Broadband Network Management Practices (Feb. 25, 2008), *available at* http://www.fcc.gov/broadband_network_management/022508/clark.pdf ("The Internet is not neutral and has not been for a long time.").

Part I frames the subsequent developments by describing the architecture and business relationships that defined the early Internet. Part II analyzes the architectural changes that have made the Internet's topology increasingly heterogeneous, including the emergence of multihoming, secondary peering, private networks, and content delivery networks. Part III describes the changes in ways that networks interconnect and price their services, focusing on the emergence of peer-to-peer applications and pricing innovations that go beyond the traditional bipartite distinction between peering and transit. Far from representing some network provider's efforts to promote its self interest at the expense of the public, as some network neutrality proponents have suggested, these changes have the potential to yield substantial benefits both to individual consumers and to society as a whole.

I. THE ARCHITECTURE OF THE EARLY INTERNET

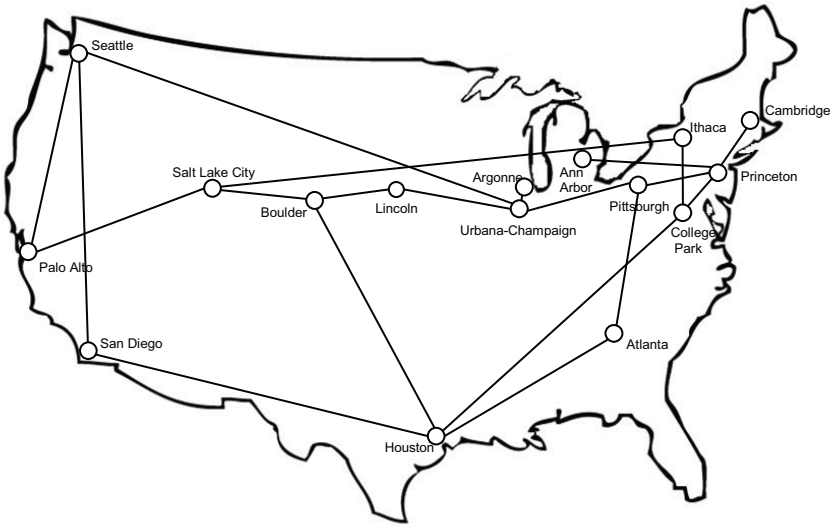
This Part reviews the architecture of the early Internet. Section A reviews the tripartite hierarchical structure that characterized its topology. Section B describes the peering and transit relationships that governed the way individual networks interconnected with one another.

A. The Topology of the Early Internet

When the Internet first emerged, its topology and the business relationships comprising it were relatively simple. As is widely known, the Internet evolved out of the NSFNET backbone, which was created in 1986 and eventually decommissioned in 1997 to provide universities all over the country access to federally funded supercomputing centers located in five universities. The primary architects of the NSFNET decided to give it a tripartite structure. At the top was the NSFNET backbone, which at its peak connected sixteen research facilities across the country. At the bottom were the campus networks run by individual universities. In the middle were regional networks (typically operated by university consortia or state-university partnerships) that linked the campus networks to the major computing centers.[8]

8. MERIT NETWORK, INC., NSFNET: A PARTNERSHIP FOR HIGH-SPEED NETWORKING, FINAL REPORT 1987–1995, at 11–12 (1996), *available at* http://www.merit.edu/documents/pdf/nsfnet/nsfnet_report.pdf; Juan D. Rogers, *Internetworking and the Politics of Science: NSFNET in Internet History*, 14 INFO. SOC'Y 213, 219 (1998).

Figure 1: The NSFNET Backbone circa 1992-1993

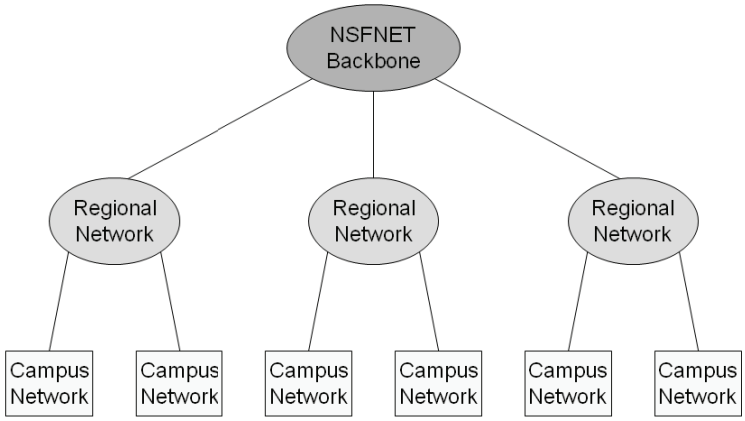


Every packet had to travel through a parallel path traversing each level of the hierarchy. For example, traffic originating on one campus network would have to connect to the regional network with which it was associated, which handed off the traffic to the NSFNET backbone, which in turn handed it off to the regional network that served the destination campus network. The result was to create a series of parallel hierarchies through which all traffic had to traverse.

The network retained this same basic architecture when it was privatized during the mid-1990s. The NSFNET backbone at the top of the hierarchy was replaced by a series of private backbone providers that interconnected with one another at four public network access points (NAPs) established by the NSF. The campus networks at the bottom of the hierarchy were replaced by last-mile providers that transported traffic from local distribution facilities maintained in individual cities (which in the case of digital subscriber lines (DSL) is usually called a central office and in the case of cable modem systems is usually called a headend) to end users' residences and places of business. The regional networks evolved into regional Internet service providers (ISPs) that transported traffic between the NAPs served by backbone providers and the central offices and headends maintained by last-mile providers.

The privatization of the Internet did not change the hierarchical nature of the basic architecture. Each regional ISP still connected to a single backbone, and each last-mile provider still connected to a single regional ISP. Indeed, the early versions of the protocol employed by the backbones (known as border gateway protocol or BGP) would not

Figure 2: The NSFNET Three-Tiered Network Architecture



support more complex topologies.[9]

The one-to-one relationship conferred a number of advantages. This architecture constituted a "spanning tree" that connected all of the nodes with the minimum number of links.[10] Furthermore, the fact that the path between any two nodes was unique greatly simplified determining the path along which traffic should be routed. That said, tree architectures are also subject to a number of drawbacks. The uniqueness of the path connecting any two nodes means that the failure of any link or node in the network will inevitably disconnect part of the network. Even when all network elements are operating properly, if the rate at which traffic arrives exceeds any particular element's capacity to route the traffic, that network element will become congested and the quality of service provided will deteriorate.[11] In addition, the hierarchical structure made each network participant completely dependent on the players operating at the level above them, which in turn provided backbones with a potential source of market power.[12]

9. Christopher S. Yoo, *Network Neutrality and the Economics of Congestion*, 94 GEO. L.J. 1847, 1860–61 (2006) [hereinafter Yoo, *Economics of Congestion*]; Christopher S. Yoo, *Network Neutrality, Consumers, and Innovation*, 2008 U. CHI. LEGAL. F. 179, 195–96 (2008) [hereinafter Yoo, *Consumers and Innovation*].

10. Daniel F. Spulber & Christopher S. Yoo, *On the Regulation of Networks as Complex Systems: A Graph Theory Approach*, 99 NW. U. L. REV. 1687, 1696 (2005).

11. *Id.* at 1699–700.

12. *See* Stanley Besen et al., *Advances in Routing Technologies and Internet Peering Agreements*, 91 AM. ECON. REV. (PAPERS & PROC.) 292 (2001).

B. Business Relationships on the Early Internet: Peering and Transit

The early Internet was also characterized by relatively simple business relationships. End users typically purchased Internet access through some form of all-you-can-eat pricing, which allowed them to consume as much bandwidth as they would like for a single flat rate. Relationships between network providers typically fell into two categories. Tier-1 ISPs entered into *peering* relationships with one another, in which they exchanged traffic on a settlement-free basis and no money changed hands. The primary justification for foregoing payment is transaction costs. Although the backbones could meter and bill each other for the traffic they exchanged, they could avoid the cost of doing so without suffering any economic harm so long as the traffic they exchanged was roughly symmetrical. Such arrangements would not be economical with when the traffic being exchanged by the two networks was severely imbalanced. Thus tier-1 ISPs will not peer with other networks that are unable to maintain a minimum level of traffic volume. In addition, peering partners typically require that inbound and outbound traffic not exceed a certain ratio. Networks that cannot meet these requirements must enter into *transit* arrangements in which they pay the backbone to provide connectivity to the rest of the Internet.[13]

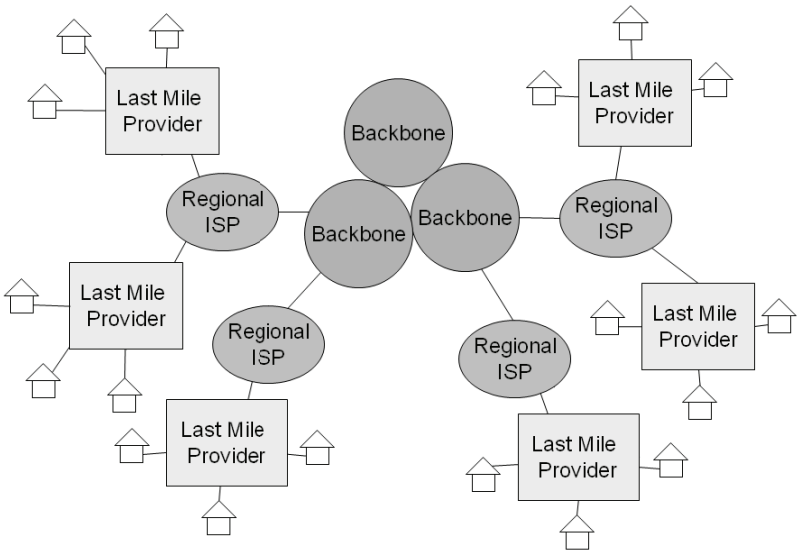
Most early analyses focused on the financial terms of these arrangements.[14] What is often overlooked is that interconnection agreements performed two distinct functions. Network providers enter into interconnection agreements not only to send and receive traffic. They also enter into interconnection agreements to announce to the rest of the Internet where the IP addresses that they control are located.

Consider this from the perspective of a small network, *A*, which serves a small number of its own customers and purchases access to the rest of the Internet through another ISP. The transit agreement between *A* and the ISP would not only require the ISP to receive traffic sent by *A* and to deliver traffic bound to *A*. It would also require the ISP to announce to the rest of the Internet how to reach the IP prefixes associated with *A's* customers. In addition, *A* can maintain a very simple routing table. It need only keep track of the prefixes of the customers that it serves. For all other IP addresses, *A* can enter a "default route" into its routing table that directs all other traffic to the other ISP.

13. Yoo, *Economics of Congestion*, *supra* note 9, at 1877; Michael Kende, *The Digital Handshake: Connecting Internet Backbones* 5 (FCC Office of Plans and Policy Working Paper No. 32, 2000), *available at* http://www.fcc.gov/Bureaus/OPP/working_papers/oppwp32.pdf; Peyman Faratin et al., *The Growing Complexity of Internet Interconnection*, 72 COMMC'NS & STRATEGIES 51, 55–56 (2008).

14. *See, e.g.*, Kende, *supra* note 13, at 5.

Figure 3: The Architecture of the Early Internet



The existence of default routes creates a potential problem, however. If none of the routing tables involved in a particular routing session contained the location of the destination, by default the networks would simply hand the packets back and forth, and the packets would never reach their final destination. The only way to avoid these problems is for one or more network providers to maintain routing tables that map the entire Internet without employing any default routes. Thus, tier-1 ISPs are defined not only by the fact that they engage in settlement-free peering with one another, but also by the fact that they maintain routing tables that contain no defaults.[15] Peering contracts also include a number of other requirements to guard against free riding and to ensure the proper functioning of the network.[16]

II. THE EVOLUTION OF THE INTERNET'S TOPOLOGY

Over the past decade, ISPs have begun to enter into a more complex set of interconnection arrangements that violate the strict tripartite hierarchy that characterized the early Internet. In addition, content providers have begun to experiment with a variety of ways to locate their content closer to end users. Both types of changes have

15. Paul Milgrom et al., *Competitive Effects of Internet Peering Policies*, *in* THE INTERNET UPHEAVAL 175, 179–80 (Ingo Vogelsang & Benjamin M. Compaine eds., 2000).

16. Faratin et al., *supra* note 13, at 54.

significant policy implications that have largely been overlooked in the policy debate.

A. Private Peering, Multihoming, and Secondary Peering

One of the first problems to emerge in the early Internet was congestion in the NAPs, which often caused throughput times and network reliability to degrade. Some estimate that congestion in the NAPs caused packet loss at times to run as high as 40%.[17] As the NAPs became increasingly congested, backbones began to find it advantageous to exchange traffic at private interconnection points.[18]

In addition, regional ISPs have begun to connect to more than one backbone, a practice known as *multihoming*, in part to protect against service outages and in part to limit their vulnerability to any exertion of market power by a backbone.[19] Regional ISPs that did not have sufficient volume to peer with the tier-1 backbones also began to find that they did have sufficient volume to peer with other regional ISPs, a practice known as *secondary peering*. Enabling regional ISPs to exchange traffic on a settlement-free basis reduced the costs borne by end users. In addition secondary peering would often shorten the number of hops needed for particular packets to reach their final destination and make them subject to bilateral (as opposed to multiparty) negotiations, both of which should increase networks' control over quality of service.[20] Secondary peering and multihoming also made the network more robust by creating multiple paths through which network nodes could interconnect. In fact, as much as seventy percent of the nodes in the Internet can now communicate with one another without passing through the public backbone.[21] This had the additional benefit of weakening the market position of the top-tier backbones, since any breakdown in the business relationship would not necessarily disconnect the ISP from the network and the ability to route along different paths places a natural limit on the backbones' ability to engage in supracompetitive pricing.[22]

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17. *See InterNAP Wakes Up Transmission Quality*, RED HERRING, Apr. 21, 1999, http://redherring.com/Home/1744; *see also* Kende, *supra* note 13, at 6 (citing reports that packet loss in the NAP located in Washington, D.C., ran as high as 20%).

18. Kende, *supra* note 13, at 6–7; Faratin et al., *supra* note 13, at 62.

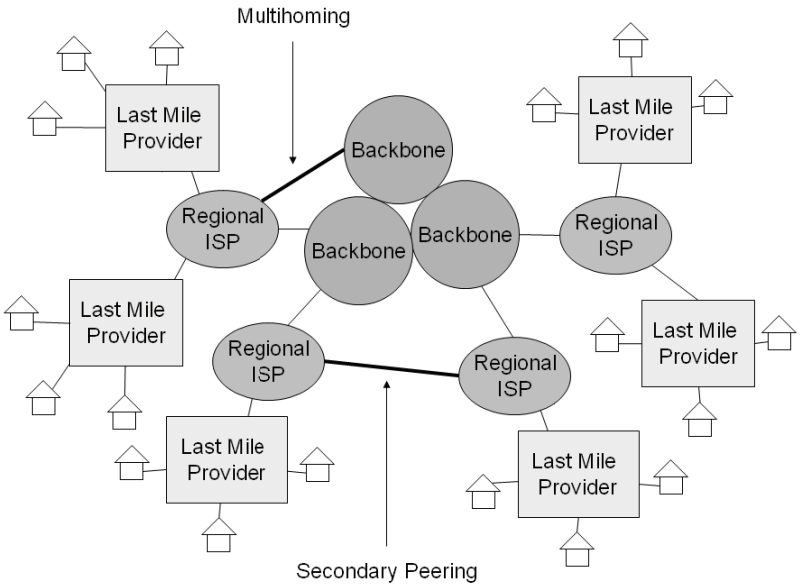
19. *See* Nicholas Economides, *"Net Neutrality," Non-Discrimination, and Digital Distribution of Content Through the Internet*, 4 I/S: J.L. & POL'Y FOR INFO. SOC'Y 209, 220 (2008).

20. *See* OECD, WORKING PARTY ON TELECOMMUNICATIONS AND INFORMATION SERVICES POLICIES, INTERNET TRAFFIC EXCHANGE: MARKET DEVELOPMENTS AND MEASUREMENT OF GROWTH 21–22 (2006), http://icttoolkit.infodev.org/en/Publication.3081.html; Faratin et al., *supra* note 13, at 55–56.

21. *See* Shai Carmi et al., *A Model of Internet Topology Using* k*-Shell Decomposition*, 104 PROC. NAT'L ACAD. SCI. 11,150, 11,151 (2007).

22. *See* Besen et al., *supra* note 12, at 294–95.

Figure 4: The Emergence of Multihoming and Secondary Peering



The emergence of interconnection relationships that deviate from the strict hierarchy that characterized the early Internet represents a substantial deviation from network neutrality. For example, assume that an end user is downloading content from both CNN.com and MSNBC.com. Assume further that the end user's regional ISP has a secondary peering relationship with the regional ISP serving CNN.com, but does not have a secondary peering relationship with the regional ISP serving MSNBC.com. The absence of a secondary peering relationship means that traffic from MSNBC.com will have to pay transit charges, while traffic from CNN.com will not. The result is that traffic that is functionally identical will end up paying different amounts. The differences in topology may also allow the traffic from CNN.com to maintain greater control over the quality of service.

The presence of multiple routes between these two points also complicates routing decisions. The presence of multiple paths connecting two points naturally means that someone must decide along which path to route the traffic. Although most networks choose routes that minimize the number of hops, networks may sometimes find it beneficial to route traffic in order to satisfy other requirements of their interconnection relationships. For example, a network may seek to enhance efficiency by balancing the loads between the two links. Multihomed entities can also monitor the quality of service provided by each connection and route the most delay-sensitive traffic along the link

with the lowest latency.[23]

In addition, transit contracts call for customers to pay a flat fee up to a predetermined peak volume (known as the committed rate) and pay additional charges for any volume that exceeds that level. For the same reason that consumers with two mobile telephones have the incentive to use up all of the prepaid minutes on both lines before incurring any additional per-minute charges, multihomed entities have the incentive to utilize all of their committed rate before paying additional fees. This lowers overall transit cost, but requires diverting some traffic along a path that is longer than the one stored in the routing tables.[24] For similar reasons, a network may intentionally route traffic over a more costly path if doing so will help it maintain its traffic within the ratios mandated by its peering contract.[25] Again, the effect is to introduce significant variance in the speed with which similarly situated packets will arrive at their destination and the cost that similarly situated packets will have to bear. This variance results not from anticompetitive motives, but rather from networks' attempts to minimize costs and ensure quality of service in the face of a network topology that is increasingly heterogeneous.

B. Server Farms and Content Delivery Networks

Large content providers have begun to employ other means to reduce cost and manage latency. One solution is to forego maintaining a single large server and instead to deploy multiple points of presence in carrier hotels across the country. Doing so allows these content providers to avoid paying transit charges to reach the public backbone and instead transmit their traffic through secondary peering arraignments with tier-2 ISPs. Greater reliance on private networks also gives the content providers greater control over network security and performance.[26] Indeed, a recent study indicates that Google, Yahoo!, and Microsoft have been able to use server farms to bypass the backbone altogether for roughly a third of their traffic and to keep their number of hops for traffic that had to pass through the backbone to no more than one or

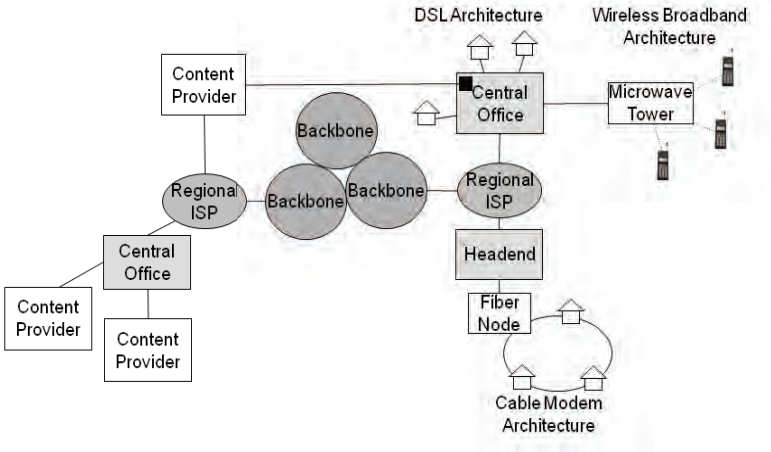
23. Fanglu Guo et al., *Experiences in Building a Multihoming Load Balancing System*, IEEE INFOCOM CONF., 2004, *available at* http://www.ieee-infocom.org/2004/Papers/26_4.PDF.

24. INTERNAP NETWORK SERVS. CORP., ECONOMICS OF MULTI-HOMING AND PREMISE-BASED OPTIMIZATION 10 (2008), *available at* http://internap.com/pdf/white-papers/WP_FCP_Economics_of_MultiHoming_0208.pdf.

25. Faratin et al., *supra* note 13, at 64–65.

26. *See* Stephanie N. Mehta, *Behold the Server Farm! Glorious Temple of the Information Age!*, FORTUNE, Aug. 1, 2006, *available at* http://money.cnn.com/magazines/fortune/fortune_archive/2006/08/07/8382587/index.htm; R. Scott Raynovich, *Google's Own Private Internet*, LIGHT READING, Sept. 20, 2005, http://www.lightreading.com/document.asp?doc_id=80968.

Figure 5: Caching and Content Delivery Networks



two.[27]

On other occasions, content providers are distributing their data through content delivery networks (CDNs) such as Akamai and Limelight. CDNs in effect substitute storage for long-distance networking capacity by maintaining a network of local caches across the Internet. When an end user sends a request for a webpage hosted by a CDN, that query is redirected to the cache. CDNs are thus able to use storage to serve multiple queries for the same content without using significant network resources. The geographic dispersion of the caches usually dictates that the file will be served by a location closer than would be possible if all of the content were stored in a central server, which minimizes cost and latency. The distributed nature of the caches also provides protection against denial of service attacks and allows the CDN to redirect queries to other caches when particular caches are overly congested.[28]

CDNs represent an innovative way to deal with the increasing complexity of the Internet. The problem is that they are nonneutral. CDNs work best for static content; they are less well suited to interactive content that changes dynamically. More to the point, CDNs are commercial services; thus greater reliability and quality of service are available only to those who are willing to pay for them.[29]

To the extent that CDNs use the public backbone to deliver the

27. *See* Phillippa Gill et al., *The Flattening Internet Topology: Natural Evolution, Unsightly Barnacles or Contrived Collapse?*, PASSIVE AND ACTIVE MEASUREMENT CONF. (2008), *available at* http://www.hpl.hp.com/techreports/2008/HPL-2008-47.pdf.

28. Yoo, *Economics of Congestion*, *supra* note 9, at 1872; Yoo, *Consumers and Innovation*, *supra* note 9, at 199, 214–15.

29. Yoo, *Economics of Congestion*, *supra* note 9, at 1882–83.

content to their caches, they are best regarded as an overlay to the existing network. Increasingly, however, CDNs and server farms are bypassing the public backbone altogether and connecting to their caches through private networks, in the process transforming CDNs into a fundamentally different architecture.[30]

All of these developments represent innovative solutions to adjust to the realities of the Internet. The differences in topology means that traffic that is otherwise similar may travel through the network at different speeds, with different costs, and with different levels of quality of service.

III. THE EVOLUTION OF BUSINESS RELATIONSHIPS

The evolution of the Internet has not been restricted to topology. Network participants have also been experimenting with an increasingly broad range of business arrangements. As I discuss in Section A, some of these innovations have been driven by the increasing significance of peer-to-peer technologies. Section B discusses the emergence of alternative business arrangements known as partial transit and paid peering.

A. The Growing Importance of Peer-to-Peer Architectures

One of the primary forces causing business relationships to change is the growing importance of applications using peer-to-peer technologies. The traditional Internet employed what is known as a client-server architecture, in which files are stored in large computers at centralized locations (servers) and end users (clients) request files from those computers. The relationship is generally regarded as hierarchical. In addition, the amount of data uploaded by clients is very small relative to the amount of data downloaded by servers. In the classic example of the World Wide Web, client traffic consists solely of uniform resource locators (URLs), the short bits of code identifying a particular website address. Server traffic, which consists of the data comprising the requested website, is much larger. For this reason, the technologies that took the early lead in broadband deployment (cable modem service and DSL) adapted an asymmetric architecture, allocating a larger proportion of the available bandwidth to downloading than to uploading. Newer technologies, such as fiber and wireless broadband, follow the same pattern.[31]

Peer-to-peer technologies follow a very different approach. Edge computers in a peer-to-peer architecture are not divided into those that

30. *See* Dave Clark et al., *Overlay Networks and the Future of the Internet*, 63 COMMC'NS & STRATEGIES 109, 123–25 (2006).

31. Yoo, *Consumers and Innovation*, *supra* note 9, at 191.

host files and those that request files. Instead, computers simultaneously perform both functions. Because this relationship is regarded as less hierarchical than client-server relationships, the computers in this architecture are known as *peers* and communications between them are known as *peer-to-peer*. Peer-to-peer is thus not synonymous with file sharing or user-generated content, as is often mistakenly assumed. On the contrary, many peer-to-peer applications (such as Vuze) support commercial broadcast services, and many platforms for user-generated content (such as YouTube) employ centralized servers. The real significance of the term peer-to-peer lies in the nature of the network architecture.

It is not yet clear what proportion of network traffic will follow each architecture. For example, peer-to-peer traffic had consistently outstripped client-server traffic for several years leading up to 2007. In 2007, however, client-server traffic staged a comeback, thanks primarily to the expansion of streaming video services like YouTube, and exceeded peer-to-peer traffic 45% to 37%.[32] Many industry observers now predict that although peer-to-peer will remain important, it will decline as a percentage of total Internet traffic over the next several years.[33] Even so, it is clear that peer-to-peer traffic is likely to remain a more important component of network traffic than it was during the Internet's early years.

The growing importance of peer-to-peer technologies is causing significant congestion in certain areas of the network and is putting pressure on the traditional approach to pricing network services. The emergence of end users as important sources of data is putting severe pressure on the limited bandwidth allocated to upload traffic. In addition, unlike in a client-server architecture, where end users usually only generate traffic when a person is seated at the keyboard, edge computers in a peer-to-peer architecture can generate traffic for as long as the computer is left running. The result is that the lion's share of upload traffic is generated by a small number of superheavy peer-to-peer users. As few as five percent of end users may be responsible for generating more than 50 percent of all Internet traffic.[34]

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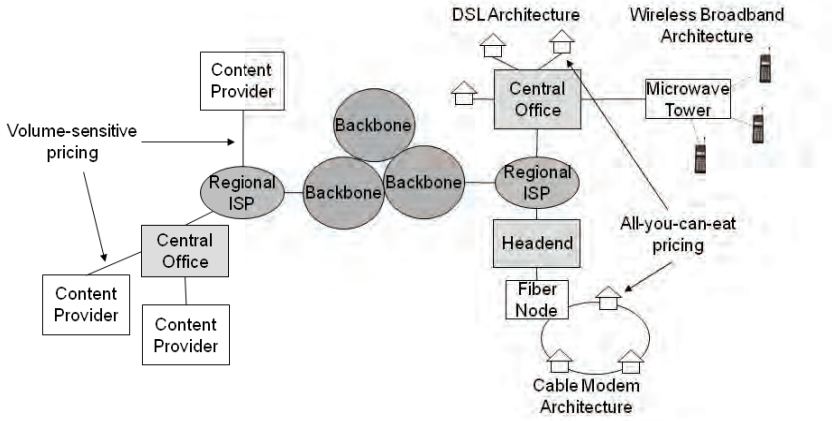
32. *See* Press Release, Ellacoya Networks, Inc, Ellacoya Data Shows Web Traffic Overtakes Peer-to-Peer (P2P) as Largest Percentage of Bandwidth on the Network (June 18, 2007), (on file with the author), *available at* http://www.ellacoya.com/news/pdf/2007/NXTcommEllacoyamediaalert.pdf.

33. CISCO SYS., INC., CISCO VISUAL NETWORKING INDEX: FORECAST AND METHODOLOGY 2008–2013, at 1–2, 5–6 (June 9, 2009), http://www.cisco.com/en/US/solutions/collateral/ns341/ns525/ns537/ns705/ns827/white_paper_c11-481360.pdf.

34. *See* Steven Levy, *Pay per Gig*, WASH. POST, Jan. 30, 2008, at D1; DAVID VORHAUS, YANKEE GROUP, CONFRONTING THE ALBATROSS OF P2P 1 (May 31, 2007); Comments of CTIA – The Wireless Association, in the *Petition to Establish Rules Governing Network Management Practices by Broadband Network Operators*, WC Docket No 07-52, 12 (Feb. 13,

Figure 6: The Traditional Approach to Internet Pricing



The most recent generation of peer-to-peer technologies can exacerbate congestion still further. In the first generation of peer-to-peer technologies, each end user stored the entirety of the files they hosted. As a result, anyone requesting those files was limited by the total bandwidth and the level of congestion associated with the network connection attached to that end user's computer. Technologies such as BitTorrent follow a different approach. Instead of storing entire files in one location, BitTorrent divides each file into pieces and distributes them at multiple locations around the Internet. When a BitTorrent user requests a file, the software then retrieves the various pieces from multiple computers at the same time. Reducing the amount of bandwidth required from any one peer improves download performance. BitTorrent also dynamically reallocates requests for pieces away from the slowest connections and toward the fastest connections, thereby placing the heaviest burden on those peers with the fastest connections.

The congestion caused by peer-to-peer technologies weighs heaviest on last-mile technologies that share bandwidth locally, such as cable-modem and wireless broadband systems. For example, cable modem technology requires that subscribers share bandwidth with the other households operating through the same neighborhood node. As a result, cable modem customers are significantly more vulnerable to the downloading habits of their immediate neighbors than are telephone-based broadband systems, which offer dedicated local connections.

2008), http://gullfoss2.fcc.gov/prod/ecfs/retrieve.cgi?native_or_pdf=pdf&*id*_document=6519841180.

Service can slow to a crawl if as few as fifteen of the five hundred or so users sharing the same node are using peer-to-peer applications to download files.[35]

The classic economic solution to congestion is to set the price of incremental network usage equal to the congestion costs imposed on the network by that usage. However, determining the congestion cost imposed by any particular user at any particular time can be quite complex. Subscribers that use large amounts of bandwidth can contribute very little to network congestion if they confine their usage to hours when network usage is low. Conversely, a subscriber that only uses small amounts of bandwidth may nonetheless impose significant congestion costs on the network if they generate traffic at peak times. The contribution of any particular usage cannot be determined simply by counting the number of bits being transmitted. The overall impact of any particular increase in network usage can only be determined in light of other subscribers' Internet usage.[36] Thus it may make sense to charge different amounts to users who are using the Internet to access the same content or application if a sufficient number of other users sharing the same bandwidth are using the network at the same time.

The growth of peer-to-peer technologies has also heightened the pressure on the models that network providers have used to price their services. As noted earlier, the traditional approach charges content and application providers prices that increase with the peak bandwidth consumed, while end users are charged on an unmetered, all-you-can-eat basis. The fact that every download had to pass through one link that charged on a volume-sensitive basis allowed this pricing approach to serve as a reasonable approximation of efficient congestion pricing. For example, one hundred downloads of a 700 megabyte movie would generate 70 gigabytes of traffic from the server, which in turn would be reflected in the price paid by the content provider to its ISP.

The situation is quite different under peer-to-peer architecture. In that case, the movie could be downloaded once from the server, and the remaining ninety-nine downloads could be served by other end users running the same peer-to-peer software. Because end users are provided with service on an all-you-can-eat basis, the additional ninety-nine downloads served by the peer-to-peer network do not generate any additional revenue. The only revenue received by the network is for the

35. *See* James J. Martin & James M. Westall, *Assessing the Impact of BitTorrent on DOCSIS Networks*, IEEE BROADNETS, Sept. 2007, *available at* http://people.clemson.edu/~jmarty/papers/bittorrentBroadnets.pdf; *see also* Leslie Ellis, *BitTorrent's Swarms Have a Deadly Bite on Broadband Nets*, MULTICHANNEL NEWS, May 8, 2006, http://www.multichannel.com/article/CA6332098.html.

36. Yoo, *Economics of Congestion*, *supra* note 9, at 1868–69.

initial 700 megabyte download. Thus, in a peer-to-peer architecture, the amounts that content providers pay under the traditional pricing regime no longer serve as a workable approximation of the total traffic they impose on the network. Moreover, the failure to charge network participants prices that reflect their incremental contribution to congestion causes excessive consumption of network resources that ultimately harms consumers.

It thus comes as no surprise that the network providers that are most subject to local congestion are experimenting with other means for managing the congestion caused by peer-to-peer applications. For example, Time Warner has recently experimented with bandwidth caps and other forms of metered pricing. Although many network neutrality proponents have no objection to metered pricing,[37] recent attempts to impose metered pricing and bandwidth caps have met such a hostile reaction from the network neutrality community that the network providers had to back down.[38] That said, metered pricing is far from a panacea. As I have discussed in greater detail, true congestion-based pricing would vary from moment to moment based on the volume of traffic introduced into the network by other users. Not only would such a pricing regime challenge consumers' ability to process the relevant information; the distributed nature of the Internet means that no one entity has the information needed to formulate such policies. As a result, other network providers have turned to proxies that are strongly associated with high-volume activity, which most importantly includes a ban on operating a server as required by peer-to-peer technologies.[39]

37. *Net Neutrality: Hearing Before the Senate Committee on Commerce, Science & Transportation*, 109th Cong 55, 58, 74 (2006) (statement of Prof. Lawrence Lessig), *available at* http://www.gpo.gov/fdsys/pkg/CHRG-109shrg605/pdf/CHRG-109shrg605.pdf; Tim Wu, *Network Neutrality, Broadband Discrimination*, 2 J. ON TELECOMM. & HIGH TECH. L. 141, 154 (2003).

38. For criticism of Time Warner's January 2008 attempt to impose metered pricing, see Catherine Holahan, *Time Warner's Pricing Paradox: Proposed Changes in the Cable Provider's Fees for Web Could Crimp Demand for Download Services and Hurt Net Innovation*, BUS. WK., Jan. 18, 2008, http://www.businessweek.com/technology/content/jan2008/tc20080118_598544.htm; Posting of Marvin Ammori to Save the Internet, Time Warner Goes Back to the Future, http://www.savetheinternet.com/archive/2008/01/25/back-to-the-future-time-warner-broadband-plan-recalls-aols-walled-garden/ (Jan. 25, 2008); Posting of Lynn Erskine to Save the Internet, Time Warner Metered Pricing: Not the Solution, http://www.savetheinternet.com/blog/2008/01/17/time-warner%e2%80%99s-metered-pricing-not-the-solution/ (Jan. 17, 2008); Posting of Fred von Lohmann to DeepLinks, Time Warner Puts a Meter on the Internet, http://www.eff.org/deeplinks/2008/01/time-warners-puts-meter-internet (Jan. 22, 2008). For criticism of Time Warner's January 2009 attempt to impose bandwidth caps, see Press Release, Free Press, Free Press Wary of Internet Caps (Feb. 4, 2009), http://www.freepress.net/node/47855; Press Release, Public Knowledge, Public Knowledge Statement on Time Warner Halt to Broadband Caps (Apr. 16, 2009), http://www.publicknowledge.org/node/2100.

39. Yoo, *Economics of Congestion*, *supra* note 9, at 1871.

Although this would constitute a violation of network neutrality by discriminating against a particular type of application, even network neutrality proponents acknowledge that such a restriction represents a good proxy for bandwidth-intensive activity.[40]

B. The Emergence of Partial Transit and Paid Peering

Network providers have also begun to enter into business relationships that go beyond peering and transit relationships that dominated the early Internet. Some are driven by the emergence of secondary peering relationships discussed above.[41] Before such relationships existed, a tier-2 or tier-3 ISP would have to buy transit from a tier-1 ISP that had obtained access to all of the IP addresses that it did not serve. In other words, a tier-2 or tier-3 ISP's transit relationships would cover the entire Internet (except for its own customers).

The advent of secondary peering reduces the scope of transit services that the ISP needs to purchase. In short, the ISP no longer needs to buy transit to the entire Internet. The secondary peering relationships already provide it with the ability to reach those customers served by its secondary peering partners. As a result, these ISPs have begun to purchase *partial transit* that covers less than the entire Internet (i.e., those portions of the Internet not already covered by its secondary peering relationships). In addition, an ISP with inbound traffic that far exceeds its outbound traffic may run the risk of having traffic ratios that put it in violation of its peering contract. Under these circumstances, it may attempt to cover its deficit in outbound traffic by selling partial transit contract that covers only outbound traffic, but not inbound traffic. Alternatively, it may reduce its inbound traffic by buying partial transit for inbound traffic.[42]

Another interesting development is the emergence of *paid peering*.[43] Paid peering involves all of the same aspects as conventional peering relationships. Peers announce to the rest of the Internet the addresses that their peering partners control, maintain a sufficient number of interconnection points across the country, and maintain the requisite total volume and traffic ratios. The key difference is that one peering

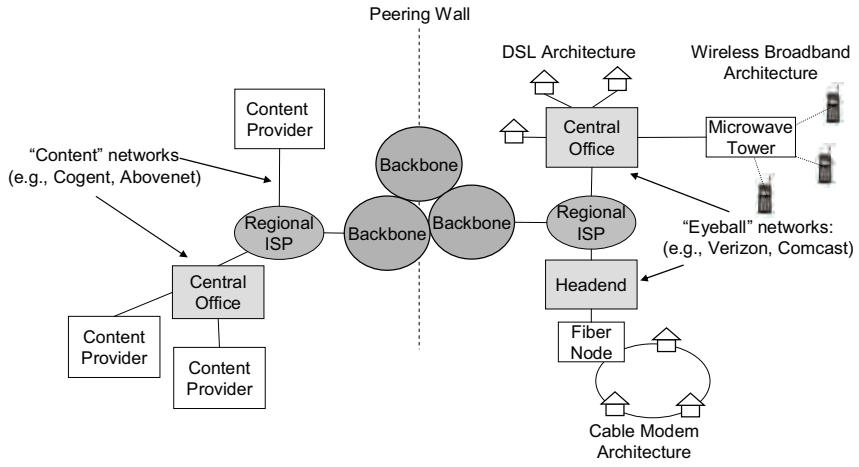
40. Brett M. Frischmann & Barbara van Schewick, *Network Neutrality and the Economics of the Information Superhighway: A Reply to Professor Yoo*, 47 JURIMETRICS J. 383, 409 (2007).

41. *See supra* Part II.A.

42. Faratin et al., *supra* note 13, at 60–61.

43. For earlier discussions, see Christopher S. Yoo, *Network Neutrality after* Comcast*: Toward a Case-by-Case Approach to Reasonable Network Management*, *in* NEW DIRECTIONS IN COMMUNICATIONS LAW AND POLICY: THE WAY FORWARD 55, 71–76 (Randolph J. May ed., 2009) [hereinafter Yoo, *Toward a Case-by-Case Approach*]; Yoo, *Consumers and Innovation*, *supra* note 9, at 222–27.

Figure 7: Paid Peering and the Economics of Two-Sided Markets



partner pays the other partner for its services.

Paid peering is driven by both supply-side and demand-side considerations. Starting first with the supply side, settlement-free peering arrangements between tier-1 ISPs with similar traffic volumes make sense only if both networks have similar costs. Over time, backbones have begun to serve two different types of last-mile networks: those that primarily serve content and application providers (such as Cogent and Abovenet), which some commentators call "content networks," and those that serve end users (such as Comcast and Verizon), which some commentators call "eyeball networks."[44] The costs of the first type of network (connecting content and application providers) are quite low, typically only requiring a single high-speed line to a small number of business locations. The costs of the second type of network (connecting end users) are considerably higher, requiring the wiring and upgrading of equipment in entire neighborhoods. The presence of such asymmetric costs provides a substantial impetus for cash to flow from networks serving content and application providers to networks providing connections to end users.[45]

These supply-side considerations are reinforced by demand-side considerations associated with the economics of two-sided markets, which illustrates the potential benefits of allowing network providers to charge differential prices to both end users and content and application providers.[46] Conventional economics has long recognized the existence of

44. *See* Faratin et al., *supra* note 13, at 58.
45. *See id.* at 58–59.
46. For a more technical discussion, see Yoo, *Consumers and Innovation*, *supra* note 9, at

"network economic effects," which cause a network to increase in value as the number of users connected to it increases. To use a classic example, the value of a telephone network to a particular consumer depends on more than just the services provided and the price charged, as is the case with most goods. It also depends on the number of other subscribers connected to the network. The more people you can reach through the network, the more valuable it becomes.

The benefits created by the network economic effect for telephone networks arise with respect to a single class of customers. When a market is two sided, instead of bringing together a single class of similarly situated users, networks bring together two completely different classes of users. In those cases, the value is determined not by the number of users of the same class, but rather the number of users of the other class. A classic example is broadcast television, which brings together two groups: viewers and advertisers. Advertisers gain no benefit (and if anything suffer a detriment) from belonging to a network with a large number of other advertisers. The value of the network for advertisers is instead determined solely by the number of viewers, i.e., the size of the other class of users.

The literature suggests that social welfare would be maximized if the network provider were permitted to price discriminate on both sides of the two-sided market. It also suggests that the prices paid by those on each side of the market can differ widely and that in many cases, it is economically beneficial for one side to subsidize the other side of the market. The fact that the Internet has become increasingly dominated by advertising revenue paid to content and application providers suggest that it may be socially beneficial for content and application providers to subsidize the prices paid by end users. An advertiser's willingness to pay for an ad on any particular website depends on the number of end users viewing that website. Under these circumstances, the optimal solution may be for the website owner to subsidize the total number of end users by making payments to the network provider to help defray their costs of connection. The costs of subsidizing more users would be more than offset by the additional revenue generated by the fact that advertisers can now reach more potential customers. In the case of broadband, this would be both economically efficient and would be a boon to consumers both in terms of providing service in more geographic areas and in reducing the prices that consumers pay.[47]

These dynamics are again well illustrated by broadcast television.[48] In many ways, broadcast television and the Internet are analogous. The

222–27.

47. *See id.* at 225–26.

48. *See* Yoo, *Toward a Case-by-Case Approach*, *supra* note 43, at 73–75.

movie studios that create television programs play a similar role to content and application providers. Television networks aggregate programs and deliver them nationally in much the same manner as content networks and backbone providers. Local broadcast stations provide last-mile connectivity that is quite similar to the role played by eyeball networks. In addition, the revenue structure is quite comparable, in that television networks receive advertising revenue in much the same manner as content and application providers. Furthermore, the cost structure is somewhat similar in that connecting individual homes is much more costly than distributing programming nationally.

For decades, the standard business arrangement has been for television networks to subsidize the operations of local broadcast stations by paying them to be members of their television networks. The industry's revenue and cost structure make such arrangements quite logical. The cost of paying these broadcast stations to affiliate with a network is more than offset by the increase in advertising revenue made possible by the fact that the network is now able to reach a larger audience. Broadcast television thus represents a prime example of when firms operating on one side of the market find it economically beneficial to subsidize end users on the other side of the market.

Furthermore, the magnitude of the affiliation fees that the networks pay to broadcast stations is anything but uniform. The precise amount varies with the relative strength of the network and the relative strength of the broadcast station. Stronger broadcast stations receive more, while weaker ones receive less. Equally interesting is the fact that in recent years, the cash flow has begun to vary in its direction as well as magnitude, with weaker stations having to pay rather than be paid to be part of the television network. The dynamic nature of this pricing regime benefits consumers by providing incentives for networks to invest in better quality programming and by providing an incentive for stations to provide better carriage.

The two-sided market analysis reveals the potential drawbacks of preventing network providers from charging differential prices. As a general matter, pricing flexibility makes it easier for network providers to recover the costs of building additional bandwidth. Granting network providers pricing flexibility with respect to content and application providers should reduce the percentage of the network costs borne by consumers. Conversely, preventing network providers from exercising pricing flexibility with respect to content and application providers would simply increase the proportion of the network costs that providers must recover directly from end users. This simultaneously raises the prices paid by consumers and decreases the likelihood that the capital improvements

will ever be built.[49] Charging content and application providers differential prices thus has the potential to increase social welfare and can reduce, not increase, the burden borne by consumers.

CONCLUSION

It is all too easy to forget that the Internet is not a monolith with a brooding omnipresence overseeing the entire system. Instead, it is a collection of autonomous systems that determines the terms of interconnection through a series of arms-length negotiations between individual networks. Given the Internet's essence as a network of networks, it should come as no surprise that no two packets will pay the same amount for the same service.

The developments that I have outlined in this article have made such differences even more likely. The network no longer adheres to the rigid and uniform hierarchy that characterized the early Internet and its predecessor, the NSFNET. Packets can now travel along radically different paths based on the topology of the portion of the network through which they travel. This is the inevitable result of reducing costs and experimenting with new structures. At the same time that network providers are experimenting with new topologies, they are also experimenting with new business relationships. Gone are the days when networks interconnected through peering and transit and imposed all-you-can eat pricing on all end users. That fairly simple and uniform set of contractual arrangements has been replaced by a much more complex set of business relationships that reflect creative solutions to an increasingly complex set of economic problems. Again, these differences mean that the service that any particular packet receives and the amount that it pays will vary with the business relationships between the networks through which it travels. Although many observers reflexively view such deviations from the status quo with suspicion, in many (if not most) cases, they represent nothing more than the natural evolution of a network trying to respond to an ever-growing diversity of customer demands. Imposing regulation that would thwart such developments threaten to increase costs and discourage investment in ways that ultimately work to the detriment of the consumers that such regulation is ostensibly designed to protect.

49. *See Wall Street's Perspective on Telecommunications: Hearing Before the S. Comm. on Commerce, Science, and Transportation*, 109th Cong. 13–16 (2006) (testimony of Craig E. Moffett, Vice President and Senior Analyst, Sanford C. Bernstein & Co.), *available at* http://www.gpo.gov/fdsys/pkg/CHRG-109shrg589/pdf/CHRG-109shrg589.pdf.