Testimony of

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Prepared Statement of
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Good morning Chairman Specter, Senator Leahy, and members of the Committee. My name is Vint Cerf, and I am currently Vice President and Chief Internet Evangelist with Google. Thank you for inviting me here today to discuss network neutrality and its importance for the future of the Internet.
Let me make clear from the outset that I am no antitrust expert. But I am one of the network engineers involved for many years in designing, implementing and standardizing the software protocols that underpin the Internet. And now, as my title suggests, some of my time is spent preaching the good news about the Internet's revolutionary impact on society and warning of the challenges it sometimes poses. My role today is to briefly outline how the Internet actually works, why that matters from a policy perspective, and how unchecked market power of the broadband carriers threatens the Net's very viability - and of the free and open marketplace which it represents.

As this Committee considers the future of U.S. antitrust laws as they relate to broadband networks and the Internet, it faces choices linked inexorably to important American values: consumer choice, market competition, economic opportunity, and technological innovation. The way we approach those policy choices will have a tremendous impact, for good or ill, on the ability of American companies
to compete effectively both here and around the world. I appreciate the opportunity to share some of my thoughts about the clear and present danger that confronts us: replacing the open and innovative Internet owned by the many, with a closed and proprietary system controlled by a few.

Among points I consider paramount:
? When the Internet first came to public attention around 1994, consumers accessed it primarily through dial-up services. This meant that consumers had a choice of literally scores of Internet Service Providers selected simply by dialing different telephone numbers. The
situation changed dramatically with the provision of broadband Internet access in which only two primary players have offered services: the telephone companies with Digital Subscriber Loop service and the television cable companies with their Cable Modem service.
? The Internet was designed to maximize user choice and innovation, which has led directly to
an explosion in benefits to consumers and businesses. A primary design goal was to make the network itself neutral with regard to the applications it supports. That is, the network is essentially unaware of the actual applications for which it is used. The users at the edges of the network essentially determine the uses to which the network is put. This is sometimes called the "End to End" principle of the network. This neutrality permits the decentralized
and open Internet we have come to expect. The resulting environment of "innovation without permission" meant, for example, that Tim Berners-Lee was not forced to seek permission from network owners before unveiling the software enabling the World Wide Web. This stands in sharp contrast to the traditional cable and telephony systems, where all control of the applications resides with the network operators.
? However, the Internet's design, by itself, cannot guarantee neutrality. Until last summer, the on-ramps to the Internet were governed by nondiscrimination safeguards, first put in place by the Federal Communications Commission over 25 years ago. These FCC safeguards precluded the underlying network providers from

discriminating against consumers' freedom to use the network and against application service providers some of whom might compete
with value-added applications offered by the network providers. These safeguards mirrored and reinforced the Internet's architectural neutral end-to-end principle. The Internet needs both elements working together in order to create an environment of neutrality: the Internet's
neutral architectural design, and legal and regulatory nondiscrimination safeguards applicable to the Internet's on-ramps.
? When the FCC removed its longstanding nondiscrimination safeguards applicable to the broadband carriers, the future of the Internet was put in real jeopardy. The broadband carriers now possess significant, unconstrained market power over the Net's on-ramps. The FCC's own figures show that phone and cable operators together control nearly 99 percent of the broadband market. Most American consumers today have few choices for broadband service.

Phone and cable operators compete directly in only half the market. The rest has either no broadband service at all or is served by at most one provider. There appears to be little nearterm prospect for meaningful competition from alternative providers and technologies.
? The carriers have both the ability and the stated desire to dictate how consumers and producers can utilize the on-ramps to the Internet. Their executives have made their
intentions clear: to artificially reduce access to capacity by creating big private pipes and small public pipes; to raise costs of application service providers (some of whom may be competing with the broadband carriers in providing value-added services to consumers) by "double-charging" for carrying traffic; and to leverage market power by unilaterally prioritizing packets on the Internet. Whether acting as a bottleneck, a toll-taker, or a gatekeeper, the broadband carriers propose to transform the Internet into something akin to a closed and proprietary system of centralized control.

For all these reasons, Google supports a tailored, minimally-intrusive net neutrality requirement in
law. As Congress creates new telecommunications legislation it must include necessary safeguards for consumers. It is time for Congress to act, by reinstating the long-standing nondiscrimination requirements for the on-ramps to the Internet.

I. Network Neutrality Has Been a Cornerstone of the Internet's Success I consider myself fortunate to have been involved in the earliest days of the invention and
development of this "network of networks." From that perspective, I can attest to how the actual design of the Internet - the way its digital hardware and software protocols, including the TCP/IP suite, were put together - led to its remarkable economic and social success.
My friend Professor Larry Lessig from Stanford Law School has written and spoken extensively about the notion that "Code is Law." In his view, the design, hardware and software of the Internet and its applications (the Code) regulate life in cyberspace generally. In short, he says, the Internet's code is its own natural law. I am a firm believer in that way of thinking. To understand this point, it may be helpful to look briefly at the Internet's virtual blueprints from four different vantage points: the Net's what, where, how, and why.

First, the layered nature of the Internet describes its overall structural architecture. The use of layering means that functional tasks are divided up and assigned to different architectural layers. This simple and flexible system creates a network of modular "building blocks," in which applications or protocols at higher layers can be developed or modified with no impact on lower layers, while lower layers can adopt new transmission and switching technologies without requiring changes to upper layers. The standardized interfaces between the layers create stability and confer a long-term ability to adapt to new technology and to support new applications. Reliance on a layered system greatly facilitates the unimpeded delivery of packets from one point to another.

Second, the end-to-end design principle describes where applications are implemented on the Internet. The Internet was designed to allow the implementation of applications to reside largely with users at the "edges" of the network, rather than in the core of the network itself. This is precisely the opposite of the traditional telephony and cable networks, where applications and content are managed
in the core (in headends and central offices), away from the users at the edge. The Internet's design places the power and functionality of the net in the hands of the end users (consumers, businesses and application service providers).

Third, the design of the Internet Protocol separates the underlying networks from the services that ride on top of them. IP was designed to be an open standard, so that anyone could use it to create new applications and new networks. By nature, IP is completely indifferent to both the underlying
physical networks, and to the countless applications and devices using those networks. As it turns out, IP quickly became the ubiquitous bearer protocol at the center of the Internet. Thus, using IP,individuals are free to create new and innovative applications that they know will work on the
network in predictable ways.

Finally, from these different yet interrelated design components, one can see the overarching rationale that no central gatekeeper should exert control over the Internet. This governing principle allows for vibrant user activity and creativity to occur at the network edges. In such an environment, entrepreneurs with new ideas for applications need not worry about getting permission for their inventions to reach end users. In essence, the Internet has become a platform for innovation. Again, closed networks like cable video systems provide a sharp contrast, where network owners control what consumers can see and do.

These perspectives suggest that Professor Lessig is correct - Code indeed is Law. And in this case, the very architecture of the Internet has engendered an environment of robust innovation without permission. The Internet has become the platform for business-to-business, business-to-consumer, and consumer-to-consumer data exchange. In particular, the nondiscriminatory neutrality of the Internet has supported the growth of thousands of small and medium-sized businesses, some of which grew up to become larger companies like Google, Yahoo, eBay, and Amazon. Google cares passionately about the future of the Net, not just for itself, but because of all the other potential
Googles out there, who in turn will spur the growth of online activity. And yet, the Internet's neutrality by itself cannot guarantee an open network and innovation without permission. There is another form of code -- the legal and regulatory environment -- that also governs whether and how users can access and utilize the Internet. It is not just the Code of neutrality, but also the Law of neutrality, that completes the equation of an open Internet.

II. Network Neutrality Has Been a Long-Standing Part of Our Nation's Telecommunications Laws

The commercial Internet did not simply burst forth from a vacuum. Its advent was aided by visionary U.S. policymakers who recognized that the government largely needed to get out of the way, and allow the free market to work its genius in this new online environment. Google firmly supports this
"unregulatory" approach towards the Internet. At the same time, that policy judgment rested on an existing regulatory framework that allowed open and nondiscriminatory access to the Internet. The Internet was originally built as a private network, utilizing dedicated facilities provided by
telecommunications carriers, as well as the public switched telephone network (PSTN) for end user access. The Net evolved into a public facility when the US Government authorized public and commercial access to the government-owned backbones (notably the Defense Department's
ARPANET and the National Science Foundation's NSFNET). By 1989, three commercial Internet service providers were in operation in the US. Users of these systems reached them either on dedicated facilities or through the PSTN. It cannot be stressed enough: the Internet has thrived because of an overarching regulatory framework mandating nondiscrimination. The underlying telecommunications network over which consumers access the Internet has rested on straightforward pro-competition safeguards that ensured openness.

Developed by the FCC over a decade before the commercial advent of the Internet, these safeguards required that the underlying monopoly providers of last-mile PSTN facilities - the incumbent local telephone companies - allow end users to choose any ISP, and utilize any device, they desired. In
turn, ISPs were allowed to purchase retail telecommunications services from the ILECs on
nondiscriminatory rates, terms, and conditions. One can think of these safeguards collectively as constituting a "Law of Nondiscrimination" governing the Internet's on-ramps
The somewhat paradoxical end result was a regulatory regime applied to underlying last-mile facilities that allowed the Internet itself to remain open and unregulated as designed. Indeed, it is hard to imagine the innovation and creativity of the commercial Internet in the 1990s ever occurring
without those minimal but necessary market safeguards already in place. A generation of entrepreneurs has been able to offer new applications and services to the world, without requiring advance approval from network operators,

or paying exorbitant carrier rents to ensure that their applications were even seen.

But perhaps no more. Last summer, the FCC decided to eliminate its nondiscrimination safeguards as applied to the broadband carriers. In doing so, the FCC ignored its own laudable heritage in protecting user interests, and its own empirical findings about the lack of meaningful competition in the broadband market. In one swift action, the FCC's longstanding Law of Nondiscrimination for the Net's on-ramps was stripped away. Perhaps the Internet's Code of neutrality is soon to follow.

III. Neutrality Is Threatened by the Unconstrained Market Power of Broadband Carriers

Were there sufficient competition among and between various broadband networks, the concerns of companies like Google, among many others, about the future of the Internet largely would be largely allayed. The Internet's design and architecture would continue to evolve as it should, in a robustly open and competitive environment. Unfortunately, the FCC's own figures demonstrate the significant degree of concentration in the broadband market.

In its April 2006 broadband deployment report, the FCC shows that incumbent cable and telephone company broadband services together control 99.5 percent of all consumer customers. This leaves only one half of one percent of the current market for alternative broadband networks using technologies such as wireless, satellite, and broadband over power lines (BPL). Surprisingly, the share of alternative networks has shrunken steadily, from 2.9 percent in December 1999 down to 0.5 percent today. Thus, any alternatives to DSL and cable modem service remain an infinitesimal, and still declining, part of the market.

The FCC's figures also demonstrate that the two dominant modalities compete only to a partial degree. In a 2004 analysis, the Commission reported that only 53 percent of Americans had a choice between cable modem service and DSL service. Of the remaining consumers, 28 percent had only one choice, and 19 percent had no choice at all. Thus, nearly half of all consumers lack meaningful choice in broadband providers.

To me, as a scientist, the question ultimately comes down to a matter of physics and economics. First, can alternative broadband networks be built, given the limitations of available network atoms and radio spectrum? Second, will such alternative networks be built, given the immense time and effort involved? Whether we are discussing BPL or WiMax or satellite, the prospect of a near-term, ubiquitous competing broadband platform does not appear promising.

In the absence of any meaningful competition in the consumer broadband market, and without the long-standing nondiscrimination safeguards that have governed last-mile facilities to date, one would expect carriers to have an economic incentive to control online activity. Not surprisingly, this incentive is already manifesting itself:

? Just last year, the FCC found that the Madison River Telephone Company was blocking ports used by its DSL customers to access competing VoIP services.

? Shaw Cable now charges a monthly $10.00 "quality of service enhancement fee" for those cable subscribers wishing to sign up for a competing VoIP service.

? Rogers Cable recently admitted employing "traffic shaping" technology that, unilaterally and without prior notice, gives lower priority to a customer's filesharing, podcasting, and video blogging applications.

? Executives at Deutsche Telekom and Telecom Italia have expressed a desire to levy "double charges" on Google and other Web-oriented companies.

? Entire countries such as Panama and Egypt have demanded that ISPs block all VoIP services as a means of protecting incumbent monopoly voice carriers.

Thus, as we move further into a broadband world, the Internet's openness is being threatened. Broadband carriers have every incentive to use their power over the Internet's on-ramps to block competitors, seek extra payments to "guarantee" that Internet content can be seen, and generally control consumer activity online.

IV. The Threat from Carrier Control and a "Two-Tier" Internet

With no safeguards to constrain them, some broadband carriers have publicly announced their intentions to substitute discrimination for the formerly neutral network service.

They seek to install a very different kind of code: one where the carriers themselves serve as the exclusive bottlenecks, toll takers, and gatekeepers leading to and from the Internet.

As I understand it, the fundamental objective of our nation's antitrust laws is to mitigate harm to consumers and to business competition resulting from the abuse of dominant market power. In words and in deeds, the broadband carriers already have demonstrated their intention to carry out various market power abuses. Through their proposed predatory behavior, the broadband carriers seek to exclude rivals by artificially reducing access to capacity (creating bottlenecks), raising rivals' costs (becoming toll takers), and leveraging market power into adjacent markets (establishing gatekeepers).

A. A Two-Tier Internet Gives Carriers Incentives to Create an Undesirable "Slow Lane" and a Fast Lane They Control

The broadband carriers claim that their IP video services will require substantial bandwidth that otherwise would be used by Internet applications. This will be accomplished by structurally bifurcating network traffic, creating two separate and unequal broadband connections to the home: a "big pipe" serving the carrier's private, proprietary network, and a "small pipe" left for access to the public Internet. The purpose here is clear: disadvantage any competing Internet-based voice services, video services, and other content and applications, by consigning them to the slow lane unless special payments are made to the broadband provider who can use these charges to raise rivals' costs or subsidize the cost of operating their own competing ervices. This provides an unfortunate example of how network design can serve anticompetitive interests, and shortchange consumers in the process.

Allowing segmentation of the broadband networks into capacious "broadest-band" toll lanes for some, and narrow dirt access roads for the rest, is contrary to the design and spirit behind the Internet, as well as our national competitive interests. And by definition, favoring some disfavors others. In an environment where consumers already have little to no choice of broadband providers, the end result is a cramped version of the robust and open environment we all take for granted today. Prioritization inevitably becomes a zero-sum game, and the carriers are allowed to create an artificial scarcity of content outlets.

B. Network Neutrality Will Not Prevent Carriers From Receiving Massive Revenues From Content Providers and Broadband Subscribers

In recent months senior executives of major U.S. carriers, as well as Deutsche Telecom and Telecom Italia, have indicated publicly that they intend to force competing Internet-based service and content providers to pay additional fees to be seen online. Why? Because according to these executives, Google and other network-based companies are merely "free riders" on the network who are "enjoying a free lunch." Further, any attempts to curtail their ability to collect these new fees, they claim, will remove their financial incentives to continue investing in broadband facilities.

The facts are all we need to dispel these accusations. First, they betray a fundamental misunderstanding of how the Internet actually operates. In the wireline telephone model, typically only one of the end users involved pays for the cost of transporting traffic. By contrast, in the Internet model, both users pay for access to the network, and then utilize that access any way they wish to view, interact with, or supply Internet applications and content. When the carriers seek to impose additional charges on Web companies, essentially they are trying to force-fit their preferred model onto the Net.

Second, broadband carriers are already richly compensated by their residential customers for their use of the network. These companies are free to charge their own customers whatever they want, in order to make back their investments. In fact, broadband subscribers paid over $20 billion in 2005 for access to the Internet. Of course, the primary reason why consumers spend all that money is to reach, without constraint, the rich and compelling content, applications, and services that Internet companies spend billions of dollars to create, develop, and deploy.

Third, Internet application companies already pay their fair share as well. Let us be clear: new carrier fees would constitute a new form of "double recovery." Internet-based companies initially spend billions of dollars annually on R&D to create and develop compelling content, applications, and services for American consumers, including news, data, video, music, gaming, and ecommerce services. This massive amount of material typically is deployed on hundreds of thousands of servers, which are located around the country. In order for the content and applications to be delivered into the Internet, so it can be made available to consumers, Internet-based service companies must

arrange with and pay network operators to: (1) carry the data traffic from company facilities to their servers over local telecom lines (the last mile); (2) carry the data traffic from the servers into the Internet over high-speed, high-capacity data lines (sometimes called "special access"); and (3) carry the data traffic over the numerous interconnected networks that make up the Internet backbone. Internet-based application companies collectively pay the carriers billions of dollars per year for all three types of network access and transport. In fact, the four Bell Companies alone collect over $14 billion annually in revenues from selling special access services to Web companies, ISPs, and other users of
the local data networks. FCC figures show that for these largely deregulated special access services, the four Bells enjoyed an average rate of return of over 50 percent.

In short, the broadband carriers will have every incentive to use market power to squeeze Internetbased companies to pay for more than just the network resources they actually use. Small businesses and entrepreneurs in particular will suffer enormously under such a scheme.

C. Without Net Neutrality, Carriers Will Seek To Leverage Their Market Power as
Gatekeepers to the Internet

The broadband carriers also have proposed a variety of ways to prioritize certain Internet traffic streams within their last-mile networks. Some plans involve creating a network-based means of optimizing the flow of preferred content and applications traffic, through practices such as caching content in local servers. Other plans include quality of service (QoS) guarantees, where the carriers
design a software-based means of optimizing certain traffic flows, usually in exchange for exclusive deals involving additional compensation.

In each case, carrier practices which prioritize some traffic inevitably degrade other traffic. Where packets are lined up in a carrier's network router for delivery, any action which moves a particular sequence of packets to the head of the queue has the effect of pushing back the other waiting packets.

If this packet prioritization is done merely to ensure the proper delivery of all latency-sensitive applications, such as streaming video, regardless of source, there should be no competitive issue. If, instead, priority is assigned based on financial or other preference, then the carriers have become the Internet's uninvited gatekeepers, leveraging their market power in anticompetitive ways.

The carriers claim a need to install network controls to protect customers against spam and other security threats, and to insure the quality of VoIP services. However, network neutrality need not prevent anyone - carriers or applications provider - from developing software solutions to remedy end user concerns such as privacy, security, and QoS. The issue arises where the network operator
decides to place the functionality in the physical or logical layers of the network, rather than in the application layer where they belong. Such a move is contrary to many of the fundamental architectural principles of the Internet. The end result is the forced insertion of a gatekeeper that -even arguably under the best of intentions - disrupts the open, decentralized platform of the Internet.

In addition, broadband capacity should not be nearly as constrained as the network owners would have us believe. Some applications, such as voice over IP, take up very little bandwidth. Other activities, such as multi-player real-time gaming or streaming video, may require more capacity.

However, such applications could be subject to additional customer charges, based on the access speeds required, as opposed to the source, destination, or content of the traffic. Indeed, it should be clear that charging consumers more for increased speed of access to the Internet is perfectly understandable and reasonable. What is at issue is interfering with consumer choice by limiting what
the consumer is permitted to do with the capacity the consumer has paid for.

V. Preserving the Internet's Inherent Neutrality

A. The Role of Competition Law

Absent significant, multiparty physical layer competition - which appears highly unlikely at this time - Google supports a tailored, minimally-intrusive, and enforceable network neutrality safeguard. An appropriate context for re-adopting consumer safeguards is in video franchising relief legislation.

Google in principle does not oppose such legislation, so long as consumer freedom of choice is preserved for Internet content and applications. The two concepts are inherently linked: the rights of broadband network providers and the rights of broadband network users.

The Senate Judiciary Committee has a clear role in this area. In passing the Telecommunications Act of 1996, Congress expressly recognized the continuing crucial part played by our nation's antitrust laws. As then-Chairman Thurmond indicated, "Application of the antitrust laws is the most reliable, time-tested means of ensuring that competition, and the innovation that it fosters, can flourish to benefit consumers and the economy."1 Senator Leahy observed at the time that "relying on antitrust
principles is vital to ensure that the free market will work to spur competition and reduce government involvement in the industry."

B. The Need for Competition Safeguards

While neutrality is the very stuff that holds the Internet together, nondiscrimination is the legal principle that preserves and protects it. Google believes that the Internet's code of neutrality must be reunited with the law of nondiscrimination that supports the modular, end-to-end nature of the Internet. The desired outcome is neutrality, based on the vehicle of nondiscrimination safeguards.

1 142 Cong. Rec. S687-01 (daily ed. February 1, 1996) (statement of Sen. Thurmond).
2 141 Cong. Rec. S18586-01 (daily ed. December 14, 1995) (statement of Sen. Leahy).

1. Do Not Block, Impair, or Degrade Traffic

The core concept of network neutrality is that broadband providers are prohibited from blocking, impairing, or degrading the consumer's ability to access content, run applications, or use devices in connection with the public Internet. These practices include the most blatant and easily-detected forms of discrimination. The best example is the Madison River case mentioned previously, where
the FCC sanctioned a DSL provider for blocking access to ports used by Vonage to carry VoIP traffic. Similar examples of "port blocking" are emerging internationally as well. All parties, including the incumbent broadband carriers, publicly decry these types of activities as contrary to fair
competition and consumer welfare. Thus, Google believes there should be no controversy over adopting this core concept in legislation, and putting it in place as actual antitrust standards, with violations enforced vigorously by federal authorities.

2. Do Not Prioritize Traffic in Discriminatory Ways

The second key element of network neutrality addresses the various ways that carriers seek to prioritize certain types of traffic. These concerns over prioritization have their roots in the fundamental concept of "reasonable nondiscrimination," or the concept that carriers should not discriminate unless they have an objectively rational reason (such as halting distributed denial-ofservice attacks, or reducing jitter). Of course, merely giving an advantage to one among many competitors is not an acceptable rationale. In Google's view, the essential formulation is that content transiting a carrier's broadband network may be prioritized only on the basis of the type of content and the level of bandwidth purchased by the consumer, and not the ownership, source, destination, of affiliation of the content.

C. The Impact of International Precedent

Finally, we would do well to heed important precedents developing in other countries - and avoid exporting the worst of our own as well. Whatever metric one uses, the United States lags behind other developed countries in the deployment and use of high-speed connections to the Internet. In fact, those countries ahead of the United States in broadband penetration employ regulatory frameworks designed to ensure that the companies in control of the pipes cannot interfere with consumers' access to unaffiliated content, applications, and services. By abandoning the principles that helped foster user choice and innovation, the United States risks falling further behind. The Judiciary Committee might find it of interest to investigate the decisions and practices of the regulatory bodies in the United Kingdom, the Netherlands and New Zealand, where open and nondiscriminatory access to broadband services is mandated by law.

The flip side of this international coin is that our nation runs the risk of exporting bad precedent overseas. Should the U.S. Government fail to reinstate nondiscrimination safeguards for the broadband market, American companies will face daunting obstacles overseas. Some foreign carriers already are looking at ways to extend their market power to

adjacent content and applications markets. The United States Congress needs to stand up unequivocally for the legal principle of nondiscrimination, both at home and overseas.

VII. Conclusion

The Internet has become an immense catalyst for economic growth and prosperity, in this country and around the world. However, our nation is risking the loss of that catalyst, just when the broadband era should be creating the most benefits for the most people. Allowing the interests of network owners wielding market power to shackle the Internet with discriminatory and anticompetitive conduct could severely undercut our nation's ability to compete effectively in the global market. In particular, millions of America's small businesses and entrepreneurs are the big losers in that skewed environment. We must do all we can to preserve the fundamental enabling principles of the Internet: user choice, innovation, and global competitiveness. We are relying on the Senate Judiciary Committee's thoughtful role in the continuing effort to maintain an open and innovating Internet in the United States and, by example, around the world.

Thank you.