

**Prepared Statement of
Vinton G. Cerf
Vice President and Chief Internet Evangelist
Google Inc.**

**U.S. Senate Committee on Commerce, Science, and Transportation
Hearing on
“Network Neutrality”**

February 7, 2006

Good morning Chairman Stevens, Senator Inouye, and members of the Committee. My name is Vint Cerf, and I am currently Vice President and Chief Internet Evangelist with Google. You may be more familiar with me for my work over the last few decades as one of the network engineers involved in devising the software protocols that underpin the Internet. Thank you for inviting me here today to discuss the important concept of network neutrality. As this Committee considers the future of U.S. communications law, it faces choices linked inexorably to important American values: consumer choice, economic opportunity, and technological innovation. In turn the way we approach those policy choices will have a tremendous impact on our ability as a nation to compete effectively on a global stage. In short, I appreciate the opportunity to share some of my thoughts about issues affecting nothing less than the future of the Internet.

I. Introduction and overview

The Internet’s open, neutral architecture has proven to be an enormous engine for market innovation, economic growth, social discourse, and the free flow of ideas. The remarkable success of the Internet can be traced to a few simple network principles – end-to-end design, layered architecture, and open standards -- which together give consumers choice and control over their online activities. This “neutral” network has supported an explosion of innovation at the edges of the network, and the growth of companies like Google, Yahoo, eBay, Amazon, and many others. Because the network is neutral, the creators of new Internet content and services need not seek permission from carriers or pay special fees to be seen online. As a result, we have seen an array of unpredictable new offerings – from Voice-over-IP to wireless home networks to blogging – that might never have evolved had central control of the network been required by design.

Allowing broadband carriers to control what people see and do online would fundamentally undermine the principles that have made the Internet such a success. For the foreseeable future most Americans will face little choice among broadband carriers. Enshrining a rule that permits carriers to discriminate in favor of certain kinds or sources of services would place those carriers in control of online activity. Allowing broadband carriers to reserve huge amounts of bandwidth for their own services will not give consumers the broadband Internet our country and economy need. Promoting an open and accessible Internet is critical for consumers. It is also critical to our nation’s competitiveness – in places like Japan, Korea, Singapore, and the United Kingdom, higher-bandwidth and *neutral* broadband platforms are unleashing waves of innovation that threaten to leave the U.S. further and further behind.

My testimony will explain briefly why network neutrality has been so important to the Internet's success and should be preserved. Among its key points:

- The Internet was designed to maximize user choice and innovation, which has led directly to an explosion in consumer benefits. The use of layered architecture, end-to-end design, and the ubiquitous Internet Protocol standard, together allow for the decentralized and open Internet that we have come to expect. This created an environment that did not require Tim Berners-Lee to seek permission from the network owners before unveiling a piece of software enabling the World Wide Web.
- Most American consumers today have few choices for broadband service. Phone and cable operators together control 98 percent of the broadband market, and only about half of consumers actually have a choice between even two providers. Unfortunately, there appears to be little near-term prospect for meaningful competition from alternative platforms. As a result, the incumbent broadband carriers are in position to dictate how consumers and producers can use the on-ramps to the Internet.
- A number of justifications have been created to support carrier control over consumer choices online; none stand up to scrutiny. Open-ended carrier discrimination is not needed to protect users from viruses, stop spam, preserve network integrity, make VOIP or video service work properly – or even insure that carriers are compensated for their broadband investments. In particular, we firmly believe that carriers will be able to set market prices for Internet access and be well-paid for their investments – as broadband carriers in other countries have successfully done.
- Even as we welcome the deregulation of our telecommunications system, we must preserve some limited elements of openness and non-discrimination that have long been part of our telecommunications law. In this regard, Google supports tailored, minimally-intrusive safeguards to promote net neutrality. Legislative approaches in both chambers have helpfully acknowledged the need for some form of net neutrality. We look forward to helping strengthen those provisions to provide the safeguards needed.

Google believes that consumer should be able to use the Internet connections that they pay for the way that they want. This principle – that users pick winners and losers in the Internet marketplace, not carriers – is an architectural and policy choice critical to innovation online. Google itself is a product of the Internet. We care passionately about the future of the Net, not just for ourselves, but because of all the other potential Googles out there. Indeed, we are not alone: Our concerns are shared by Internet companies, small businesses, end users, and consumer groups across the country. The vibrant ecosystem of innovation that lies at the heart of the Internet creates wealth and opportunity for millions of Americans. That ecosystem – based upon a neutral open network -- should be nourished and promoted.

Mr. Chairman, Google commends you and the members of this Committee for your thoughtful leadership and attention in this area, and we look forward to working closely with you in the weeks and months ahead.

II. The lasting lessons of the Internet

Some believe that the Internet was born and flourished out of a fortuitous accident, a random interaction of market forces and technology. But that simply is not the case.

The advent of the Internet took tremendous vision and initiative, by numerous network engineers, and software developers, and hardware vendors, and entrepreneurs. That advent also included 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 interactive, online environment. At the same time, as I will explain below, that policy judgment rested on an existing regulatory framework that allowed open and nondiscriminatory access to the Internet.

I was fortunate to be involved in the earliest days of the “network of networks.” From that experience, 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.

First, the layered nature of the Internet describes the “what,” or its overall structural architecture. The use of layering means that functional tasks are divided up and assigned to different software-based protocol layers. For example, the “physical” layers of the network govern how electrical signals are carried over a physical medium, such as copper wire or radio waves. The “transport” layers help route the user’s data packets to their correct destinations, while the application layers control how those packets are used by a consumer's email program, web browser, or other computer application. This simple and flexible system creates a network of modular “building blocks,” where 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. 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 the “where,” or the place for network functions to reside in the layered protocol stack. With the Internet, decisions were made to allow the control and intelligence functions to reside largely with users at the “edges” of the network, rather than in the core of the network itself. For example, it is the user’s choice what security to use for his or her communications, what VOIP system to use in assembling digital bits into voice communications, or what web browser to adopt. This is precisely the opposite of the traditional telephony and cable networks, where control over permitted applications is handled in the core (in headends and central offices), away from the users at the edge. As a result, the power and functionality of the Internet is left in the hands of the end users.

Third, the design of the Internet Protocol, or the “how,” allows for the separation of the 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 related design components, one can see the overarching rationale -- the “why” -- 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 need not worry about getting permission for their inventions will reach

the end users. In essence, the Internet has become a platform for innovation. One could think of it like the electric grid, where the ready availability of an open, standardized, and stable source of electricity allows anyone to build and use a myriad of different electric devices. This is a direct contrast to closed networks like the cable video system, where network owners control what the consumer can see and do.

In addition to this architectural design, the Internet has thrived because of an underlying regulatory framework that supported openness. Wisely, government has largely avoided regulating the Internet directly. Google firmly supports this deregulatory approach, which is supported by the openness and consumer choices available in this new medium. At the same time, the underlying network through which consumers access the Internet has rested on a telecommunications regulations that ensured openness – including a century’s-old tradition in American law that telephone companies are not allowed to tell consumers who they can call or what they can say.

In the zone of governmental noninterference surrounding the Internet, one crucial exception had been the nondiscrimination requirements for the so-called last mile. Developed by the FCC over a decade before the commercial advent of the Internet, these “Computer Inquiry” safeguards required that the underlying providers of last-mile network 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 local carriers on nondiscriminatory rates, terms, and conditions.

The end result was, paradoxically, a regulatory safeguard applied to last-mile facilities that allowed the Internet itself to remain open and “unregulated” as originally 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 safeguards already in place. By removing any possibility of ILEC barriers to entry, the FCC paved the way for an explosion in what some have called “innovation without permission.” A generation of innovators -- like Tim Berners-Lee with the World Wide Web, Yair Goldfinger with Instant Messaging, David Filo and Jerry Yang with Yahoo!, Jeff Bezos with Amazon, and Larry Page and Sergey Brin with Google – were able to offer new applications and services to the world, without needing permission from network operators or paying exorbitant carrier rents to ensure that their services were seen online. And we all have benefited enormously from their inventions.

III. The challenge posed by a concentrated broadband market

As we move to a broadband consumer network, the Internet’s openness is being threatened. Most consumers face few choices among broadband carriers, giving carriers tremendous market power. At the same time, the FCC has shown little willingness to extend the long-standing non-discrimination rules governing our telecommunications system to the incumbent broadband providers. As a result, carriers increasingly will have an economic incentive to use their power to block competitors, seek extra payments to ensure that Internet content can be seen, and generally control consumer activity online.

Were there sufficient competition among and between various broadband networks, Google’s concerns about the future of the Internet would largely be allayed. Unfortunately, the FCC’s own figures demonstrate the significant degree of concentration in the broadband market. In 2004, the Commission reported that only 53 percent of Americans have a choice between cable modem service and DSL service. Of the remaining consumers, 28 percent have only one choice, and 19 percent have no choice at all. Thus, nearly half of all consumers lack meaningful choice in broadband providers.

Moreover, the alternatives to DSL and cable modem service remain a very small part of the market. As of December 2004, the FCC's figures show that incumbent cable and telephone company broadband services together constitute 98.7 percent of the total market. This leaves only 1.3 percent of the current market for alternative broadband networks such as wireless, satellite, and BPL. Shockingly, the share of alternative networks has *shrunk* steadily, from 2.9 percent in December 1999. Thus, even the FCC's own figures demonstrate that there are only two dominant and only partially-competitive modalities – cable and telco -- and a tiny and declining share of third modalities.¹

To me, as a scientist, it comes down ultimately to questions of physics and economics. First, can such alternative 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 user safeguards that have governed similar last-mile competition to date, one would expect carriers to have an economic incentive – and the opportunity -- to control users' online activity. Not surprisingly, this incentive is already manifesting itself. Just last spring, the FCC found that the Madison River Telephone Company was blocking ports used by its DSL customers to access competing VoIP services.² Similar examples are emerging internationally as well. More revealingly, in recent months senior executives of major U.S. carriers have indicated publicly that they intend to force competing services and content providers to pay to be seen online.³ Together, these examples show that carrier discrimination is not a hypothetical concern.

IV. Debunking the ever-changing rationale for network discrimination

Recently, various justifications have been offered to explain why carriers need to limit the ability of end users to control their own connections to the Internet. For years many broadband carriers insisted that they would never discriminate against application providers, or limit their customers' access to the Internet. More recent arguments for carrier discrimination have included the need to insert network controls to protect their customers against spam and other security threats, or to insure the quality of VoIP services. Now they argue that their IP video services will require substantial bandwidth that otherwise would be used by Internet applications. They also have decided to look to

¹ AT&T CEO Ed Whitacre also has acknowledged the highly concentrated nature of the consumer broadband market. In a recent interview with Business Week, he noted that in the broadband space, "it's still about scale and scope. It's about owning the assets that connect customers. The assets that probably can't be duplicated except maybe by the cable companies." Certainly the FCC's numbers bear that out.

² Federal Communications Commission, In the Matter of Madison River Communications, LLC and affiliated companies, Order, File No. EB-05-IH-0110, adopted March 3, 2005.

³ Just three months ago, AT&T CEO Edward Whitacre observed that only telephone carriers and cable companies have broadband pipes to customers. He insisted that Google and other companies "use my lines for free, and that's bull." He then warned that "I ain't going to let them do that" because "there's going to have to be some mechanism for these people who use these pipes to pay for the portion they're using." *Rewired and Ready for Combat*, BUSINESS WEEK ONLINE, November 7, 2005; *Online Extra: At SBC, It's All About "Scale and Scope"*, BUSINESS WEEK ONLINE, November 7, 2005. As noted below, Mr. Whitacre's economic theories leave something to be desired.

applications providers such as Google to help pay for the expense involved in providing broadband networks - and that any attempts to curtail their network control will remove their incentives to continue investing. None of these justifications stands up under close scrutiny.

- Network neutrality need not prevent anyone – carriers or applications provider – from developing software solutions to remedy end user concerns such as privacy, security, and quality of service. 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. In particular, attempting to solve applications issues at the physical layer violates the layered, modular nature of the Net. With a few very narrowly-tailored exceptions – such as defending against network-level denial of service attacks or router attacks – altering or blocking packets within the network is inconsistent with the end-to-end design principle. The end result is the insertion of a gatekeeper that – even arguably under the best of intentions – disrupts the open, decentralized platform of the Internet.
- Broadband capacity is not 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) – but without discriminating based on who is providing the service.
- The broadband carriers already are fully compensated by their residential customers for their use of the network. These companies can charge their own customers whatever they want, in order to make back their investments. Trying to extract additional fees from Web-based companies – who are not in any way “customers” of the provider -- would constitute a form of “double recovery.” Google takes no issue with the broadband carriers’ ability to set prices for Internet access that compensate for the costs and risks associated with their network investments.
- Some carriers are also seeking permission to create two separate IP networks: one for the public Internet and one for a privately-managed, proprietary service. 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.
- Many seem to forget that the rationale for reduced regulation at the FCC was based in part on the promise that carriers would build robust broadband platforms to support the Internet. Turning away from those commitments would undermine the rationale for deregulation. Moreover, retaining some type of user safeguard that promotes an outcome of net neutrality would seem a small burden in the context of the immense deregulation that has happened, and likely will continue to happen, at the FCC.

Finally, we would do well to take important lessons from other countries. Whatever metric one uses, the United States lags behind other developed countries in the deployment and use of high-speed connections to the Internet. Ironically, many such countries employ the same principles of network openness and nondiscrimination that helped shape our own experience of the Internet. Certainly the

incumbent providers in those countries do not appear to suffer from any lack of incentives under those principles. For example, in the United Kingdom, British Telecom has agreed to split itself into a retail arm and a wholesale business, with a fundamental policy of nondiscriminatory treatment governing the relationship between them and other providers. In a number of Asian countries, both incumbent and competitive providers operating in an unbundled environment sell huge amounts of bandwidth – 100 Megabits or more per second -- at a fraction of U.S. prices. By abandoning the principles that helped foster user choice and innovation, the United States risks falling further behind in the global economy.

V. Preserving neutrality in our telecommunications law

Even as we welcome the deregulation of our telecommunications system, we should preserve some limited elements of openness and non-discrimination that have long been part of our telecommunications law. Absent real physical layer competition, Google supports a tailored, minimally-intrusive, and enforceable network neutrality rule.

Congress now is considering possible legislation in this area. We are gratified that legislative approaches in both chambers recognize the need for some form of network neutrality safeguards to protect the interests of Internet users in a concentrated broadband market. Unfortunately they do not go far enough towards creating enforceable protections against carrier interference with consumer choices.⁴ Allowing broadband carriers to discriminate in favor of certain kinds of services, and to potentially interfere with others, would take control away from the end users of the Internet, and place it in the hands of those who own the network. The current draft bills take a step in the right direction, but ultimately do not go far enough to preserve the vibrant innovation at the edge of the Internet. Our concerns are shared by Internet companies, small businesses, Internet end users, and consumer groups across the country.

As Congress and the FCC consider these issues, we should establish our end goal with as much clarity as possible, and then work back from there to develop an optimal mechanism for achieving that goal. In this context, we favor an environment much like the one that gave birth to the Internet: where end users can engage in activities such as running applications, employing devices, and accessing content, unfettered by the provider of the underlying network connection. Such an environment is best engendered by retaining a public policy framework that reflects the modular, end-to-end, and open nature of the Internet.

The best long-term answer to this problem is significantly more broadband competition. Ideally, physical layer problems merit physical layer solutions. While the prospects for such “intermodal” competition remain dim for the foreseeable future, Congress should ensure that the FCC has all the tools it needs to maximize the chances for long-term success in this area.

⁴ Last July, Senator Ensign introduced S.1504, the “Broadband Investment and Consumer Choice Act of 2005.” While the focus is on establishing streamlined nationwide video franchises, the bill also contains language concerning consumer access to the Internet. In September 2005, House Commerce Committee Chairman Barton issued a draft bill, widely known as “BITS I.” A revised version, “BITS II,” was released in November. Both drafts include provisions requiring broadband providers to allow consumers to access content, applications, and services, and to connect devices. Both versions also contain a number of important exceptions to those duties, related to elements like value-added services and enhanced quality of service. Unfortunately, as written the exceptions in each of these bills are so broad that they undermine the underlying neutrality requirement.

We must stress here that finding a straightforward, minimally-intrusive safeguard need not deny the network operators the ability to recover their investments, and the proper incentives to further deploy their networks. In a very real way, content and application companies like Google need the high-speed access provided by broadband carriers, just as they need the attractive new Internet offerings to drive demand for that access. It is in our collective best interest for the United States to have the best broadband capabilities in the world, bar none. The prospects for continued American ingenuity and entrepreneurship deserve nothing less.

VI. 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 to shackle the Internet could severely undercut our nation's ability to compete effectively in the global market. We must do all we can to preserve the fundamental enabling principles of the Internet: user choice, innovation, and global competitiveness.

Google looks forward to working with this Committee to fashion carefully-tailored legislative language that protects the legitimate interests of America's Internet users. And that includes the future interests of the next Google, just waiting to be born in someone's dorm room or garage.

Thank you.