Testimony of
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Hearing on Net Neutrality
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Mr. Chairman, Members of the Committee:

Thank you for the opportunity to testify today. With respect to the issue of net neutrality, some have said that the future of the Internet is at stake. We in Internet2 would agree, but might go further. The future of American innovation and competitiveness is also at stake. To compete in the world, we need a simple, inexpensive, and open network, not a costly, complex, and balkanized one.

Who we are. Internet2 is a not-for-profit partnership of 208 universities, 70 companies, and 51 affiliated organizations, including some federal agencies and laboratories. Our mission is to advance the state of the Internet, and we do that primarily by operating for our members a very advanced, private, ultra-high-speed research and education network called Abilene that enables millions of researchers, faculty, students and staff to "live in the future" of advanced broadband. By providing very high speed pipes – 10,000 times faster than home broadband, in our backbone – we enable our members to try new uses of the network, develop new applications, experiment with new forms of communications, experiencing today what we hope the rest of America will be able to have and use in just a few years.

Today on our campuses students are able to take master music classes with world-renowned musicians via DVD-quality video conferencing technology. Recently, students at Wichita State were able to play and take lessons from the New World Symphony in Miami using Internet2's network. The fidelity of the audio and video is so fine-tuned, it is as if the teacher and the student are in the same room, able to discuss details about playing technique and musical phrasing. Famed oceanographer Bob Ballard is able to take elementary school children on undersea expeditions using Internet2's network. They can have a 2-way video conversation with an underwater diver in real time from any connected school in the country – imagine the lasting impression this must have – especially for those who may never have experienced the ocean firsthand.

We have a very strong interest in the current telecommunications reform discussion that is unfolding here in the Congress: we have seen an Internet future that is possible for this country and we know that the rules and incentives that you are considering could have an enormous and lasting impact upon the kind of Internet we will actually achieve.

Importance of Net Neutrality. If we lose the open Internet, the Internet controlled by users, the Internet that allows innovation and entrepreneurial investment, we will lose something very important to our economic well-being.

Our experience working with advanced networks dictates that we support an open Internet where the network operator does not block or degrade content or applications. Users should be able to decide how much bandwidth to buy from the network operators – a little or a lot—but once they've paid for the bandwidth, they should be able to go to any web page, use any lawful application or service, and send any lawful content. As network managers ourselves, we understand the need to be concerned with security attacks, spam, and overall congestion – but these should not be used as excuses to discriminate.

We also understand that the "net neutrality" issue goes deeper than just blocking a web page or a Voice over IP application. If a network operator starts to give preference to packets from one source (that perhaps pays the operator for preference), what happens to all of the other, ordinary packets? We know that when an ambulance or fire truck comes down a congested highway, everybody else has to pull over and stop. For emergencies, and for public safety, that is accepted, but what if UPS trucks had the same preference? Giving a preference to the packets of some potentially degrades the transport for everyone else.

In addition, if economic toll booths are allowed for content and applications to access the Internet, then soon only the richest content providers will be able to make their material available. What happens to the little guy, the start-up, the entrepreneur? If charging content providers to carry their bits to local customers had existed ten years ago, we would never have seen Amazon, e-Bay, or Google. As start-ups they could never have afforded the tolls that telephone companies today are imagining.

Our experience. Having deployed an advanced broadband network to over five million users for some seven years now, we at Internet2 believe our experience will interest Congress as you consider important telecommunications legislation.

We are aware that some providers argue against net neutrality, saying that they must give priority to certain kinds of Internet bits, such as video, in order to assure a high quality experience for their customer. Others argue that they want to use such discrimination among bits as a basis for a business model. Let me tell you about our experience at Internet.

When we first began to deploy our Abilene network, our engineers started with the assumption that we should find technical ways of prioritizing certain kinds of bits, such as streaming video, or video conferencing, in order to assure that they arrive without delay. For a number of years, we seriously explored various "quality of service" schemes, including having our engineers convene a Quality of Service Working Group. As it developed, though, all of our research and practical experience supported the conclusion that it was far more cost effective to simply provide more bandwidth. With enough bandwidth in the network, there is no congestion and video bits do not need preferential treatment. All of the bits arrive fast enough, even if intermingled.

Today our Abilene network does not give preferential treatment to anyone's bits, but our users routinely experiment with streaming HDTV, hold thousands of high quality two-way video

conferences simultaneously, and transfer huge files of scientific data around the globe without loss of packets.

We would argue that rather than introduce additional complexity into the network fabric, and additional costs to implement these prioritizing techniques, the telecom providers should focus on providing Americans with an abundance of bandwidth – and the quality problems will take care of themselves.

For example, if a provider simply brought a gigabit Ethernet connection to your home, you could connect that to your home computer with only a $15 card. If the provider insists on dividing up that bandwidth into various separate pipes for telephone and video and internet, the resulting set top box might cost as much as $150. Simple is cheaper. Complex is costly.

A simple design is not only less expensive: it enables and encourages innovation.

The design of the Internet. The original Internet grew so fast, and spurred so many new uses, in part because of the way it was designed. It was designed to have an agnostic, neutral "core" whose job was to pass packets back and forth – and not to discriminate or examine the packets themselves. This allowed the network to be very cost efficient and economical. It also allowed all of the "intelligence" in the network to be at the "edge," that is, in the hands of the user.

This was very important to the evolution of the Internet. The network provider did not have control, the user did. As long as the user utilized the standardized protocols, he could expect to send and receive packets to anyone else on the network in a completely understandable, predictable manner. That allowed the user to experiment with new programs, new applications, slightly tweaked applications, and even new devices – and the user would know that the network would treat the packets all exactly alike.

Innovation was possible and could happen very quickly at "the edge" because you didn't have to re-architect or re-build the entire network in order to make a tweak or improvement in an end-user technology (such as improving a web search engine or developing a new video encoding program).

As a result of this remarkable design, sometimes called "end-to-end architecture," an explosion of new Internet technologies were developed over the past decade, many of them on university campuses or by recent graduates. The World Wide Web, the Web browser, the search engine, instant messaging, and many other technologies were innovations by users of the network. Not one of these innovations was developed by telephone or cable companies.

The future of the Internet. The faculty and staff and students at Internet2 universities are experimenting with the next generation of the Internet today. If we do this telecommunications reform right, it could unleash another wave of new uses, new applications, money-saving innovations, and economy-driving benefits.

We believe that Americans are going to need, and want, significant increases in broadband speeds over the next two decades (just as they have experienced increased computer processing

speeds and ever-expanding computer memory). At Internet2 universities today, we routinely provide 100 megabits per second to the desktop, and many of our schools offer 1000 megabit (1 gigabit) per second connections to their faculty and students. We have done so using commercially available, open-standards technology and our traffic flows on the very same fiber used by today's Internet service providers. Today's typical home broadband connection – which admittedly is a big step up from dial-up – is only about 1 megabit. So the goal of broadband legislation should be to encourage ever-increasing bandwidth.

We would like to see Congress set a national goal of 100 megabits of symmetrical bandwidth, meaning the same speed for both uploaded and downloaded content, to every home and business and school in America in five years – and a gigabit (1000 megabits) in ten years. This is absolutely doable using coaxial cable and fiber to the home. That would allow plenty of bandwidth for telephone, video, email, and many other uses – and enable brand new uses that we cannot even imagine today.

It does not cost all that much, relatively, to upgrade a network once the basic wiring is in place – that's the big original cost. For example, a university campus in the Midwest that serves 14,000 students and faculty, recently estimated it would cost about $150 per port (per end user) to replicate their current 100 Mbps network for a five year period, or about $30 a year per user. To upgrade to 1000 Mbps (1 gigabit) it would cost $250, or about $50 per year. University campuses are like small towns or suburban neighborhoods. Once cable companies and companies like Verizon make their initial fiber investment, the relative cost of upgrading bandwidth to customers is small.

What will that kind of high-speed Internet provide?

You will be able to transfer electronic health records that include X-rays and body scan data in seconds, rather than the hours it takes on today's broadband networks. It will be possible to monitor patients at home, remotely, both improving health care quality and reducing costs: a recent study concluded that we could save over $800 billion over 20 years using home medical monitoring technologies. A Veterans Administration study showed you could cut hospital stays in half for many patients – and yet monitor and watch over them for longer periods of time.

With DVD-quality two-way video-conferencing, patients will be able to consult with their doctors, parents will be able to confer with teachers, rural schools will be able to deliver Advanced Placement courses to their students, and families will be able to stay close no matter how much distance separates them. Students will be able to search the Library of Congress from their homes, and form study groups with friends around the world.

Telework and tele-commuting will finally be realistic for workers who need the ability to see and talk to their colleagues and transfer large quantities of data; this ability to reconstitute work at home will not only save employers money, and reduce oil consumption and traffic congestion, but also make Federal agencies more resilient to disaster or attack.

Our foreign competitors. We believe that these new high-speed networks will unleash a huge new wave of American innovation – new uses, new products, new services, new jobs, and new

wealth. But we have to be honest: the first time around, America was alone in developing the Internet and we exported our success to the rest of the world. We were the leaders. This time the rest of the world is aggressively working to be ahead of us – and in many cases is ahead of us. We cannot assume that the next wave of economic benefits, spurred by this technology, will be American. Our international competitors are adopting high bandwidth, open, simple, low cost designs for their networks. We are the only nation looking at making the network more, rather than less, complex and expensive. We at Internet2 feel this is the wrong choice.

For example, just this past week it was announced that Vienna, Austria, plans to bring fiber to all of its 960,000 households and 70,000 small and midsize businesses through a collaboration by the city, a power provider, and a cable company. They will offer their citizens one gigabit of symmetrical bandwidth. They emphasize that the network will be an open access platform for all service providers under equal conditions. Access will not be limited to classic Internet service providers but also offered to other services such as, for example, the health sector.

Already, consumers can now get 100 megabits to their homes in Hong Kong for $49 a month, and a gigabit for $200. Japan has a goal of bringing fiber to every home this year or next. South Korea, Europe and Canada all have ambitious plans that put them and their people on the "path to a gigabit" in the coming decade.

Some critics make the point that many of these places have very dense populations, making it easier to deploy big broadband. That may be true, but why have we not done it in New York, in Chicago, in Boston, in San Francisco?

Again, our research and experience shows that if the broadband pipe is large enough, you do not need to discriminate in favor of some of the bits. A cost-effective, simple network can provide as high a quality experience for the user as a more complex, costly, partitioned network.

MIT is pioneering a move to put all of its course content – written materials, multi-media, videos of lectures and more – onto the Internet for free distribution to the world. It is an experiment, but a bold one that could have transformative impact upon those who might never be able to see the inside of a college classroom. Stanford University is making the audio from class lectures available on the Web. The Library of Congress is working on projects to make rare materials available over the Internet. Should MIT or Stanford or the Library of Congress now have to pay Verizon and AT&T, Comcast and Cox, and all of the other local network providers to allow Americans access to this material? Other nations are not putting up toll booths, why should we?

We in the Internet2 community have a keen interest in this upcoming legislation and we hope that you will protect the integrity of the Internet architecture that has given our nation so much benefit. Net neutrality is an important component of that design. Keeping network design open, inexpensive, and simple is better than costly, complex, and closed. If you do, we believe you will be enabling another amazing wave of innovation and growth. We know, because we have seen part of that future. Thank you for your consideration.