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IMPROVING BROADBAND INNOVATION
AND INVESTMENT

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PARTICIPANTS:

Moderator:

DARRELL M. WEST
Vice President and Director, Governance Studies
The Brookings Institution

Panelists:

JOHN HORRIGAN
Consumer Research Director, Omnibus Broadband Initiative
Federal Communications Commission

ROBERT SHAPIRO
Chairman, Sonecon, LLC

THOMAS Z. FREEDMAN
President, Freedman Consulting, LLC

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PROCEEDINGS

MR. WEST: Good afternoon. We will get started now. I am Darrell West. I'm vice president and director of governance studies at Brookings, and I would like to welcome you to this forum on improving broadband innovation and investment.

Broadband and wireless technologies represent key elements of our nation's infrastructure, and people are used to thinking about infrastructure in terms of highways, bridges, and dams. And I want to make the point that it's important to understand that digital infrastructure is as important as the physical variety. You know, just as we need a strong interstate highway system and viable mass transit, we also need accessible and affordable broadband so that businesses and consumers can reap the benefits of digital technology because we all know that digital technology is key to international competitiveness as well as long-term economic development. So we really need to focus a lot of effort on this area.

And many of you, I'm sure, know that the Federal Communications Commission recently put out a report estimating that it will require \$350 billion to require universal and high-speed broadband coverage in the United States. But yet, when you look at the public investment that was authorized as part of this year's economic stimulus package, in the broadband area it was only \$7.2 billion. So, you can do the arithmetic. It certainly raises a lot of interesting questions in terms of the gap between our

aspirations in terms of what we would like to do in this area versus the reality of current public funding.

And so what we want to do today is look at a variety of different questions in terms of the future of broadband, in terms of how do we pay for our infrastructure development? How do we improve adoption levels so that we can get better economies of scale in this area? How do we bring affordable broadband to more Americans? How can we identify innovative applications that will engage citizens and businesses?

Now, in order to examine the opportunities facing us, we have assembled a distinguished panel of experts to discuss broadband innovation and investment. On my far right is Thomas Z. Freedman. Tom is the president of Freedman Consulting. He also is the author of a very interesting report entitled *A Kindle in Every Backpack: A Proposal for e Textbooks in American Schools*, and he'll be talking about that in a minute.

To my immediate right is Robert Shapiro, not the lawyer of O.J. fame, but the other Robert Shapiro of technology fame as well as other areas of expertise. Rob is a senior policy fellow at the Georgetown Center for Business and Public Policy and also the president of Sonecon, LLC. And he wrote -- he coauthored a report recently entitled *Toward Universal Broadband: Flexible Broadband Pricing and the Digital Divide*, and so he will be talking about that as well.

To my left is John Horrigan whose current position is consumer research director of the Omnibus Broadband Initiative of the Federal Communications Commission. And in his prior life, before he joined

the administration, John directed surveys at the Pew Internet & American Life Project on broadband adoption as well as other topics, and really is one of our country's leading experts on the consumer behavior part of broadband.

So, I'd like to start the conversation with Tom. I mean, as I had mentioned before, you developed this very interesting proposal asking the government to provide each of our nation's 56 million K-12 students with electronic reading devices, and it's an interesting way to think about using technology to improve education. So, I just wonder if you could explain, first of all, how this plan would work and why would this help students?

MR. FREEDMAN: Great. And thanks for hosting us. I appreciate the chance to talk about the paper and these really, really important issues today. And I think the easiest way to answer it is to sort of give a brief overview of what the paper's theory is and why we wrote it and then sort of go to some of the issues that I think are underlying it that may actually cross--cut across this panel about how we use these kind of policy-solving tools in an Internet and digital broadband age.

And I guess I'd start with a couple of caveats that the idea was to try and write a provocative paper saying how can we use this technology in an intelligent way? We already see in our education system that ad hoc things are being -- the technology is being used bit by bit, and I wanted to try to think about it from a national, kind of federal point of view. If you were going to make policy in this area, what would be a way to look down the field 20 yards and 50 yards and think how would you actually implement it? And

my mother, who's been an educator for 30 years, is very forceful in pointing out that I think we really need a dialogue with educators to make sure that we're using this in an intelligent way and it's not a substitute for all the other education reforms that we really need to make in order to succeed.

But broadly put, I think there's a set of benefits that would accrue to us educationally and in terms of governmental efficiency if we see it as a coherent implementation problem. On the benefit side, the technology obviously offers incredible opportunities to update materials in a much more rapid and appropriate way. When you're looking at one state where the average textbooks in their libraries were from 1986 and the opportunity you have with whatever type of device that eventually gets adopted in schools is to make that a much, much more prompt availability of materials. Second is that it makes it possible for teachers to tweak their textbooks and to utilize materials from a broad array of sources and to really put together something that's custom built for the way they want to teach. And finally, that it's really helpful for students who are using this kind of technology a lot in their own personal lives and are quite familiar with it, and it's a lot more interesting and exciting to them. And we site some public polling about how they react to using this.

I should say that shortly after I wrote the paper, a number of companies that are active and involved in this field sent us information about the devices that they've been creating. And we used Kindle as just an example of the type of technology that will be used going forward. And I think it was Intel that came forward and they had a kind of clamshell laptop

that you could bang on a table, you could pour a soda on, you could read like a Kindle, you could make notes on with a pen, and also had a camera that you could do mash-ups and other things with. And they said one of the first field trips that students took with it, the director of the museum took them aside and said this was a failure. The students spent all their time sketching and drawing from the museum into their laptops and they weren't looking around enough. When the teachers came back, the students had created on their own a number of projects integrating video and their drawings. And they had taken pictures of the text in the museums and it was exactly how you would want a creative, interested, engaged student to behave. They had taken the material from the trip and were using a whole number of different things to try and understand it and enjoy it as part of their learning.

The second, you know, issue that we mentioned, the paper is the cost factor. And I think this is, again, I'm sitting next to an economist who I've worked with, you could spin it a number of ways. And it's obviously a lot of projections here about where the costs will go, but it's a reasonable assumption in this field that the more people and the bigger the market here, the more there will be producers trying to service it, and, over time, the product's price will probably go down.

In the analysis that we did, we said that after about four years of implementation, we think you would reach a point where you start to make money. You have to actually get the capital cost of the devices into people's hands, but after about halfway through the process, we would imagine you would start to actually have some real cost savings. There are a number of

factors you have to count in there, including not only the cost of the technology, but also the cost of the textbooks and what happens in that industry.

I think the last thing I'd like to talk about is I think a broader question for people. We've all worked in the administration at one time or the other. There's going to be a number of times where we're going to confront this opportunity to use technology to try and solve a public policy problem. And this case, I think, has many of the same symptoms that we're going to have over and over again in that the technology is constantly going to be evolving and there's going to be a temptation for policymakers to say, well, we should just wait and see where it ends up.

And the alternative is, of course, to try and have a comprehensive kind of rollout and integration of the technology and just trying to solve the problem. And I think that's a really important debate and we'll obviously decide it on a case-by-case instance.

But in this situation I'd say that there's real merit to not just saying let's wait forever to see where the technology ends up because the technology will constantly be evolving. And if we take that approach, first of all, there will always be the, I think, those who have less access to technology and who tend to be more disenfranchised, who will fare the worst because it will be integrated into their schools last. It will also be more expensive because we'll have a smaller marketplace for it. And even if you imagine a fairly rapid scale up of this type of technology into -- in this case, into schools, it still is quite a long process.

You know, in our paper we wrote we think we would be pushing the envelope if it takes eight years. And if you add on to that a few years up front where I think we really do have work to do, obviously in making sure this is appropriate and the technology is evolving, you're going to be at a point where if you have a five-year-old child, that they'll probably be through with high school by the time the whole process in the country starts using something like this.

So, I think there's real merit on the side of trying to think about this within a coherent national federal policy level even as you're acknowledging that the technology is going to change and the types of tools that will be used by students, in this case, will probably be quite different from what we imagine it as we talk here today.

So, appreciate the chance to talk a little bit about that, and I know we have some time to talk and answer questions later on.

MR. WEST: Okay. Thank you very much.

Rob, you co-authored this study about flexible broadband pricing and the ways in which that could help the U.S. reach its goals of universal broadband. How does your plan work and why do you think we should do that instead of the current pricing models based on flat rates?

MR. SHAPIRO: Right. Well, economists, including myself, for a long time have been interested in how new technologies which have very, very broad usefulness, diffuse across the society and particularly diffuse across income classes, and there have been a number of detailed studies of this with other technologies, with personal computers, for example, then with

dial-up Internet. And one of the first things that we -- that has been established in how these technologies diffuse is that they mainly diffuse because their price falls, that technological advance and competition drive down the price. Drove down the price of PCs. Drove down the price of dial-up Internet. And yet, even as that happens, you don't get an even diffusion across income classes because people with lower incomes have less to spend on new technologies and because people with lower incomes are more sensitive to the price of these technologies. And so what you get is a spread that with what is generally called a digital divide. And that is lower income people or the intersection between income and race, minorities tend to -- their uptake rates of these technologies lag those of higher income people.

In fact, it is technically something that's closer to a digital lag than a digital divide, which was something when I was under secretary of Commerce. We oversaw the government reports on this phenomena and it became clear in 1999 that what had been called a digital divide was more accurately a digital lag. That is, lower income people were adopting these technologies at the same rates as higher income people, but with a four- to five-year lag.

And so, the expectation is that as price continues to decline, those lags close, the gaps close. And that's what we have been seeing with broadband.

The problem -- and today, for example, while about 86 percent of -- this is, of course, Pew data, while about 86 percent of those with

incomes of 75,000 or above have broadband; 30- to 75,000, it's about 69 percent; and below \$30,000, it's about 44 percent. So you see what could be characterized either as a lag or as a divide.

The problem is that the Internet itself has been changing and, in particular, it's moving from a text-based medium to a video-based medium. And the problem with that is, of course, that video consumes much more bandwidth than text. A minute of text browsing consumes about 2 to 200 kilobytes. In audio, it's a minute of audio is about 1,000, a minute of video is somewhere between 5,000 and 9,000. So as video has really begun to dominate the Internet, the Internet providers have faced the fact that they have to significantly expand the infrastructure in order to avoid congestion from the enormous increase in demand for bandwidth arising out of the use of video.

Now, the infrastructure in the past has been easily financed by the expanding number of subscribers to the Internet, so that as more subscribers come online, their monthly fees, in effect, finance the expansion of the infrastructure in order to accommodate their demand. The problem is that the Internet is approaching a kind of mature industry in which the numbers of new people coming online, new subscribers, is declining. That is, it's still going up, but at a much slower rate. And in order to avoid Internet congestion in the future, experts estimate that the investment in the infrastructure of the Internet will have to increase over the previous pattern of increases in investment by between 100- and \$300 billion. The question

is, how do you finance that? And what effect does the way that you finance that have on this process of the diffusion of this technology?

And the current model of access to the Internet has been a fixed-fee, fixed monthly fee, regardless of how much bandwidth you consume. And if we -- so, the first question we asked was, if there is no -- if there were no increase in rates, that is, if this investment were not necessary, how soon would we reach universality based on the patterns that we've observed and the diffusion of the technology from dialup and PCs? And what the simulation showed that we should achieve -- that the market alone would achieve universality by about 2016. At that point, the rates of uptake are about 98 percent across income classes.

Then we asked, what would happen if we had to increase fees in order to finance this additional 300 billion in investment required to expand the infrastructure to accommodate this very sharp increase in demand for bandwidth driven by the shift of the medium from a text-based medium to a video-based medium? And we looked at several patterns of this. In fact, if we maintain the current model and we pass along that cost, the providers pass along that cost in higher fixed fees for everyone, what we see is a persistent digital divide, and that's because the fees go up significantly to finance the build-out of the infrastructure. And lower income people are much more sensitive to the increase in price than higher income people.

And so by those simulations, in 2016 or 2017, you still have 30 percent of people with incomes of 30,000 or below without access to broadband; about 15 percent of those with incomes of 30- to 75,000

adjusted for inflation, that's real dollars; and you're at about 96 percent of those above 75,000.

The fact is, that even though the Internet is moving from a text-based medium to a video-based medium, there are, in effect, what are sometimes called -- I don't mean this in a pejorative way -- bandwidth hogs. They're a small percentage of people, relatively small percentage of people, who account for the majority of bandwidth demand. These are gamers, for example, high consumers of video, whether it's from YouTube or the ubiquitous pornography on the Internet, and also people who are shifting to watching television over the Internet instead of over their television set through sites like Hulu. And in fact, somewhere between 5 and 20 percent of Internet users account for about 80 percent of the bandwidth that's used.

So the question is, what does it look like -- what do these digital divides look like if fees, either directly or indirectly, are -- the fee for the expansion of the Internet to accommodate video demand are distributed in some sense based on how much bandwidth you're actually consuming?

And so we simulated a case in which 20 percent of users who are the heavy Internet users, who we take to be relatively priced and elastic, that is, they'll pay a higher price because they're used to consuming so much bandwidth. That 20 percent bears 80 percent of the cost of the additional investment and the other 80 percent bear 20 percent of the cost. And here we found that the simulation showed that you are nearly back to the base case, that is, you approach universality in 2016 or 2017. It's about 97 percent access as opposed to 99 percent access. And this tells us that if,

in fact, we are concerned, as we should be, about the social and economic implications of differential access to broadband as a medium for consuming government services, health care services, educational services, and being a general consumer in the United States, then we need to be certain that our regulations and our laws permit flexibility in pricing and -- or we can undercut the goal of universal access.

MR. WEST: Thank you very much. John, you are the person in terms of consumer behavior: technology, television, broadband, you name it. So when you were at Pew, you were doing surveys over a number of years. What have your surveys taught you about broadband adoption in the United States and some of the limiting factors on broadband adoption?

MR. HARRIGAN: Sure, happy to expand upon that. Let's just start out with some data points and also let me try to characterize some of the problems and challenges we face at the FCC in developing a plan. Congress would like us to come up with some proposals that will get everybody on broadband within the next couple of years, so we have to first fix our minds on what the data shows.

If you look at most data about whether broadband is available to people or not, sort of the consensus notion -- and we have people at the FCC working on this figure as I speak -- but the consensus idea is that about 95 percent of all Americans have access to at least one wire line broadband option. So, that's availability. When you look at the take rate, the latest data from the Pew Internet Project from April of this year shows that 63 percent of Americans are broadband subscribers at home. So, from the adoption

perspective for the broadband plan, it's about a 30 percent problem. How do you get those 30 percent of non-adopters to get broadband? One way to address that question is to look at research and do some of your own.

In terms of research done in the past, when I was with the Pew Internet Project, we did ask non-adopters why they don't have broadband, and before I get to some of those figures, let's trade out the three baskets of non-adopters. So you have 63 percent of Americans using broadband at home. You have something like 7 percent or 8 percent of Americans with dial-up Internet connections at home. You have roughly another 7 or 8 percent of Americans who are Internet users, but do not use the Internet at home. These are people who may only have access at the work place or they are people who may go to libraries or community centers, but do not have access at home. That leaves about 20, 21 percent of Americans who are not Internet users. So these are people who simply do not use the Internet and the issue for each of those three baskets is to try to figure out why these folks are not using the Internet.

And the Pew data from the past couple years kind of puts the non-adoption problem into a couple different baskets. The first basket is relevance. When you look at survey data, about half of non-adopters cite some reasons that suggests that they just do not see what the utility of the Internet is and you can imagine many of these non-adopters, those who don't use the Internet at all, falling into that basket. They tend to be older, they tend to be lower income, and they simply haven't had experience with the Internet such that they can understand what the big deal is all about.

You know, the thrill of using the Internet the first time is something, maybe some of us can remember here, but we're all generally familiar with what the Internet offers in terms of content to make it relevant to us. For lots of non-adopters they simply haven't had that familiarity with the Internet to understand its relevance. So relevance is a barrier cited by about half of non-adopters.

Following that is the issue of price. About a fifth say the price has to come down to a more comfortable range. Now, if you look at the Pew research closely, for dial-up Internet users, which is sort of now a small part of the overall problem with non-broadband adoption, but if you ask dial-up users why they don't have broadband or what is keeping them from switching from dial-up to broadband, a plurality, about a third, say price is an issue. But when you look at people without the Internet at all, they're less likely to say price, more likely to say relevance.

Finally, the remaining roughly third of non-adopters are split between saying that usability is a problem that keeps them from using the Internet. So, again, you can imagine an older person who does not have much exposure to computers simply saying that it's too tough to negotiate an Internet session because of the computer interface.

And finally some people site availability as an issue, that they can't get broadband where they live.

Now, in terms of what we're doing at the FCC to understand this issue better, we currently do have a survey in the field that is intended to focus heavily on non-adopters and the barriers that they face to non-

adoption. So, that research will be coming out some time before February 17, 2010, which is the deadline for the plan. But that's going to try to probe further into the adoption barriers. And the technique we're using just in terms of framing the questions on the survey is just to ask people whether a list of things -- items on a list of things are barriers to adoption. So we'll ask whether price is a problem for you. Is the cost of owning a computer a problem for you? Is relevance a problem for you? And the question is a little more elaborate than simply saying is it relevant to you or not.

We asked some questions about whether worries about security are a barrier to being online. And then after people are allowed to pick more than one category, we asked them, what is the most important reason out of the reasons we listed for you not having broadband at home. So, we hope to fix the barriers to adoption a little more precisely using the forthcoming survey from the FCC.

And finally, if I could just pick up on something that Rob said about, you know, the changing nature of the digital divide. He noted that, you know, the Internet's changed over the past couple years as it's become much more of a video type of medium. I think it's also important, as we think about the digital divide and how to characterize it, I think it's important to understand that the offline world has changed over the past 10 years.

So 10 years ago, if you were on the wrong side of the digital divide, if you did not have access to the Internet, it really wasn't all that consequential because there were plenty of offline alternatives for you for information if you needed information. So, if you were looking for a job 10

years ago you could turn to ads in a print publication without too much difficulty.

These days, there is a shrinking news hole, ads are more likely -- much more likely to be online than offline than they were 10 years ago. So the reduction in offline alternatives today as the Internet has become more ubiquitous and more high speed really shrinks the options for the offline population these days and, arguably, raises the cost of digital exclusion today in a way that wasn't the case 10 years ago.

So, with that, we can turn it over to conversation.

MR. WEST: Okay. What I'd like to do now is move to a kind of -- I'd like to describe it as a free fall stage of any -- I'm going to throw out a couple of questions and any of you can jump in. And if you want to argue, you're allowed to argue at Brookings, so that's okay, too.

The questions I'd like to pose are the following: I mean, it seems like, you know, we have huge aspirations and limited resources, but yet we also have competing goals. I mean, there are lots of things that we would like to do. We want universal coverage. Several of you have alluded to that. Some people suggest we really need high-speed broadband because we're moving to video applications. People want to watch television online. Gaming is coming in, et cetera, et cetera. And John is talking about raising adoption levels.

So I guess the question I'd like to throw out is, given the limited resources we have and given some of the tension across these goals of universal coverage, high-speed broadband, or just focusing on raising

adoption levels, what do you think should be our highest priority? Any of you.

MR. SHAPIRO: I do think our highest priority should be promoting universal access on a sustainable model, that is, on a model that doesn't depend on government subsidies. In an era in which the constraints on government resources are very great, and the priority -- and the best way to figure out how best to do that is to look at the history of how other technologies like this have become virtually universal and see how we can apply that. And that means that, you know, we don't want to stand in the way of technological advances which drive down the price, for example. It's not simply a matter of letting the market work. It's a matter of promoting cost-saving technologies. And, for example, in, you know, one of the things that will -- that we expect to, in effect, rescue the Internet from congestion as this transformation to video goes forward are future advances in compression technologies, so that it takes less bandwidth.

So, it's a -- and the second is to -- this whole model only works when there's real competition because competition is the other force that drives down the price of these technologies. So the government has a real role in promoting those two facets of diffusion. I think if we do that, we can achieve this in a very sustainable way and without interfering with the way science and consumer taste and the reorganization of all the institutions in this society that deliver goods and services in response to the Internet, that process can proceed.

MR. FREEDMAN: When I was in grammar school we had a particularly gruesome game where you would compare which body part you would least like to have cut off.

MR. WEST: That was pretty much my question.

MR. FREEDMAN: I think it's a tough question. I think the reasonable answer is to say, well, one is it gets at the competitiveness of our economy and our society generally, and the other gets at the quality of opportunity in our society going forward. And it's a tough policy problem because you really can't afford to sacrifice one or the other if you're going to be the kind of country we want to be. And I think part of the challenge is, you know, we talk about this topic in a kind of circumscribed way, like this is one of the many different problems the country faces. And that's true, but to me it's also important to lift it up and recognize this is the most important infrastructure decision probably in the history of the country: How do we do this in a smart way? And it's not always treated that way. It's treated as a kind of wonky topic about pricing and other things. And I think we don't really have a choice to sacrifice one or the other if we're going to be the kind of country that we want to be in the next decade.

MR. HARRIGAN: One thing in looking at the question of how you increase adoption rates goes to some findings from our workshops that the FCC held on a variety of issues over the past couple of months. But one that we held on adoption had a number of experts of academics studying what good adoption programs are and actually people doing those adoption programs in cities around the country. And one key takeaway for me from

one workshop, I think it was on August 19th on adoption, was the need to build social infrastructure around non-adopters.

Now, the story goes, for many of us, as we first started using the Internet, we probably were introduced to the Internet in a university setting or in the workplace, in an environment where we had a very well-developed social infrastructure to help us understand how to negotiate those early online sessions. When things might go wrong, there was somebody to turn to. When you wondered what the heck this browser was for, there was somebody to tell you, oh, there's some cool content over here, you might want to check it out.

For non-adopters, these are older Americans typically, they're lower income. These are not people who have that kind of social infrastructure around them to help them get comfortable with technology. So the recommendation from this workshop was to fund training that helps users understand the value of the Internet and helps draw them online. That goes to the point that Rob just made about sustainable adoption. And I think if you can seed and expand some of these programs that do exist around the country to help build social infrastructure around adoption, you can really move to that place of sustainable adoption.

So, Rob mentions the policy lever of competition as a way to drive adoption. I think that's important. But it's also important to look at some of the social infrastructure, the training programs that help people be drawn to the Internet in sort of a technology pull way as opposed to a

technology push way, to get people using the Internet among the remaining non-adopter population.

MR. WEST: What do you mean by “social infrastructure?”
Could you explain?

MR. HERRIGAN: Well, there are a lot of programs, many of whom were represented at various workshops. One economy, for instance, is a nonprofit headquartered in D.C. that has a program called the Digital Connectors Program whereby young people go into housing projects or senior centers and become kind of the tech team to help people learn what the Internet’s all about and to help them troubleshoot programs.

Research I did at Pew years ago, this was actually qualitative research, looked at how the Internet was impacting institutions in cities. And lots of storefront nonprofits would provide not just computer access and Internet access, early '90s -- rather late '90s, early 2000s, a lot of the discussion was let’s put up community technology centers and provide access. That’ll be a good way to bridge the digital divide. Those were good as far as they went, but when you started to talk to people doing this, they realized that somebody had to provide training and then somebody had to be the sort of first responder when new adopters had trouble using the Internet at home.

A guy in Cleveland told me this great story about how he had become accustomed to being the first responder from his storefront nonprofit, but that faded away after about a year. And he realized people were no longer calling him, but they were calling neighbors who had become

confident enough with the Internet to be the first responders in the neighborhood. So, that was an example of the social infrastructure in the neighborhood emerging over time on the heels of training programs at community nonprofits.

MR. SHAPIRO: I can give another example, perhaps. It's a proposal that the administration has adopted -- it hasn't been enacted -- and one we've been talking about actually since the mid-'90s, and that is grants to community colleges to keep their computer labs open in the evenings and on weekends for any American to walk in and get free training in the use of the Internet and the use of computers. Because there is a -- young people have access to these skills, it seems, from -- you know, in an osmotic process from the environment, but workers, particularly older workers, don't. And in fact, there is a real divide in Internet skills and computer skills; hits in around 35 to 65 within the workforce. And this kind of access to training not only will make people more productive, more comfortable in work places that are dense with information technologies, but also will increase the value of broadband adoption to them because they will be able to do so much more with it.

MR. WEST: I mean, it seems like a lot of the things that we've been talking about are focusing on increasing adoption among consumers. It seems like the other category of new innovations that are arising are so-called machine-to-machine applications, like smart grids where it's not really the consumer that is engaged, it's smart grids that may monitor electric

usage and then put the utilities in a position to manage consumption a little bit better.

Do you think those types of applications are going to be very important in the future?

MR. HARRIGAN: Well, I mean, I think it's unquestionably the case the advent of centers, the machine-to-machine communication you're talking about, will be increasingly important. And I think it's going to be, you know, sort of a classic adoption curve whereby if the infrastructure is available, you'll have your set of early adopters who glom onto this first.

I should say that the National Broadband Plan does require the FCC to talk about, you know, purposes for use of broadband and technology, and that includes looking at things like energy management, smart grid issues, other issues as well, health care and homeland security. But that, I think, is going to be a tremendous bandwidth driver.

I was at a conference in California a week or so ago, talking about the volume of information being created. And I learned a new word, yadabyte, which is 10 to the 24th numbers of bits, which is, you know, some off-the-scale dimension that I can't really comprehend. But in forecasting information production over the next couple years, a lot of these experts were saying that, you know, machine-to-machine is really going to be the driver. So today, we talk a lot about, appropriately so, about video driving a lot of bandwidth demand. That's very true. I think the thing coming around the corner is the explosion of machine-to-machine communication, which has tremendous impacts on the infrastructure requirements.

MR. SHAPIRO: I think that's -- I absolutely agree with you, John. And another clear example is telemedicine, where we will have -- and it's really a potential source of enormous saving in health care, that people will have embedded devices that will be sending their medical signs to other machines, one machine to another machine through broadband. And consequently, can reduce the number of doctor visits and hospital visits that people may need. But again, all of these uses require, particularly telemedicine, they require kind of a surplus of bandwidth. You can't -- you know, you can't afford to have any of the signal dropped without potentially very serious consequences.

So it does put enormous new demand on the build-out of this infrastructure, which, again, cannot be financed by simply increasing numbers of subscribers. That is not a sustainable model. And so we have to figure out how to distribute these costs in a way which doesn't constrain, in particular, access by lower income Americans.

MR. HERRIGAN: And just to take off on that from an adoption perspective, the telemedicine example does raise an interesting adoption point. I've been on panels where somebody from the audience will say, well, you know, why are you worried about broadband adoption among, you know, older Americans? And usually there's somebody in the audience with a grandmother who doesn't -- insistently does not want to have broadband at home. And with some good reason behind the question, the question is, well, if she doesn't want it, why should we worry about that? It's just a choice.

True as far as it goes. She may not want broadband, but her health care provider may want her to have broadband. And there could be tremendous benefits in terms of quality of service delivery and cost savings on service delivery if broadband is in that person's home and if that person has enough facility with it to deal with some of the home health care applications. So, again, digital literacy becomes a key part of the equation for some of the niftier, more innovative applications that people talk about.

MR. WEST: So give the trends that each of you have noted, what are the most concrete things you think the federal government should be doing now? If you were the broadband czar, what would you suggest?

SPEAKER: Well, you ought to ask the advisor to the broadband czar.

MR. HARRIGAN: Well, I'm not (inaudible) answer. I guess my advice would be to deliver the plan on time by February 17, 2010. We'll be talking about some ideas in the coming months and certainly by February we'll have some concrete ideas on the directions we have to go in. Our September 29th all-day session at the Commission laid out some of our thinking about some of the challenges, but I might let the advisors-in-waiting take a shot at this, too.

MR. WEST: Yes, we'll give you a pass because you're on the front lines, but Tom and Rob.

MR. FREEDMAN: I mean, I'm a fan of what they're doing. I should admit I was on the transition team. I do think they have a really remarkably good team. And the commitments of having a dialogue about it,

putting out ideas about how to do it, and being as transparent as they're being I think is really important.

I think the one thing that's sort of missing from the discussion is I do think it kind of gets cabined off in this kind of discrete way and it's treated as a factionalized dispute among some powerful interests. And there really is an enormous national interest here that, you know, we're touching on here, that I think the ability of the President and everyone to engage and make people realize this is a major fork in the road moment for the future of our country and it's not a peripheral or a dull topic when you look at whether America's going to be a successful country, I think is a really crucial and difficult challenge.

But, you know, we're going to probably need to have a national debate and national investments and a national education about this as we go forward. And we can do it. It will happen happenstance absent that, and that'll be fine, but we'd be a lot better off as a country if it happens as a real national debate.

MR. SHAPIRO: I think there are four principles. One is promote technological advance because technological advance not only will expand the usefulness of broadband, but will also drive down the cost of access.

The second is promote competition because that also drives down the cost and, consequently, drives the diffusion.

The third is prepare everyone for the most effective and efficient use of the medium, and that's a training agenda.

And the fourth is permit the market to set the price in the way that will drive the diffusion along the same patterns that it has successfully done with other technologies.

And don't try to dictate the price. Let the market experience a kind of flexibility that, in fact, it does today. You know, we have differential pricing with respect to speed and I think those four principles can drive universal access and the increasing usefulness of this medium, which is, I absolutely agree, really central to the future economic development of this country.

MR. WEST: Yeah, I mean, it's the equivalent of the 1860s to getting the new national railroad system right.

MR. SHAPIRO: I think so.

MR. WEST: And if you mess it up, then you have extreme consequences for society.

Why don't we open the floor now to questions and comments from you?

Back there, (inaudible).

SPEAKER: (inaudible) inelasticity and the result of that is that you get the sort of numerical implications that you got. But I wonder why that makes sense. Maybe even for the people right now there's some sensitivity to price, but certainly for the new guys who want to come on and be heavy users, they would be sensitive to price. And so one thing you may be doing by following that scenario out is preventing the development of the Internet to be used as an alternative video distribution mechanism because

you're making the price too high for people to use it to cut the cord and find another way of getting access to video in addition to the stuff that they're doing now.

MR. SHAPIRO: Well, our simulations did not assume -- know that the demand was entirely inelastic. We assumed that it was relatively -- that it was less elastic and less sensitive to the price increases, which is based on survey evidence. It was not, you know, a pure assumption.

The issue here is that there will be additional costs. The additional costs will be substantial. And, you know, the estimates of the build-out of the infrastructure are only based on the expansion, which is taken to be -- expected to be required for video. It does not take into account what, indeed, will be the next stage of the expansion, which could be even greater.

The question is not whether these costs are going to occur. They are going to occur. The only way to avoid them is, in effect, to stop the development of the Internet where it is. The question is how you distribute the costs and what is the model which is most likely to interfere less -- the least with universality.

But, yes, the price -- if, for example, you had tiered pricing, either directly through -- which some countries do now; there are kind of regular Internet users and then very high Internet users and the high Internet users pay an additional fee. People would still have the option to not be high, but to be regular Internet users. It doesn't remove their access.

The other way to do it is indirectly by higher charges on content providers that consume a lot of Internet. And those costs can then be distributed in a lot of ways. It can be distributed through fees. You know, if you want to consume 100 downloads of YouTube a day, then you would pay an extra fee to do that. Or it could be paid for with higher advertising rates. There are lots of ways. Let the market figure out how to do that.

But it is -- look, the best option would be if we could expand it for nothing, but we can't.

MR. WEST: Right there on the aisle.

MR. ALTMAN: Hi. I'm Fred Altman. And what is the difference in cost by expanding the broadband wired versus over-the-air? And a broader question that came up, it reminded me of 60 Minutes this weekend, there's a whole lot of security problems. How will you deal with that as the broadband expands?

MR. HARRIGAN: So the question is the cost running broadband, wireless broadband versus wired broadband? I don't have estimates in my head. I do know the Broadband Plan is well aware of the fact that we have a spectrum shortage. We need more spectrum that can serve as a potential third entrance into marketplace. It could impose some marketplace discipline, which could help drive prices down.

I, unfortunately, don't have a relative cost breakout for you. I know that -- or at least my understanding is that in the short term, wire-line broadband is going to have better performance in terms of speed than

wireless broadband. But certainly a goal of the plan is to try to think about ways to get greater quantities of spectrum.

As to security, we are looking at that in the survey that we're conducting as a potential barrier to broadband adoption. Certainly, as more and more people's data does go online, people worry a great deal about security. I can tell you from work that I did at the Pew Internet Project, you do have that classic gap between worry and actual behavior. Meaning people say, oh, yeah, I'm worried about my credit card being stolen, yet that has a very modest, if any, impact on the incidents of using the credit card online. But as certainly more data and more personal data as people's entire social networks migrate to the Internet, security becomes a big issue.

SPEAKER: (inaudible)

MR. WEST: Any other?

Yeah. There's someone coming to the microphone behind you.

MR. FINNERAN: Hi. I'm Kevin Finneran with Issues in Science and Technology at the National Academy of Sciences. A couple years ago, my son explained to me that this was a competitiveness problem, that when he was staying up all night playing computer game tournaments, the Koreans were beating the pants off the Americans because they had faster connections. He thought it was important to get this fixed.

But my question has more to do with how much broadband we need. Broadband's a broad term. For some people it's 1 megabyte, for some people it's 10, for some people it's a 100-megabyte connection. And,

you know, John explained that access was important, but in telemedicine. And yes, you need slow access to get your blood pressure sent to your physician if you're an old person at home or some other readings. If you're performing surgery remotely, you need a much higher connection.

Just technically speaking, can we separate out those uses? Can we provide extremely high throughput broadband for defense and security purposes, for telemedicine, so Goldman Sachs can trade faster and sink the economy even more quickly the next time? Or do we need to provide -- you know, can we separate that super high-speed broadband from various other types of access?

And just as a quick corollary to that, there's a wide range of difference among nations and how much broadband access is available. What have learned from the nations that are ahead of us and behind us in terms of the effect its had to have wider and faster access?

MR. WEST: Well, for Internet surgery, I would vote for really high-speed broadband.

MR. SHAPIRO: Well, on the international question, you know, you said Korea, Korea is probably the most wired country in the world and the most broadband, the fastest broadband on a society-wide basis, and they have moved to models of pricing flexibility to deal with the enormous demands of some relatively small numbers of people. But the fact is, you know, the demands of telemedicine today will be the demands of regular consumers in five years.

When the -- as the bandwidth becomes available, the applications are written for that bandwidth. And so we will -- and we don't know what direction it'll take. That's kind of the essence of innovation. But we certainly have seen, you know, the kind of -- the ubiquitous applications that are very hot, that require very large amounts of bandwidth relative to similar applications five years ago, and we would expect that process to continue.

So the -- we could say today, okay, we're going to say telemedicine and national security get this additional bandwidth, but in five years, there are going to be a lot of business applications and a lot of consumer applications that will require just as much bandwidth. And the telemedicine and national security will require even more than they do today. So it's not a -- it's always a moving target.

MR. WEST: Over here.

MR. KILPATRICK: Henry Kilpatrick. One of the byproducts of the smart grid is broadband over power line and that would also provide competition, yet it's sort of dropped off the map. You just don't hear anything about it anymore. Can anybody address that issue?

MR. HARRIGAN: I can only speak to that loosely in a third-hand sense, and let me underline a couple steps removed from the center of this. But it's my understanding that the way that our electric grid is set up makes it less amenable to broadband over power line than in some other countries.

So I think -- I was talking to an economist who had been in Colombia recently, in South America, where he was surprised to learn that very smart people were insistently pushing ahead on broadband over power line there. And I think that has to do with the different nature of the architecture of the electrical systems there versus the U.S. But it's not something I think for those technical reasons that's had a lot of takeoff here in the U.S.

MR. WEST: You had a question back there? You had a question?

SPEAKER: No.

MR. WEST: Okay. Other questions? Over here.

MR. JONES: Hi, yes. I'm Phil Jones and just a concerned citizen. I wanted to comment on Mr. Horrigan -- I hope I got that right -- your comments in saying education is key. And when you asked the question about what's priority, education was the first thing that popped into my mind, although I had a different take on it than you did in that it may be best to start with the young folks, you know, at schools, technology in schools, kindergarten on through second -- through high school. Because, number one, they do pick it up quicker and because, number two, they also make pretty good teachers. If they bring that stuff home and start showing their parents that whole training situation becomes a little less important.

I did -- the part about the -- the comment you made about health care, the company wanting the grandma to have the technology, maybe that pushing her adoption of it, I'm not so sure I agree with that. I

mean, I get a little nervous because people aren't going to -- you can't push it. I'm completely in agreement with your poll theory.

But I do want to ask a question about universality. I see it as being equitable to the word, it's utility. The Internet's become a utility, although we're not 100 percent there yet with 20 percent of the folks not being 100 percent adopters. It's not quite like electricity. But, you know, there's comparisons to electricity, television, all that good stuff. So for uses of context, I think of it as it's a utility and we need to figure out how to deal with getting this utility to everybody.

And I understand a lot of the different challenges that are out there. Even (inaudible) here, for example, getting the infrastructure to, you know, the middle of Pennsylvania. I know a farmer out there who actually runs an online business and sells his products online, takes orders online. He couldn't get cable. He has to do it through a pretty expensive satellite connection, so -- because he couldn't get enough petition signatures to get the company to lay the line, so on and so forth. So the challenges there are pretty rough.

My question is about regulation. And, you know, I agree that there should be a lot of -- we should let competition do its thing. But at the same time, too little regulation can obviously lead to problems as we've seen with even power companies in the not-so-distant past in California and that sort of thing, deregulation of these sorts of things. So thinking of it as a utility how do we, you know, let the free market do its thing, but also ensure that we're acting in the best interest of the public?

MR. WEST: Okay. So what's the balance between relying on the market versus government regulation?

MR. HERRIGAN: I can tell a historical story along those lines that I think has some resonance today about that balance. Sometimes you'll hear people say, well, why do we have to worry about these inequalities in adoption patterns because eventually it gets to everybody? You know, these new technologies, electricity being an example often cited. Well, if you look at electricity, particularly among rural America in the 1930s, there were public-private partnerships -- I don't think they used the term then -- to try to boost demand among farmers. The utilities worked with the Rural Electrification Administration with inside wiring kits so that farmers could wire their homes so that they could get electricity. That was an expensive proposition for them. There were programs to help, you know, new adopters learn what appliances were relevant.

The goal, from the utility's perspective, was to boost demand, to boost load. But they found out that they had to work with agricultural extension agents to build that -- effectively that social infrastructure so that novice adopters could understand how to put this technology to work. So that was an example of industry working together, as far as I can tell from my reading on this in maybe an ad hoc way, to try to boost demand.

But both sides of the equation understood that they had a problem. Utilities wanted -- were sort of under some government mandates to build infrastructure; they wanted to boost demand. The government

wanted the policy of electricity being ubiquitously available. And the parties worked together to try to address the problem.

Yeah, I'm not going to speak to how or whether the Broadband Plan will try to do similar things, but those kinds of combinations among interested parties are definitely worth thinking about.

MR. WEST: Other views on the balance question? Do we have the balance right?

MR. SHAPIRO: Well, I think we're trying to figure out the balance right now. And I think that, you know, I really salute the administration for being the first to embrace the commitment to universal access and to recognize the social and economic significance of universal access. And to go through an open process to try to figure out how to achieve it.

Look, this is -- we have some historical examples, but this could be different. We need to continue to monitor it. You know, I was looking -- you know, we had, for example, among -- from 2005 to 2009, home broadband adoption among people with incomes of 20- to \$30,000 went, and this is each year, from 19 percent to 27 percent to 34 percent to 42 percent to 53 percent. That's a very steady pattern. We need to continue to monitor that and see -- make sure it continues.

And if -- this is a medium, however, that has developed, has produced enormous social and economic benefits for everyone not just in this country, in the world, in utterly unexpected ways through the process of innovation. And we need to be particularly careful that we don't take steps

that inhibit that process because it could have large costs that we could never -- we'll never be able to recognize.

MR. FREEDMAN: And I do think it gets at one of the fundamental questions about Americans' attitudes towards this technology and this infrastructure is whether it's a public good that we need to figure out, you know, to regulate and -- you know, or whether it's a private sector interest that has the right to do whatever pricing it wants. And, you know, we're viewing it from this -- even Rob's paper is certainly viewing it as a public policy problem, like what's the most efficient way to distribute this out. I think there's going to be all sorts of tensions as it becomes increasingly ubiquitous to policymakers.

And just one example, if we increasingly put, you know, public universities' curriculum online and have professors lectures on, we say that's an important opportunity for people to have access to public, taxpayer-provided education, and it is an amazing tool that anyone in the country or in the world can see these -- can see lectures. But that will increasingly take up a lot of bandwidth. And you have to say, you know, from Rob's point of view of his paper, what is -- you know, is there a price then to be passed along for that.

And I think we're also going to go through a real period of looking at other countries' models. We talked about one country (inaudible) enormous variety of models where countries have answered this question in very different ways.

MR. WEST: Okay. Is there a question back there? Yes.

SPEAKER: JBD from the American Foundation. As we mentioned during the discussion, competition policy has brought down the Internet's prices and promotes technology innovation. I'm just curious what kind of competition policy that you are anticipating to be included in the National Broadband Policy.

In addition, the Berkman Center from Harvard University released a report last month and it's talking about an open access policy in various technology-advanced countries. Do you have any thoughts about an open access policy to be implemented in the States?

MR. WEST: The question basically was about competition policy and open access as a federal policy and what you think about that.

SPEAKER: Study from (inaudible), did you see that?

MR. WEST: What?

SPEAKER: The study from Harvard.

MR. WEST: Yeah, the Harvard study that was commissioned by the FCC by Professor Binkler.

So, open access? It's a panel thing.

SPEAKER: What do you -- your specialty.

SPEAKER: We'll let you go first.

MR. FREEDMAN: Well, I mean, I thought it's a very lengthy report, so I -- and I think he's a distinguished researcher. It strikes me, you know, the question I'm (inaudible) is this first part. But the most striking thing, you know, before you even got to the open access part of the report, where you're listing the different countries and where they're at, and I took it

as a very critical notion that we tend to perceive ourselves at the front end and the leaders in technology, and I think it has us listed as 13th, I think, in the world. And I think it was a very compelling question about will that -- those are alternative models for us to pursue rather than just assume that we have this figured out.

MR. WEST: Rob?

MR. SHAPIRO: Well, I agree that, you know, if we ever think we've had this figured out, we'll -- reality will bring us to account pretty quickly. This is simply not a medium that stands still.

And I think with respect to the competitiveness of the sector, that's something that really needs to be regularly monitored. You know, we saw a -- you know, we had seen a steady decline in broadband pricing until the last year and prices went up. We need to understand why that occurred. Is this part of this very peculiar economic cycle we're in or not?

It's a -- I do think, you know, and with respect to open access issues, I mean, it's a -- you know, the truth is that as broadband becomes embedded in everything we do, it implicates hundreds of other policies. You know, I think a lot about intellectual property rights, which will have enormous impact how we approach intellectual property rights with respect to the Internet to its future development and the content that becomes available and the applications that are developed. We need to be thinking about all these policies with respect to their impact on the usefulness of the medium and on everyone's easy access to that medium.

So there's kind of not a -- you know, there are open aspects of open access that makes sense to me with respect to these policy goals of, you know, creating an environment for the future development and innovation and also universal access. And then there are other aspects in which I can see it undercutting it. So there's no kind of simple answer to any of this anymore.

MR. WEST: And I think even the position of the FCC seems to be pretty complicated on this question of open access. I mean, when the Chair of the FCC came here more than a month ago and announced the start of the process to consider open access, I mean, as a principle, he endorsed the idea of open access. But then if you listened to his speech carefully, he actually laid out a couple of caveats that I think have not attracted sufficient attention.

One, he talked about Internet service providers actually should be able to engage in some form of network management techniques, in part because of these digital traffic jams, the rising broadband usage and so on. And I think what everybody is watching now as the evidence-based part of the FCC proceedings is underway is how broadly or narrowly is that concept of network management going to get defined? Because it really matters a lot in terms of whether the policy actually comes down in favor of openness or some other version of that.

The second thing he mentioned that was very interesting was he seemed near the end of his speech to be open to the concept to of premium pricing on the idea that -- I like the term Rob was suggesting of

bandwidth hogs. And having come from a college campus, there were a lot of college students who would fall within that category. He seemed to be open, at least in the abstract, to different pricing levels for people who are using big bandwidth applications.

So I think on both the management network techniques side and the premium pricing side there seems to be -- he seemed to leave more room open than what some of the headlines would have indicated of reporters who reported his speech.

Yes, sir?

MR. PEYTON: Thank you. David Peyton with Vermeer Corporation. I'd like to address the physical facilities necessary to offer all these services, in particular fiber to the home. I don't think anyone has mentioned that phrase yet today.

I guess for Mr. Horrigan, of the 95 percent, what slice of that is fiber to the home as of now?

For Mr. Shapiro, your simulation's out to 2016. What results did you get for fiber to the home, if any, by 2016?

And in general, how important is it for any of these applications we're talking about -- telemedicine, machine-to-machine, anything else -- to have fiber to the home as opposed to any other configuration?

MR. HERRIGAN: On the data aspect to it, we do have our deployment team looking at not only the overall availability of infrastructure, but what kind of infrastructure is available in different places. I can tell you from surveys from the Pew Internet Project, I think it's in the Home

Broadband 2009 Report. But I think something like 5 percent of broadband users report having fiber to the home. There could be more fiber passing homes than reflected in that take rate, but that's the figure from the April 2009 report, 5 percent of broadband users having fiber at home.

And maybe my other panelists want to comment on the notion of how much bandwidth to the home is needed for these various applications. You know, I think the FCC is technology neutral as to what infrastructure needs to be in the home. But, you know, we do -- in developing the plan are looking at profiles of user behaviors to see not only what people are doing today, but also thinking about, as you are, what is going to be required in the future to run various applications.

MR. WEST: Okay, we're just about out of time, but I think we have time for one more question. Right there.

MR. GERGARVIN: My name is Eric Gergarvin. I'm with FTK5, and a quick question. In terms of the infrastructure that we're talking about, are we talking about infrastructure for applications that are currently in existence? Or have there been algorithms or some simulations developed that would give us an idea, similar to what happened when the railroad or the electrical infrastructure was put in place, that we would build an infrastructure for?

I mean, if we're expanding at a certain rate, then it's going to take us X-amount of years to get the infrastructure in place. Then are we talking about building for what will be in existence then when the bandwidth requirements might be some multiple of what they are now? Or are we

talking about just simply -- not really simply, but just expanding to make sure that the current applications reach every home?

MR. WEST: I mean, I view this as a once-in-a-generation opportunity. I mean, how often does national broadband policy end up on the front pages of American newspapers? I mean, it is right now, but it's a very unusual thing. And I think we have to take advantage of this opportunity to really build the infrastructure for the future, for applications that we can't even envision now. Or as Rob was pointing out in the health care area, I mean, there are lots of new IT applications that are coming about that are still in somewhat the experimental stage, but over the next 5, 10, and 15 years, are going to gain much greater currency, become more widely deployed and will become much more prevalent in their usage. I don't think we want to design the infrastructure just for what we have now because we want to lay the basis for the long-term competitiveness of our country.

MR. SHAPIRO: Well, certainly the expectations of the expansion of the infrastructure are not based on a kind of static model of bandwidth demand, but rather on demand not only increasing, but increasing at an accelerating rate.

Now, the fact is that I am -- I would not be at all surprised if in 10 years we looked back and said, wow, well, we're really going to have to further accelerate that investment because of 2 or 3 generations of innovation and applications that we can't imagine today. So I think this is, you know, a continuing process, but it is one which the current shift in the

use of the Internet creates the kind of occasion to begin to rethink this and to recognize the enormous investments that are going to be required in order to maintain an infrastructure that increasingly our whole society runs on.

MR. WEST: Okay. Unfortunately, we are out of time, but I want to thank our panelists, John and Rob and Tom, for each of your contributions to this discussion. We appreciate your coming out. And we appreciate you, the audience, for your interest on the topic. Thank you very much.

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