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NATIONAL BROADBAND PLAN WORKSHOP

BIG IDEAS WITH POTENTIAL TO

SUBSTANTIALLY CHANGE THE INTERNET

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Panel 1: The Future of the Internet

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P R O C E E D I N G S

MR. PEHA: Let's get started. There's Scott. Okay.

Welcome. Today we have a workshop on Big Ideas. I think there's been a lot of confusion on what big ideas meant, so big ideas, at least to me, means things that may come along that may significantly change what we're doing. Whether that's a new technology, a new business model, a new policy. If this were, for example, 1996 and you were talking about telecom policy, you might be talking a lot about, you know, teleco competition. And some people at that time might have thought that the importance of the Internet was that it might make a few people want a second phone line. Occasionally, things come along that really change the game a little bit. And of course, since we're talking about the future, they also might not. So we're going to be a little more forward-looking today and we're going to talk about things that maybe the National Broadband Plan ought to think about that could be a little

more disruptive.

Two topics -- I should also say this has been billed most recently as Big Ideas I because there are lots of big ideas and maybe there will be others, but we will be talking about two big ideas in today's workshop. For the second panel, which we'll get to later, we will talk about the possibility that maybe video grows greatly in popularity and what that might mean.

But for the current panel we're going to talk about the Internet of the future and how to get there. Maybe the Internet of the future -- you know, we all like to think that the future looks pretty much like the present with a few little changes here and there. Maybe we want it better. Maybe we want the Internet spread to more households. Maybe we want it a little faster. But maybe it'll change more fundamentally. And we'll talk about what that means.

So, for those who go to Washington, D.C., events mostly, they may not realize what an amazing panel we have here today, that everybody

up here could be a headline keynote in some other context. In fact, you know, if you go out to the Internet research community and you say who are the technical researchers that are thinking and doing work that really could change the vision of the Internet, you're going to hear a lot of names like Dave Clark from MIT, who is a professor who has been an Internet pioneer and working in this space and continuing to innovate for many years. You're going to hear names like Van Jacobson, currently a research fellow at Palo Alto Research Center, previously a chief scientist at Cisco and Packet Design. You're going to hear names like Scott Shenker, who is a professor of computer science at Berkeley and founder of the network group at ICSI.

All very important in their own right. You are going to ask who is doing work to make the next generation happen. You're going to hear a name that we may or may not hear further in this workshop since he's not here yet, but Taieb Znati, who as division director at the National Science

Foundation is leading some efforts to think about the Internet of the future along with his very capable colleagues. And if you want to ask people who is thinking about -- what makes innovation work and the policies that foster innovation, you're going to hear a name, Rob Atkinson, quite a lot, who is the president of the Information Technology and Innovation Foundation and founder of the ITIF.

Also, one name that is not on your program, but he -- at least not for this panel; he is listed for the next panel, but I have asked him to join us -- is Dr. Richard Green, who has long been president and CEO at CableLabs. And I guess -- at least through 2009. And, you know, during his tenure at CableLabs we saw that bizarre and improbable idea that maybe this infrastructure that could only be used for one-way dissemination of video might actually become something fairly important for the national infrastructure for the Internet. So I think he's seen something of Internet innovation in the past.

So I would like to talk about two things today. We're going to start by talking about what the Internet of the future might look like. And, again, this is speculative, but I'm welcoming ideas from my panelists here. And after that I hope we will shift gears a little bit to the extent that 90 minutes permits and talk a little bit about what it might be that would foster that kind of innovation, what a broadband plan ought to think about if we want to keep our infrastructure not just at the cutting edge today, but in the future.

I have not had a chance to talk to folks about order. Maybe I'll ask the technical people to go first and Rob second. Dave, would you like to --

MR. CLARK: Sure. I will. So, thank you very much for the opportunity to present some observations. I want to make four points. The first one is that broadband deployment is not a one-time objective, but it's a continuing process. And I'm going to argue that the goal of the FCC

plan will be what I call sustainable broadband.

The second idea is that over the lifetime of this plan the nature of the Internet may -- and I think it will -- change greatly. I'll catalogue some of the driving forces for change. The written statement I prepared has a bunch of examples. I'll give two.

The third point is not only may the Internet change, but the structure of the industry as it is implemented may change as well and that is equally important.

The fact is implications for any plan that attempts to influence the future by means of shaping incentives and obligations of specific actors, by the time you shape them they aren't there.

And finally, as we finish the job of getting some form of broadband available we're going to need to shift our attention to the question of why almost one in four citizens report they do not use the Internet.

And let me elaborate on each of these

very briefly. First, the deployment of broadband must be seen as an ongoing process, not a one-time conversion. Moore's Law suggests that information technology advances at a rate that gives us a factor of 10 in performance about every 5 years. And broadband, if it's not to be a sea anchor for Moore's Law, must track that rate of advance and it must keep doing it. I would believe that so far -- I would say so far residential broadband has done a reasonable job of matching that pace, but an effective broadband plan must ensure that this sort of improvement continues appropriately. And we could argue about what appropriately means.

I would like to suggest this term to describe the use of -- this goal of the U.S. plan -- sustainable broadband or broadband sustainability -- in the larger context of economic planning and develop the goal of sustainability as now seen as a core objective. One time infusions of money are often not effective. Ventures launch and they falter once the money runs out. We could see the same sort of

failure if broadband deployment becomes a one time event.

In 2002, the Computer Science and Telecommunications Board of our National Academies released a report on residential broadband which was titled "Bringing Home the Bits." In this report for which I was one of the authors so, yes, I'm talking about my own work here, we proposed a dynamic definition of broadband which is consistent with the idea of sustainability. And I don't have time to elaborate here, but I commend that report to the FCC.

My second point is that the Internet is not a fixed and final technology. The Internet has been a great success, but we can catalogue a number of forces that might trigger change, and I think the change might be rapid and dramatic. Let me quickly list some drivers. The need for better security, which is pretty compelling; the need for better manageability, which may or may not be obvious to you unless you've ever tried to configure a wireless base station; new sorts of

computing devices, in particular, inexpensive sensors and actuators, things that are not PCs; mobility, of course; and new applications.

Let me give you two examples right here of how the Internet might change. To support diverse requirements and insulate groups that are mutually distrustful, I think the current global, open Internet may drift toward a collection of virtual Internets. Corporations today do not directly attach to the open Internet, but to what are called virtual private networks. And they connect to the public Internet through boarder crossing points that limit modes and interaction, provide some sort of security checks.

This trend could expand. It could become the pattern by which most of all of us connect to the Internet. Whether this is a socially desirable outcome, which is a different conversation, it would challenge what it means to be an Internet service provider. It would challenge any definition we try to put forward with respect, for example, to neutrality. And it

would blur the boundary of what it means to be connected to the Internet, which may turn out to be a policy term of art.

As a second example, if you look at applications such as healthcare, you recognize that speed is not the only dimension of access. The ability to deliver healthcare monitoring may not require high speeds, but it will stress other dimensions of that access service: Ubiquity, cost, and reliability. Speed is not the only measure of progress; it's only the most obvious.

My third point is that since economics and investment are major drivers of change, we should expect that as the Internet itself evolves -- which it will -- the industry structure that creates the Internet will change as well. The concept of Internet service provider itself is only about 15 years old. And in that time it's mutated from the idea of an overlay provider on circuits provided by the telephone company to a set of providers that may own their facilities. It may seem that facilities ownership implies a

certain degree of stability, which it does due to sunk capital. Proposals such as that virtual Internet that I put forward have the potential to split the traditional facilities-based provider into two layers. It's somewhat akin to a virtual form of facilities unbundling if I can gum up two ideas in one sentence. And that will shift the incentive structure in industry. It will shift the ability of facilities providers to implement various sorts of policy objectives.

If the FCC plan addresses any objectives other than simple deployment of facilities -- if it addresses, for example, national concerns such as targets for serviceability or the implementation of lawful intercept or emergency preparedness, all of which the FCC has dealt with in other contexts -- then this would require attention to a larger set of players and the plan would then have to deal -- take into account the plasticity of this set of actors in trying to create suitable incentives and obligations.

Finally, our focus must shift from

buildout to uptake. I'm looking at data from the Pew Internet and American Life Project, which I think is a reasonable source of data in this space. And for a variety of reasons I would make the estimate that if we complete the broadband buildout in rural America, we will increase the percentage of the population that takes broadband Internet by about two percent. Now, I think the buildout is a valid social goal, but if the FCC plan only looks at this narrow mission, a very modest segment of today's population is going to be affected.

If the plan addresses what I'm calling sustainable broadband, it will affect everyone who uses broadband, which today is about 63 percent of the adults at home.

And finally, 22 percent, according to Pew, of adults report they don't use the Internet. A plan that addresses this issue would affect almost a quarter of the population and in the end will be the real question as to why we do not have higher broadband penetration in the country. Only

seven percent of adults today say that they use dial-up, so most of our existing residential users have already made the switch. It's the pool of nonusers that will shape the future trajectory of broadband usage.

Now, I don't want to be seen as expanding the goals of the FCC beyond what can be reasonably be done. For example, I'm not asking the FCC predict the future; none of us are doing that here. I think the plan should deal with uncertainty -- uncertainty both in the technical form of the Internet and in the industry that provides it. I think the plan should enable the country to track the ongoing evolution of broadband and look at the process of sustainability, not the relatively simple, I stress, completion of a national buildout. Your task is important. It's difficult. I wish you the best of success.

MR. PEHA: All right. Thank you.

MR. CLARK: Next victim?

MR. PEHA: And I should say for all the

rest of the speakers, apparently time is perpetually frozen at 10 minutes, but please try and keep your statements to 5 even though we can't apparently time you.

Van, do you want to? Okay, your slides are coming. Very good.

MR. JACOBSON: I foolishly prepared slides. I'm going to go through them very quickly and not read what's on them.

The first point I want to make is a historical one that when the Internet was created the world looked like this. It was done in the late 60s and when the Internet was created, data looked like that box in the lower right. You carried it around -- or lower left -- you carried it in your hands as tapes and cards. So the Net wasn't created to move data around. You moved data around by holding it and moving it. It was created so that you could share resources. It was, George, put this file on your printer. Right? We wanted to have conversations about resources. Conversations are point-to-point

between two parties. So that was the model that was built into the Net.

It was a fabulous piece of engineering -- one of the greatest artifacts -- this was the Internet architect sitting next to me, and it not only did its job, but did many other jobs. And in particular, it created a web of information and it made it valuable to have information on computers. But if you want to get the chicken and egg right, it was the Net that allowed the information to happen; it wasn't the information that drove the Net.

This year IDC says that we're going to create a zettabyte of content and move it across the Net. That's getting to be a pretty significant number. That's basically Avogadro's number. Right? Ten to the 23. Very big. We're doing that over a Net that was never intended to move content around. And because of this mismatch between what we're using the web for and how it was designed, a lot of problems arise. We're starting to see the effect of those problems. And

we're starting to think about how we can evolve from where we are to something that doesn't have these problems.

I'm getting brain pain from jet lag. Probably the biggest one is one that Dave brought up that because of the initial goals and the initial models, we didn't have security in the architecture. The way that we're using the Net today it gets more and more embedded in our lives. And we're not facing up to the fact that the security really sucks. And we're trying to trust it to do things like banking, do public discourse, do elections. It's not trustable. And the failing is not a failure of engineering or a failure of operations; it's a failure of architecture. The basic abstractions that we built into the Net, which is a conversation between two machines, are not what a person needs to trust and not related to the problem that a person wants to solve. I get something from my bank that says please withdraw this money or move it between accounts. And I ask, is this really

from my bank? And the Net says, well, I know what host it's from. I say, I don't care about hosts. What about my bank? Is this really what they sent me? Well, it's the bits that got put in on the other end of the wire, but I don't know if those are the bits that the bank generated. They could be anything.

So there's this really fundamental disconnect because the content is invisible to the Net and the content is all we care about. And the way the Net works we don't care about. We don't want to know about Nets. We don't want to know about the wires, about the hosts, about the ports. So, we need to do something to get the way that people use the Net more in line with the way that the Net works. And that's driving some of the research landscape today. You can see in the commercial world a bunch of what I call point solutions emerging to deal with content. Things like peer- to-peer protocols, content delivery networks. You can see hot topic and enterprise's virtualization, which is basically saying I don't

care about the particular host so I want it to be any host. Right? One that I can put where I need it to be. So we virtualize the disk or we virtualize the host or we virtualize the wires so that they can move around, be more related to our content.

All of these things are sort of telling us that the way people want to use the Net are much more concerned about the what about our data and about its content than the particular host that's fueling the back content. These are point solutions. They work for a particular person at a particular time or a particular problem. They don't have the generality or universality of the Internet because the Internet had an architecture. It was designed to solve a whole range of problems and to evolve.

There is some architectural work. It's centered mostly in the European Union right now. I listed some projects there that are looking at how you would do something like the Internet starting from now, evolve to something that has an

architecture and deals entirely with content. And I think one way or another that's going to be in our future. With that I'll stop.

MR. PEHA: Thank you, Dr. Van Jacobson from Palo Alto Research Center.

And coming back to the table, Professor Scott Shenker from UC Berkeley.

MR. SHENKER: I agree with everything that Van said. And if you knew the two of us you'd know that hell just froze over.

But I want to start off with a confession, that I'm terribly narrow-minded. So when confronted with the question, you know, what is the future Internet going to look like, I can only answer it in terms of the technical issues that I tend to think about. So the fact that I'm not going to talk about future applications or policy implications or societal ramifications or, you know, what would happen when we connect the people who are currently unconnected, it's because I don't know anything about it. It's not that it's unimportant, just I'm not the person to talk

about it. So I'm going to stick to what I do know.

So as a researcher I spend my time imagining, you know, ways we might improve the Internet architecture. The trouble with that is that it's very hard to figure out which of those ideas will ever make it into the deployed infrastructure. So I could tell you about, you know, sort of some of my fanciful ideas, but instead I'm going to tell you something that I've learned over the last two years about a change that's happening directly in the infrastructure itself and is being driven entirely by industry, not by academia.

So as a background let me remind you that the current Internet infrastructure is largely driven by the large ISPs who are heavily reliant on the high-end router vendors. So it's not a surprise that the infrastructure is centered on expensive routers running proprietary software. And because the providers can't control the forwarding path of the routers that they own, the

pace of innovation is quite slow.

So what's going to change this? What new is going to happen? Well, there's a new class of network. These are networks that are connecting huge data centers. Think of Amazon and Google. These new wide area networks -- I'll call them WANS -- are in terms of the bits carried on the backbone at least as large as the Tier 1 ISPs. So they're very large networks and they're growing very rapidly.

So what makes them different? Why would that cause a problem? Well, the reason why they're different is because they're run by cheapskates. These companies refuse to buy expensive hardware or support proprietary software. So remember what these data center companies did for data center computing. They took a market that was dominated by high-end serve vendors and they turned it into commodity x86 boxes and open source software. And they have decided they're going to do exactly the same thing for the WANs.

So their goal is an infrastructure around low cost commodity routers and switches built around Broadcom or fulcrum chips or other vendors and open source software to control those boxes. Whether it's a centralized control or a distributing control in the routers themselves is immaterial to this point. So it's open source software control and commodity boxes. So, when that happens, or if that happens, that means that they then can control the innovation in their own networks. And that's the thing that I think will be the big idea -- one of the big ideas for the future Internet.

So, why should the FCC care about this? There are four reasons. One is there's a new set of industry leaders.

They have very different regulatory histories. They have very different technical backgrounds. But they have huge teams of developers. So they can easily create the software systems needed to control a very large network.

And they're going to open source this so that any ISP can pick it up and run their networks. Now, granted, these new WANs are much simpler networks than the traditional ISPs because they have last mile connectivity. They have lots of legacy equipment. But for the first time we will have at scale a working example of a radically way to build and manage networks.

Second, costs will decrease dramatically. The cost of these commodity boxes is shockingly low. And with this open source software it's going to be much easier to manage the networks.

Third, the pace of innovation will greatly increase because the innovation is now in the hands of the users. And as we saw on the Internet, when the users can innovate things happen very rapidly. And so we don't know how they're going to innovate, but we know that they can. In particular, Dave's mention of these virtual networks is something that could fairly easily supported in this kind of infrastructure.

And so the fourth point is precisely that, that once you get this infrastructure it may be possible -- this is a speculative point that I'll have to clarify later -- it may be possible to more easily support some of the new architectural ideas that Van and Dave have talked about so far because some of them -- not all of them, but some of them -- can be implemented just by changing software. So you can keep the same infrastructure. You can run a new architecture in parallel. So it may be a much easier way to let innovations into the Internet.

So, the summary is new leader technology leaders in the broadband space; innovation in the hands of the operators, not the vendors; a revolution of the way networks are built and run; and perhaps an easier way to deploy new architectures.

MR. PEHA: Thank you, Scott. Taieb, you missed me saying good things about you so I'll take them all back. Let me introduce Dr. Taieb Znati, the division director at the National

Science Foundation.

MR. ZNATI: Thank you, Jon. I think we all agree that the Internet and associate services -- that this infrastructure has enabled through the years to transform the lives of many, many people in so many diverse areas. And I also think that we may agree that the lack of performance or liability is becoming truly a hurdle toward advancing this Internet to become a truly dependable critical infrastructure.

So, the question that I think Jon wanted us to address is what is this network of the future and why should FCC care. Let me say in a nutshell what I think about the network of the future ought to be. I think the network of the future must be robust, secure, and ubiquitous information and communication infrastructure whose performance is sustainable and whose behavior is predictable.

So, let's look at the context within which this network has to be developed. So, first we have a multi- faceted ecosystem of

stakeholders, something that really was not in place when the first Internet was created. We have university and industrial research enterprises. We have mature technology companies. But we also have emerging start-up companies trying to find their way in this competition. We have industry that influences innovative firms and then we have the regulatory environment and legal frameworks within which these frameworks have to operate.

And if you look at the stakeholder, they have a lot, you know, to compete for and they have a lot of pressure and powerful contextual forces to deal with. First, we have the regulatory and legal environments. We have the supply of financial and human and intellectual capital and all the tussles that occur because of the tension of openness and ownership and so on and so forth. We have the economic infrastructure. And last but not least, the international competition. There's a lot of people thinking about creating the next Internet. There are stakeholders competing for

the production of IT-based goods and services that create economic wealth, jobs, and social benefits. So it's no longer about communication.

So what needs to be done? I think, first and foremost, I think the U.S. broadband infrastructure is not as advanced or as widely deployed as in many other countries in terms of the nationwide availability, use, and speed of broadband. The use has been -- U.S., in a way, has been losing ground with respect to many other nations who are developing their broadband infrastructures.

So what should be done? I think the United States should establish an ambitious target for regaining and holding a decisive lead in the broad deployment of affordable gigabit and even higher broadband services. Federal and state regulators should explore models and approaches that reduce regulatory and jurisdictional bottlenecks and should increase incentives for investment in these services. I think the government -- and I mean by that federal, state,

and local -- should foster commercial innovation and itself make strategic investment in research and development. This Internet is not going to happen by itself. I think it's going to require having investment for all these parties.

And it's not, again, about the development of this network; it's also about the deployment of this network which may require some understanding and which may require test beds to be developed in order for us to gain the understanding needed to develop these networks. But there are also a myriad of research and development challenges that we have to undertake and we have to explore in order for us to build the network on a sound ground so it achieves the purpose it is built for and maybe nothing else, so other people and attackers and terrorists would not attack us through our own infrastructure.

So what are the situation developments? I'm not going to go into detail about them, but I think the first thing is the network behavior and performance. I think we have to understand how

the complex dynamics of a system occur, in what way it fails, and how can we adapt to the failures as this emergent behaviors of this system occur.

The second thing is future network design. I think we have heard about a few paradigms here and frameworks. I think we should think a little bit more carefully about what is this architecture and how should it be developed. And what are the choice that have to be made to enable the self-evolving, robust, and manageable infrastructure of the future.

The next point is the information privacy design tradeoffs. I think it's very important that our networks are economically viable and they maintain the social values that we care about. In this space there's a lot of legal tradeoffs in the design of robust, secure, yet privacy protecting network systems.

Next one is the social requirement and interdependencies. I think we have to understand what the fundamental social requirements for our future networks are.

What are the purposes and what are society's expectations for reliability, performance, and security? I think it's about people. It's no longer about computer scientists defining mechanisms to measure delays and so on and so forth and relating the performance of the network to that. I think there are other factors that have to be embedded in this framework.

We need new foundational hardware and software technologies, but also we need understanding of this technology. I think one fundamental question that we have to understand is what are the fundamental capacity limits of optical and wireless systems, how spectrum ought to be managed, and how networks can be designed to leverage the capability of these emerging technologies. I mean, we build this network sometimes without good understanding of the technology underneath them and enables them.

And more importantly, how would the emerging cyber physical system impact future networks? What I mean by cyber physical system is

the systems that are developed like all these devices and iPhones and so on and so forth, and how this connection to this physical world should happen so that we can build these devices and build this application so that our life can depend on it.

Thank you.

MR. PEHA: Okay. And final speaker. Dr. Rob Atkinson, president of ITIF.

MR. ATKINSON: All right. Well, thank you, Jon. It's nice to be here.

I think, unlike everyone here, I'm not a scientist. I'm a social scientist. I think that counts for something, but probably not very much. However, my coauthor of my statement and my colleague at ITIF is a network engineer, Richard Bennett, so I want to credit him with much of what is in this statement.

I guess I just want to start at a very broad level and argue that -- I would argue that if you look at the world as it was in '95 to where it is today, and then say where's the world going

to be in another 14 years, say 2022, which year it will have more change, I would argue it's the year we've just come from, not the year that we're going into. I think the Internet -- the year before 1990, we had really no Internet. Certainly, no commercial Internet. No Netscape. None of the real things that we're enjoying today. In 2022 or 2023, we'll have all these things; they'll just work a little better.

I don't mean to underestimate the fact that there won't be evolution and innovation and change, but I don't think it's going to be anywhere near as dramatic as what we've just come through. I think we have the system that we're going to be playing -- that we're going to be working with. And that's the question here is how do we make that work better?

I think there's a real risk from a lot of different factors, and particularly how people view the Internet, that it is this thing, like the black telephone. That it's this thing that's inevitable and you can't change it. And I think

that's a fundamental mistake. I think we -- basically we need a regulatory, legal, and technology policy framework that encourages and enables evolution in the Internet really at all levels, whether it's all the way at the application or in the network itself. I think that's going to be important.

Let me just sort of risk repeating what David said. I think the big changes in the next 15 years in this area are going to be several. They're going to be -- I think embedded intelligence is going to be a big driver of Internet usage. We see that with IBM's Smart Planet Initiative or what we call making the world alive with information, whether it's intelligent transportation systems or what's going on in various places with different kinds of sensor systems for environment and a whole set of other things. That, I would argue, is just going to grow, probably the fastest growth of anything in the Internet over that period.

We're certainly going to have more

users. We're certainly going to have more wireless. A nice article today in either The Post or The Times. It was talking about iPhone users and how much data they use and how much of a stress that's putting on the wireless network. We're going to have more bits -- people alluded to a lot of video. We'll also have more real-time apps. David talked about that with healthcare, but certainly, a lot of applications are going to require real-time. Certainly, more risks.

And then finally I think an area that I don't think a lot of people talk about is authentication. I would argue we need an Internet that enables authentication and ID.

There are some people who would see that as an anathema to the Internet. I think it's critical and central to the progress in the Internet. You see a lot of other countries making dramatic progress there -- Belgium, some Asian countries -- where they're equipping their citizens. You see that in some of the Health IT initiatives going on in Denmark where they're

really equipping their citizens with real authentication.

Where are we in terms of the policy on the R&D side? I think we're at a real risk in the U.S. because we had a policy system -- excuse me, a technology system that enabled us to create the Internet and be the world leader. And we don't have that anymore. That was essentially institutional structures like Bell Labs and like DARPA that enabled this kind of generic, but shared technology development. And DARPA has really moved more towards later stage technology more narrowly focused on defense. Bell Labs is a shell of what it was. So we don't really have any kind of institutional system for research in the U.S. that is able to bring together all of the key players in one place and in a shared way that is focused on generic technology development.

I think it's critical that we replicate these. If you look at what other countries are doing, they're doing that and they're also investing significant amounts of money.

I always like to look at Finland, to me the real leader here in a lot of areas. If we were to invest on a per GDP basis what they do on Internet and telecom R&D, we'd be investing $6.8 billion a year. We're investing much, much less than that today in the U.S. The E.U. and their six framework program and IT is investing $5.1 billion equivalent. The European countries are all investing. Some of the Asian countries.

So if you look at sort of -- if you look, excuse me, if you look at IT investment -- R&D investment by the federal government over -- since 2000 to 2008, it's actually growing at a slower rate than overall federal R&D investment.

I find that quite troubling. I think that's one of the key things we need to turn around.

My final point is how do we go about replicating some of this kind of shared generic technology research that brings together all of the players, including industry and academia. I think the model in the federal government today is

a program called the Focus Center Program. It's a partnership between DARPA and the semiconductor industry. It used to be called MARCO, the Microelectronic Advanced Research Corporation. And it's a partnership where the companies, the government, and academia get together. They develop a research roadmap, and they implemented some six or eight universities, leading edge universities around the country.

I think that's a great model. I think we could replicate that here in the Internet broadband telecom space and envision four or five of these shared research centers ultimately that would be in academia, but would have deep industrial involvement, deep federal support. But the only way for that to happen is with federal leadership and that may be something that NTIA could take a lead on perhaps with the FCC and NSF.

So, thank you.

MR. PEHA: All right. Thank you all. Did you want to jump in? Okay.

MR. GREEN: Thank you, Jon. My role

here is probably more as a commenter than a presenter. Thank you for inviting me to be on this panel. It's just a privilege to be up here with all the experts.

As a commenter, what I'd say, I think I detect some common threads in all of this. It harkens back to a paper that Dave Clark published a few years ago called Tussle. Well, it had a more elaborate title than that, but Tussle is a very memorable phrase. And I think the thesis of the paper was that the Internet was formed in simpler times.

There was a sense of purpose shared among the architects and there was a sense of common vision. We don't have that anymore. In fact, what we have is a much more complex playing plain and I think stakeholders is the right name for it. We have governments -- and very diversified, from very repressive governments in the world to very liberal governments. We have users. We have commercial ISPs. We have people that are concerned about rights, rights holders,

and so on. So there's quite a collection of stakeholders now that are involved in the Internet.

And if we're going to solve the architectural problems of the future Internet, I think, as Dave correctly points out, we need to consider these stakeholders and we need to consider what architectural changes or directions or concepts can be introduced in order to try to address those issues. As a technologist, of course, I think we can solve most of the problems, but I'm sure that's not true. And I'm sure there are a lot of problems beyond the technology. But at least it's an area that from the technology point of view we can approach. And I certainly agree, coming from a research background, that we need is research. And not only that, we need experimentation. I think particularly in this area it's very hard on just a pure theoretical research basis to understand how these stakeholders all fit together. And so I think we need platforms and experimental situations.

I very much agree if we could have sponsored research centers that somehow bring academia and industry and some of these stakeholders together to try to figure out what the best direction is. I'm always a little bit concerned that if we don't do things like that we're going to wind up with incremental approaches to the development of the Internet which concerns me. While I think we need that, and I certainly wouldn't want to discourage anybody from expending effort in that direction, I think what we really need is some leaps. And I think the only way that that will develop is out of more emphasis on research and development.

I think my colleague here clearly listed the right areas to work in. I'm personally concerned about security. I think authentication is a huge issue that we need to address and we need to look at from a research point of view.

As I mentioned, experimentation I think is part of this, and certainly focus on architectures and architectural approaches. I

know NSS has programs in this area. And I guess what I would say is I'd encourage much more emphasis on research and organizing research and experimentation, preferably on a national basis if possible.

Thank you.

MR. PEHA: All right. Thank you. I'm first asked to ask people to turn off their telephones or their cell phones. We're having a natural experiment in interference in the room apparently.

So, I guess I will kick off with a few questions. I will ask my -- some of my worthy colleagues who are up here to ask some questions and there will also be a chance for people online to submit questions or via Twitter or even on old-fashioned paper and pencil for those who are in the room.

And I think maybe I was looking at the clock overly ambitious that we can do this as phase one and phase two. So I will ask a few questions, mixing together where the technology is

going and something about innovation, and then you all can ask what you like in there.

I was intrigued, I mean, Scott Shenker raised the idea that with new switches you could have different players managing the innovation. We heard, you know, Van Jacobson suggesting a fairly radical potential shift in the protocols you would need. And Dave Clark mentioned the phrase facilities on bundling. I put these together. Is it possible that one might actually have multiple Internets running simultaneously with different sets of protocols and maybe even serving different purposes? And if so, does that mean -- you know, is this a new product line for the same Internet providers or is this a more fundamental restructuring in who can offer services?

Anybody?

MR. CLARK: Whether or not it comes to pass it is clearly a possibility. There are people in the research community who deeply believe in it. They think that the ability to

take the physical resources -- the routers, the circuits, et cetera -- and virtualize them in the same way we virtualize a machine so that you can then run different -- what today we would call Internets; different architectures on different slices -- is the way to preserve flexibility in the future.

Now, there are technical issues there. There are also issues of investment there. If I'm a facilities owner, what is my motivation to build a system like that in which, in fact, I have reduced the part of the value chain over which I have any control? And for example, if I don't control routing, how do I know where to put the physical circuits so that the logical network actually has circuits going where they want? There are lots of problems in that space, but the excitement of the enthusiasts there is that if it turns out that you want different Internets in different places, different architectures, you can do so without having to go back and replace the equipment. And that's -- the virtualization of

the machines in the machine rooms has incredibly changed the facility with which people can evolve service offerings.

So, that is a distinct possibility. It's got problems. I'm really enthusiastic about people that are pushing on it and it might change your whole sense of what it means to own facilities, what it means for there to be a network. And I think that is a possibility and it's a radical one.

MR. PEHA: Taieb?

MR. ZNATI: I'm going to go one step further and say maybe it's virtualization.

Does this work?

MR. SHENKER: You have to get in close.

MR. ZNATI: Okay. So maybe the paradigm just depicted right now is going to be the only possible one because if you think a little bit and go back to the history of how the Internet emerged and what we have done in the past, I think we have tried to run for a long time different types of networks. You have telephones and you have video

systems with the multiplexers and so on and so forth, and then we had the data networks. And we tried to merge them together, and we tried to build a unique uniform paradigm to enable the quality of service of these networks.

We all know that ATM has not gone, you know, far with that and the ATM basically reverted back to a switching network, the type of network that people were envisioning at the time it was created. And the differentiated service and the integrated service had problems as well. So it looks to me that the only way we can actually allow evolvability of the network and meet the quality of service of applications -- not only the ones we know about right now, but the future ones -- I think virtualization will allow people that flexibility to be able to deploy networks for specific purposes. Some of them will be short duration; some of them will be long duration. But nevertheless, the application will determine how these networks ought to be configured in order for the application to reap as much benefit as

possible from the infrastructure it's using.

Now, I'm not saying this is going to be easy to do, and I think virtualization has problems right now, just like what David has said. But that's going to be the challenge for us, how can you enable, you know, virtualization at scale that will allow you to do the type of things you just talked about right now?

Thanks.

MR. PEHA: Okay. Any comments on that or -- okay. I will ask you on a different part of the network, we've had a lot of discussion in previous workshops about last mile capacity and some discussion about middle mile capacity. I'm wondering if some of the changes -- potential changes that you've discussed here today -- will that make these greater bottlenecks or smaller bottlenecks? How might that shift where the problems are in the network?

MR. CLARK: I spoke first last time. Does somebody else want to speak?

MR. PEHA: I've stumped the smartest

people I know. That's great.

MR. CLARK: So let me give you a framing of that. We're going through a transition now with the movement of the video experience onto the Internet. And it's clear that a lot of ISPs are struggling with the usage demands in that space. And we're coming to grips with the fact, which is if you imagine all the video in the world going over the Internet -- which is now taking us to the second panel -- while usage -- the cost of actual usage, the cost of sending bits across the network, is not an application killer, it is neither zero. So I think there's an interesting question, which is whether or not there is something else after video which is as demanding relative to video as video was, say, compared to music. Or after this are we going to stop and take our breath for a little while?

I know a lot of the middle mile buildout that people are contemplating now has to do with fiber infrastructure. And once you do that you give yourself quite a bit of time. You've

slightly future-proofed the world if you do fiber buildout. Because, well, you know, you can light up more lambdas and maybe somebody can figure out how to squeeze more lambdas into the fiber. And if you look at the way we're milking the fiber base today that we built during the exuberance of the last dot-com event, we're doing a pretty good job of milking that fiber.

So, I think it possible, despite the fact that I've said that broadband is a -- that sustainable broadband is a serious issue, I think that if you make your middle mile plans properly you may discover that you can make a capital investment now that you can live on for a while.

The answer for the last mile clearly depends on the technology base you have. Okay? To me, the interesting question is in the wireless base where we have, again, I think a question relevant to policy, which is whether broadband will be a complement or a substitute -- wireless broadband will be a complement or a substitute to wireline broadband. And depending on how good

your wireline broadband is, it can take one role or it can take another. And I think you're getting different answers in different countries right now.

I tend to feel that there's a -- innovation has -- experimentation with user applications has not died with HD television and there will be things which we discover emerging as the bandwidth empowers them. So, that's why I argued. And I would say specifically with respect to last mile that anybody who makes plans in that space, which is obviously very capital-intensive, should be thinking about it as a sustainable plan and not a one time plan.

We could argue about whether video is actually the end of the road. I just -- I don't think so because we haven't -- you know, never before has the road ended. You know.

MR. ZNATI: Jon, actually --

MR. PEHA: Oh, no, no, no. Go ahead.

MR. ZNATI: Actually, it's going to be quick. I just wanted to bring something that I

know is dear to your heart. And I think we're going to still have the same problems that you probably talked about in the previous workshops, but I think the biggest concern is actually to have to deal with mobility and how to deal with resource scarcity, especially when it comes to wireless. And I think one potential solution to that problem is really to focus on cognitive networks as opposed to really cognitive radios and system and isolations. I think it's going to be a great challenge for the future in order for us to actually build the type of applications to support the type of services that David has just talked about.

MR. GREEN: I very much agree with that. I think cognitive networks are quite interesting. I should come and talk to you more about that.

And I really hesitate to approach this subject because it's a bit self promotional, but I've spent the last decade or longer worried about the last mile. And I hope the work that has gone on in my laboratory is in some way helpful in

providing an infrastructure that will be able to expand and adapt to these needs. As you know, we're on our third generation of the DOCSIS model and we started out at one megabit, and then we did 10 megabits, and now we're up to 100 plus. I think there's enormous capacity left in the cable infrastructure.

The hybrid coax model is a good one economically. I think we've shown that it's a good one technologically.

So, I would say I think this is at least one approach to the last mile that can continue to grow and continue to provide that last mile access. The actual drop into the home is capable of 5 gigabits. So, you know, moving back in the rest of the network you can see there's still a lot of room. If we convert everything to digital and everything to packets, we would have, I think, what amounts to a very useful solution.

Again, I apologize if that sounds self-promotional. I didn't -- I tried to make it not that way, but I simply had to say -- since we're

talking about the last mile I simply had to get it out. Sorry.

MR. CLARK: Jon, can I build briefly on what Van said a minute ago in response to your question?

If you think about, for example, the flow of information into the home where the dominant number of bits coming into the home today is the television experience, you recognize that there's tremendous potential to trade off the traditional tradeoffs in computing, which are storage versus processing, versus communication. There are tremendous benefits if you ask, well, where is the cache, for example, from which the information is being drawn? Well, the answer is it can be in the head end; it can be in your home; it could be the digital video recorder of the future. And if you look at the cost efficiencies of the video delivery systems we have today, they really don't have to do with the fact that they can compress the data better than we can. It has to do with where the stuff is stored.

And so the emergence of an information architecture -- and there could be competing points of view about an information architecture -- can have a tremendous effect on how we are able in the future systems to flexibly trade off storage against processing against communication. And if you think that the last mile is an economic -- will continue to be an economic challenge -- and I'm saying sustainable broadband in that space is a sustainable challenge -- having an architecture that lets you make those tradeoffs -- and by the way, having an industry structure in which you don't have to regulate the resulting tradeoff, assuming you're in favor of the preamble of the Telecommunications Act of 1994, which says to reduce regulation -- that ought to be architected. And that's a big change.

MR. PEHA: Van, did you --

MR. JACOBSON: For video, in particular, the issue isn't the last mile; it's the first mile. The problem is that unlike WiCast video, where the fact that I turn on my TV set doesn't

cause the transmitter to use more frequency, the fact that I pull a new vide from YouTube causes YouTube to use more bandwidth because I have to make a connection to it, then I pull my copy of that video down from the connection. What that means is for popular services if you have a high degree of sharing, which is, I think, the thing that we want to promote with the Internet is to have a lot of shared context and shared communication because the bandwidth that we use is a function of the popularity, we have a hell of a time scaling it up. You improve the last mile -- and by all means, improve it and, as Dave says, have a roadmap where you can keep improving it, where you don't say, oh, this is the final form of the last mile. We say, you know, whatever works and let's just keep making it faster. But every time you do that you get this multiplicative effect on the first mile of all of these sources and that's architectural. That happens because you have to have a conversation to pull the data down.

And so it's just what Dave was saying. The way that you get around that is the content has to move into the Net. So, when I ask for a YouTube video it's coming, you know, from YouTube, but it's percolating through content caches or content routers or some model and I get a copy from the closest thing that's got a copy, say, on the way to YouTube. It's a very different architecture. From a user's point of view I'm asking for the same thing. I'm asking for a YouTube video, but I'm not asking for it by a connection to YouTube. I've got to get it a different way. The Net has got to know the data that I want at the content level, not at the connection level.

MR. SHENKER: So, that's where your comments about security come in. If you're not getting it from YouTube anymore, you need to be able to verify --

MR. JACOBSON: Correct.

MR. SHENKER: -- that that was the original source of it, even if I'm getting it from

my neighbor.

MR. JACOBSON: Yes. It's the same problem that you had in the evolution from landline to cellular, which is you used to know exactly where to send the bill for a phone call because you sent it to the house on the other end of the wires and it was fixed. You're walking around with a cell phone and say, well, where do I send the bill? How do I tie this call? If you can't tie it to a physical location like we do today with our communication, then you've got to be able to get identity out of the data itself. And that means that you need to have a security model and it's got to be an architectural model because it's got to be useable everywhere.

MR. PEHA: So if I've got this right there are implications on the last mile, but it depends on the amount of storage; it depends on where the storage; and it depends on how much we can share information. And I've got to work out a security model to make all this work.

MR. JACOBSON: Absolutely. Yes.

MR. CLARK: Right. That's it.

MR. PEHA: I would love to ask questions forever, but I have frustrated colleagues here, so Stagg Newman.

MR. NEWMAN: Both of us are here waving our hands. I guess you called on me first. And I've got 20 questions, too, but I'll try to confine it to one and turn it back to Daniel.

We raised some great questions -- what I'll call at the architectural level -- but Dave also raised a question at the bit pipe level, the plumbing level. And that is, is wireless -- will wireless be a substitute for access? And then separate that into -- I mean, clearly I think all of us believe mobility is a service which can only be done through wireless. It's going to be a tremendous platform for growth and innovation. But as a substitute, if I look at the calculation -- and I've done them over and over again -- you know, a single sector with LTE, the best 4G technology of a carrier -- has 20 up and 20 down -- is going to support about the same amount of

bandwidth as a single copper pair. You know, 20 to 40 Mbit/s per second pipe -- as Dick said, cables of 5 Gbit/s pipe -- do we -- are there radically different wireless architectures that can solve that problem? Do we need research there, that are economically viable? Because, you know, we've seen a lot of attempts at different wireless architectures, but we haven't seen any make it yet.

MR. CLARK: May I?

MR. PEHA: Please.

MR. CLARK: I'm going to give you an answer you don't want, which is I think you should--

MR. NEWMAN: We've done that before.

MR. CLARK: Yeah, yeah, yeah.

MR. NEWMAN: And you were right.

MR. CLARK: I think the best way to approach this is in some sense to unask the question. And the reason I say that is that all such architectures will, once you stare at them closely, be wired-wireless, hybrids. Just the way

we have hybrid fiber coax hybrids. And, you know, if my wireless link was as short as the coax links are getting in the HFC systems, you can get honking bit bandwidth to cross that, but the buildout cost is about the same because you've got to push the fiber just as far out.

So, the whole answer will relate to the way the architecture -- and this is something that in today's Internet could be done underneath the Internet which is very powerful -- the way that architecture trades off the cost of further penetration of the wireline into the system the size of the cells, the size of the base station, there are magic things coming out of the wireless space. There are these people who are building vealicide chips that can go at -- that transmit at 50 GHz and I just look at them and I say, I don't believe you did that. I don't believe you made a commodity chip go 50GHz.

But fundamentally in the last mile space or the fixed wireless space, the overall architecture question will not be just a wireless

breakthrough. It will be a clever idea about how you trade off wireline and wireless hybrids. And I think that in some respects the incrementalism which the cable industry can so effectively use -- as they push the fiber further they split the system; they do these kind of things -- may be what you see happening in spaces where you're trying to make wireless -- fixed wireless into a powerful substitute.

MR. PEHA: Danny Weitzner from NTIA.

MR. WEITZNER: Thank you very much.

MR. PEHA: Who we recruited for the day.

MR. WEITZNER: Thank you. I actually have one really concrete suggestion, which I think we should just bolt all you guys to the floor here for about a week and you write the Broadband Plan and when you've left -- when you're done, you can leave. And then you guys will make your February deadline, which Blair is very worried about. So get comfortable. Food will be brought in.

I guess I want to just sort of ask a question based on the observation that it seems

like there's this large-scale agreement here that we need both innovation and broader penetration. We need to advance the Internet from what it is today to address all the questions that you all have raised, whether it's security or better innovation for routing fabric or everything else, content management. And that we also have this challenge of getting from 60 percent penetration up to whatever the magic number is above 90.

And I guess I want to try to ask about what you think is going to be the relationship between those two efforts. It seems like in the old black telephone world there was a certain sense in which over a long period of time we could have our cake and eat it, too. That we decided to focus on the one hand on getting black telephones out to everyone, and that was reasonably successful on the one hand.

And we, at the same time, had this whole communications and information technology innovation process that led to the Internet that we have today. And I think that based to a

significant extent on, you know, very concentrated resources at places like Bell Labs and then a lot of sort of disruptive people, like Dave Clark and others, doing other things to a greater extent outside of that process.

And I guess I'm wondering whether you have some prediction about how the innovation that you're all talking about is actually going to happen. Where is it going to happen? Who is going to do it? What do those people need to actually make it happen? And should we be thinking about any relationship between that innovative process and the deployment process, the ubiquity challenge, or should we decide that they're somewhat separate?

MR. CLARK: I've been doing a lot of talking. Does somebody else want to talk?

SPEAKER: You first, Dave.

MR. CLARK: All right. Dave Clark again. With respect to penetration, let me go back to the data from Pew. And again, they have really rich data and I don't want to appear to be

an expert in it because I'm not. You should get an expert in here.

If you look at the nonusers, you can explain a lot of them with a couple of simple questions. They are the elderly and they're the poor. And if I can be slightly harsh, over time the problem of the nonusers among the elderly will pass out of the demographic pool.

MR. WEITZNER: You're old enough to be able to say that.

MR. CLARK: That's right. Yes, I know. I turned 65. I got my -- I went and got my discount Metro card. I ride the Metro for half price down here. I think it's a really great bargain getting old.

So, and if you can drive cost out of this, obviously, you will deal with the people who are poor. But I think the black phone model really was based on the assumption that we knew what the service was. And so we need to have a different model here which will be that there's going to be a wave and there will be early takers.

And early takers enable the emergence of new applications and then there are going to be late takers. And the late takers will eventually allow for the attrition of other early activities.

And so at this point, for example, I really suspect that if you can't do your taxes on the Internet, you have to pay somebody else to do it. We have digital scriveners. You know, we're scraping up the tail of the -- you can't get the tax post office anymore. They don't bother to put them out there. We're scraping up the tail of the curve by using digital scriveners. That's how you deal with the last grandma (sic) in the space. You don't have to be online; I can just go pay somebody.

Okay, and so there's going to be this wave through the system, and at the front new innovation occurs and at the back all things die. And they die when there's been enough penetration. So, first, if we can drive cost down you will solve the cost problem. If you can either educate the elderly or just realize that this has a

natural time constant. If you look at home today where people are 40 and 50, essentially everybody's using the Internet, so this problem -- that 22 percent -- I'm sorry, it's just going to fix itself over time. The only question is from a policy point of view do you want to accelerate it?

MR. ATKINSON: I take a slightly different take on that. I agree with the elderly. If you look at the model and people adopting automatic teller machines and the fusion of that, it was somewhat similar. Old people didn't use them and then they were replaced by other people who were users.

But I think on the other side though, the biggest factor in people not using the Internet or broadband is not using a computer. And that's -- if you look at the international studies that we've done, if we had the same computer adoption rates as other countries, our broadband adoption would be much higher.

And that's not just a question of income. There are a number of studies that

suggest it's more than income. There are various academic studies that have shown that. Not to say that income is not a factor, but it's not the only factor. And I think the problem here, Danny, to your point is it's unclear where this is going to go. One could argue that all of this innovation that we're talking about is actually going to make things more complicated. You know, it was easy to get a black telephone and figure out how to use it. All you needed to know was numbers. It's still incredibly complicated. I mean, I have a 17-year-old son who fixes my wireless router when it goes out and does all those things, but you know, I think it's still a very, very complicated system for a lot of people -- the PC, the router, the whole thing. And I think that may be actually an area where research is useful. How do we make this a simple thing without sacrificing the flexibility? We don't want to be a black telephone, but we also want something that's simple.

My last point of that is I think the one

area that may work in our favor here is that as we move more towards the video Internet, I think that becomes a more appealing kind of take-up for certain people who will say I like the video part a lot. I might not want to do some of the other things.

MR. WEITZNER: Now, you guys kind of ducked the second half of my question which is where is the innovation going to come from. And I want to try to separate the question of where is the basic research going to come from? How do we make sure we have just a pool of great science that can be the source of new network kinds of innovations? And people who can do that. But also how do we get it from lab to network to services that are in people's hands?

And I'll take your point, Dave, that those are going to be the people at the front of the wave. But how do we -- how is that process going to happen? Does it look the same as it looked in the traditional regulated communications infrastructure? What is it -- does it look the

way it looked over the last 20 years of the Internet or is it going to look yet different again?

MR. CLARK: I don't think it's going to look the way it looked in the regulated telephone industry. I don't think we will ever go back to sort of a centralized Bell Labs which was a repository of tremendous intelligence, but was in some sense centrally directed. I think the current innovation -- I'm not talking about research now, but I'm talking about current innovation and productization -- is emerging in a space which is essentially entirely unregulated. If you look at what Google is doing, you know, where do all my students want to go? Google is the sinkhole into which all loose rocks fall. They all want to go to Google. And that's because Google has made itself such an exciting place to go innovate. And the answer is right now they're really pretty good at it.

So, you know, I don't see us going into a space where innovation -- it would be a strange

space if we somehow found we were going back to a world in which the innovation was occurring in the context of a more regulated and top-down managed space. To me our challenge for innovation, just as it is for research, is maintaining the U.S. standing. But right now, you know, we still own -- we may have sent all our chips overseas, we may have sent a lot of our industrial stuff overseas, but, boy, we still are pretty good at getting bright ideas into the marketplace.

Somebody else --

MR. PEHA: Go ahead.

MR. JACOBSON: I agree with what Dave said, but a consequence of sort of venture-driven innovation -- which I come from Silicone Valley and it's, you know, God is the culture -- but it means you've got a very short-term time horizon because you've got to get commercial return. That means that you're thinking at most 3 to 5 years out because product turns are 6 to 18 months.

And when that happens you can get really great things, but I don't think you get something

like the Internet because it looked to me like it was designed with a much longer time horizon, thinking much more to the future. And if I were asked the question where is the innovation going to come from, I would probably say Finland. We've lost not only the research labs in this country, but I think we've lost the long view of research culture that -- there was a big push from Congress, starting in '95, saying research should be commercially relevant. And I was working at a U.S. National Lab and we got the directive that our research should be commercially relevant. That was one of the prime funding requirements. And then on through the bubble, academics learned that if they took their research and turned it into a business plan, they would get very rich.

So, you ended up with a lot of forces in society that were causing people who were thinking long term to think short term because they got a lot of rewards for that. And we've been doing that now for almost 20 years. So I think we've lost a lot of people in this country who think

long term, and I think we -- in particular, the U.S. -- is going to feel the pain of that loss as we see a lot of fundamental research coming from overseas.

MR. ATKINSON: I'd just make a point. I think it's somewhat of a false dichotomy to say the choice is between Bell Labs and what we have now -- the old Bell Labs in a regulatory system. What we try -- I think, Danny, what we need to find is that sweet spot because I don't think we have it right now.

We did a study called the Atlantic Century where -- which Aniche cites every once in a while -- where we benchmark the U.S. in innovation-based factors and competitiveness and looked at 37 other countries and 3 regions -- the E.U., NAFTA. And we were 40th out of 40 in progress since 2000 on these innovation-based factors. Things like government support for R&D, corporate R&D, IT investment. I think that when you look at a lot of the innovations that have happened in the U.S. in the last decade, I don't

want to diminish them and they're cool, but they're sort of simple in a way. You know, they're things that a few people can do in a small lab; they're not big things. The big things, I think, are really the risk of the big things. And to Van's point, the systemic things I think other countries may be able to do them better because they're more organized about it. So I think we need to figure out a way to -- how can we be in a more organized, but still entrepreneurial way in a way that still respects the importance of basic or early stage exploratory research.

And I go back to this, there's a wonderful book or article -- book by Donald Stokes, a science policy person. He makes this point called Pasteur's Quadrant, which is what we really want is this sort of basic research that's directed or that has a focus, if you will. And that's what he calls Pasteur's Quadrant. That's, I think, the challenge for where we need to be in this space.

MR. PEHA: Bruce Gottlieb, jump.

MR. GOTTLIEB: My question is actually a historical one that maybe can put in context what we're talking about today. My question is if you step back 10 years or 20 years and thought about the predictions that you might reasonably make about how the Internet would have developed, either as a sort of social phenomenon or at a technical level, what did happen that were a surprise to people. I assume we have a sample here of folks who had as good an idea as anybody 10 years and 20 years ago about how it was going to develop.

I have to ask this question, but this is almost an afterthought. If the government played a role in any of that it would be interesting to know, but this is not a question about how government affects the development.

MR. SHENKER: Ten years ago what did we predict?

MR. GOTTLIEB: Ten years ago and 20 years ago, what would you have predicted? And what didn't happen that you would have predicted?

And what were the things that really surprised you about how it developed? It's a question about how we should assess our ability to kind of guess the future. We all know we're not perfect, but, you know, we engage in these exercises because we think that there's some chance we'll be right.

MR. SHENKER: So, I mean, one guess I know I got wrong which was I expected video to become important much earlier.

COURT REPORTER: Excuse me, sir. Can you use your microphone?

MR. SHENKER: So I expected video to become important much earlier and not through something like YouTube, which I certainly didn't envision. Home produced video. So, I mean, now it's dominating the Net, but it came in a way much different than I would have expected.

MR. JACOBSON: There you had to wait. So you have to get all your ducks in a row. And even though we had the front-end video capture devices, we didn't have the last mile that would let the video fit. Intel gave us enough cycles so

that we could crunch the video down so that it would fit, and suddenly everybody got video. You put the box in place and then the last run drops in and suddenly you get the service.

And the last run for video was the compression technology and having the cycles that would let everybody -- you know, what else are you going to do with your machine? Right? God knows how many mbps. Might as well be compressing and decompressing the video.

So, that was one that was just going to happen when enough of the factors lined up for it. I guess I was more surprised by the web. That just came out of left field.

I was a physicist and I came out of a physics lab and we were doing this cumbersome data sharing and suddenly this guy said, oh, there's a better way.

MR. SHENKER: Actually, that's an important example because I was at Park at the time. Their hypertext was (inaudible). So sort of, on the one hand, you had physicists who were

surprised you could do this and you had the computer scientist who said, oh, that's too simple. Who cares? We want to do hypertext. And so the web was this perfect medium that took off.

MR. PEHA: Did you want to --

MR. GREEN: Bruce, were you thinking of broad- scale technology or just Internet technology for that question?

MR. GOTTLIEB: Anything.

MR. GREEN: Okay. Well, high-definition surprised me because it took longer than I thought it would by quite a lot. And I think it was interesting because the government did play a role in that. There was a Blue Ribbon panel at the FCC that helped produce what amounted to the U.S. Standard for high-definition television. But it languished in the marketplace for quite a while because the technology development necessary to really make it happen, which was large screen TVs -- all right, a way of presenting larger pictures in a reasonable way -- before that CRTs of any size were very heavy and cumbersome, so it took a

40-inch device.

And so it was very interesting. Even though the U.S. led in many of the developments which led to high- definition television -- and certainly one of them was video compression because before video compression, of course, digital video was so large you simply couldn't do anything -- and the government played a role and the U.S. really moved out in front, but it didn't really happen in the marketplace until the consumer electronic technology was there to make it commonplace.

MR. GOTTLIEB: Can I -- sorry, go ahead, Taieb.

MR. ZNATI: Twenty years ago, I think one of the things that surprised me the most is -- actually, two things.

The first one is Ethernet is still around. I mean, 20 years ago, when I did my Ph.D. research thesis, people were discussing the Internet. And even though it has been stripped of its basic characteristics, it's still around and

people are using it and innovating on it.

And the other thing that surprised me has to do with what Scott said, quality of service. I thought that after all the time and effort that we spent for 10, 15 years working on this problem you're going to have (inaudible) actually deploy this mechanism and have them in place to enable the type of video and so on and so forth.

But if you think about it, the reason for this -- there is a common reason for that. Ethernet lasted because it was simple. And the quality of service paradigms did not last because they were not simple and they introduced a high degree of complexity for the routers for the ISPs and so on and so forth because they didn't have the other pieces -- the social impact, the economical impact, and so on and so forth.

So simplicity is really a very important principle as we move forward to build these networks.

MR. WEITZNER: Bruce, just apropos of

the Ethernet. The Ethernet inventor, Bob Metcalf, somewhere between 10 and 15 years ago declared that the Internet would collapse. And then famously had to -- he wrote a column to this effect and then famously at a conference that he ran had to eat his column, which he promised to do if he was wrong when it, in fact, didn't collapse.

MR. GOTTLIEB: I hope he'll still be wrong in five years.

MR. WEITZNER: I always think that's a good story about what didn't happen because, you know, I think it's a testament to -- frankly, to the architectural work that the people on this panel have done that the resilience of the network is quite extraordinary.

MR. ZNATI: But if you think about it, the Internet has been built with a lot of simplicity in it.

MR. WEITZNER: I think that's a critical point.

MR. ZNATI: Simple this, trivial this, you know, all that stuff. And that's probably why

the Internet (inaudible).

MR. ATKINSON: One thing -- I was surprised by many things, but one was when we passed the Digital Signature Act in 2000 or in '99, I would have thought we would have had digital signatures and then almost none now.

MR. PEHA: A sad fact for those of us who write our thoughts down. Actually, all of us have bad predictions.

We'll go with you, Dave, and then I want to switch gears a little bit.

MR. CLARK: I've got to give you a negative answer. We're coming up on the 20th anniversary of -- or maybe it's already happened; I lost track of the first worm.

And it never occurred to me we could be so incompetent at recognizing the importance of the security problem. I thought we'd solve it in 10 years and, I mean, I just -- you know, I will not rant, but our willingness to recognize the fact that it ought to be something we deal with. It has been known for 20 years that there's a

serious problem there and we have manifest ignored it.

I want to pick up on what Dick said, which is the Internet is a network to hook computers together. And so a lot of our predictions about the Internet, right or wrong, don't have to do with Internet technology at all. They have -- with our ability looking over the fence -- to guess where technology is going. When will large-scale displays show up?

When can you produce a consumer-grade HD television which is an -- I mean, camera which is an astonishing device? How fast will these emerge?

And now, you know, when will sensors -- when will you be buying health sensors at Radio Shack and what network will they be hooked to? When will all cars be networked? It's really about those devices we hook together. The Internet does a pretty good job of keeping up with the devices, so if you want to understand the predictions that went wrong, there are actually

predictions about when other things like this would enter the market.

We thought we hooked every computer in the world together. We just didn't know about the PC and it was a mistake to guess the rate of the PC's emergence that surprised us in the '80s; not the fact that we could hook them all together.

MR. PEHA: Since we're very sadly going to run out of time soon I want to bring this back concretely to the National Broadband Plan, which is if the drafters of the National Broadband Plan decide that what they'd like is a broadband infrastructure that not just today, but in 15 years is cutting edge, as useful to society as possible -- you know, we've heard -- Van criticized our research programs, but we do have some, you know. When it comes to research, are we funding the most important things? Are we funding them in the most important ways? Are we funding them at the right levels? Or maybe there are things other than research funding. You know, if you were to make recommendations about the most

important thing we could do to keep innovation moving and to stay on top I'd love to hear what those recommendations might be.

MR. SHENKER: Well, I would put in what Van says, allow researchers to take a longer time horizon. It's not just the number of dollars, but the way most of the funding agencies work now it's very short. I mean, I write four or five proposals a year. It's a constant turnover and that's not conducive to planning your research out in four or five year blocks.

MR. ATKINSON: I would -- you can't have a discussion on this without raising it, but I do think the risk is we have to have a regulatory framework that enables innovation at the core and not just at the edge. And if we don't have that there'll be no incentive to do any of this innovation.

And then the second thing would be to go to this point of how do you get sort of longer term, but not totally blue sky, not relevant research, but that's somehow able to translate

into this. And I do think that's where this notion of somehow getting more ability to do these kind of research consortia along the lines of the Focus Center Program would be a good direction to go in.

MR. PEHA: Any other takers? A couple of minutes to tell you (inaudible).

MR. NEWMAN: Well, I'd like to hear all the speakers answer your question. It's a great -- I've been charged to make sure that the broadband plan has a research chapter or program in it. We're obviously going to be working closely on that.

MR. PEHA: So the question is would anybody like to write Stagg's section?

MR. NEWMAN: Yeah, the homework assignment is write this up. I'm serious. We would love written -- we would love filings, but also I'd like to hear all the panelists answer that question.

MR. CLARK: Well, I want to -- you have to look at the whole milieu from the long range

research and the innovation. You have to look at this whole pipeline and you have to ask all along the pipeline what's right and what's wrong. And you know, clearly I work in an academic research world. I suffer terribly from the considerations that Scott and Van have been bringing up. I will be blunt and say I think the absolute amount of money we're spending to support the beginning of this production process is miserable. Simply miserable. And if you look at the amount of money that's being spent in other countries in this space, and if you look at their articulated national policy -- which is in words of small syllables to exploit our failure in order to leapfrog us and make sure that we are left in the past, which is what they are saying -- you have to raise a question about whether this country actually cares about staying technologically in the lead.

Clearly, our competitors overseas think we do not and they see this as a great opportunity. And they're very blunt about this.

There's no mistake. You need people who are blue sky and make mistakes because the measure of doing good (inaudible) is you have a reasonable degree of failures.

You need to allow bigger projects to occur so that we can actually take ideas and carry them to an experimental stage.

I'm happy to talk to you about the amounts of money we spend, but it's a structural thing, as Scott said. There's absolutely no way today -- I'm sorry, excuse me, excuse me, excuse me -- there are ways, but they're incredibly difficult to undertake to put a five-year program in place.

And then the question is are we producing the right people that are carrying the ideas into industry? Do we have an architecture that lets us innovate. All of these things are true. But I have to tell you right now when I see some of our best students coming out and deciding that they don't want to go into research, but they'd rather go into short-term industry because

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they see the current climate of research in this country as being so hostile -- and that's what they say to us as they refuse to become junior us -- that there's a structural problem here which in one sense has to do with money and in another sense has to do with the sense that we don't care anymore. And I hear your words and we care about innovation. And most of us who live in this space think all we hear is words. And it's a bigger problem than you can solve. Flame off. That was my hot button.

MR. PEHA: Anyone else want to take a stab?

MR. JACOBSON: Can we applaud?

MR. PEHA: Actually, this is precisely the moment you can applaud. We're after 11, so I want to thank our speakers for coming from California and Massachusetts and across town to be here with us today.

MR. CLARK: Thank you for having us.

(Recess)

MR. PEHA: So let's get started. All

right. It is my privilege to welcome the next panel today. The next Big Idea is to discuss video over Internet and its possible implications for the Internet in the future.

Let me -- actually, we didn't -- maybe I will just go down the row. That's easier. So, I'll start with our first speaker today.

The question is -- the big idea is video -- will video become much more popular, and if it is, what implications it might have for all sorts of things, particularly in ways that might affect the National Broadband Plan. So we'll start with -- our first speaker -- we're going to have five-minute introductory statements and then we'll go to questions -- is Gilles BrianRosa who is the CEO of Vuze. And before that from McKenzie and Company in Palo Alto. Right?

MR. BRIANROSA: Thank you. My name is Gilles BrianRosa and I'm the CEO of Vuze, a company located in Redwood City in California. And I'd like to make the case for a national broadband policy that will foster innovation and

support the emergence of independent truly over-the-top video networks.

As an entrepreneur, I firmly believe that disruption is a key engine for positive change because it forces industries to reinvent themselves. And I also know that overly conservative approaches driven by protectionism often end up destroying value for everyone in the long run, especially when competition is almost absent.

Vuze is a Silicone Valley venture-backed startup. We are a very small company, less than 30 people. It's almost like we had to change our product roadmap to be here today. However, we operate at a global scale with 65 million downloads of our application for streaming and downloading high-def videos; more than 150 content partners; and 14,000 licensed videos on our content side called the Vuze HD network.

Delivery infrastructure is based on a highly scalable, cost effective, peer-to-peer technology. And by being independent, Vuze is

able to connect original content producers directly to the online viewers. And great things happen when you shake up the traditional value chain this way. In one example back in 2007, Vuze discovered a science fiction series called Sanctuary that quickly shot up to the top of the charts on Vuze and, as a result, got picked up by NBC's Sci-Fi Channel and became a hit TV series. So this is a real-life example of how industry disruption can create major value.

So why is Vuze and its audience relevant here? Well, Vuze users are early adopters and they are pointing the way of the future. They are avid, paying entertainment consumers. They're buying 35 percent more movie tickets and DVDs than other Internet users. They also own more high-def TVs, more Smartphones, more high-end electronics than average, and they're online inferencers. They're connected to 55 percent more people on social networks and they are sharing their opinion with friends and family.

So, in other words, they were the first

ones to buy iPods and TiVos and to tell their friends about it. So we should be closely examining the needs of these early adopters as a leading indicator for what broadband users of the future are going to require. And so if we let the incumbents lock down the future of digital entertainment, history shows that we will not be optimizing for the end consumer. Today, TV everywhere is under development by the cable operators in an attempt to ensure that consumers will still pay their TV cable bill even if they don't need it anymore. It's like having oil companies, like Chevron, saying oh, you can have all the electric cars you want as long as you still spend $200 a month on gas.

Also, NBC, ABC, and FOX, you know, see the joint venture of Hulu as a TV catch up service and artificially limit the user experience to make sure it doesn't disrupt established revenues from the (inaudible) coming from Comcast. So there are many other examples like this. And so let's face it. The incumbents have a vested interest in

preventing the emergence of online entertainment. NBC CEO Jeff Zucker's "Analog Dollars Versus Digital Dimes" reminds us of the fundamental conflict in asking the incumbents to reinvent their business.

So what is needed here? So first, consumers fundamentally want a great user experience. They want high- def, high quality videos to support long form viewing as opposed to just clips. It will require faster pipes and there is no way around this. Second, consumers are looking for portability. They want the freedom to move content around -- PC, MAC, mobile TV -- unencumbered by video format incompatibilities and DRM handcuffs. They already have these benefits through DVDs on MP3s so there should be no reason for why broadband video should be any different.

On the infrastructure side, the industry is struggling with how to cost effectively deliver these high quality videos that consumers are requesting. At Vuze, we believe that peer-to-peer

is the answer. Peer-to-peer is the only delivery technology in which more demand for a given video leads to both significantly lower cost and high user experience. That said, and as the Commission well knows, incumbent ISPs have been discriminating against and impeding peer-to-peer technologies in their network management practices. So the Commission should remain vigilant here to ensure that network operators are not permitted to unfairly interfere with peer-to-peer delivery all in the name of reasonable network management. We need a level playing field here for which neutrality is crucial.

So, in sum, the emergence of broadband video is another classic example of technologies routing established, consolidated industries -- in this case both the telecommunication and the entertainment industries. If large incumbents in these industries could have it their way, it is unclear whether we would have any meaningful broadband video ecosystem despite massive consumer

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demand. At the end of the day, we believe that businesses that are not tied to either existing offline content or the network infrastructure will experiment faster by focusing on the end consumer. By analogy, it was Amazon and eBay that revolutionized the shopping experience with E-commerce, not world model targets. And similarly, it was Yahoo and Google that revolutionized the publishing and advertising industries.

So, the one thing we need from the FCC is a policy that will foster innovation and support the emergence of independent, truly over-the-top video networks. Our vision at Vuze is to build such a network that doesn't rely on anything, but a second to none user experience and the emergence of new original content. And this is our big idea.

Thank you.

MR. PEHA: Thank you. Our next speaker will be Phil Wiser, who is the cofounder, chairman, and president of Sezmi. He was also

previously the CTO of Sony Corporation of America and Liquid Audio.

MR. WISER: Great. Thank you. Thanks for having me here today.

Well, my concept for a big idea is a very simple one. I found they work the best and are the easiest to communicate. And the concept here is that the television as a portal to broadband information is very powerful. And I was pleased to hear on the previous panel that there was an understanding that broadband access -- while speeds and feeds and building out more access to rural areas is important -- leaves most of the consumers that are not on broadband today still not on broadband.

The concept here is that the television screen in the home is a portal for information. Broadband video is very powerful. Video is powerful relative to other information for a few simple reasons. It connotes information that you can't get through text or other means -- emotion, intent behind the information that's flowing over

that. That's one of the reasons that video is one of the fastest growing data source on the Internet today. Unfortunately, we're in a situation today where that growth in broadband video is not reaching everyone.

If you could just throw up my slides I'll make one point with them.

While you see here that broadband video is accelerating really since 2007 -- thank you -- 2007, we've seen a dramatic increase about a factor of three. And overall, video consumption via broadband. And this is driven by obviously YouTube, which still garners 45 to 50 percent of the market. But the unfortunate fact that's associated with this growth is that the number of users that are taking part and are taking advantage of this broadband video is not growing. We're still at 50 percent or less of the U.S. Population that's taking advantage of broadband video to get information and entertainment. And that's a disservice.

And it's creating a digital divide.

And, in fact, those that are on the right side of that digital divide are taking advantage of broadband video to grow the gap. And their consumption is increasing while others are still left out of the picture on this. And while we look at broadband penetration and even broadband video use, we're in the 65 to 70 percent range. If you look at the users that are not online today and look at the computer penetration, you'll see that there's a large portion of those that are not on broadband also are not on compute platforms. And we have an opportunity there to leverage the platform they do have, which is their television screen, to deliver new information and services.

The beauty of broadband video is that it provides a diverse set of programming, a targeted set of programming, if you can get it into the home. And this is where really the social aspect of broadband adoption is very important. And one of the speakers on the last panel mentioned this as well, that the barrier to adoption in the Pew Internet Studies that I've looked at back this up

-- the primary reason that broadband access is not in these homes is generally a lack of understanding of the value of that access and also complexity -- it's too difficult to access that information. If that access were combined with something they understand -- and we used the black telephone metaphor previously -- if we combine that with something they do understand, which is television and television programming and make that available in a more convenient manner, we will raise awareness and inform the next generation of those households that they can take part in this revolution and not have to do it simply limited by what resources or platforms they have in the home.

So as we're considering the expansion of broadband access, we need to ensure that there is an unrestricted growth of broadband video. And there are several elements to not restricting that growth. Some of them are technical and we heard about that earlier today. The current network is not designed for what is a common viewing

environment. If you look at the brownouts of broadband video, they are almost always peak events related to simultaneous viewing of events, like the inauguration which browned out. If there were a broadcast component to video, those peaks would be smoothed out and we'd be able to scale video more effectively.

But I won't dwell on the technical issues; we do have economic issues, as well. As we just heard, we do not benefit from service providers that control the pipes restricting the types of information or services that flow over those pipes. The competition that would come from a broadband video environment would drive value to the consumer; it would open up access to programming for those consumers. And we've seen that happen over and over again. Look at voiceover IP as an example. When Vonage came onto the scene, they offered a very attractive telephone service to consumers, and when they were allowed to compete they changed the marketplace. They didn't just offer one service; they changed

the landscape to the benefit of consumers. We'll see the same thing with broadband video if that is supported.

The other element of the business is economic. There is yet to be found a sustainable economic motive for delivering broadband video. Fortunately, Google makes a large amount of money off of search that they can use to subsidize delivery of YouTube video. They don't make money on that and there are many studies that have shown that out.

It's very important as we support broadband video we support sustainable economic models, which means copyright and authentication for delivery of that video so that the industry can grow in a sustainable manner which it will not if it's only ad supported or ultimately pirated video that is used to deliver broadband video.

So, with that I'll wrap up by saying I'm hopeful that a key element of the National Broadband Plan is explicit support from broadband video and the utilization of that broadband video

to increase access for broadband in general to those underserved and under reached households today.

Thanks.

MR. PEHA: Thank you. Our next speaker is Gigi Sohn, who is president and co-founder of Public Knowledge.

MS. SOHN: Thanks, Jon. Good morning, everybody. It's not going to surprise anybody that video over the Internet is one of the most important drivers of broadband adoption utilization today. We saw the slide up there that Phil put up there that 158 million Americans watched video over the Internet in July 2009 alone. That represents 81 percent of all U.S. Internet users and it really serves as a testament to the creativity fostered by an open and decentralized Internet. Unbounded by traditional gatekeepers, like broadcasters and MVPD, Americans have embraced the myriad of opportunities that Internet video offers, both viewing and producing content that fills a variety of critical civic,

educational, economic, and cultural needs.

Internet video really holds great potential to further some of the most important goals of the National Broadband Plan because it encourages Americans to adopt broadband services and promotes their use for purposes such as education and civic engagement. Thus, the federal government must help foster an Internet video ecosystem that is competitive, open to new entrants, and accessible to all Americans.

One way the FCC can achieve this goal is by ensuring that providers that serve video content directly to consumers over the open Internet -- what we refer to as over- the-top video providers -- are able to compete fairly with traditional MVPDs. Increasingly, Americans are choosing to, what they say, cut the cord by replacing MVPD services with over-the-top services like Hulu, Netflix, Flip TV, and interpedently produced video podcasts. Because this trend threatens their subscription video business model, traditional MVPDs -- many of whom also act as ISPs

-- have responded with initiatives that limit access to Internet video content to subscribers of certain MVPDs and ISPs. For example, we've heard about TV Everywhere. That's an initiative that's being pursued by a number of MVPDs, both cable and telephone company MVPDs, that would bundle access to Internet video content with MVPD services. So, in other words, if you're not a subscriber to the video service, you don't get access to that content.

On the flip side, ESPN limits access to its ESPN360.com programming to subscribers of certain ISPs with which it has negotiated a deal. So Disney says to Comcast, you know, if you want to pay a per subscriber fee, we'll let your subscribers -- your broadband subscribers -- get access to ESPN360.com. Well, Comcast has said, no, thank you. And that per subscriber fee, it doesn't matter whether you watch ESPN360.com or not, the ISP still has to pay a per subscriber fee.

Such practices hold the potential to be

anti- competitive and to limit consumer choice. Exclusive deals, for example, could block providers of Internet video from offering certain types of content to their customers or prevent programmers from making their content available directly to viewers. This would prevent the emergence of Internet video services that could compete with MVPDs. Such deals could also harm small and rural ISPDs -- ISPs and MVPDs -- which may not possess the means to negotiate exclusive deals. This, in turn, would also limit choice for customers of these services.

Also worthy of scrutiny is the practice of limiting bandwidth consumption through the use of bandwidth caps. While we recognize that bandwidth caps can be used for legitimate network management, a system that threatens subscribers with disconnection or overage fees without also offer a means to monitor consumption effectively, discourages users from engaging in activities that use large amounts of bandwidth, including the viewing and production of Internet video. As

such, bandwidth caps should be reasonable, dynamic, and treat all content equally. Users should also have access to robust tools for monitoring bandwidth use.

In the interest of fostering competition and protecting consumer choice, public knowledge makes the following recommendations to the Commission with regard to the National Broadband Plan. First, the Commission should publicly acknowledge that Internet video is a valuable edge- based tool and should encourage its use by enforcing the principles of openness and nondiscrimination with regard to network management. No provider should be allowed to use network management techniques that privilege or discourage access to lawful content.

Second, the Commission should closely scrutinize initiatives such as TV everywhere and the typing of content to ISPs, like ESPN360.com, as well as the use of bandwidth caps. The Commission should ensure that these practices are not used for anti-competitive ends.

Third, the Commission should encourage innovation in the Internet video hardware and software marketplace by rigorously enforcing Section 629 of the Communications Act to ensure that there is a cable, card, or phone that allows Internet video content to be delivered to the television set without interference.

Fourth, the Commission should ensure that over- the-top video providers have the same safeguards against anticompetitive activity and the same access to programming as do other video providers.

And finally, consumers should be able to buy their video service or their broadband service separately without being penalized if they don't want to buy one or the other.

I look forward to your questions.

MR. PEHA: Thank you, Gigi. Our next speaker is Angela Morgenstern. She is currently managing director of PBS Online and coming before that from MTV where she managed a team of digital producers for news coverage.

MS. MORGENSTERN: Thank you so much. I'm so honored to be here. It's really exciting because for obvious reasons we feel public media's interests are really aligned with some of the efforts around this program.

Just to frame my contents, I'm a content person so I'm representing the consumer or as we at PBS call them, the audience or the citizen.

I'm just going to go to the first slide. PBS serves a few distinct audiences: Kids, general audience or grownups, parents, and teachers. I'm on the general audience side, but what I'll do is just run through a few examples in the hopes that they're instructive to the conversation because we're mission driven, but we're sort of data oriented. And to the degree that these examples are useful we wanted to present them today.

We're learning some interesting things about our audience. For one, we're reaching new and younger audiences online. One-third of the PBS.org general audience is between the ages of 18

and 35. And we also skew high on 45 and under, even when compared to the general Internet population.

So that's pretty exciting for us because it suggests that the services are complimentary at this stage.

And what does the audience want? Increasingly, they want video. It seems that they want everything ever made. Our focus groups show they especially would like to see HD full quality, full screen, like one of the panelists said here, although they appreciate the supplementary material, as well.

Here are some comments before the launch of our recent new and improved online video portal for audits. You'll see that speed and ease of use are paramount and there's little patience for delay. Public media institutions are expected to keep up with our commercial counterparts.

In April of this year we launched a high quality, general audience streaming experience with full length video.

The response was overwhelming. We had thousands of comments. By the way, "sick nasty" in this context is a really good thing.

I want to point out that every video in the National Experience is available to local member stations who are participating in the program. So local stations can create a mix of local and national content to better serve their local communities and sort of promote diversity. And local content can also bubble up nationally.

We're learning a few things. One, people are watching much longer than we expected. We're seeing an average video view duration of 20 minutes, which compared to what I understand to be the industry average of three to four minutes is quite high. And we're also seeing a sort of double primetime effect. PBS.org always peaked during the day which is great, but we're now seeing a peak in video usage at night. And people are likely to watch 25 percent more video at 10 p.m. versus 10 a.m. So these are really early findings. We only launched in April, but a lot of

interesting data.

So, to move on to the kids side, PBS Kids Go, which you can see here, launched even before the general audience portal in September. They're already averaging five-plus million stream requests a month. And that's with very little sort of external or paid promotion. What's really interesting to me about the PBS Kids offering, in addition to the fact that it's fun and tailored to kids and safe and tied to curricular standards, is that it's an interesting example of a commercial technology that's been adapted for public media use. So what the PBS Kids Team did is team up with a company called Panache, which specialized in video advertising overlay. And they actually found a way to overlay educational games on top of the video. And once they launched this, they actually saw that there was a five time increase in the amount of video requests for videos that had games on top of them because as many of you know, when you put the word games on anything kids are more likely to take advantage of it.

They also saw that kids were playing games not just once, but multiple times. Once a kid sort of becomes familiar with a game, they want to play it again and again so that they can show that they've mastered it which, for the purposes of this Commission, has real interesting implications for informal learning both in the school and the home as you're making decisions about where to wire.

So the way we see it, online video expands our mission. Before these two experiences -- and I'll run through them really quickly -- I want to make it clear that local stations were already using broadband to reach their communities. I can't go through all the examples. I would love to, but in Vegas they've partnered with the Clark County Public School System to offer online education for teachers through PBS Teacher Source. Kentucky Educational TV is providing distance learning. KQED in San Francisco is creating multimedia online content with the audience around local issues of

relevance. And right now in the south of California the local station there is teaming up with safety and service providers to provide multimedia content in light of the wild -- the fires that are going on. So, these examples have always existed, and while we can't kind of predict the future, we can prognosticate what might be possible with increased broadband.

One of the last examples I wanted to provide is something that we consider to be an innovative partnership between a commercial and a nonprofit entity, ourselves and our member stations. During the last election cycle we teamed up with YouTube and with 12 member stations. These stations have people on the ground. They have relationships with local organizations. And what they did was pass out 1,000 flip phones to citizens who were encouraged to video their voting day experiences in accordance with state law. And we received over 2,500 videos from 50 states. So some of those videos even made it to air, so we considered it a

sort of successful testbed and a model for what could be possible.

And finally, in case it's not obvious, PBS is really interested in meeting the needs of teachers. My colleagues and PBS teachers just finished a study with some research findings that may be of use. One, they found that streaming in the classroom is way up. Probably no surprise, but it's now rivaling DVD use. PBS is a particular media leader in educational media in the pre-K classroom, but interestingly pre-K classrooms tend to be the least wired. And when you ask teachers what type of digital media they value most, they unilaterally say games. So in terms of thinking about the merging of video and other applications, we're really keenly interested in thinking about how technologies can merge to create new experiences for 21st century skills building.

So, just to conclude, for obvious reasons from an educational perspective and an audience perspective, we're really, really excited

about the prospect of extending broadband. We think it's not just a philosophical need, but an operational need, particularly as we try to involve more Americans in the process of defining PBS. We need to be able to reach all those Americans.

So, thanks.

MR. PEHA: Thank you. I think one thing I've learned, if the IT staff wouldn't mind changing the name of this to the Big Ideas Workshop Game we'll be much better off.

Next up, back again we have Dr. Richard Green, president and CEO of CableLabs.

MR. GREEN: Thank you, Jon. Yeah, we need to put games. Uh-oh, it cost me two minutes -- two seconds. Good morning. My name is Dick Green. For 21 years, I was president and CEO of CableLabs, the cable industry's research and development consortium. Before that I was CTO of PBS. I also have served as the director of the CBS Advanced TV Laboratory. I'm pleased to join you to discuss cable's experience with the plans

for video over the Internet.

Companies in the cable industry account for the majority of broadband Internet customers in the United States. Our leadership is the result of more than $145 billion in private capital that cable has invested in digital broadband networks since 1996. Although cable leads the way in broadband, there are now multiple broadband platforms available. These competitors include telephone companies, wireless, and satellite providers. Content and application providers are using these platforms as well to create multi- billion dollar businesses, including online video services.

Video on the Internet has grown in a dramatic way and you've seen Phil's slides. In July 2009, 158 million U.S. Internet users watched online video, the largest audience ever recorded. The same month, 21.4 billion videos were viewed over the Internet. This is more than twice as many as viewed in February of '08.

The amount of total Internet traffic is

increasing by 30 percent per year. We believe that this growth is driven primarily by increased video transmission. Probably the most interesting prospect is for the development in two- way Internet video for education, healthcare, and other purposes. Our networks are growing faster, smarter, and bigger. The applications are engineered to be better and more efficient. We believe these advances will lead to new and exciting possibilities.

Consumers can watch video over the Internet through numerous means. They can stream programming free from Hulu, Fancast, and YouTube. For a fee they can access Netflix, Blockbuster, and Amazon. They can watch music videos from MTV and VH1; news videos from CNN, FOX News and the BBC; and games on PBS. They can watch video clips and sometimes longer video from the four major television programmers, and Comedy Central, History, and Nickelodeon also make video clips available online. In fact, I could fill the full five minutes just listing available online video

sources.

The evolving uses the Internet, including video, place changing demands on the cable broadband network. Cable companies consistently have responded by increasing both the available bandwidth and the data transmission speeds to meet the demands of consumers. The basic technology building blocks for Internet access are contained in the Data Over Cable Service Interface Specification -- that's why we call it DOCSIS. The most recent version is DOCSIS 3.0 or D3. D3 was designed to significantly increase transmission speeds to meet growing consumer demands for all kinds of application, including video. Many cable operators are offering D3 and others have announced plans to launch it in the near future.

D3 utilizes something called channel bonding. Today, the terrific speeds that cable delivers are generally accomplished using a single 6 MHz channel. By bonding multiple 6 MHz channels into a virtual single wideband transmission path,

cable operators can dramatically increase speed and capacity. This is accomplished by delivering the same video -- I'm sorry. D3 also allows operators to provide multicast services, and this is accomplished by delivering the same video to a group of destinations simultaneously using the most efficient network routing. D3 is also more secure because it supports the advanced encryption standard.

Another important part of cable's drive to make Internet connections more robust is managing the network to maximize network efficiency. In the online video area, cable operators will continue to work with application developers and content producers. These efforts seek to refine common ground -- define common ground that makes transmission of video over the Internet work for all parties. It's also important to ensure that cable operators could reclaim bandwidth from traditional, but inefficient uses. This is necessary to make certain that there is sufficient capacity on the

cable network available for broadband services.

Cable operators' ability to continue migrating their core services to digital from broadband inefficient analog is important. In addition, the introduction of technologies like switch digital video is necessary to achieve our shared goal of bringing advanced competitive broadband services to the public. The cable industry is committed to assisting the Commission in formulating and implementing the National Broadband Plan. We look forward to working with you to bring faster broadband to more Americans so that they can be informed, connected, and benefit by everything broadband has to offer.

Thank you.

MR. PEHA: Thank you. For those who saw the first panel, you already know the next person on the end is Dave Clark, who is a professor of computer science at MIT. I wasn't -- he's not listed on this panel. I asked him if he might -- actually, I was terribly worried that he might actually be in the audience and enjoy this event

and we couldn't have that. If he'd like to sit up here and participate in the discussion, particularly some technical things may come up, if you'd like to make a comment now, fine. If not --

MR. CLARK: I'll give you a brief response to what I've heard.

MR. PEHA: Okay.

MR. CLARK: And since I'm a technologist I'm going to talk about money. And economics. And therefore, I am in a space where I may be out of my breadth rather than out of my depth.

There's a word that we only just heard once in passing, I think, from Phil Wiser, and that was advertising.

And I want to stress the importance of advertising. If you look at this question of how, for example, particularly the cable operators make money, it's clear today they make money by selling their Internet service; they make money selling their cable service; and these revenue streams are part of the financial model that allows them to buildout broadband. And obviously I'm sympathetic

to both sides here because I talked about sustainable broadband.

But when you talk about the video product, it's important to remember that when they do over-the-top video today, they don't generate any revenues from it, but they don't pay for it either. And, in fact, if you look at the current expenses that cable operators have to buy their video content wholesale, go look at an annual report from a company like Comcast or something like that, they pay a significant amount.

So, in any situation like this you ought to ask the fundamental question, which is where is the money? And clearly the consumer has a certain amount of discretionary money here which they spend today on the Triple Play; they spend it on cable; they spend it on Internet; they spend it on telephony. And there's always been a fear that the cable experience or the entertainment video experience might erode to nothing. There's always been a fear that the telephone experience might erode to nothing, that it all become just an

Internet experience that somehow the consumer will reap all the benefit of that.

I think you should assume that there'll be a lot of concern on the parts of the operators to maintain the cash flow. And you should construct their own cost models as to whether you think they're getting reasonable cash flow to support sustainable broadband. But you shouldn't assume that the model is going to be the same. It may evolve a lot.

What I want to point to for a moment is advertising and the fights over advertising. Depending on how you estimate it -- how many people and the average they spend -- I think you could figure out today that consumer are spending $30 to $33 billion a year on broadband access. You take the number of homes, multiply by, you know, $40 a month or whatever it is.

I looked around on the web to find out how much was being spent on online advertising. I found one number from IDC and they predicted that in 2011 -- so this is a future number as compared

to the present number I just gave you -- online advertising spending might be $45 billion. And the point I'm making is whether or not I've got the numbers right. What that says is that the money flow into the consumer corner of the Internet here from the advertisers is actually more than the consumer is putting into the Internet experience. So you have to assume that you're going to see fights over that money. You know, follow the money. It's the Willie Sutton story.

So, what are we fighting over? We're fighting over the privilege of ad placement. And right now Internet video has a variety of strategies for Internet ad placement.

If you look at something like YouTube you could splat it up on the side, but if you have a long video experience you're watching a movie and we really don't have a standard today to stick ads in. The cable industry actually makes significant money by ad placement in video content today because there's actually a set of standards

by which there are slots in the video stuff into which local ad placement can be done. And it's a space in which there are commercial understandings. The network gets a certain amount; the ISB or the cable operator gets a certain amount.

The emergence of standards for ad placement will be an interesting issue. The other issue is who is best positioned to place the best ads. And the answer is that's the person who can sell it for the most money, which means they're the person who knows the most about you. And a lot of the concern we've had about deep packet inspection has been cast in terms of, oh, my goodness. I want to inspect what you're doing so I can control you. But if you look at what people have actually been talking about -- and in some cases being beaten up for doing -- it's deep packet inspection to learn more about you so they can build a better demographic profile of you so they can sell higher priced ads to you because they can sell you the ad you actually want to see.

And in this respect, you can imagine a fight between the ISP as the person who knows about you because they can watch everything you do and Google, who knows everything about you because they know all about your searches -- arguing about which one knows more about you so they should be privileged to sell you the ads because they can make the most money.

But when you worry about a fight, it's important to ask what you're fighting over. And I think fights over money are in many respects the most fundamental. And so I just want to say one word. You know, plastic was the word a while back. The answer is advertising. Okay. And you have probably never regulated advertising. There's probably some guy on the street when you get to the Federal Trade Commission. But when you get to the relationship between advertising and deep packet inspection, you might actually ask who owns that space.

MR. PEHA: All right. Well, thank you. So once again I will kick off with a few

questions. I will then turn to my colleagues here for questions also. For those in the room you can write questions on pencil and paper. Also, via WebEx and Twitter we're accepting questions. And my apologies to those from the last. There were great questions last time and I couldn't keep up with all of them.

I was amazed, 158 million people watching video online. I'd be curious actually if anyone knows the extent to which that is user generated versus canned or streaming versus P2P which might matter. But in any of those I want to -- imagine for the moment that, like PBS, you can move people to watching from three minutes to 20 minutes, and from low quality to high quality and still keep it at 158 million people doing that.

What does that do? So I guess I first asked if anyone knows a content question, but I'll follow that with a technical one of what does that do to the network? What does that do to -- you know, are there new bottlenecks created? Are there new -- does it change what individual

consumers need at the edge or what's needed in the middle?

MR. WISER: I would jump in with a quick answer. YouTube still dominates broadband video with about 40 to 45 percent of the overall views in there. So it's generally user generated. Now, there is commercial content on YouTube, but it's generally user generated content.

One point I would make is that the extension of viewing from three minutes to 20 minutes will follow directly the transition to more commercial content being viewed over the broadband connection. And that engagement, you know, was seen at PBS and is seen on sites like Hulu. The engagement level is the length of viewing, the type of viewing. Those patterns change significantly when you move from user generated or short form clips to commercial content that's being sold or delivered.

It also will change when you move from the place of viewing. When you move from a computer monitor to a television and change the

environment to a living room environment, the type of engagement and the level of engagement will change significantly as well. And I think the one pattern that we all need to look at, and it was mentioned previously, is the type of simultaneous viewing will change as well. There will be more broadcast-type viewing patterns that emerge as commercial content becomes more widespread over the Internet. Therefore, the way you deliver that content could benefit from things like multicast or cognitive networks that are smart about the way their routing their content to take advantage of synchronicity of delivery across different users.

MR. BRIANROSA: Yeah, I would like also to sort of maybe illustrate a little bit more the statistics that were provided because it's true it seems like a really big number.

But just to put some perspective, you know, they way the websites actually count users is if you actually hit the website once they count this as a unique amount. Right? And so the fantastic thing about YouTube is that it's

extremely easy to sort of share videos with all your friends, which is usually what people do. And then what most of your friends do with that is they watch one second of it and then they stop watching because it's not relevant. But yet that still is counted as a user.

There was a study done by Pete Margell about six months ago looking at the average watching period across six major video streaming sites. And they found out that after 60 seconds you had lost 50 percent of the audience. So while it's a big number in terms of number of uniques per month, if you actually watch the number of minutes watched and you compare it to, like, even television, it's absolutely abysmal. It's small. It's less than 5 percent; even less than that, I think.

So that means that people -- this is really the emergence of broadband video. People are getting used to watching those clips, and the average lengths also, you know, it's kind of androgic. Like, all the clips on YouTube by

design are small in size. Right? Even though they have some commercial programming, most of the user provided content is capped to 100 mbps and kept to a certain length, whereas if you start to put obviously longer form content of high quality, then by design people are going to watch longer.

So, to answer your question, what happens if you start to now multiply those numbers or keep them the same, but increase the length of content in the engagement -- let's call it that way -- well, look at the Presidential Inauguration that occurred. Every single site that tried to stream it actually failed. There was only one that worked. It was CNN and they were using a P2P infrastructure to deliver it. So, there might be something to explore there.

MR. PEHA: Dick?

MR. GREEN: A couple of technical points. Video is really an interesting application. I've been fascinated with video for a very long time. And some of the characteristics that it has is that people with different screen

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sizes need different formats in order to watch video.

In other words, you wouldn't want to waste network resources to send a full high-definition picture necessarily to a cell phone. And besides, a cell phone couldn't handle -- would probably not be interested in handling that kind of data flow. So you have a wide range of formats that are necessary in order to support video: PCs, cell phones, and so on. Right?

Another interesting aspect about video is it can be delivered in many different ways. In an earlier panel, Vince Surf raised the issue that 85 percent of the video that people watch now on the Internet is prerecorded, which means that it's in a file somewhere. So, sending a file is a much more network-friendly way of delivering video. And Vince talked a little bit about that. Maybe there are ways that we can optimize the transmission of video by using different methods of sending it. That doesn't mean that there won't be real-time video because there always will be.

And that's important. Things have to be delivered live. So there's some percentage that will need streaming video in order to get there at the right time.

In those cases, I think as Phil has mentioned, techniques like multicast are very important because they allow the network to be very efficient in routing. Instead of routing a separate stream to each user, you conserve the network resources by special routing techniques so that the simultaneous delivery is delivered in an optimum way. So what that means, I think, is there has to be conversations -- I think it's likely and I think it's certainly in everybody's interest that content producers and the network operators work together as we develop this expanding video experience because there's a lot of ways that both sides can adjust in such a way that we can provide the optimum experience.

And to your question is this going to overwhelm the network -- I don't think so. I mean, certainly the laboratory that I'm involved

in has been anticipating this for a long time and we've tried to develop technology, including the DOCSIS 3.0 modem which is capable of handling 160 mbps and next year 320, to be able to handle this kind of load. And I think getting the right technical people together to work together as this proceeds is one of the important elements going forward.

MR. PEHA: Okay. So that actually -- I'll go in a different direction. That is intriguing and there is value in having technical people from the infrastructure provider and the content providers work together on some of these things. I'm also thinking of some of the tensions -- the issues that Gigi Sohn raised of competition. Is there a tension here between wanting to optimize in a way that makes best use of and, you know, avoids congestion, but also clears the way for competition?

MS. SOHN: If I could just jump in here for a second.

MR. GREEN: You should have the first

word.

MS. SOHN: Of course. I mean, I don't have a problem with content producers. And when we talk about content producers I think we have to be really careful. You know, as Gilles or Phil mentioned, much of what's watched on the Internet now is user generated content. Everybody tries to always narrow everything down to it's Hollywood and the big ISPs. Okay, a lot of what's being watched is independent production; it's user generated content; it's stuff that has never seen and never will see a Hollywood studio. So when we're talking about, you know, the technicians getting together, I think it has to be broader than, you know, the big ISPs and the big production studios. So that's number one.

And if it's not -- if it is just, you know, this dark and smoky room with the big ISPs and Hollywood, there's great opportunity for collusion and anti-competitive activities and the type of activities that make my organization very, very nervous.

So, I just want to clarify that point that when we're talking about, you know, content providers, we're talking about a huge universe. And while we're not going to have every single person that posts a video of a cat on a treadmill, you know, get in a room with CableLabs, I just think that's an important point to point out.

MR. GREEN: Yeah, Gigi, I didn't mean that to sound as narrow as it sounded. And I'm sure there are other aspects besides technical that would benefit from coordination. And I don't know. My experience is that the smaller and start-up companies have really good ideas, so I certainly didn't intend that it would be collusion of just major studios and major ISPs. I think it needs to include a wide range of people.

I forgot to mention P2P is one of the distribution techniques. And it's -- I want to congratulate you, you know, because the HDTV path that you've taken I think is very important. It provides HDTV services and uses a peer-to-peer kind of distribution system. So, you know, I

apologize if I said it in a narrow way because I think it needs to be considered over a broad range of providers, content developers, and network operators. And I'm sure there are other players and stakeholders that need to be included in those conversations, as well.

MR. WISER: So one point I think is important here is to simply this down to a separation of services and transport. Ultimately, what we're talking about here is that, you know, for services that are delivered into the home, the binding of those to the transport used to deliver them is an impediment. It's an impediment for the consumer because for video, in particular, there are decades of legacy where the video services are bound to very specific delivery infrastructures that frankly are inefficient and are not in the economic interest of the consumer. Yet, there are decades of contractual restrictions that limit content producers, even if they wanted to, to make those video programming available to someone that wanted to deliver it purely as a broadband

service.

And if there's any effort that we should look into, it's helping the industry move beyond that. And I think it's a historical business relationship. There are regulations that were created in the analog multi-channel video era that should not -- absolutely not -- be applied to broadband-delivered video so we can assure that there's a level playing field on a service-by-service basis.

And Gigi alluded to it in the bundling of services. Bundling of services and pipes is a dangerous precedent and I think it's one that does unfairly inhibit competitors that could better serve the consumer if they had access to that consumer. And while the current pipe providers are concerned about being a dumb pipe, they don't have to be a dumb pipe, but they do have to compete fairly for the things that make their pipe smart. So they should provide video services and compete fairly with other video service providers. The same with telephony, search, home automation,

the next string of advanced services that will want overnight peak connection into the home.

MR. BRIANROSA: One of the interesting aspects of this value chain -- you said there's like services and transport. There's contact also. Right? And here the particularity about the industry is that before the Internet, transport -- meaning the cable industry and content -- sort of would work together and there wasn't any sort of service layer in between or consumer phase-in service.

And so the danger is, I think, that the cable industry has a lot of leverage over the major content providers because if you look at any cable network, right, that you can -- let's pick the Sci-Fi Channel, for example. So if, you know, the revenue is a billion dollars a year, half of that is coming from advertising, but the other half is coming from the carriage fees. Meaning that the Comcast and DirecTV is not paying to that. And so that gives them a lot of leverage. So I'm glad to hear that whenever the (inaudible)

producers and the cable companies would get in that room, likely some service companies, you know, Internet companies could get in that room, too, to discuss. Because otherwise, we might just get squeezed out.

MR. GREEN: Well, I've got to push back a little bit on this because we have a wonderful ecosystem going here.

Right? People are watching more video; more video producers are putting more online; various companies trying different models; everybody's out there experimenting. I mean, how could you ask for a more inventive and a more -- a greater platform offering greater opportunity for innovation?

And a cable operator is in a position where they have a very good business with broadband. It's expanding; it's growing. It's very important in a competitive world, and there are other broadband providers that would be very willing to take away customers if there's abuse and the customer is disadvantaged in one way or

another. So it's very important for a service provider, including the cable operators, to make sure that the customers are happy.

I don't believe and I think it's incorrect to think that a cable operator would do something on the broadband platform and in some way disadvantage customers to advantage another part of the business because this part of the business is extraordinarily important to them. And customers in this area are very important and therefore, I think this is just not going to happen.

MS. SOHN: I just have to ask. How do you explain -- I mean, TV anywhere -- the details are sketchy, but how do you explain the idea of putting content behind a cable wall only available to particular subscribers of that MVPD? I agree. The ecosystem is great. So why don't we have content on that ecosystem as opposed to putting it behind a wall?

And let me just clarify. I'm not saying putting it out there for free. Okay? Because

people are going to say, oh, well public knowledge just wants everything for free. No. I don't care. All right? If Phil wants to make money, or Gilles wants to make money, or Hulu wants to make money, be it through subscription of advertising -- Netflix does it through subscription -- by having programming over the Internet and have people pay for it -- I pay for Netflix. I have a LG -- wonderful LG Blu-ray device that lets me get that -- that's fine. But they have to have access to that programming. If you put it behind the cable wall, then they are probably not going to get access to that programming.

Now, I've been promised by both the MVPDs and the program producers who are engaged in this TV Anywhere that there are going to be no exclusives. All right? But I harken back to 20 years ago when DBS was trying to be a viable competitor in the MVPD market and Congress, unfortunately, had to pass a law to force the cable operators to give up the programming to their competitors in the DBS market. So that's my

fear. I really, really hope I'm wrong.

Tell me why I'm wrong.

MR. PEHA: Give Dick Green a chance to respond and then Dave Clark. Go ahead and respond to that and then we'll --

MR. GREEN: Let me just respond briefly that you're absolutely right. These are non-exclusive. Anybody can put any service that they want -- and there are plenty of services that deliver video in broadband that charge fees. So, it's possible for anybody to do this. It's an open platform.

These arrangements that you see -- and I don't know the details to any of them because they're all different and they're all experiments of one sort or another. And let a thousand flowers bloom. Let's see how this goes. I can't see that it's restrictive.

I guess to address your particular question about -- and I think what you're addressing is authentication -- what I see is these services provide video to consumers that has

not been available before because this tends to be very high valued content that's valued at a higher level. And therefore, security is an important part of the equation. So, being able to authenticate a customer is part of the needs of a programmer to provide these kinds of high value services on the Internet. So, again, it's an experiment.

Programmers want access to people. This is one way they can do it and they can be reasonably assured that their product won't be stolen.

MR. CLARK: Without wandering into this particular space, let me give you a more general answer. If you go back to the first panel and you listen particularly to what Van said -- and I completely agree with what Van said -- he talked about information delivery. Not communication between points, but the dissemination of information as a platform rather than as an in-service.

And this is absolutely going to happen,

but the point is that platform can emerge in a bunch of different ways. Peer-to-peer, for example, bit torrent which underlays a bunch of commercial service as well as consumer misbehavior is a very creative platform. And you can say, well, why did peer-to-peer emerge as opposed to something else? And the answer is, well, it was the one people could build without asking anybody's permission.

At the other extreme you have somebody like an Akamai or Limelight who sell as a commercial service a replicating hierarchy of information which presumably makes it more efficient. So you have two -- you have a technical contest going on here which is who can build an efficient platform and who can duck around various people's incentives to say no or say yes. And in some sense you say peer-to-peer is a really strange idea. I'm depending on computers over which I have no control. I'm depending on uplinks which have traditionally been less capacity than downlinks. How much would it

take to displace peer-to-peer as the poster child for creative content dissemination? You can say, well -- you could say, well, why aren't the ISPs providing this platform?

You could ask why didn't the ISPs invent Akamai? And the answer is because there are coordination problems among companies that compete. And Akamai is one-stop shopping, as are their competitors, of course. You go to them and they say, yeah, we'll make it available everywhere in the world. It's hard for the ISPs to figure out how to do that.

But you could imagine the ISPs actually taking advantage of the physical capabilities. They have the physical head-ins, the opportunities for co-location to provide part of the platform in a very technically efficient way. And you would then be asking the question you asked, which is is it an open platform? And we would be talking about neutrality of disks, just the way today we were talking about neutrality of something else. That is a path into the future. And the ISPs

might very well like to consider such a platform, but obviously that's not something they're going to do unless they either get absolute cost reduction -- there's fewer bits on the system. They can internalize the tradeoff of storage against a buildout of capacity or it's got a business model in which they get compensated.

And so you could say, well, is their enemy Akamai or is their enemy peer-to-peer? But I could easily imagine in a few years that somebody is in here uttering a sentence which at one point has the word neutrality in it and another part of the sentence is talking about storage as a platform.

The information dissemination is a platform. And I think that's the thing to watch going forward. Absolutely. Because it could emerge in a whole bunch of ways, some of which are vertically integrated; some of which make it a clean platform; and some of which are all over the map. It's a space of great innovation right now. A lot of experimentation going on in that space.

Cool experimentation.

MR. WISER: I would just throw in a comment just which is a view I have through about 10 years and losing a lot of money trying to invest in P2P as a commercial delivery platform. It doesn't work. So I think the P2P as a transport -- we should separate that out. I think you framed it the right way. It's one of many tools. CDNs today, ad hoc, work with ISPs. They peer with them. They (inaudible) actively co-locates caching service within ISP infrastructure. So I think that building on the current unicast IP for delivery of content is taking shape, but P2P itself as an answer to any, you know, large-scale commercial distribution of content. It has some value, and I think you know, within a very closed network, you know, it could have some value.

But on the content side of the equation I think the issues around the use and what user behavior happens on aggressive P2P users is sort of independent of the fact that they're on P2P.

They just consume a boatload of content; they break all the caps; they abuse the network and bring down quality of service. It doesn't really matter that they're doing it on a P2P transport technology. That just helps them do it without getting hit with copyright violations.

So in a discussion of how we evolve the transfer for broadband video, I always like to put P2P as one of a set of tools. It's not a holy grail. No one that's used it has made it a holy grail for delivering commercial content, so we shouldn't overweight it too much.

MR. BRIANROSA: I would like to react to this. I mean, peer-to-peer has been evolving for a lot of time and I have to sort of slightly disagree with the statement that it doesn't work because I'm sort of here talking about it. We're delivering terabits of information every month it is licensed and peer-to-peer based. I think, you know, there are challenges with it for sure, piracy being one; the fact that you have to install a client, you know, it creates friction,

all that stuff. But, like, you know, our system works with both traditional CDNs, like Akamai. With our own CDN we share (inaudible) and the measurement we make every month on the bits we deliver is, you know, between 40 and 60 percent, you know, of the bandwidth taken over by the swarm.

So it works. It doesn't work all the time. I completely agree with you. But I think it's a little bit unfair to say it doesn't work. Especially, I mentioned on the live streaming side, you know, again, the only live streaming events you can get without having network completely breaking down on a peer-to-peer base now. Now, one of the challenges that we have in the U.S. is clearly the sort of symmetry between the uplink and the downlink. And in other countries, you know, whether it's Asia or Europe, that symmetry is a lot more there than it is here. And my sense is in order to sort of -- if we were to decide, you know, or if it was established that, you know, peer-to-peer should be part of the

solution and how to sort of help broadband to emerge, then I think that an interesting discussion with the ISPs would be to see whether or not -- and at what cost -- it would be possible to sort of increase the uplink.

MR. PEHA: Okay. Give the final word --

MR. GREEN: I'd just briefly respond to that. Well, yes, with these -- especially with the new modems we're deploying there's a lot of upstream capacity. And the upstream that's provided by a lot of MSOs now -- and I'm not sure -- I'm pretty sure companies like Verizon provide a lot of upstream as well. So the upstream is perfectly capable of carrying video.

MR. PEHA: I'm tempted to ask so many more questions, but I'm going to turn to my colleagues for a bit and then we'll see if we have any more time.

Jeff Neumann?

MR. NEUMANN: Shifting gears ever so slightly, I was wondering if you could speak to -- we spent a lot of time talking about issues in the

network, but we also started out with talking about how there is a fair amount of penetration.

To what extent do you see the bottleneck to further adoption in the devices, in the applications, this idea that the router is difficult to fix when it breaks; that people don't understand their PC and that the television -- maybe that's part of the answer. You know, the iPhone is sort of bringing -- you know, the network has now had to catch up to the ease of use of the iPhone. And to what extent do you see the problems being in the network, that if only there was the network or the capacity or the infrastructure in place, then the devices would appear and people would be able to use it more? Where is that balance at?

MR. BRIANROSA: That's a great question. I'd like to just maybe illustrate further for the benefit of the panel as well because our business -- we run a PC application and we spent every -- you know, we launched the devices integration, specifically because our users were asking for

that. So, meaning -- you know, looking to how to sort of move that content over from the PC over to the TV. Right? And I would tell you the two things that -- you're absolutely right. There will be friction there. Definitely.

It's not about capacity; it's about standards. And there are literally two main issues. One of them is Codecs because every single device right now -- whether it's a gaming console, you know, a setup box, a mobile, you know, portable device -- they all use different Codecs. That's number one.

And number two is DRM. So in order to sort of be able to protect the contents, you know, from end to end, you want to have it protected. The problem is that there is not today an interpretable DRM platform so every time you try to move that content from one device to another, which consumers want to do because, you know, that's what they do with DVDs and that's what they do with MP3s. You can't do that. This is literally the next -- once we hit -- once we

resolve the network congestion issue, then this is going to be the next definitely sort of problem to resolve. Absolutely.

MR. GREEN: I think Angela.

MS. MORGENSTERN: Well, I was interpreting your question slightly differently, which is are you asking what are some impediments to encouraging adoption in some of these communities that aren't taking advantage of these technologies?

MR. NEUMANN: Well, it's a very broad question. You know, obviously there are bottlenecks in both places and as we look towards increasing adoption going forward, you know, what's the balance? You know, should we really be focusing on developing E-books that play video because that's the answer and nobody will see the network? That's the problem because it's hard. Or is it that the network can't sustain these things that people want?

MS. MORGENSTERN: I think it's both of the points that you brought up, but also just to

bring the human factor back into this conversation, I think earlier panels have talked about the importance of creating purpose-built applications and content services that really drive people to answer their own needs and desires. So from the PBS perspective, an interesting example for me is people are familiar with Ken Burns, The War, a series that we ran last year. We tried to have a national experiment where we asked members of the greatest generation, this generation of veterans, to share their stories with us. And they could do so by e-mail, by photo. They could also go into their local station to have their video story, you know, videotaped which is a really interesting merging of the local services and the technology. But we also had to set up a 1-800 phone line so that they could be recorded by audio. And that's an obvious application because of where that demographic was at the time, but I think it takes programs and services that are so appealing that people want to get over the hump and either learn that new

technology or adopt it in a way they might not have been previously comfortable with.

MS. SOHN: I just want to make two points. And this maybe undercuts the first sentence I said in my opening statement. Let's not get hung up too much on video as a driver of adoption. It is a driver of adoption, but if you look at video use compared to the use of social networks or other, you know, e-mail applications, it pales. Okay? So, I think you have to look at it separate apart and say if you look at the Pew studies, clearly the fact that people don't have the devices and a lot of people that have the devices don't know how to use them, clear problem with adoption. Okay? So I would separate the two out and not get too hung up on that.

But I also want to make another point that really is applicable here, is that I'd love to see a world where you could take -- just like you can in the wired telephone network where you could take any device -- any non-harmful device and hook it to your telephone network -- you could

do the same with a cable network or a wireless network. There has to be a cable, card, or phone provision that allows for innovations in the device market.

If you look at the set-top box device market today, I mean, it's almost wholly controlled, you know, digital devices by the cable industry. There's TiVo and there ain't nothing else. I mean, try to buy a standalone DVR from somebody other than TiVo. Can anybody name one? I can't. And I think that's because Section 629 has not been enforced. I don't want to get too legalistic, but that's my point about devices. There is not a lot of innovation in the device market, and a lot of it has to do with the fact that the Commission does not really enforce Section 629.

MR. WISER: So, Gigi, I would encourage you -- I'm going to have to give you a demo Sezmi at this point because I've just answered your question.

MS. SOHN: I can't buy it, right?

MR. WISER: You can buy it standalone. And you can get it -- I want to use a use case to, I think, answer the question for all of those users that don't have broadband access. So I walk into a home. There's no Internet access in that home at all. It definitely has a TV because almost every household in the U.S. has one. I walk to that user and say take this little black box, plug it in, take your rabbit ears off your TV -- or now, you know, whatever you have connected -- plug this little black box in and you're going to have all of the TV you had before. You're going to have it on demand because 90 percent of viewing going forward will be on demand, not live. You're going to have access to e- mail, the Internet, a browser, all the information, search. And you can get it all in this little black box. You don't need to hook up a router. You don't need to learn how to use a computer. Everybody in the household can have it. That's a great use case.

And for a large number of households,

the ones that are predominantly not using broadband because they don't understand it, it's too complicated, they don't see the value in it. There's value in that because now I'm coupling entertainment and information services in a way that will increase awareness and access to broadband content. And when I promoted in my opening statement the use of the TV, that's the type of use case I'm looking at here. If we had simple broadband access and you could couple those services together to motivate consumers to take advantage of that and use the primary manner in which they're receiving information today which is their television, it's very interesting. And naturally, broadband video rise on top of that. And I think the use of broadband video enables economics and the technology to receive that is cheaper in many ways than using it on a general purpose compute platform.

MR. GREEN: Three quick points here. Let me start with the third one first.

At least my laboratory has produced a

specification -- an open specification that anybody can build called true two-way. Anybody can build a box. There are television receivers built to this specification and it allows the connection to the cable network. So there may not be any boxes in the market yet, but there are certainly television sets. So I think there are a lot of other devices which you've kind of overlooked, Gigi.

On the user device, I think you have to look at this as an ecosystem. You have the receiver, you have the network, and you have the source. And you have to consider this altogether. If you miss any of the pieces or somehow it's not coordinated, there are problems. I think on a previous panel I know that one of the cable operators, Dallas Clements, said in his area between the cable company and the telephone company and so on they serve 70 percent of the people in that footprint. The other 30 percent, two-thirds of them don't have PCs. So, there just isn't any way that those people are going to be

interested in broadband at this point. And then there was an income-related matter with that, too.

So, I think in terms of -- it makes a lot of sense to consider what the terminal device is. And I think that's a very important part of the ecosystem. And I'm glad you brought that up because it's equally -- maybe not quite equally, but very important compared to the network.

MR. PEHA: Thank you. Jonathan Levy?

MR. LEVY: Thanks very much. At the risk of subjecting myself to some ridicule on a panel that's focused on the future, I want to ask a question about the impact of the developments we've been talking about on the more traditional media and take off a little bit on a comment that Professor Clark made about advertising. Because, really, one of the issues that I think we've been talking about or alluding to is that the business model for the creation and distribution of all sorts of content is changing and the developments we've talked about have influenced that change substantially.

So I'd just like to take a moment to recall that the traditional media that the FCC is still concerned with -- broadcast television, for example -- there are certain expectations that they provide programming in the public interest. And I'm just wondering, I'd like to ask people to comment on how are these new developments with regard to over-the-top video impacting the ability of the traditional media to fulfill these functions? Are the new platforms that we're talking about in some sense going to be able to replicate those functions? Should we care and what should we be thinking about doing about it? In 25 words of less. Thank you.

MR. WISER: Well, I'll jump in again, I guess. As part of, you know, at least what I see going forward, broadband video is a better platform to promote educational content, information about news, raising awareness about issues that you care about because you can target it one-to- one. It's smarter delivery. It's not saying I've got a broadcast medium reaching a

large number of users and I will deliver the same message to them independent of demographic, interest, location, geography. So you can be more effective, but the way you influence that is by incenting it.

So, as an example, in the little black box scenario I laid out, if part of the broadband plan was to promote that to get to the 20 to 25 percent that don't have broadband access, and as part of the incentive -- not unlike the converter program -- you went in and put some controls around that in terms of ensuring that there was access to the right types of programming and information to encourage service providers to support access in those homes, I think that would be a very smart use of the broadband plan. You could go in and say I've now got for this 20 percent a very simple value proposition. And for the service providers delivering it, you are going to deliver programming of interest to help those consumers going forward.

MS. MORGENSTERN: I love your question

because I think it's a really important moment in time is what you're alluding to. And I'm looking at it in two ways. One, there's more opportunity now to redefine what the public interest means because we have an opportunity to engage the public in the activities that they consider to be in their public interest. So to the degree that the FCC can involve the audience in the decisions around what their information and community needs are, they can now help us in a way that they couldn't with one way broadcast -- define how we should resolve those needs.

So that's really exciting. Public media can be broadly defined. Public needs can be broadly defined as was alluded to earlier as content creators become more broad and serve each other in new ways. So that's great.

One of the sort of disadvantages of these new systems is, as you can see from the panel, it's really hard to keep up with all of these new innovations and technologies. So I just want to put a mark in there for public

institutions and nonprofits and government and educational institutions that are trying to keep up with all of these new ways that consumers are accessing information. So the information may be there, but discoverability is becoming increasingly important. And what are ways that we can help those institutions keep up with trends in the marketplace so that as it evolves as quickly as it's evolving, public interest needs are still on the forefront of the audience's mind. It's really, really challenging and it's not as simple as, you know, free our time or a channel here or there.

MS. SOHN: I guess I just have a hope. I hope that the proliferation of video -- and I do think localism is going to be a huge thing over the Internet. Why? Because broadcasters are not serving those needs. I take issue at the proliferation of public interest programming on broadcasting. But I do think if we are allowed to have an online video ecosystem that really grows, it will meet those unmet needs. I kind of look at

-- present company excepted, of course.

I look at NPR. Why is NPR so successful? It's successful because radio broadcasters have a band in their local communities. Plain and simple. You know, huge -- you've got people owning 1,000 stations in their program from some place in Texas or New York or what have you. I think you're going to see that online. I think you're going to see online programmers pick up where local broadcasters have left off. And hopefully, that will drive the broadcasters to say, oh, my goodness. I need to consider programming that will allow me to keep my spectrum.

MR. LEVY: Could I just supplement my question briefly because, you know, really both what Angela said and most of what Gigi said emphasized sort of the nonprofit portion of our media. And I guess I just want to push back and say, you know, these new programmers you're hoping for, Gigi, are these going to be noncommercial or is there actually a sort of commercial model for

producing content of this nature? Because what I --

MS. SOHN: People, I'm going to say something nice about cable so everybody listen. Cable does it today. Right? What's NewsChannel 8? What's Channel 1 in New York?

There is a commercial market. There is a commercial market for local news and local programming. And I think there could be one online, as well.

MR. BRIANROSA: I think you're really asking about what are the -- in the short term, not in the future -- the business models are not going to help those new programs to emerge, you know, in an over-the-top fashion. And you know, I spent a lot of time with Madison Avenue working with advertisers trying -- because our system -- essentially, most of our videos are delivered, you know, free ad supported. So, and to David Clark's points, if you think of the entertainment industry worldwide, it's a $230 billion business, of which $160 billion is advertising. So that includes

offline and online, obviously.

So, the point is, you know, this is an issue. And it's very important and relevant to the debate here because one of the key challenges to actually have sort of a meaningful broadband ecosystem online is the money. And because $160 billion, that's a lot of money that is still sort of not transferred online. Everybody wants to see, okay, what is it going to take to sort of start to transfer some of those advertising dollars online.

So it takes two things. One is premium content that advertisers are going to be willing to be associated with. Because, you know, for all those YouTube videos, I mean, YouTube monitors less than 5 percent of that inventory because the rest of it advertisers don't feel comfortable enough putting their brands against it. So, you know, from that standpoint we're still sort of in the very early days. And so for that, advertisers want content that they can feel is something they want to be associated with. There's not all of

that right now happening.

Secondly, standards. As David mentioned, you know, there is not really a standard around advertising for videos. I mean, YouTube obviously, they're small clips so they do, you know, overlays and things like this. We do high-definition (inaudible) because we have longer form (inaudible) in HD, so it's kind of a little bit all over the map here and so that is a friction point.

And the last point I will make -- and that's a very basic sort of, you know, simple, I guess, you know, Business 101 equation -- is that every time you stream a video as a business, you want to make sure that you make more money than you spent. Right? And so the Internet -- the social networks you were talking about -- so far without video it didn't have that problem because the cost of delivering a page, a HTML page, was kind of very low. And so you could always find an advertiser willing to pay something that would always offset the cost of delivering that page,

whether it's a Facebook page or MySpace, you know, what have you.

And so that sort of enabled many companies to basically, you know, actually be profitable, including Yahoo and others. The problem with video is that as soon as you put a vide on that page, the cost of delivering that page is multiplied by, you know, an order of magnitude. And so if you still want to rely on advertising, the advertising also needs to be multiplied beyond that magnitude. So we are not talking about, you know, an advertiser paying a dollar per (inaudible), but now we need to go to more of the $15, $20 (inaudible) impression. So - and those things are not happening yet.

And so those are the challenges, I think, in order to sort of enable, you know, sort of new programmers to sort of start making money online.

MR. PEHA: Phil Bellaria?

MR. BELLARIA: I had a question specifically related to the National Broadband

Plan. We have an interest in creating the plan and bringing full access to broadband services to all Americans. You guys have either a business or a public interest in doing that also. Right? Because all of your business models or interests rely on that. And one of the challenges is for anyone to make a business model work to build out a network where it's not currently built out. Historically they've relied on video revenue as a core component of that. So if you look at an overbuilder who has done that or Verizon FiOS or a cable operator or a municipal network, they all rely on some video networks.

So, there's a challenge to that business model if they cannot sort of monetize the video part of their business model. So how do we think about that in terms of encouraging buildout either from policy perspective or just the public interest perspective into unserved areas if there's a fundamental challenge to the video business model as it currently stands right now?

MR. WISER: Well, that's one of the

reasons I was advocating a coupling of the television and the broadband service into a single unified offering to get to null and broadband-accessible homes today. I do think there's an opportunity to couple those services together if you will. I think the requirements for broadband service to get access to the information are different, so you could -- you know, in the scenario I laid out before, just light up a wireless network that would not be adequate for, you know, consumers that want, you know, a sustainable broadband -- to take Dr. Clark's term earlier -- but would be a way to provide access in the near term. And then you could scale that up with cell density and others.

So I think there is a combination. I think wireless to get to those homes is the best path to have simplicity and also to let this thing scale up based on usage and not have a big capital build at the front end of the process.

MS. SOHN: I don't think subscription video is going away tomorrow. Okay? So, in my

written statement I put like 900,000 people cut the cord and no longer get their video service. So it's a business model that's going to be around for a very, very long time.

I want to agree with Phil that when you talk about unserved, there's rural areas and then there's like one person on the mountaintop who is 50 miles from anybody else.

We talked about this. We had a conversation about this in Aspen last month. And you may never serve that person. Okay? And that person probably doesn't want to be served. But for the vast majority of unserved areas, you can look at obviously redirecting universal service money to broadband, which is something that's been discussed a lot. And also, again, using wireless services, perhaps allowing the White Spaces devices in very rural areas to be higher powered so you allow for more unlicensed uses. I think you're going to have to be very, very imaginative in how you get service, but it's definitely going to include a wireless component.

MR. GREEN: I'll try to be brief. Just as an example, we have one cable operator in Bend, Oregon -- a smaller operator in a very rural area. They converted their whole system to digital already. In addition to that, they purchased licenses, wireless licenses, so they could expand as an extension of their footprint out into serve the peripheral areas around Bend. And I think it makes a nice combination. It might be -- that particular case we're looking at as a kind of case study.

MR. PEHA: I have time for a last piece. I'll combine some questions coming in.

Focus particularly on education. Could -- how important -- we've seen some very interesting things from PBS. How important is video over Internet for -- this particular person asked literacy, but I'll say education, and what does that mean? Should we be focusing on the classroom as a place to be getting this? Or the home? Or are both just as important?

MS. MORGENSTERN: Yeah, I'd love to

answer that just briefly. I think the difficult, but true answer is both. PBS has an initiative called PBS Kids Island which focuses on video and interactive games to teach literacy to low income children. And the power of that is not just the video or the games, but the fact that parents can follow along as their child reaches developmental milestones. So it's a combination of something that could be used in a daycare center or in a Pre-K or in a school environment, but also has a benefit if it can be extended to the home. So I think it's really -- both of those scenarios are really important.

And in terms of what the teacher folks are hearing out in the field, the one thing I will say is that teachers increasingly are less interested in flat lesson plans. You know, that was so very 10 years ago. They're very interested in multimedia teaching objects. So whether that's a purpose- built video that teaches a specific concept that they can integrate into their existing curriculum or plans, whether that's an

interactive game or a photo gallery or a piece of multimedia, they're really interested in having the targeted pieces that they need at the moment just in time for that classroom experience. And so we and other people are really looking into ways that we can serve that up in a useful user-friendly way over broadband. So obviously broadband connectivity becomes really, really important in the school setting.

MR. PEHA: Does that further imply you can't preload stuff? You actually have to have the capability and the infrastructure to download things as needed?

MS. MORGENSTERN: It's both. I mean, teachers prefer to preload material for obvious reasons, for planning.

And that's part of the scenario planning for some of these services. But speaking from a content perspective, it's interesting that we have this vast storehouse of wonderful material that's teachable and some of it is rights encumbered. And some of it is easier to free up in a streaming

environment rather than a download environment, even in an educational setting. So maybe that's a short term issue, but right now we're just working in any way we can to get those materials into the classroom.

MR. PEHA: Did you --

MR. GREEN: Yeah, again, just a brief support of PBS. At one time I had the responsibility of the PBS library, a vast wealth of materials. A lot of it educational. And I think PBS is a shining example of how you use video in an educational application.

One of the things that I tried to say earlier is entertainment and video are kind of the sexy side of the development, but as we solve the problems in the applications -- make the applications more efficient and we make the network more used to larger amounts of video -- all of this provides a great platform for many other societal needs: Education, reduction of travel, power management. All of those kinds of things, I think, follow naturally from the

advancements in the networks that come out. The kinds of things we've been talking about here.

MS. MORGENSTERN: And if I can add to that. One thing we haven't talked as much about is imagining in the future what the applications could be. And I think now there are great examples of sort of two-way communication that can happen in the classroom. But that could be greatly enhanced.

If you can imagine that students could actually participate virtually in a town hall or actually experience something in a really visceral emotional way through real-time video. Those kinds of applications haven't been built out or explored as much as we'd like to see, but we know that it's much better than, you know, popping a tape in and hitting play and walking out.

MR. BRIANROSA: Maybe I will just add an example that I'm familiar with because we are right next to Stanford.

Six months ago -- as you know, Stanford has been sort of putting a lot of the courses

online. Right? They basically have those videos online. And they came to us and said we have a problem here. We have all the curriculum for undergraduate and graduate school. It's like hundreds of videos and we'd love to put them out for free under the Creative Commons license and we don't know where to put it because everybody is charging us. And so could you guys help us because you're peer-to-peer?

And so that's what we did. We basically sort of took on their entire library of videos. Why we could do that? Because we sort of could afford to do it at a very small cost. So those are small things we can definitely do to sort of help sort of distribute and essentially see sort of the running outside of the classroom as well. And it's interesting to see universities sort of trying to do that more and more using the Creative Commons as a licensing sort of framework to do that.

MS. MORGENSTERN: And just to tie back to an earlier question, I don't know what the

incentives are that can encourage companies like yours to participate in those kinds of partnerships, but they seem to be very important. Even, you know, I won't name names, but we're interested in streaming some cultural events and we're talking to a number of commercial partners about that because we think that Americans should have access, no matter where they live, to something like Live from Lincoln Center or the Ballet. And what's interesting is once they start to see that it might actually be successful, some of those commercial entities say I'm sorry, our business model doesn't support that. We can't stream it.

So imagine if their business model doesn't support it, how can a public business model support it?

MR. BRIANROSA: Well, you know, we host the UNICEF, you know, United Nations children's video. We host the TED Conferences. And we don't put advertising against it. So I'm happy to talk.

MR. PEHA: So I understand -- so

intellectual property issues are now both affecting the educational content that is available over the broadband network and are affecting whether it's streamed or sent another way which actually might work better for places that don't have hi-band width connections. It becomes part of the broadband infrastructure.

MS. MORGENSTERN: And the real cost implications in the clearing process. So if you have something like An American Experience, which is really rich in archival, third- party material, there's, you know, a real differentiator there.

MR. GREEN: I can tell you one of the problems is clearing property rights on a lot of this material, too. That can be a major issue. So there are lots of legal problems with this that have to be worked out.

MR. PEHA: I think we found --

MR. BRIANROSA: Just to sort of illustrate this very quickly. It's actually an antiquated law that has to do with public performance that is now driving the fact that you

can actually license things for streaming versus download. And it sounds completely illogical, whether it's actually commercial content or non-commercial one, there's a lot of like rights issues that have to be sort of waived by the common owners, you know, to enable either streaming or downloading, or both. So that is definitely a challenge, for sure.

MR. PEHA: I think we've found a topic for one or five more workshops if we're so inclined.

MR. GREEN: Follow on workshop.

MR. PEHA: So I want to thank your panelists for coming here today.

SPEAKER: You're welcome.

(Whereupon, the PROCEEDINGS were adjourned.)

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I, Carleton J. Anderson, III do hereby certify that the forgoing electronic file when originally transmitted was reduced to text at my direction; that said transcript is a true record of the proceedings therein referenced; that I am neither counsel for, related to, nor employed by any of the parties to the action in which these proceedings were taken; and, furthermore, that I am neither a relative or employee of any attorney or counsel employed by the parties hereto, nor financially or otherwise interested in the outcome of this action.

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