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NATIONAL BROADBAND PLAN WORKSHOP

FUTURE FIBER ARCHITECTURES AND LOCAL DEPLOYMENT

CHOICES

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1   P R O C E E D I N G S

2   MR. ISENBERG: We have our first speaker

3   on the phone. Ladies and gentlemen, welcome to

4   the FCC National Broadband Plan Workshop on Future

5   Fiber Technology and Local Deployment Choices.

6   I'm David Isenberg. I'm an old hand

7   here at the FCC. I've been here about six weeks.

8   I hope I do things according to protocol. Please

9   punish me appropriately -- oh, that -- never mind.

10   I wish to thank everyone who's been

11   affiliated with the National Broadband Plan and

12   specifically with this workshop. I'd like to

13   start by thanking Stagg Newmann, who's been my

14   mentor in the ways of the FCC. Stagg, thank you

15   very much. Yes, please.

16   MR. NEWMANN: Just remember your

17   protocol has got to be open.

18   MR. ISENBERG: Open, indeed. This is

19   the new FCC here -- open protocols.

20   I'd like to thank Julie Knapp and Walter

21   Johnston and Tom Koutsky for serving as FCC

22   Co-Panelists with our distinguished outside panel.

1   I'd like to thank the FCC Event

2   Production staff. Krista Witanowsky has pulled

3   this physical facility together. Thank you,

4   Krista.

5   And to our FCC volunteers -- Whitey

6   Thayer on the timer; Jonathan on -- Jonathan,

7   please stand up. This is also important.

8   Jonathan has cards. If you have a question --

9   better, pass out the cards, please. If you have a

10   question for any of the speakers, the way the

11   protocol works is write it down on one of these

12   business cards or index cards, and give them --

13   wave it, and Jonathan will pick it up and come up

14   to me, and I'll chose the most important

15   questions, of course, and ask them on your behalf.

16   You can sign them or keep them anonymous

17   -- your choice. If you wish to be named, I'll

18   name you as the originator of the question.

19   Similarly for those of you out in

20   Internet land, who are online, if you have a

21   question, there are ways to Tweet the question and

22   e-mail the question. The instructions should be

1   online. I'm sorry. Remind me your name, please.

2   Ellen here will be moderating the online

3   discussion and transmitting questions to me.

4   So thanks to all of our moderators. And

5   I'm sorry. You're -- tell me your name.

6   MS. PAYTON: Jeree.

7   MR. ISENBERG: Jeree?

8   MS. PAYTON: Yes.

9   MR. ISENBERG: Jeree is in the back, and

10   she's loading up the viewgraphs for the -- as each

11   speaker comes up to present, and she'll also be

12   changing the slides when our one off-site

13   participant, John Cioffi, speaks.

14   So I'd like to once again thank all of

15   my colleagues on the National Broadband Plan, most

16   of whom are busy upstairs with blood coming out of

17   their fingernails as they write the plan right

18   now. This is day 90 of the Plan, and we're all

19   busily working.

20   I'd like to thank especially Blair

21   Levin, who is the -- our fearless leader on the

22   Plan. Blair has the vision to know what the

1   Internet can become, and the wisdom and

2   Washington, D.C. experience to know what's

3   possible, and he's walking this fine line and

4   doing an excellent job of it. And I'm sure that

5   the final plan will incorporate both the vision

6   and the practical steps that we can take.

7   I'd like to thank our outside panelists,

8   some of whom came -- three of whom came over from

9   Europe for the specific purpose of being here at

10   this workshop today. So I'd like to thank

11   especially Johan, who's on this panel. Benoit

12   Felton, wave -- at least put your hand up. Benoit

13   came over from Paris to give us the word on global

14   fiber services, and Herman Vagtair, who is back

15   there, who will be on the second panel, also who

16   is the Managing Director of CITINET Amsterdam.

17   So today's agenda -- the workshop might

18   be subtitled, "The Future is Here: It's not

19   Evenly Distributed Yet." It's sort of the leading

20   edge of the National Broadband effort. It's the

21   stuff that's too small on a spreadsheet, but too

22   advanced to ignore. The main theme and this isn't

1   a mystery, so I'll tell you what the -- what

2   you're going to take away at the end of the day:

3   That fiber is getting longer and the other media

4   -- copper, co-ax, and radio -- are getting

5   shorter; that fiber and the other media are

6   getting better, faster, and cheaper; that open and

7   simple win -- and you'll see that in the second

8   panel on services especially.

9   And finally, while I thank each speaker,

10 I point out to the audience here in the room and

11 online that each speaker has a specific role.

12 I've asked him to cover a specific limited set of

13 material in their few minutes and that I've

14 explicitly asked them to not do product pitches,

15 not represent their organization so much as

16 represent -- help us on the Broadplan Plan figure

17 out the future to the benefit of all United States

18 citizens and indeed all people of the world.

19   So with that, I want to just mention one

20 thing: We have two David Reeds in the audience --

21 oh, on the panel. And they're sitting right next

22 to each other. And indeed, I think this is the

1   first time that the two David Reeds in our field

2   have sat next to each other on the same panel; is

3   that correct?

4   MR. PATRICK REED: That's correct.

5   MR. ISENBERG: Okay. So while that's

6   remarkable, one might ask, and I say this a little

7   tongue in cheek, one might ask are two David Reeds

8   enough? Okay. In the marketplace of ideas, are

9   -- when David Reed from CableLabs contends with

10   David Reed from MIT, will one be able to

11   discipline the other and spur them on to new,

12   greater thinking or will they be sitting next to

13   each other going nudge, nudge, wink, wink -- what

14   you say is what I say and I agree, and you agree.

15   And so to that end, we at the FCC, have

16   a secret weapon upstairs in the office right next

17   to mine, there's a David Reed. Okay. He is our

18   public option. He will discipline the market

19   where the other two that where the Reed duopoly

20   fails.

21   So with that little attempt at levity, I

22   turn the panel over to our first speaker, who is a

1   remote participant, and that's John Cioffi from

2   ASSIA, and, John, are you online?

3   MR. CIOFFI: Yes, I am. Thank you,

4   David.

5   MR. ISENBERG: Okay. Let's see if we

6   can get your slides up.

7   MR. CIOFFI: Okay.

8   MR. ISENBERG: Okay. There's your

9   introductory slide. John, you've got seven

10   minutes. Take it away.

11   MR. CIOFFI: Okay. Well, thank you very

12   much. Thank you for the opportunity. I'm sorry

13   to all the participants that I wasn't able to

14   attend in person, but happy that I could at least

15   participate by phone today in your workshop.

16   And what I'll be talking about is really

17   the copper alternative to broadband, specifically

18   twisted pairs or DSL area and its future. In

19   particular, the area is growing rapidly, as we'll

20   see, through the techniques that are generally

21   characterized as dynamic spectrum management, the

22   title of my talk here; and there is very much a

1   path through hundreds of megabit and gigabit per

2   second DSLs that we'll try to outline for you here

3   today in the next few minutes.

4   The second slide, if you could put it

5   up, slide two -- and it's a bit animated, so you

6   may have to put everything up since we're

7   operating over a phone link here -- but you can

8   see a graph there. This is from point topic.

9   It's through the most recent quarter collected on

10   the growth in broadband subscribers. Now this is

11   worldwide, and you see the upper blue curve there

12   is the DSL curve touching 300 million customers

13   worldwide. A couple things of note there: The

14   green curve is a cable modem curve, and the brown

15   curve, the lower curve is the fiber to the

16   anything curve. About half of those are actually

17   DSLs. Point Topic chose to present the data that

18   way.

19   So a couple of things, the DSL area is

20   much larger, and it's also -- even though it's

21   larger, it's growing faster as well. The slope of

22   the line is pretty constant in going up at a

1   faster pace than the other broadband alternative.

2   So this is really the broadband

3   mechanism of choice around the world today, and

4   the key reason for that is it costs a lot less to

5   have a DSL connection than it does with, for

6   instance, fiber connections.

7   So that is 70 percent of broadband and

8   growing. So moving onto the next page, your

9   question there at the top, you can see it on page

10   three, is how fast is copper, and the answer, you

11   know, this is an important question because if DSL

12   is dominating in such a way and it is cheaper, you

13   know, how fast can it go? Can it satisfy the

14   need?

15   And to just give you kind of a

16   background on this, the copper itself is pretty

17   fast. A ten gigabit Ethernet is available today.

18   Ten gigabits per second on essentially four

19   twisted pairs of links, exceeding 100 meters. So

20   that's about two and half gigabits per second per

21   twisted. So there's evidence there that obviously

22   this is a very high bandwidth. Bandwidth

1   decreases with the length of the twisted pair, but

2   there have been demonstrations of hundreds of

3   megabit per second DSLs by various companies the

4   last year or so. In fact, a kilometer, or 3,000

5   feet roughly of twisted pair will easily handle

6   over 100 megabits per second bandwidth if there is

7   no noise. And that's typically the case in

8   Ethernet where there are less impairments than you

9   would see in DSL, which, of course, is in the

10   outside world plant subject to far more severe

11   conditions than is a typical Ethernet twisted

12   pair.

13   But it's not the copper itself that has

14   an unusual bandwidth limitation. It's all the

15   other impairments, namely, the noise that the

16   copper is subject to for broadband connections.

17   So that's what DSM tries to address is

18   getting rid of those other impairments or

19   addressing them or mitigating them and thereby

20   enabling these 100 megabit to gigabit per second

21   like speeds. And that does involve quite a bit of

22   signal processing.

1   Moving on to the fourth slide, the

2   technical challenges in DSL. As I said earlier,

3   to get the full slide up there, it's noise and

4   interference, and there are many sources of noise

5   to a DSL connection. There are in- home

6   appliances of all types; almost anything

7   electronic can generate noise, and it can get in

8   the phone lines. AM radio stations, amateur radio

9   operators impinge on the telephone lines, and they

10   are very easily picked up.

11   There's crosstalk between the different

12   connections, and that serves as a source of noise;

13   and then as well people touching the lines are

14   getting bad connections and such. Most of these

15   effects tend to be closer to the customer's

16   premises than the other side, closer to the

17   telephone company. So many of the noise source is

18   out near the customer.

19   And furthermore, those change day to

20   day. Things go on and off. New services may

21   occur in the cable. The environment changes. And

22   so it creates a dynamic environment for DSL, and

1   so really the response needs to be dynamic also,

2   and to date, DSL connections around the world have

3   been largely static in terms of their response.

4   They have had no management at all, but the area

5   of dynamic spectrum management just over the last

6   year or two has begun to come into use, and it

7   actually addresses these noises; tries to optimize

8   each line to handle the daily changes in

9   (inaudible), and so it can make a nice improvement

10   in terms of data rates that are achievable.

11   Moving on to slide five are a couple of

12   basic DSM functions -- a loop on the right and a

13   loop on the left that you can see. The one o one

14   on the right is basically a diagnostic loop. A

15   DSM system is a management system. It sits back

16   in the network. It monitors the DSL connections

17   every day; collects data 24 hours a day from them;

18   and will look and see what will be the problem on

19   an individual line. Is it a certain type of

20   noise? Is it a certain type of impairment? A bad

21   connection?

22   And it will help the customer care

1   people actually repair or remove that particular

2   problem from that line and thus obviously get a

3   higher data rate once it's removed. But even more

4   importantly is the automatic part, on the

5   left-hand side, the dynamic part, if you will,

6   where every DSL is monitored all day long, and

7   many of them can be fixed automatically by

8   changing the default settings in the equipment.

9   And this is really the new feature of DSM that

10   takes it from static to dynamic. Those default

11   settings are being changed as a function of the

12   quality of service observed; the number of times

13   the customer's line may have gone up or down

14   instantaneously; the number of packet errors that

15   are made and so forth.

16   And that changes from line to line.

17   It's different on each line, and said the

18   automatic part is very important. Now what this

19   does is it allows the service provider to remove a

20   lot of problems before the customers complain.

21   That means their cost goes down to operate the

22   network.

1   If their cost goes down, they can be

2   more aggressive in terms of the data rates that

3   they try to achieve, and so they get much higher

4   data rates than they could previously with using

5   one of these automatic management systems, namely

6   a DSM system.

7   So moving on to slide six, DSM has been

8   standardizing the United States and the U.K. and

9   is now just emerging from the International

10   Telecommunications Union, the so-called G Vector

11   standard, just consented a few months ago. And

12   what this graph does is it gives you an idea of

13   the speeds versus time. And there are actually

14   three standardized levels of dynamic spectrum

15   management technology.

16   Level one is already in service on tens

17   of millions of customers around the world. I'll

18   show you some results from that in a moment. But

19   the level two takes speeds up faster. Level three

20   is the highest level. These are so-called

21   vectored DSL. In the most recent standards that

22   are emerging, those are expected to hit the market

1   in a few years as the chips and equipment become

2   available and conform to that standard. And they

3   very much do get over a hundred megabits per

4   second on connections in the half a kilometer to

5   more than a kilometer range.

6   So if a telephone company can afford to

7   put fiber close enough, it's cheaper than putting

8   it to everyone's home; then they can indeed get

9   100 megabit per second type speeds with these

10   standardized DSM technologies.

11   On slide seven, here some results. This

12   is actually from a European network that's already

13   using dynamic spectrum management. On the

14   left-hand side, you can see before results; on the

15   right-hand side, after results. And the pie-chart

16   there is representing the percentage of customers

17   in that particular network, and basically shades

18   of blue are good here. And brown and orange are

19   bad. They mean that the -- the bad means that the

20   customer is retraining several times a day.

21   That's a 30-second outage and that their packet

22   error rates are very high. And you can see with

1   this automatic management, something like 40

2   percent of the customers were at risk earlier in

3   causing problems and less than 10 percent are

4   after the dynamic spectrum management is used.

5   That allows him to get more aggressive, and you

6   can see the results on the right-hand side where

7   the data rate distribution is dramatically

8   changed. The number of customers in the video

9   range from 10 megabits per second and above is

10   roughly now 55, 60 percent of that network. It

11   was a very tiny fraction, only about five percent,

12   prior to the use of this technology -- so both

13   stability and, therefore, better data rates.

14   Now today, there are about 17 million

15   lives under management with DSM Level One in the

16   United States, and that will rapidly grow here

17   over the next year. And there's about six million

18   systems in Europe, and that's growing even faster,

19   and (inaudible) just beginning to see the use of

20   that.

21   So that's Level One. And then, as you

22   saw in a previous graph, Level Two, Level Three --

1   higher-speed jet as equipment becomes available

2   that supports that today. All of the equipment

3   that's in the field today for DSL will support

4   Level One management.

5   So then moving on to slide eight, this

6   is Level Three. These are projections from one of

7   the main participants. I got these from actually

8   Econos, which is one of the -- actually, they're

9   the largest supplier of DSL chips in the world,

10   and these are what they expect to see from DSM

11   Level 3 performance. You can see the 100 megabit

12   line there for single twisted pair. They're

13   projecting somewhat conservatively here in the

14   range of 700 meters, and if you use bonding with

15   vectoring, that means you use the two pairs that

16   typically go to a home together for the service.

17   They're projecting that out to a kilometer, so in

18   terms of the range that you could get 100 megabit

19   per second service with a hundred megabits, of

20   course, being much faster than any other broadband

21   technology today if it's done on a per customer

22   basis, which is what this is.

1   And it's believed to be sufficient for

2   the needs of most broadband users, at least for

3   the next several years.

4   And then finally, slide nine, simply if

5   you take this bonding to an extreme, many American

6   homes have actually four twisted pairs in the drop

7   segment. They don't have it all the way back to

8   the central office, but they do have it near their

9   home.

10   Originally, those pairs were placed

11   there in case they were to order a second or third

12   phone line. The phone company would come out and

13   connect them on one of the pairs going back to the

14   central office. But they can be used if you move

15   fiber closer to the home, if you want to bomb

16   those pairs together, you can even get a gigabit

17   per second. Here, as you can see, symmetric

18   gigabit per second at 500 meters using those four

19   twisted pairs in a bonded unit.

20   So, indeed, that is a little better than

21   ethernet does today, which is maybe about 170

22   meters for one gigabit per second service on four

1   twisted pairs, but there's a much more

2   sophisticated signal processing being used here

3   with this dynamic spectrum management.

4   And so that can be pushed out a bit to

5   the range of about 500 meters or so.

6   And then finally, the last slide, slide

7   10, the opportunity is here to pass a hundred

8   megabit per second DSLs and beyond. Three steps

9   have been outlined in standards. The first step

10   is already starting to find its way into wide use.

11   The second and third steps expected in the next

12   few years.

13   DSL is a wire line growth vehicle for

14   most telcos. While their POTS revenue is going

15   down, the segment of fixed line revenue associated

16   with DSL is going up, and particularly important

17   is the wireless dependency on DSL with the new

18   higher bandwidth i-Phones and Blackberries and

19   applications proliferating in the wireless area,

20   the bandwidth that's allocated for wireless is

21   just not sufficient to handle that going forward

22   in the future without smaller cells.

1   And as we go to smaller and smaller

2   cells, you have to have a way to get to the middle

3   of the cells, either WiFi or Femtocells and in

4   particular the only way that you're going to get

5   there is with DSL service to those cells on a

6   widespread nature.

7   So the future of wireless very much

8   depends on the broadband systems getting out to

9   the middle of all these smaller cells and most of

10   the major telecom service providers are very

11   cognizant of that in their efforts to go forward.

12   And so, again, at the bottom of the

13   slide, this is the future of the copper path to

14   higher and higher speeds in the future, namely,

15   this combination of signal processing and

16   management techniques known as Dynamic Spectrum

17   Management.

18   So thank you very much for the

19   opportunity to speak here today.

20   MR. ISENBERG: Okay. Thank you, John.

21   I was lenient in part because I know you couldn't

22   see the timer and in part because I didn't have a

1   mic to ask you to please sum up. I hope this

2   doesn't set a precedent for other speakers.

3   I thank you very much, John, for

4   spending the time and waking up early to be part

5   of this. Will you be around for the Q&A?

6   MR. CIOFFI: Yes, I will.

7   MR. ISENBERG: Okay. Thanks so much.

8   So I implore the other speakers who can see the

9   clock to heed the clock. We now have David Reed

10   from CableLabs, who will tell us about hybrid

11   fiber co-ax and the future of DOCSIS.

12   MR. REED: Thank you, David. And thank

13   you for the invitation to participate in this

14   workshop. This is one funny anecdote with David.

15   It's not only are we -- do have the same name. We

16   have the same middle initial, so we often try --

17   David Reed being a common name, we tried to

18   differentiate by saying David P. Reed, and it

19   leads. We were just exchanging notes on some of

20   the funny anecdotes, and I don't know if David

21   will share his.

22   But one for me is I walked in one

1   morning and, you know, voice mails and e-mails out

2   -- you know, going out -- and it turns out all of

3   them are asking, "Why did you write that letter to

4   the FCC Chairman?"

5   So, you know, it adds some spice to

6   life. It turns out that David P. Reeds are very

7   opinionated as well. I happen to have another

8   David P. Reed in my hometown of Boulder, who likes

9   to write letters to the editor.

10   And so, you know, people come up and

11   "Why do you want to fire the superintendent of the

12   schools?" You know, and things like that. So it

13   adds spice to life.

14   I'm from CableLabs. For those of you

15   who don't know, CableLabs is a -- founded in 1988.

16   It's a non- profit. We have about 47 members of

17   CableLabs. They are only cable operators that are

18   members. They represent about 80 million cable

19   subscribers in the Americas, Europe, and East

20   Asia. And, as David mentioned, what I'm going to

21   be talking about here is the evolution of HFC. So

22   if we can go on to the next slide? I don't have

1   control of the slide. Okay. There we go. Okay.

2   So the broadband platform for cable is

3   known as DOCSIS, and this is the road -- this

4   slide shows the roadmap so to speak for the DOCSIS

5   platform and as it has evolved over time.

6   I look at DOCSIS as a toolkit that is

7   designed to support a progression of services, as

8   described within this roadmap, and, you know,

9   we're at the 3.0. It's really the current

10   version. It's just now being deployed en masse by

11   cable operators.

12   So this toolkit consists of speed -- an

13   upgrade to speed, as we'll talk about on the next

14   slide. It also has a lot of other things within

15   the toolkit to enable these services, and supports

16   multicast, source-specific multicast, a quality of

17   service associated with multicast; packet

18   suppression to make it more efficient when you use

19   multicast; IPV-6; security -- enhanced 128-bit AES

20   upgrade from the 56 kilobit or 56 bit advanced

21   encryption standard that was used in DOCSIS 2.0.

22   So within this toolkit, as we're moving

1   forward, we think DOCSIS 3.0 is very

2   well-positioned, and, in fact, there is no -- one

3   of the things David asks is -- implied that there

4   may be something in the works for next generation

5   for DOCSIS. This is just getting deployed right

6   now. And in the discussion, when David said -- he

7   was kind of interchangeable as saying the post-100

8   megabit world being post DOCSIS 3.0, and we don't

9   look at it that way for the reasons I'll describe

10   in the next slide, if we can per --

11   The higher data rates that you give and

12   that are available in DOCSIS we think easily will

13   have headroom going forward over 100 megabit per

14   second downstream service. And as the one who

15   helped to initiate the DOCSIS 3.0 version a couple

16   years ago, it was the -- to meet the competitive

17   offerings of DSL, as John was just talking about

18   in his previous discussion, that really drove a

19   lot of this.

20   And what these capacity amounts are and

21   what DOCSIS 3.0 introduces that differentiates it

22   from earlier versions is something called Channel

1   Bonding, which is putting the channels together.

2   John again talked about it within the DSL context

3   in the previous presentation.

4   So if you -- at a minimum with

5   implementation of DOCSIS 3.0, you bond four

6   downstream channels. And with the modulation

7   that's typically used on cable systems today, that

8   means four channels come out to about 152 megabits

9   per second. So that's the minimum that you'll see

10   in a downstream that is available that a group of

11   customers can share in the downstream. Eight

12   channels is 300 megabits, and vendors today are

13   shipping or will be shipping in 2010 basically

14   chips and products and modems that can support

15   eight bonded channels.

16   So you can see there's a lot of headroom

17   in terms of the amount of capacity that cable

18   broadband subscribers can get. In the upstream

19   side, began a similar story: You can support

20   bonding, and with two channels that can go up to

21   54 megabits per second. That's a maximum rate,

22   assuming that the plan is clean enough to support

 1   the highest modulation that's specified in DOCSIS

 2   3.0.

 3   And four channels you can -- so you can

 4   see how you can progressively get more and more

 5   bandwidth in both the downstream and the upstream,

 6   and you can choose to bind any channels you want.

 7   They don't have to be adjacent to each other. And

 8   this is all backward compatible with the legacy

 9   motives.

10   Go to the next slide. It provides a

11   little bit more description of what the upstream

12   bandwidth, since that's a question I often get in

13   terms of, you know, is the upstream for cable

14   Limited. There are many options here. This is

15   one that happens to be in the DOCSIS 3.0 standard

16   today. I look at this is more a long-term type of

17   discussion here. This isn't something that you

18   would anticipate a cable operator would do in the

19   next two or three years certainly.

20   And in that timeframe, other

21   developments might happen, and so there might be

22   other ways to address the upstream issue, but this

1   happens to be in the DOCSIS 3.0 standard today.

2   And that's to simply extend the upstream

3   part -- we call it a mid-split option -- to 85

4   megahertz. The way the cable system works is the

5   upstream is in the lower portion of the spectrum

6   on the coaxial cable. And so in doing that, that

7   will add nearly -- it's actually 175 megabits per

8   second, if you check my math there. I apologize

9   for that, but it's about 175 megabits per second

10   if you're using 64 QUAM at 27 megabits per 6.4

11   megahertz channel.

12   And so you can how that extends up. Go

13   to the next slide and last slide.

14   So another important point here that I

15   think is sometimes lost is that, at it's from the

16   Heritage -- the cable plant being a tree and

17   branch architecture, whereas everything was

18   broadcast. In fact, two of the most significant

19   developments of the last decade for cable have

20   been the introduction of two-way capability and

21   interactive capability on the plant.

22   And so the way the cable systems

1   implement those interactive services is called

2   something -- the concept of segmentation, which --

3   what that means is that segmentation of the cable

4   spectrum increases the system wide capacity. You

5   take some amount of the spectrum, and by

6   segmenting that, you replicate it. You don't

7   replicate it for everybody, but you customize it

8   for a certain service group size, a certain amount

9   of homes, and then it's not duplicated for the

10   next set of homes. It's customized for those.

11   So in that way, you can really expand

12   the capacity of a cable system, and this chart

13   shows that a kind of a -- in today's system what a

14   typical plant will look like, if you break down

15   the services offered over it to linear content,

16   which is the traditional one-way broadcast, but

17   then some of the major interactive classes of

18   services being switched digital video or broadcast

19   video, video on demand and broadband. And the

20   service group size then for those segmented -- in

21   order to support those different segmented

22   services, you can see vary between, say, 900 for a

1   switched digital video service group size, up to

2   1,500 for Video-D. Broadband is around a

3   thousand, which means that for those -- for a node

4   or for a group of about a thousand homes, that's

5   where the bus part of the cable architecture

6   shares the architecture.

7   And so then you can see as a consequence

8   of that the percentage of the delivered bandwidth

9   how that breaks down. It's not -- if you use one

10   or three channels per DOCSIS, that's a very small

11   percentage. In fact, the amount of information

12   flowing over the cable network is much larger when

13   you take a perspective like this.

14   So I look forward to the discussion and

15   any other questions we have on the HFC network.

16   MR. ISENBERG: Thank you, David Reed.

17   Now David Reed, from MIT.

18   MR. PATRICK REED: Thank you. I have a

19   very short presentation that really I think

20   focuses on what I think is the most important

21   question, which is this -- what this panel is

22   about, which is the future of communications and

1   presumably that future impinges on the

2   deliberations around the National Broadband Plan,

3   but I leave discussion of some of those things to

4   the questions I'm asking rather than providing an

5   answer of what the future is.

6   My sense of how you predict the future,

7   being an engineer and a system designer is the

8   best way to predict the future is to invent it,

9   which is attributed to Alan Kay, but also to some

10   other people. And if we think back, do I -- can I

11   control this -- next slide.

12   MR. ISENBERG: Just -- actually, you

13   know --

14   MR. PATRICK REED: There is a

15   controller; right?

16   MR. ISENBERG: I've been remiss in my

17   duties.

18   MR. PATRICK REED: Yeah.

19   MR. ISENBERG: Sorry. But thank you for

20   filling in.

21   MR. PATRICK REED: Oops. Yeah. So the

22   -- in the years I've been sort of designing

1   systems and building them in the communications

2   range. I constantly refer back to a paper that

3   was published in 1967 by Bob Taylor and J.C.R.

4   Lickglider to gray beards in the field. And the

5   paper was called "The Computer as a Communications

6   Device," and the reason I bring that up here is

7   because communications is not just about the

8   speeds and feeds and the technologies underneath,

9   but it's actually about what people do with it.

10   It's about communications, which is something that

11   humans do.

12   And so what I'm going to try to do in

13   this discussion is focus on what humans will be

14   doing, extrapolating from work that is going on in

15   the technical field.

16   One of the observations I'll make is

17   that the way we think about wireless right now is

18   disconnecting us. It's literally making us walk

19   around, staring at phones, walking into walls, and

20   crashing cars and doing a variety of things.

21   And that doesn't have to be the way

22   wireless technology is deployed. But it's being

1   deployed because it's being modeled after

2   historical communications modes of television

3   watching or making phone calls as opposed to other

4   things like communications can do.

5   So particularly, and I'm going to -- if

6   you take away a major point, the title here that

7   wireless is much more than a third pipe, to

8   satisfy some notion of broadband, notice a couple

9   things: First of all, that these two devices --

10   my android phone and my Prius car key, smart key

11   for a car -- are both wireless devices, and

12   they're not about delivering broadband, but they

13   do deliver enormous value to me in various ways,

14   which I'll talk about.

15   But if you also think about

16   communications as including, for example,

17   Facebook, which is probably the most popular

18   communications medium that's grown in the last

19   five years, or SMS, which is not so much valuable

20   because of the number of bits per second, but

21   because of the interaction it provides, and you

22   start to think that communications is more about

1   situational awareness, access to data and

2   resources, and so forth, and less about delivered

3   content or the ability to call your family.

4   So the focus that I would like to claim

5   as we think about broadband deployment is that

6   what is really happening, the sort of third

7   revolution after the Internet and personal

8   computing, is really personal mobility, and let me

9   define what personal mobility is.

10   It's not about mobile devices, although

11   that's part of the solution. But it's about

12   allowing people to move through the world in a

13   much more connected fashion, and so when we look

14   at the personal device, it's more important that

15   my phone be able to tell me what's going on around

16   me than it is to, you know, for example, be able

17   to place phone calls from where I am in the long

18   run.

19   So the -- in particular, this is what

20   happens when you decouple the owner of the medium,

21   whether that medium is fiber, copper, or spectrum,

22   from the use that people are allowed to make use

1   of that medium. And the decoupling that was done

2   in the Internet era decoupled the physical mode of

3   transport from the protocols and so forth that ran

4   over it.

5   What we see I think coming up -- and

6   this is my particular notion of what the

7   collection of inventors out there in the world --

8   in academia and, you know, creators of apps for

9   cell phones are doing -- is creating a power that

10   I might capture in the key here, which is the

11   power something I'll call the amulet.

12   And amulet is something that puts you in

13   connection with your environment and in control of

14   your -- both your physical environment and your

15   other -- your social environment.

16   So if you think about it, communications

17   is always embedded in a context, and now we can

18   make that context supported by the infrastructure

19   that we've built. And that's really what

20   broadband is moving toward. Broadband is about

21   creating an always live context, and I think what

22   we have always live on our desktop or always live

1   in our living room, you know, in terms of the

2   Internet will move into the wireless environment,

3   that we will always-it's always on, not something

4   you dial to or something you place a phone call to

5   and so forth.

6   And in particular, it's enabled by

7   personal identity and centered on communications

8   acts that are not thought of as communication, but

9   really are core communications acts -- awareness

10   -- being aware of what's going on around you;

11   discovering what's around you and so forth.

12   And a good example of that awareness is

13   keeping track of what's going on with your

14   friends, keeping track of where you are and what

15   bus schedules are going on, and so forth -- and

16   even relatively simple steps forward that allow

17   you to be aware of -- or put you in control of

18   your environment so when you are watching a

19   television program on your TV, you can pause it

20   and take up, you know, watching or listening to it

21   over your cell phone from the point where you

22   paused it. That's a mobile context-related thing

1   that's about the architecture of the

2   communications environment, and it raises security

3   issues. It starts to include things like signage.

4   It starts to include really important societal

5   benefits like the ability, for example, to support

6   first responders who are potentially in your

7   vicinity being reachable when you have a

8   significant accident, and all that sort of thing

9   surrounds wireless.

10   So moving to the implication for

11   wireless is that we need to move beyond spectrum

12   sharing to inter-working. Spectrum sharing is a

13   negative thing. It basically says making radio

14   systems that are owned by different owners not

15   interfere with each other, which basically

16   decouples and fragments things as opposed to

17   creating opportunities to cooperate and

18   opportunities to be mobile through an environment.

19   That involves a whole lot of technical questions

20   at the radio level, which I'd be happy to talk

21   about, but not here.

22   But since we're talking about fiber,

1   what -- if you think this through over the next

2   five or six years, and it's been a little bit

3   mentioned, is that fiber is the key to wireless

4   broadband at scale. And a few years ago, I worked

5   on a research -- you know, set of research

6   activities, as of many others, trying to say can

7   we do it with pure wireless, and the idea there

8   was mesh. Okay. Well, mesh is a really

9   difficult, technically challenging way to achieve

10   universal wireless coverage.

11   We have at hand a very different way to

12   do that, which is to have fiber and to make, as

13   David Isenberg said, make the wireless part very

14   short range, and whether we do this with cellular

15   type technologies or other type technologies, what

16   that means is that we're operating radios at the

17   point where they are the most efficient -- over

18   short distances, at high bit rates, which, you

19   know, in the case of even home distribution of

20   video content, we know that we can do that over

21   300 megabit, 802.11n, which is a standard, and has

22   caused all kinds of consumer electronics companies

1   to realize that wireless within the home is

2   totally practical and doable today.

3   What this leaves, and this is my final

4   slide, is that in some sense we have a new tussle.

5   I expect it will take 20 years to sort this out.

6   It's the 21st century tussle, an the tussle is

7   that wireless is moving to local, and I think

8   fiber will cause it to move more local, which

9   means that the cellular operators and the fiber

10   operators need to do something.

11   One thing they may do is, you know, grow

12   to do -- create femtocells and things like that.

13   But I think that will work, because when you're in

14   a campus or some other environment like that, it's

15   not -- there is no reason for me to get my access

16   to my physical vicinity or my social vicinity

17   through an operator who has no stake in that

18   campus, no power stake in that campus.

19   So wireless will become local, and the

20   challenge is getting fiber into those local places

21   and fiber of a very different form, not fiber that

22   controls accounts, but fiber that serves as an

1   Internet-like infrastructure for a predominantly

2   wireless space.

3   With that, I'm done. Thanks.

4   MR. ISENBERG: Thank you, David Reed.

5   Now continuing the string of Davids, David

6   Russell, who will give us the roadmap that he sees

7   -- actually the standards roadmap that is widely

8   acknowledged for fiber going forward from today.

9   Thank you, David, for being here.

10   MR. RUSSELL: Thanks very much. I think

11   this is the most Davids I've seen since my

12   elementary school class.

13   I represent a company by the name of

14   Calix, and I'm also active in the Fiber to the

15   Home Council, and so what I'm going to talk about

16   today is where the fiber access technologies are

17   today and where they are going.

18   So as a little background, the company I

19   work for actually is very involved in the fiber

20   optics standards, and we really specialize in the

21   rural markets. And rural is a very interesting

22   place for fiber, because your loop links are so

1   long in rural areas that it's not well suited to

2   copper-based technologies. So what we do with our

3   customers typically is we're working with them on

4   a transition path from copper to fiber. And the

5   speed at which they move in that path is dictated

6   by a number of variables -- densities, their

7   economic situation caused the capital.

8   But what we've seen over the last few

9   years is a pretty major shift, where if you put

10 out an RFP today, or if you are planning a rebuild

11 or a new build, you'll do it with fiber. And it's

12 just a matter of time as to when the conversion

13 will take place throughout rural America from

14 copper to fiber.

15   Now that said, what's driving this, of

16 course, is consumer demand, and the all video

17 world, which is driving that consumer demand. So

18 we're at stage three in the Internet. In stage

19 three, we move from a text-based to a

20 graphic-based, and now a video-based environment.

21   So our general advice to customers has

22 been if you get fiber in the ground, your

1   incremental cost of bandwidth is essentially zero.

2   And ONTs that exist today in the market

3   can do a gigabit of bandwidth up and down, into

4   the house already. So as bandwidths increase,

5   consumer demand drives that -- you can leave that

6   ONT in place and just up the speeds with the click

7   of a button, and you're getting higher and higher

8   speeds.

9   So that's -- that kind of roadmap is

10   what I'm going to talk about from a technology

11   perspective.

12   So today, there's really two standards

13   organizations that are involved in fiber access

14   standards. The first is the ITU, and they have a

15   working group that's called FSAN, or Full Service

16   Access Network, and the IEEE is the second body.

17   And the standard, the current standard from the

18   ITU and the Full Service Access Network is the 2.5

19   GPON standard. And in the IEEE, you actually have

20   to standards that are being deployed today. One

21   is the one gig EPON standard, which is a passive

22   standard, and then you have an active or

1   point-to-point one gig standard that is being

2   deployed. And I've put up here the actual

3   accounts of how these different standards are

4   being deployed in the United States.

5   And you can see that GPON, about 100

6   operators since one year ago to today, about a

7   hundred operators have started deploying GPON. So

8   the total number is now approaching 300 operators

9   in the United States that are doing GPON.

10   BPON has been dropping off as people

11 switch over to GPON, and then active Ethernet is

12 also growing in the United States. EPON is not.

13   So if you were going to go to Europe or

14 to Asia, these proportions would differ from those

15 regions to the United States; that this is what's

16 going on in the United States.

17   Now when we talk about next-generation

18 standards, each of these standards bodies is

19 working or has now published a next-generation

20 standard. The ITUFSAN is actually working on two

21 standards. The first is what's called NGPON1,

22 which is essentially a 10 gig PON standard. And

1   they also have a second standard they're working

2   on which will come after NGPON1 in a time

3   sequence, and that's not surprisingly called

4   NGPON2. And NGPON2 is to take us beyond 10 gig,

5   and essentially when most people talk about this

6   next standard after 10 gig, usually people get

7   around to talking about WDM PON, and I'll talk

8   about that in a minute.

9   The second standard that has now been

10 actually ratified -- the IEEE has ratified their

11 10 gig standard, and that is now a fully

12 commercial, ready to go standard.

13   Now when you look at these two 10 gig

14 standards, you'll start to see product rolling out

15 on the IEEE standard probably in the next year,

16 and then on the 10 gig GPON standard, it's

17 probably going to be about two years from now.

18 It's running about nine months behind the IEEE

19 standard.

20   And they both have -- I think the IEEE

21 standard has some advantages in being first to

22 market, being pushed by a lot of entities in Asia.

          1   The downside is they only have one gig in the

          2   upstream, and most people say that is too limited.

          3   They do have a second 10 gig in the upstream

          4   standard, but the 10 gig is not cost-effective,

          5   nor can it be deployed outside, so it's not really

          6   suitable for single-family deployments. It's more

          7   of a fiber to the building type architecture.

          8   The GPON, next generation GPON standard,

          9   the 10 gig will be two and a half gigabits up, and

         10   10 gigabits down. But they will also have a

         11   symmetrical standard of 10 gig.

         12   Now what's coming after that? The last

         13   set, the NGPON2, is really aimed at making --

         14   creating much larger distances, allowing people

         15   much higher bandwidths, and hopefully getting to

         16   the point where we have one wavelength for home.

         17   And there have been a lot of standards that have

         18   been proposed -- or technologies I should say.

         19   Some of them I -- frankly are probably

         20   not going to make it because they're too brunt

         21   force. They're not very elegant. There are some

         22   people out selling WDM PONs today that are not

1   standardized, but have difficulties with component

2   prices as well as with temperature -- fluctuations

3   with temperature.

4   Last week at the FSAN Meeting in Kyoto,

5   Japan, there was a proposal that Nokia-Siemens put

6   forward that our architect and many other

7   architects got very excited about, which was

8   essentially a coherent detection WDM PON that was

9   insensitive to variations in temperature, and we

10   think has some great promise. And so we'll be

11   monitoring that, and I'm sure there will be a lot

12   more presentations about that in the upcoming

13   standards meetings.

14   But the point I wanted to make here is

15   great promise here. We see these being

16   commercialized after around 2015. And there's

17   going to be some twists in the road here over the

18   next two years as these new standards come about.

19   And so we'll be monitoring those of the next two

20   to three years as those develop. Thanks very

21   much.

22   MR. ISENBERG: Thank you. We now have a

1   little bit better idea what we're planning for.

2   John Jay, from Corning, pick it up and take us

3   forward.

4   MR. JAY: Thank you, David. Yes, my

5   name is John Jay. I am application engineering

6   manager for Corning Optical Fiber. I don't have

7   -- my resume doesn't really have quite the heft of

8   some of the distinguished panelists here, but

9   there are two things I wanted to mention: One is

10   I've been involved in fiber-optic industry

11   standards for 20 years now, and, in fact, I was

12   just attending the meeting that ratified some of

13   the standards Mr. Russell talked about in Geneva

14   last month.

15   The other thing that this group might

16   find more interesting is I'm actually a founding

17   member of the Fiber to the Home Council. I wish I

18   could tell you it was my idea, but actually one of

19   our equity partners recommended it. My team got

20   approval from my management to try and organize

21   this. I was sent to evangelize and recruit among

22   the industry, and I was on the first

1   teleconference of about four companies to get the

2   Fiber to the Home Council off the ground.

3   My greatest claim to fame is I insisted

4   that the first conference be in New Orleans rather

5   than a less worthy city, and the first managing

6   director actually was one of my employees who

7   reported to me while she was Managing Director of

8   the Fiber to the Home Council as well.

9   So it's a privilege to see that it's a

10   -- the important part it's played in developing

11   broadband access networks, knowledge, and

12   information in our industry.

13   The -- about that time of that first

14   conference, in 2002, I returned back to

15   engineering for marketing, so this is my first

16   time back in this part of the business in several

17   years, and it's very sobering to see the decrease

18   in U.S. competitiveness in broadband performance

19   during that time.

20   David asked us to talk about the future

21   today, and I think the future is now. And I

22   believe it's time for -- we need some aggressive

1   broadband performance -- network performance

2   objectives to get -- renew and recapture our

3   competitive position. I spend a lot of my time

4   working -- we export a lot of product to China.

5   We have a lot of activity in India. I can assure

6   you nobody there is waiting for us to catch up.

7   David asked me to talk about future --

8   passive network future fiber architectures, and

9   it's difficult to do, because really our view is

10   that the fiber access network architectures,

11   technologies, and products being deployed today

12   really carry us well beyond the 100 megabit per

13   second era. I think Mr. Russell's presentation

14   showed that a lot of those technologies that maybe

15   be considered beyond that are available today.

16   Fiber network technology is well

17   established and proven. The standards for

18   networks like the FIOS service Verizon sells have

19   been in place since the late 1990s; actually,

20   interestingly, much longer than a lot of competing

21   technologies like DSL or VDSL what you're maybe

22   seeing is more conservative.

1   Fiber networks are highly reliable.

2   It's very common for me to get phone calls from

3   people operating networks installed in the early

4   1980s wanting to know if they can run the latest

5   technology on there.

6   So those systems continue to run well.

7   Fiber networks reduce operating costs. At one of

8   the first Fiber to Home Council meetings, Verizon

9   told us that the net present value of the cost

10   savings of service and maintenance of a fiber

11   network Greenfield versus a DSL Greenfield was

12   worth $200 per subscriber.

13   And, of course, fiber networks have the

14   smallest carbon footprint of access network

15   technologies, and so the advantage of a fiber

16   network access network investment today is you're

17   running a low operating cost position and a small

18   carbon footprint. As you expand the networking

19   capabilities, if you have to look at other

20   technologies, as a better solution in the end,

21   you're scaling off a nice, comfortable base to

22   begin with.

1   So if we look at -- our view is that the

2   fiber networks installed today are capable of the

3   network performance today. They're upgradeable to

4   the performance requirements in the future, and

5   scalable to the long-term performance requirements

6   that can be envisioned.

7   When I was working in this part of the

8   business seven or eight years, we were trying to

9   convince people that 200 kilobits service was not

10   an effective broadband service, and they needed

11   one to two megabits of service, and hopefully

12   nobody today thinks one to two megabits of

13   delivery is sufficient. We don't want to be back

14   here in seven, eight years and think that we shot

15   behind the duck and set our objectives too low.

16   I won't go in -- I think there's a

17   consensus on the capability of fiber network

18   transmission performance, and Mr. Russell

19   mentioned about the standardization well

20   established for GPON today and beyond it. Those

21   standards are there. More importantly, developing

22   standards -- as someone who attends these

1   meetings, I can tell you these standards are --

2   when they're drafted and even when they're

3   envisioned, it's insisted that they leverage the

4   current investment in fiber product and invested

5   plant. There's strong representation of operators

6   worldwide, and I -- also, but the vendors feel the

7   same way that these physical plant investments

8   have to take us to whatever we can possibly

9   envision.

10   There's not the economic capability to

11   rebuild and reinstall access network plant with

12   high frequency.

13   The important thing is is these fiber

14   networks are compatible with other access network

15   technologies as well as generational compatibility

16   among fiber access networks. A good example is

17   there's an effort in the ITU now to harmonize the

18   management and administrative software for ONTs

19   for all generations of PON. Very high

20   compatibility with other access network

21   technologies.

22   For someone from Corning, I can tell you

1   it's hard for us to envision. There are cases

2   when fiber is not the right answer, but I suppose

3   that's probably true. In all seriousness, in

4   cases where it's not, fiber is certainly the best

5   infrastructure for innovation and investment to

6   finally connect these subscribers.

7   The fiber network standards in the ITU

8   specifically call out terminating to services such

9   as XDSL, 802.11, Ethernet services. These are all

10   standardized of how to connect these. In fact,

11   one of the technical submissions we just made last

12   month was to help deliver time of day over fiber

13   networks so that it could be used for 3G and 4G

14   wireless backhaul rather than having to create

15   that capability in the wireless site itself. So

16   it's a great cost savings, and Mr. Russell's

17   company actually has products available for

18   putting wireless backhaul off of GPON.

19   In some cases, it's enabling. 4G

20   wireless you must have fiber backhaul for that

21   capability, and most of the products require fiber

22   up the mast to the antenna, and with all due

1   respect to Dr. Cioffi, at the DSL standards

2   meetings I attended at the ITU last month, the

3   experts there were telling me that the jitter

4   tolerance on DSL standards is too high to support

5   wireless backhaul, that you have to have fiber.

6   So our view is these networks and

7   products, as they're being installed today, are

8   taking us beyond the 100 megabit world, David. I

9   mention most of these here already. Reach

10   extension. There are standards to extend fiber

11   network out to a 60 kilometer span or more as well

12   as increasing split ratios, reducing cost for

13   operators and construction.

14   And also in the cable television area,

15   RF over glass or DOCSIS over glass, extending

16   fiber out -- extending the DOCSIS service -- on

17   optical -- keeping an optical format as close as

18   possible to the subscriber.

19   So this is probably more slides that I

20   thought I had, so I'll wrap up.

21   MR. ISENBERG: Yeah. If you could.

22   MR. JAY: And if I could just take one

1   second. David asked me to mention some of the

2   products that are used in fiber to premise

3   networks. I don't want to turn this into a

4   commercial, other than to mainly point out that

5   most of these are scalable to all the standards

6   that Mr. Russell mentioned as well as some of the

7   further technologies that are being proposed.

8   MR. ISENBERG: Thank you, John. Okay.

9   John Hanaes, thank you again for flying all the

10   way over from Norway to be part of this panel

11   today, Johan.

12   MR. HANAES: Oh, thank you for inviting

13   me. Hello, everyone. My name is Johan Hanaes. I

14   come from a systems integrator in Norway called

15   INS Communications. I've been more or less all my

16   career working with telecom systems and telecom

17   networks, and for the last five years, I've been

18   working quite actively with what has been

19   mentioned by these guys, a standard called WDM

20   PON, or not the standard yet, but the technology.

21   I was one of the initiators of the

22   GIGAWAN Project, which is a EU-funded project for

1   integrational components for the future of WDM PON

2   systems. And I also was a part of the

3   architecture group in the Fiber to the Home

4   Council in Europe, based on the fact that the

5   Norwegian market over last 10 years, there are now

6   16 new players offering fiber services. We saw

7   that there was definitely room for a new systems

8   integrator in Norway, so last year we established

9   INS Communications.

10   So when I was invited to talk about the

11   future of fiber optics, I was inspired by an old

12   Roman to maybe look a bit back -- step back and

13   take a look at what's happened before us.

14   And if you look back to the '80s, there

15   was a lot of activities for finding solutions also

16   for fiber in the access part of the network. At a

17   time when the access speeds were in the hundreds

18   of bits, it makes sense to use TDMA as a

19   technology, and BT was very active trying out

20   several architectures and ending up with a 128

21   split type of solution for their TPON, a telephony

22   PON metric.

1   In the early '90s, they started rolling

2   out their system for as much as 30,000 users in

3   the Milton Keynes area, and they had a plan for an

4   upgrade of this network, for worldband for the

5   services they envisioned at telephony obviously,

6   television, high-feed stereo, and video library.

7   So after a while, when the customers who

8   wanted broadband, they tried to find solutions for

9   it. And based on the fact that they had 128 users

10   connected to the same fiber and they made the flaw

11   that they had two splits in field -- eight plus 16

12   -- it made it impossible to decrease the number of

13   users per country; hence, they weren't able --

14   either themselves or through standards to find a

15   solution for offering broadband to these

16   customers.

17   And in 2003, after the customer shouting

18   for broadband, BT had to actually start replacing

19   these fiber systems with what they branded as

20   copper overlay, which was an ADSL roll out. And

21   the great dimension of this is that the fiber

22   ducts they had for the original TPON system were

1   too narrow, so they had to actually dig again to

2   get the copper into the ground. And, as you see,

3   they did it in this decade.

4   We also know that Deutsche Telecom had a

5   similar project going on, and they also had to

6   fork lift upgrades hundreds of thousands of users,

7   not by copper, though, that they replaced the

8   systems with active components in the field.

9   So did we learn something? Well, it

10   might be the tomorrow's services are neither

11   broadcast TV, high-feed stereo or video library.

12   And if we look at the architecture that we have in

13   the central part of the network, the core and

14   metro, we have moved from a one network per

15   service type of architecture in the '90s to what

16   the carriers call the next generation networks --

17   one network and one platform for all services.

18   These are optical WDM-based flexible platforms for

19   tomorrow's services.

20   So when rolling out the fiber

21   infrastructure based on TDMA PON, which is a

22   25-year-old invention, what then about your

1   business customers and your wireless backhaul and

2   future services? Even if you look at the

3   standards picture, we see that if you deploy power

4   splitters in the field today, there are good

5   reasons to believe that you will need to replace

6   these or at least do something to (inaudible) that

7   plan for the -- within the next decade.

8   And I think that this is one of the --

9   or some of the reasons why the European market now

10   deploys mostly point-to-point connections. I

11   don't have the numbers in my head, but I think

12   there's something like 80 or 90 percent

13   point-to-point in Europe.

14   What is the backside of the

15   point-to-point is obviously the high cost of

16   operating a point-to-point system. And since we

17   have such great capacity in the fiber today, we

18   see that WDM PON could be a very attractive

19   solution.

20   As mentioned by the people before me, we

21   have symmetrical bandwidth in such a system. We

22   have a point- to-point connection in such a

1   system, so we have the best from two worlds

2   bringing together point-to-point and PON.

3   And if you look at the numbers and the

4   performance of these systems and knowing that

5   bandwidth is the future product in your network,

6   we know that today even with the non-standard

7   systems that we have, the cost performance --

8   bandwidth versus dollars -- is actually better

9   than the other systems.

10   And another important role for WDM PON

11   might be in the future to also collapse the border

12   between the access and the metro part in the

13   network, allowing us to have new architectures and

14   new networks offering totally new services.

15   So we are a group of people that has

16   started a small initiative called the WDM PON

17   Forum. Today, it's a small group on the LinkedIn

18   website, so if you want to have a look, please

19   logon and we hope to expand to a website called

20   FiberIn within the next year. Thank you so much.

21   MR. ISENBERG: Very good. Thank you

22   very much. So I'd like thank the panelists for

1   enlightening presentations. I am wondering first

2   of all, are there any questions that are specific

3   to cable or hybrid fiber coax or DOCSIS that we

4   could ask right now because David Reed has a

5   delayed -- kindly delayed another commitment to be

6   here, and he needs to go pretty soon.

7   Here's -- Benoit, which David Reed is

8   this for? How many end users are -- oh, okay. So

9   here it is. Okay. So, David Reed, how many end

10   users are sharing this up and down bandwidth in a

11   typical cable implementation?

12   MR. REED: So it -- first off, it varies

13   with each operator so there's not a standard

14   number that an operator will use. And it also

15   varies depending upon the users in a particular

16   area. You get different usage patterns from a

17   college area than you would from another type of a

18   demographic.

19   As I mentioned in my last slide, there's

20   a service group size of about a thousand. And so

21   that gives you some insight into how that sharing

22   occurs in terms of -- in a DOCSIS system we have

1   something called the cable modem termination

2   system, which is a CMTS that is in the head end,

3   and there's a line card. And that defines how

4   much the capacity will be shared upon of the bus,

5   so you can, say, serve up to a thousand with, you

6   know, a line card. You may have multiple line

7   cards per fiber node per service group, so there's

8   no one way, but what-you know, the cable operator

9   looks at the oversubscription, so to speak, of

10   that bandwidth as a real benefit to the approach

11   because you get the benefits of statistical

12   multiplexing on the cable system, and with the

13   network management capabilities on the DOCSIS

14   platform, you can basically monitor the usage in

15   the sense of the overall amount of capacity that's

16   being utilized during any particular time; and

17   based upon the patterns of that, if the usage, the

18   downstream usage, for example, gets too some

19   percentage, the members -- or the cable operators

20   typically have a level that they flag to say,

21   okay, we need to expand the capacity on the system

22   based upon usage that's being tracked on that

 1   particular node at that particular time for a peak

 2   hour.

 3   And so, you know, there's no one number

 4   that I can just give you as a rule of thumb

 5   exactly, but there's no question that that the

 6   operators look to try to maximize the utilization

 7   of a bus as, you know, any network operator would

 8   with their capacity.

 9   MR. ISENBERG: Thank you very much. I'd

10   like to invite my colleagues from the FCC to ask

11   questions if they have any, and I know Stagg here

12   has one. Stagg.

13   MR. NEWMANN: Yeah. First, I've

14   observed nobody is proposing fiber to the person,

15   which I think is good, because most of us don't

16   want to be tethered, and also even within a

17   building, you know, realistically we're still

18   going to be using our twisted pair, our wireless,

19   or our coax probably for the distribution from

20   within the building.

21   So in some sense, the question I'm

22   trying to ask is how close is close enough with

1   the fiber under the different architectures, with

2   the observed that in the cable industry today we

3   do get fiber within a kilometer and less than a

4   kilometer to most homes. The telco architecture

5   -- I guess the question for John would be, how

6   close do we need to get that fiber practically to

7   realize the benefits you see to future-proof the

8   network so we don't have a massive step change in

9   capital investment needed. And for David "MIT"

10   Reed the same question for you: How close is the

11   fiber need to be to realize the type of future

12   architectures.

13   I think the fiber in the home guys

14   probably don't need to answer that question.

15   We're probably close enough.

16   MR. ISENBERG: Actually, John Cioffi, if

17   you're out there, you want to take a first crack

18   at it?

19   MR. CIOFFI: Yes, I can, and, of course,

20   the range of the fiber is dependent on data rate

21   that the customer needs. If you assume that 100

22   megabits per second is enough, and most experts

1   today I think believe that is beyond the range

2   that they contemplate for individual broadband

3   connections, one kilometer range is close enough

4   to be able to do that. Fiber typically costs

5   between $20,000 and $1 million per kilometer to

6   install, and obviously if you can divide that cost

7   over a larger number of customers, and typical one

8   kilometer range is what's called the node,

9   particularly evident in the United States, but

10   other architectures internationally also --

11   typically have a junction box in that range so

12   that is, for instance, the architecture that AT&T

13   is using on their -- in a very large population of

14   DSL subscribers. So one kilometer, 100 megabits

15   per second.

16   In Europe, you see a lot of networks

17   with two kilometer to three kilometer pretty much

18   range -- just a little shorter line. And you see

19   IPTV service in the range of 10 to 20 megabits per

20   second being offered along with data; and voice in

21   those networks at two kilometer, and then you

22   don't need only fiber at all.

1   So it really is a question of the data

2   rate and the network architecture, but I think one

3   kilometer has kind of emerged as the architecture

4   of choice for the advanced DSLs when there is

5   fiber heading -- you know, used to shorten the

6   length of the copper.

7   MR. ISENBERG: Thank you. David Reed,

8   Cable Labs?

9   MR. REED: See in the cable network that

10   -- you know, the cable industry went through a

11   significant upgrade of their systems over the past

12   decade, where they extended fiber out. It really

13   that -- it's less a distance issue. With the

14   telephone network, it's a distance issue because

15   of the attenuation you get on the copper and the

16   tradeoff in the bandwidth that's available is

17   based upon that.

18   On the cable system, for the most part,

19   you can -- you're much more able to design your

20   network basically on a household basis based upon

21   your estimate for the amount of traffic required.

22   And so in that -- in those upgrades that occurred

1   over the last decade, they generally went down on

2   average to about a fiber node size of 500 homes

3   past.

4   So, you know, the distance for that from

5   the home is going to vary due to the geography and

6   the typology. There are some constraints with

7   coax with regard to amplification on how many

8   amplifiers you want to have in the network

9   subsequent to the fiber node, but in general the

10   fiber extends down to about 500 homes past, and

11   based upon that, you can get the speeds of DOCSIS.

12   There's no variation in the speed based upon that.

13   If you took -- were to look at a cable

14   network, a 750 megahertz cable network, if you

15   were to digitize it entirely, that's roughly about

16   5 gigabits per second of information that's

17   flowing over that, and so looking on -- or based

18   upon the service mix, the triple play that cable

19   operators provide, that can then dictate what the

20   next steps are if at a 500 homes past node they

21   were to start to need more capacity than can be

22   provided by simply allocating some of the -- by

1   spectrum management within that network. And then

2   they can start doing some node splitting, or it

3   doesn't necessarily mean that you have to extend

4   fiber deeper. You can put in -- because the way

5   the nodes work, the fiber comes down; it

6   terminates. And then you have these coax legs,

7   and you're looking at, say, four coax legs coming

8   up. That can be a very convenient way to split

9   the node so that you have to replicate, say, the

10   lasers and receiver of the fiber node in that

11   location, but you don't have to extend fiber

12   deeper, and you can get a four to one gain in your

13   bandwidth for those dedicated amounts of spectrum

14   that I was talking about -- the segmented spectrum

15   that I was talking about in my presentation.

16   MR. ISENBERG: Thank you. I put up the

17   -- one of John Cioffi's -- yeah, I'm going to call

18   on David Reed from MIT in just a second. John

19   Cioffi's last slide spoke to this issue fairly

20   directly. On the Y-axis is megabits per second.

21   On the X-axis is loop length in meters. And so

22   you can see that at about 1,500 meters, even the

1   most advanced form of DSL looks like it's about 50

2   megabits per second. Is that fair -- am I

3   characterizing that correctly, John Cioffi?

4   MR. CIOFFI: That's a lower limit.

5   Basically, this slide here from what is --

6   specifically from a chip vendor, and it's not

7   including all the management techniques, although

8   it does include the removal of crosstalk. It

9   still includes some of the customer premises

10   noises, so if you can manage those customer

11   premise noises, you can push these curves up a

12   little bit. But otherwise, you're reading the

13   curve correctly.

14   MR. ISENBERG: Okay. Thanks. David

15   Reed, from MIT.

16   MR. PATRICK REED: Okay. This is -- I

17   can only touch on two or three key technology

18   changes that are going on right now. I think the

19   whole area of providing infrastructure for richer

20   wireless mobile experiences is in a huge amount of

21   flux even today as the marketplace is going

22   forward, and just as an example the latest

1   generation i-Phones are capable of 802.11n

2   capacity, but they're not currently served by

3   access points that are deployed enough, so we're

4   basically talking about how do you get 300 megabit

5   per second peak rates to -- on a dense basis

6   within, say, a campus of multiple dwelling units

7   or enterprises or college campuses or whatever.

8   The challenge there is that the fiber or copper

9   needs to terminate pretty close to the access

10   points, and, as you say, there may be copper on

11   the campus or within the home, but if you actually

12   look at what's happening with deployment of

13   gigabit Ethernet, the cabling is actually quite

14   difficult to install. It's quite expensive, and

15   fiber is actually a better choice for a variety of

16   environmental reasons. You can ask folks who are

17   involved in engineering that much more than I, but

18   we've had experience recently at MIT

19   reprovisioning buildings that we're building to

20   create wireless environments that show these very

21   practical challenges.

22   And in some sense, fiber may be the

1 answer all the way up to the access point even in

2 -- certainly in multiple dwelling units and

3 enterprises not too far from now and maybe even in

4 residences as we start to see consumer electronics

5 adopting that for inter-connections among

6 televisions and set-top boxes and stuff, which

7 CableLabs might have a view on, although they

8 don't directly touch that.

9   I think the other thing worth thinking

10 about in this space is that there are technologies

11 emerging, and if you speak to Rajeev Rahm of MIT,

12 a professor there who's expert in fiber

13 technologies, but also in microwave -- fiber

14 microwave technologies, and also Professor Ian

15 White of University of Cambridge in England, they

16 have actually been involved -- and there are a

17 variety of other companies who have been involved

18 in direct interfaces between fiber and microwave

19 systems at very high bit rates that use passive

20 transformation; that basically you can up convert

21 and down convert direct radio waves or whatever

22 directly into fiber and power the -- both

1   transmission and reception over short distances, a

2   few hundred meters, directly by the power of

3   lasers, so you don't need to pull copper; you

4   don't need to pull power. It's environmentally

5   safe -- you know, compatible, low noise, and so

6   forth.

7   So those technologies I think, you know,

8   they're not being deployed for a variety of

9   reasons, not the least of which is that building

10   cycles are very slow. You don't rewire buildings

11   more than once every 10 years.

12   But in new start buildings and new

13   enterprise deployments, you're starting to see

14   those technologies scale.

15   So I actually think there's a

16   possibility -- you can argue with me -- that

17   copper will get squeezed out. It's got a variety

18   of drawbacks, but it would be very interesting to

19   see why not, you know, in some sense, even in --

20   of ultimately in residential.

21   MR. ISENBERG: Thank you. My other Bell

22   Labs colleagues, any questions? Tom Koutsky?

1   MR. KOUTSKY: Um.

2   MR. ISENBERG: Or would you like to?

3   MR. KOUTSKI: Well, actually my question

4   was a little bit of a -- sorry -- my question was

5   a little bit of a follow-up to Stagg's, kind of

6   related to, you know, how -- some are related to

7   how close did the fiber need to be, but what -- if

8   you were -- I was actually interested in the

9   British telecom example, where they have the

10   instance of having to trench for copper after

11   already having trenched for fiber, which is

12   interesting to say the least.

13   I mean we certainly don't want to have

14   to dig more than once in the country. So when we

15   talk about -- I have two questions related to

16   getting fiber closer to consumers. I want to know

17   if there's any level of path dependence in this

18   that let's say and a fiber provider has an

19   infrastructure program where they for whatever

20   reason decide we wanted to put fiber to within

21   12,000 or 5,000 feet of consumers.

22   And then they wake up five years from

1   now or 10 years from now, and realize that that's

2   probably a little bit too far. Is it a simple

3   matter of just continuing to go? My understanding

4   is it's probably not; that you would actually

5   design the network completely differently if you

6   were to try to get fiber to within very close to

7   someone.

8   So I'd kind of like to have some kind of

9   confirmation from that from people that have kind

10   of thought about these architectures.

11   And the second one is to more think in

12   terms of what type of access to those fiber nodes,

13   for lack of a better term, do the panelists think

14   it would be required would be necessary to

15   basically unleash the next generation of what I

16   would like to call access technologies or last

17   mile technologies, and I think that -- what Johan

18   was talking about I think was an approach like

19   that, but I'd like to hear everybody else's

20   thoughts in terms of, you know, what would be the

21   kind of interface at a kind of a fiber node

22   that's, say, in their neighborhood, and what would

1   that look like?

2   MR. JAY: Maybe I could start on your

3   first question.

4   MR. KOUTSKY: Sure.

5   MR. JAY: And, of course, I volunteered

6   because the answer is it depends. So I think the

7   problem is certainly not the technical capability

8   of the fiber and cable that you would install to

9   that area. And I think it has much more with how

10   you are provisioning -- how you would provision

11   that versus what type of provisioning you would

12   actually need were you to then migrate fiber

13   deeper into that network.

14   As you get closer to the subscriber, as

15   you push the subscriber, the issue is not so much

16   the bandwidth or the signal loss. It's the

17   connectivity. And if you have to somehow connect

18   -- if you have to connect let's say several

19   thousand subscribers, and you have a -- you've

20   terminated a feeder cable -- you've terminated a

21   12-fiber feeder cable, then you might have some

22   problems. If you've terminated a 432-fiber feeder

1   cable, you're in a much better situation.

2   It will also depend on whether you plan

3   to install a passive optical network like Mr.

4   Russell described, where you would be -- the same

5   feeder fibers will serve 16, today 32, in the

6   future 64, 128 customers or whether you intend to

7   use Mr. Henaes' network, where you connect a

8   direct fiber to each customer or, for example, at

9   British Telecom where they need to provide four

10   fibers per customer.

11   So that's why it depends. It has less

12   to do with the -- I think in each case, we're

13   talking about probably the same optical fiber, and

14   I think we're talking about more or less the same

15   cables and termination equipment other than

16   scaling them for the different sizes.

17   MR. RUSSELL: I have a little bit of a

18   different viewpoint. I actually don't believe the

19   British Telecom example is very illustrative. I

20   actually worked for a company that licensed that

21   technology, and, to be blunt, it was the dumbest

22   application of technology I've ever seen. And, in

1   fact, it stopped. It was actually -- the

2   implementation that we did when we licensed the BT

3   technology, it was a fiber to the curb solution,

4   serving about eight customers. So it got fiber

5   close enough that you kind of went -- or you

6   either want to take it all the way, or you want to

7   back up.

8   And we ended up -- this was not the

9   company I work for today -- we ended up junking

10   the system before we ever deployed it, and

11   switched it to a hybrid fiber coax system.

12   So I think that is the answer. You

13   either want to take fiber all the way and you

14   benefit from all the -- the fact that bandwidth is

15   then zero dollars to upgrade. You benefit from

16   having no noise. You benefit from the essentially

17   having an infrastructure that is unlimited in its

18   potential or you back up to a place that makes

19   sense.

20   And I would say the cable industry

21   probably in their node positions is at about the

22   right place, because it's cost effective. And if

1   you look at where the cable industry's nodes are

2   and you equate it to where the ADSL 2 plus nodes

3   are today, they're in about the same place. So I

4   think the answer is one of those two going part

5   way in between.

6   I can't tell you how many operators

7   there are in the United States that deployed the

8   Marconi fiber to the curb solution that are now

9   begging equipment providers to come in and try and

10   find something to replace it. Hundreds of

11   thousands of homes are stranded by that system.

12   So that -- fiber to the curb is not the

13   right answer, and BT learned that.

14   So I don't know if that answers your

15   question?

16   MR. KOUTSKY: It does.

17   MR. ISENBERG: Thank you, Tom.

18   MR. REED: If I could just --

19   MR. ISENBERG: Oh, okay.

20   MR. REED: -- from a cable perspective

21   the one thing is that there is some flexibility

22   with the cable operator or an HFC network operator

1   that how many fibers they pre-install to that node

2   and that will vary from two to four to six even,

3   and that will impact economics and for upgrading

4   in terms of if you want to extend it deeper,

5   you've got to still either use a backup fiber or

6   you wait for the WDM solution and the cost

7   associated with WDM to use a different wavelength.

8   And so, but that's the beauty of the HFC. It

9   gives you flexibility to have a dif -- some

10   different levers.

11   MR. KOUTSKY: But oddly enough was my

12   next question.

13   MR. REED: I'm going to have to run, but

14   I want to thank you guys.

15   MR. ISENBERG: Okay. Sure.

16   MR. REED: And I apologize.

17   MR. ISENBERG: Thank you, David Reed.

18   As moderator, I'm going to give us another 10

19   minutes. That will put us 15 minutes over the

20   line, and I think a half- hour break will still be

21   appropriate if anybody on the second panel going

22   to be messed up if we run 15 minutes over on the

1   second panel? Okay. So that's how it will be.

2   We'll stop at 11:15 a.m. We'll start again at

3   quarter to 12. Okay. So we have time for a few

4   -- two or three more questions, but let me ask at

5   this point, with 10 minutes to go, that we have

6   succinct questions and succinct answers. Walter,

7   Julie, do you have anything burning.

8   MR. KNAPP: I was fine until you said

9   succinct. Just a quick question. Increasing

10   speed and bandwidth is generally thought of as a

11   desirable thing. And some of the new technologies

12   we're looking at here are so much greater in terms

13   of speed and capacity than what we've had before.

14   Do you ever reach a point in your

15   thinking where you wonder if there is a use for

16   something as large as the pipes we're talking

17   about here or just build it and they will come and

18   how does that affect investment? I'm just

19   curious. Yeah, David.

20   MR. PATRICK REED: I'd certainly like to

21   -- you know, it's touches on a subject that I

22   didn't get to talk about, but, in fact, the other

1   David Reeds and I were talking about it just

2   before we started.

3   The value of speed, especially in

4   broadband systems, is not sort of continuous

5   streaming download. The value is latency. And

6   there's latency at different scales, sort of

7   ranging from how quickly the packets turn around

8   to, you know, how quickly, you know, my Apple TV

9   can download a movie so I can start watching it

10   with the guarantee that it doesn't, you know, run

11   into a hiccup, you know, down the road, and or for

12   that matter uploading a -- you know, when I'm --

13   my wife is uploading pictures to a picture sharing

14   site, she doesn't want to sit there and supervise

15   the transmission. She wants to say go, and, yeah,

16   it's fine if it's in the background, but if she

17   has -- comes back and finds out that it failed,

18   you know, that isn't a happy experience.

19   So when you talk about these things, I

20   don't think these speeds that we're talking about

21   are enough -- anywhere near enough -- at a peak

22   rate, especially when they're shared. When

1   they're shared in the merge of PON or in the

2   hybrid fiber coax, you can get that peak rate, but

3   you have to really depend on statistical

4   multiplexing, and statistical multiplexing doesn't

5   always work. We can talk to the cable people

6   about the switch to IP TV, where when you do a

7   channel change, you actually have to buffer up all

8   the stuff that's in there, and that affects the

9   user experience directly.

10   And so these kind of -- and

11   unfortunately channel changes happen in a

12   synchronized way, so there's no statistical

13   multiplex, and people always change channels

14   exactly at the same time. So this kind of peaky

15   behavior and latency is what I think will drive

16   the issue for a long, long time.

17   MR. JAY: Just a quick example, Mr.

18   Knapp.

19   MR. PATRICK REED: David.

20   MR. JAY: An obvious application that

21   people have talked about over the years for

22   broadband is remote lessons and training -- and

1   even remote performance, and particularly if you

2   think about something like remote music lessons,

3   remote music performance, the -- if you've ever

4   tried to see this simulated, it's very difficult,

5   and the problem is latency. It's like in the old

6   days when you had to use satellite telephone calls

7   overseas and had all the delay in trying to

8   synchronize your conversation.

9   And the estimate I saw was that remote

10   -- for example, remote music lessons, remote

11   performance might take 200 to 250 megabits not for

12   the video and audio streaming, but to have enough

13   bandwidth so that the latency was low enough that

14   you could actually functionally do this.

15   MR. RUSSELL: I think I have a little

16   different view, too, that one thing as an operator

17   you don't want to build multiple networks. So you

18   don't want to build a network to residences and

19   then have to turn around and build another network

20   for cell sites, and then have to come back and

21   build another network for institutions, and

22   another network for schools. That just destroys

1   your business case.

2   So what you want is an architecture that

3   allows you to address all those, and the problem

4   is when you build that architecture, you can't

5   predict where the Verizon cell tower is going to

6   be. They're going to make that decision. So

7   you've got to have an architecture that's very

8   flexible and can scale from grandma's telephone to

9   Verizon wireless wanting a gigabit to an LTE cell

10   site without having to completely deploy a new

11   network.

12   MR. KNAPP: Thanks.

13   MR. ISENBERG: Okay. Thank you very

14   much. There's been --

15   MR. JOHNSON: David, could I just get

16   one question?

17   MR. ISENBERG: -- oh, I'm sorry.

18   Walter, of course. Please. Walter Johnson --

19   Johnston from FCC.

20   MR. JOHNSON: I'll try to make this

21   short.

22   MR. ISENBERG: Also from Bell Labs.

1   MR. JOHNSON: Okay.

2   MR. ISENBERG: From FCC.

3   MR. JOHNSON: I will direct this to the

4   surviving David Reed. But I'll make this quick.

5   My perception -- and I'll offer it as my

6   perception -- is that government policy has been

7   directed up until just very, very recently on

8   delivering statically broadband to the outside of

9   a residence. If we recognize that mobility is an

10   important principle, how do we start changing

11   government policy to really capture that and

12   leverage it?

13   MR. PATRICK REED: Gee, that's

14   interesting. That was a quick question to state

15   and an incredibly hard question to answer. I do

16   think that that's one of the challenges, and, you

17   know, right now even in simple cases, you know,

18   the policy around how you get service for cellular

19   inside buildings where buildings are being built

20   like Faraday cages, you know, to use an example.

21   You have to -- every building owner has

22   to negotiate, whether it's a hospital or whatever,

1   has to negotiate with cellular carriers to get the

2   spectrum that you would think of would be their

3   own managed, you know, because it's inside their

4   building, but it's actually owned by the carrier,

5   right, and each -- you have to negotiate with each

6   carrier.

7   So I think there is a challenge. It's a

8   huge challenge to start to address the spectrum

9   management thing around what I would call sort of

10   radical inter-working or interoperability so you

11   could actually move through environments and get

12   these services and uses in a variety of different

13   places.

14   And that's why I said at the end of my

15   slide that getting the -- that I think fiber and

16   those kind of things will ultimately, you know,

17   whoever provides that, and I don't know whether it

18   will be Verizon negotiating with building owners

19   or, you know, or building owners themselves

20   negotiating with Verizon, starting to think about

21   the fiber more and more as a kind of universe of

22   roads -- you know, the kind of road networks that

1   we build in municipalities, which are sometimes

2   privately owned and sometimes publicly owned, but

3   the point is you build the infrastructure to

4   provide coverage as opposed to building the

5   infrastructure to provide account management, and

6   that -- I think the FCC needs to start to think of

7   the unity of those things as it regulates them

8   rather than services associated with wireless

9   versus fiber and stuff. And I don't have an

10   answer.

11   MR. CIOFFI: David, if -- this is John

12   Cioffi, if I could kind of, you know, summarizing

13   this question of bandwidth is that --

14   MR. ISENBERG: Sure.

15   MR. CIOFFI: -- with an antidote, I've

16   been working in (inaudible) and remember a

17   statement vividly in 1989 from an executive at

18   Pacific Bell, which is now AT&T, who said that

19   they would have fiber to everyone's home as part

20   of a national information infrastructure within

21   five years, and that they would never use a single

22   line of copper because it didn't have enough

1   bandwidth. Today, AT&T has 18 million DSL

2   customers. There are a billion phone lines around

3   the world, and it's 20 years later. And the

4   reason we need to make infrastructure to be

5   competitive or to be competitive is we need to do

6   it quickly and we need to do it cost-effectively,

7   and if you have the bandwidth on the copper, there

8   is no need to wait and debate on whether it's a

9   gigabit or 10 gigabits on fiber or only 10

10   megabits on fiber, if you want to move quickly,

11   that is the only alternative, and it's why

12   broadband today is dominated by the copper

13   connections.

14   And I think that's going to continue for

15   a considerable amount of time.

16   MR. ISENBERG: Thank you, John Cioffi.

17   At this point, I think we've simply started to --

18   started on this discussion of future technologies,

19   and I'd like to thank first of all thank and

20   apologize to the people online who have asked a

21   bunch of good questions and the people in the room

22   who have asked a bunch of good questions that I

1   was unable to get to given the inability to time

2   multiplex. I wish I could just manufacture more

3   or put the time on several different wavelengths

4   or something, but that's right now -- the --

5   that's still a physics challenge, so thanks to

6   everyone who has submitted questions. They will

7   become part of the public record, and we will

8   resume in half an hour, and thanks to the

9   panelists also.

10   MR. NEWMANN: Yeah. And let me say to

11   the -- both the panelists from the first session

12   and the panelists who will be on the second

13   session, I think I've managed to procure some

14   coffee, since it's not easy at the FCC, in the

15   first conference room on the left, 402, down the

16   hall.

17   (Recess)

18   MR. ISENBERG: (In progress) -- they

19   have to turn off the music and turn up the

20   microphones. Oh, the clicker, Joanne? Who's got

21   the clicker? Bring it down to the first speaker,

22   please.

 1   So thanks to the second panel. Thanks

 2   especially to Herman and Benoit, who flew here

 3   from Europe over the last couple days to be part

 4   of this. Thanks also to the rest of our

 5   distinguished panel, and without further ado, I'll

 6   turn it over to Dick Lynch, the CTO of Verizon on

 7   the Future of FIOS.

 8   MR. LYNCH: Okay. Thank you very much.

 9   With that, clock staring at me, I promise I will

10   beat it. How's that sound?

11   Okay. What I was asked to talk about --

12   and I'm going to do this in a very short order, I

13   hope, with very few slides -- is talk about FIOS

14   essentially, Y-Fiber to the PREM, where we

15   actually are with our deployment, and then what we

16   see as the future fiber.

17   Why fiber to begin with? If you think

18   about all of the various applications, service set

19   whatever you want to call it, that is currently

20   being used today, and you look at the requirements

21   of each of those increasingly complex service

22   sets, it becomes pretty apparent that the

1   bandwidth per individual is going to have to

2   increase over time. And what I show on here, on

3   the bottom right-hand side of this, is a chart

4   that has stood up for quite a few years now, and

5   what it essentially says is that about every six

6   years we see an increase of 10 times in the usage

7   per customer. And that has really not varied

8   dramatically over the last X number of years, 10

9   years or more.

10   But what I think is critically important

11   here is that that is a band. And I will tell you

12   that within that band the slope is increasing, and

13   it's increasing more for the uplink than it is for

14   the downlink. And so one of the things that I'd

15   like everybody to think about here is that if we

16   continue to talk about performance of networks and

17   performance of any bandwidth delivery solution

18   only in a downlink sense, we're missing a very

19   important link to the future, which is that the

20   uplink really does need to be there.

21   Now why is fiber the right solution for

22   all of this bandwidth demand? I believe that

1   fiber has a lot more head room than anything else

2   that is out there. First of all, in the last

3   panel, you heard a lot of the technology, so I'm

4   not going to burden you with that here, but today

5   Verizon provides a 50 by 20 service, and I will

6   tell you that that 50 by 20 service is a

7   commercial decision because today we're capable of

8   doing more than that. The existing infrastructure

9   we have in place truly is capable of more than

10   that, and you'll see more than that coming from us

11   as the customers really demand it.

12   Now I happen to be very aggressive in

13   terms of bandwidth expectations, but I will tell

14   you that today very few customers by 50 by 20.

15   They don't really yet see the need for it. That's

16   still the tail of demand when you get to that

17   particular kind of speed. But we see it coming.

18   We see three digit numbers in that area.

19   I believe fiber is also the leading

20   competitive solution, both in terms of quality and

21   reliability. Cost effective solution was a

22   challenge when we first started. We believed we'd

1   get there. Certainly, in the beginning, it took

2   some effort.

3   But today the cost per bit to build is

4   better with fiber than it is with anything else,

5   and the cost per bit to operate is dramatically

6   better than it is today with copper.

7   Why lower operating costs than with

8   copper? Well, first of all, it's more immune to

9   the weather. Copper does have pretty significant

10   environmental impacts. But probably more

11   importantly than that, there's less active

12   equipment. We're using a passive network. We're

13   using PON. And so we do have an awful lot less

14   failure points if you accept the fact that an

15   active element is certainly going to be more

16   likely or more prone to failure than as a passive

17   component.

18   And as having spent, as many of you

19   know, an awful lot of time in wireless, I have to

20   say that there is not enough wireless spectrum

21   available, and this Commission can't find me

22   enough wireless spectrum to satisfy what we can

1   deliver on fiber.

2   Look at fiber as having the same amount

3   of spectrum as the FCC's total cache of spectrum

4   to give. Our technology is pretty

5   straightforward. If you look at the topology of

6   our network, it's really not all that different

7   than a historical copper network. You take feeder

8   out of the central office, and you go to

9   distribution points, and then those distribution

10   points you have drops into the various premises.

11   So from that standpoint, it is not a

12   surprise. It's something that's pretty easy for

13   us to replicate along the lines of where our

14   copper plant always has existed. But what's

15   important is that the same amount of plant needs

16   to go into that big building in the back as going

17   to the home in the front, a fiber. Maybe in the

18   biggest of buildings, we need a few more than one.

19   But the fact of the matter is that we really do

20   have the capacity out there as a result of the

21   fiber that we've deployed in the feeder.

22   Where is our program today? As of the

1   third quarter of this year, we've passed about 14

2   and a half -- actually, probably it's a little

3   more than 14 and half by now -- premise. We've

4   got about a 29 percent penetration of data

5   customers on that today. And I will make a point

6   on that, too, is that that 29 percent actually is

7   calculated using the entirety of the denominator,

8   so even the customers who we opened up for sale

9   yesterday, even though they haven't had a chance

10   to buy yet, are actually in the denominator. So

11   that 29 percent, I think, suggests that customers

12   really do want this, and we will continue to pass

13   more and more PREMs as we go forward.

14   Finally, the future of fiber. No pun

15   intended here, but the future of fiber I think is

16   very bright. Building costs continue to decline.

17   You take innovations like bendable fiber, optical

18   network terminals that are built for desktop use

19   in an apartment. The scale of fiber and the

20   construction over the world continues to drive

21   costs down.

22   Our operating costs, both year-over-year

1   and versus copper, continue to decline.

2   And so I think that that's something

3   that will continue as well. The profitable field

4   of use is also increasing. With these new ONTs,

5   it's a lot easier to bring fiber right into the

6   living room, and put a little tiny ONT on the desk

7   or on a table someplace. You've got higher

8   penetrations, and so you can divide that common

9   cost by an awful lot more customers.

10   And also with the improvement in

11   electronics and improvement in optics, we can push

12   further and further out in those less dense

13   populations. And I don't expect that that trend

14   is going to stop anytime soon.

15   Let me just say as far as performance

16   improvements are concerned, the technical

17   capabilities we have today exceed what the

18   customer wants today, and I think that as the

19   customer continues to demand more, the technology

20   will continue to be able to accommodate it.

21   And finally, I think -- and this is

22   maybe a sales point here -- but I think this is

1   really the only technology today that is not

2   bounding demand. If you think about some of the

3   other technologies that have been discussed here,

4   we're talking about hundred megabit. We're

5   talking about 50 megabit, and we're saying things

6   like well, customers really don't need any more

7   than that. I'd rather be in a position of

8   delivering to the customer what they want,

9   regardless of what that is, and I think fiber can

10   do it.

11   So with that, thank you very much. And

12   I'll pass this on to Joanne.

13   MS. HOVIS: Thank you.

14   MR. ISENBERG: One second. Oh, well, we

15   have 15 seconds, let's say. Do you see your

16   customer traffic rising to fill the available head

17   room? Brief answer, please.

18   MR. LYNCH: Let me answer it this way,

19   David: Yes, I do, but it's going to take time.

20   It's not going to happen overnight. Maybe we can

21   expand on that when we get to the question and

22   answers.

1   MS. HOVIS: Thank you. Working? Yeah.

2   Okay. I'm Joanne Hovis. I'm President of CTC,

3   which is a public interest consulting firm focused

4   on the nonprofit and local government communities.

5   I'm also here in my capacity as president-elect of

6   NATOA, the national association that represents

7   local governments and communications -- a

8   community that is very closely following what is

9   happening here at the FCC; has some very strong

10   interests and opinions, and also has something of

11   a track record and a history of involvement in

12   this market in seeking to meet the needs of

13   internal anchors and constituents and intends to

14   continue doing so, hopefully in real partnership

15   with the FCC.

16   Let me start by suggesting something,

17   and then tell you a little bit about what I know

18   from a municipal perspective, about what we've

19   done, what we've learned about fiber, and where we

20   think we may be going.

21   Let me suggest that local governments,

22   nonprofits, universities, educational

 1   institutions, and our consortia that bind us all

 2   together are in some ways the laboratory in

 3   progress on optical development. We have 15 years

 4   of experience of building and operating fiber

 5   networks to meet the needs of our internal anchors

 6   and institutions; and increasingly experience in

 7   meeting the needs of the public as well.

 8   Localities are ideally suited to trying

 9   a range of technologies based on local market

10   conditions, and they are not tied to legacy

11   investments. They are not tied to legacy business

12   models, and in that way, they are an important

13   opportunity for experimentation and innovation.

14   And these local choices and local

15   experiences can really inform this debate. There

16   are, at last count, 57 municipal networks that

17   reach all the way to the home and business in the

18   United States, primarily in rural areas in some of

19   the most remote and conservative parts of the

20   United States. I will add to this also that there

21   are thousands of municipal and county fiber

22   networks that connect schools, libraries, health

        1   care institutions, government buildings, such as

        2   firehouses and police stations and so on.

        3   And there's 15 years of experience doing

        4   that. And in many cases, these networks either

        5   provider would be very interested in providing

        6   open inter-connection points for last mile

        7   deployers that want to push those networks even

        8   further out into the community.

        9   When I say that we are in some ways an

       10   opportunity for experimentation and innovation,

       11   let me share a couple of examples with you that

       12   David encouraged me to share and to focus on. And

       13   these are hopefully, I think, little proof points

       14   that might be an interesting way to think about

       15   what can happen when the incentives of the

       16   operating entity -- in this case, an entity that

       17   is not focused primarily on profit, but is focused

       18   on community needs -- run in certain directions.

       19   So here's an example. This is an

       20   illustration. In Montgomery County, just up the

       21   road from here, in Maryland, many of the

       22   elementary schools in the county, which has areas

1   of great prosperity and wealth and areas of great

2   poverty and both urban and rural areas, many of

3   the elementary schools are served over fiber that

4   was built by the county gradually over the past 15

5   years -- a very extensive fiber network.

6   Those schools receive a symmetrical 100

7   megabits in service, and the operating costs of

8   the county, which does not charge the schools, is

9    $71 per megabit per year to these schools that get

10   100 megabits.

11   The schools that are not served over

12   city fiber -- excuse me county fiber -- are

13   leasing T1s from a carrier. The cost to the

14   schools per megabit per year is just under $2,000

15   after the e-Rate subsidy. Before the e-Rate

16   subsidy, it's just under $4,000 per year, and

17   those schools are getting 1.54 megabits. The

18   schools served by the county at $71 per megabit

19   per year are getting a hundred megabit

20   symmetrical. I think that's an interesting proof

21   point and one of many as to what is feasible when

22   you have an entity involved in construction and

1   provision of services that has incentives that run

2   in the direction of greater bandwidth, more

3   services, lower costs, and, frankly, ideally,

4   competition.

5   My time is short, and I'm not talking

6   nearly fast enough. So let me move really fast

7   here, because I've got four more slides to get

8   through, and I barely covered the first one.

9   There are a range of drivers that drive municipal

10   projects, particularly the ones that are focused

11   on last mile, and getting to the home and

12   business. The 57 municipal networks I told you

13   about that currently reach the home and business

14   are those that are operational so far. There are

15   probably a couple hundred other communities that

16   are in various stages of evaluation, including

17   some big cities, like Seattle; San Francisco;

18   Portland, Oregon; St. Paul. Seattle actually two

19   weeks ago a letter to the mayor who, as one of the

20   three main planks of his campaign, said municipal

21   fiber to the home -- it's an absolutely key part

22   of our future development.

 1   Seattle is served by Qwest, and has no

 2   potential for seeing anything like what Dick just

 3   describe to us anytime soon. So the drivers in

 4   Seattle are all of the ones that you have here up

 5   on this slide. You get a sense of the things that

 6   they're very concerned about, ranging from

 7   economic development to community development --

 8   the core things. Technology built Seattle, and

 9   they're very cognizant of it, and these drivers in

10   terms of the way they think about architecture,

11   and the way they think about the technology they

12   want to use very much push toward more bandwidth,

13   more coverage, full buildout, reaching entire

14   communities and lots of services at affordable

15   costs, because when you are a local government or

16   a nonprofit or a consortium that is focusing on

17   this kind of market, your success is based on how

18   many people you reach and how much you develop --

19   you deliver to them as opposed to how much you

20   generate from the smallest number of customers

21   possible.

22   One of the key pluses that local

 1   governments see in terms of building these

 2   networks themselves is the potential for community

 3   intranets, the on-network services that would

 4   never transverse the public Internet, where the

 5   bandwidth can be significantly higher. And from

 6   the standpoint, of some of the big cities that are

 7   considering this kind of technology, the real game

 8   changer is interconnecting their networks over

 9   long-haul fiber. And what's so interesting about

10   this from the open access or the competition

11   standpoint is the fact that when you have big

12   fiber networks that are interconnected, a new

13   provider can insert at any point on that network

14   and reach an enormous subscriber base, including

15   one that's potentially quite far away.

16   So, for example, the Utopia Network in

17   Utah could be interested in interconnecting with

18   the City of San Francisco, and a service provider

19   in Utah could be providing services to San

20   Francisco -- voice and video.

21   Now I have 27 seconds. I'm going to talk

22   very fast. There's -- my colleagues here will

 1   talk about the debate over point-to-point versus

 2   passive optical network within the municipal

 3   network. Within the municipal community, there

 4   have been choices of both. There are a wide range

 5   of different choices about technologies. We would

 6   say the key thing should be local decision-making

 7   and local process as opposed to decisonmaking

 8   elsewhere in the country, and the flexibility of

 9   local communities and decision-makers who are

10   answerable to the public rather than to the

11   industry.

12   And then finally this -- something

13   called enhanced PON, something David asked me

14   address very briefly, is an emerging architecture

15   that may be of real interest.

16   As the cost of PON has come down really

17   dramatically, there is something of an emphasis

18   still on point-to-point architecture because of

19   the flexibility and the great bandwidth that it

20   offers, but we are suggesting, and the city of San

21   Francisco is evaluating because of its interest in

22   open access, but also its interest in keeping cost

 1   of deployment down as much as possible that a

 2   variation on PON, we're calling enhanced PON, that

 3   looks a bit like this would give a certain amount

 4   of flexibility and options while giving us all of

 5   the advantage is of the lower costs of PON that

 6   have been realized through the economies of the

 7   fact that it has been the dominant industry choice

 8   throughout the world, but at the same time pushing

 9   up bandwidth and allowing direct fiber connections

10   to some users.

11   The key thing here, from a municipal

12   standpoint, where, a city like San Francisco that

13   has been very focused on open access is one of the

14   drivers of its investigation of fiber to the home

15   is that there's always going to be a central

16   entity. In any network, there will be some kind

17   of central decision-making entity. Whatever the

18   technology choice for the architecture choice, the

19   key thing is governance. The key thing is going

20   to be the commercial decisions rather than the

21   technology decisions, is the true goal is openness

22   or competition. Thanks.

1   MR. ISENBERG: Thank you, Joanne. Tim

2   Nulty?

3   MR. NULTY: How does this work? Okay.

4   My name is Tim Nulty. I've been involved in

5   building rural telecommunications systems all over

6   the world since 1985 and that include early

7   adoption of all kinds of things like wireless

8   local loop in rural Poland and fiber to the node

9   or the building in Hungary and Sri Lanka. This is

10   almost 20 years ago. Currently, I'm the head of a

11   project to build universal fiber to the home in

12   one of the most rural parts of Vermont, which is

13   the most rural state in America, a fact not widely

14   appreciated, and several other projects in

15   extremely rural parts of Minnesota.

16   I'm going to take for granted, just to

17   make this go quickly, I'm going to take for

18   granted something that still may be debated in

19   this room, and that is -- but it's not for me --

20   as far as I'm concerned, the issue is over -- and

21   that is that universal fiber into every single

22   premise is an absolute goal and necessity, and it

1   will happen. The only question is how quickly and

2   how it goes about.

3   David Reed's vision of fiber everywhere

4   as the roads system and then various mechanisms

5   for getting from some kind of fiber final

6   connection point to the device I take as beyond

7   debate now. It's over as far as I'm concerned.

8   And I'm going to go on and talk more

9   about how and some of the things that most people

10   seem to think -- well, some myths that I think are

11   not true.

12   One is I will state flatly that in every

13   single part of rural America where you can

14   aggregate an average of at least 10 premises per

15   mile, you can economically deliver universal fiber

16   without any grants or any Universal Service Funds

17   support whatsoever. Now let that sit for a

18   minute.

19   The $7 billion we spend on Universal

20   Service every year, which is approximately equal

21   to the AARA money, if that were spent directly on

22   building fiber networks, I believe that in three

1   years we could wire the entire, absolute entire,

2   rural America. We're talking 40 million people.

3   Now the economics of this -- the

4   territory I just talked about everywhere less than

5   10 per mile. When you get into the really sparse

6   areas, actually size matters more than density.

7   It gets harder and harder to aggregate a critical

8   mass of customers that will support the network.

9   And when you're down in the -- you know,

10   you're in the 20 per mile area, then you can live

11   with 6,000 to 8,000 paying customers will support

12   a complete network. When you're in the eight or

13   nine, then you need 25,000 or 30,000 paying

14   customers.

15   And in rural America it gets hard to

16   aggregate those kinds of numbers in really sparse

17   areas.

18   Number two, the economics and the most

19   rural parts, the sparser areas, are much better

20   for community or municipal or some such, you know,

21   co-op or something like that, than they are for

22   traditional investor-owned. This is not

1   necessarily true for the denser areas, but very

2   part -- it does not mean they're not economic.

3   They're very economic. But it works better for a

4   municipal or community for the simple reason that

5   the costs are lower. You don't have to pay --

6   they're nonprofit entities, and they're municipal,

7   they have access to tax-exempt municipal

8   financing, which is, even though it's considerably

9   more expensive than the RUS, it's still

10   satisfactory. You can live very comfortably in

11   the most rural parts of America with financing of

12   six, seven eight percent on these projects -- even

13   nine percent in some cases. Another thing is if

14   you take it as a policy goal, which we used to do

15   in America, and, in fact, the Communications Act

16   of 1934, which seems quaintly modern nowadays,

17   states as a policy goal of this country that we

18   will have universal access to telecommunications

19   services. If we take fiber, universal fiber, as a

20   goal, then open access, and by open access I mean

21   nondiscriminatory access. I don't mean free

22   access. I mean nondiscriminatory access is

1   actually better for the economics than the

2   opposite. Now that sounds anti- intuitive, but

3   it's not. It's actually true. It's once you've

4   decided to build this pipe, anyway you can get

5   stuff on it, paying stuff of any kind, makes it

6   better, makes the economics better. Number three,

7   the electronics don't matter. A debate about GPON

8   versus active versus electronic is really a

9   relatively trivial decision, a relatively trivial

10   matter. What really matters is the availability

11   and the topology of the fiber itself. If you

12   build a fiber network properly, so that it is

13   transparent to the technology you hang on, it

14   literally doesn't matter.

15   We're building a network extremely

16   similar to the FIOS. It's one generation earlier

17   because they started earlier, not because we're

18   smarter. But the - it's one generation later

19   because we started later. But it's essentially

20   the same thing. PON makes every bit of sense at

21   this point, from a price point of view, a

22   maintenance point of view, a robustness point of

1   view and so forth.

2   But the network we build, which is

3   essentially a modified homerun or a modified point

4   to point, makes it possible to upgrade, to change,

5   not only the whole access network, access

6   technology, but piecemeal. So right away, if

7   somebody needs - if somebody in our area comes

8   along and says a 90 megabit - 90/45 GPON multiplex

9   circuit - is not good enough, you know, united

10   technologies, I want more, we can patch right

11   around and give them a gig, ten gig, or a terabit.

12   We can provide terabit point to point services

13   today to anybody who actually wants it, and you

14   can do that because in a properly structured,

15   modified homerun network, you can individually

16   upgrade specific pieces customer by customer or

17   customer block by customer block, and that's what

18   counts. The fiber is what matters, not the

19   technology that it gets hung on.

20   Now, in this area, we have a slightly

21   different point of view from FIOS, FIOS structure

22   is there, the topology of their fiber network

 1   rather differently from us, and the difference is

 2   very important, in my view, but otherwise, the

 3   networks are quite similar.

 4   A final thing, it's not a technological

 5   point, and that is that optical fiber networks

 6   properly structured are the absolutely most

 7   perfect natural monopoly ever invented by mankind.

 8   What do I mean by that? They have - if once in

 9   place, they have effectively infinite capacity.

10   The obverse of that means they have zero marginal

11   costs, and they have very high barriers to entry,

12   and finally, the services being provided, at least

13   some of the services being provided, are

14   considered extremely essential to the people

15   getting them. That is the textbook definition,

16   PhD from Cambridge, a long time professor of

17   economics at Cambridge and Oxford, that is the

18   textbook definition of a perfect natural monopoly.

19   A perfect - the question is, should a perfect

20   natural monopoly providing essential services be

21   an investor owned activity? That's the real

22   question. And I will leave you with that. I

1   think I hit - I actually got under the seven

2   minutes.

3   MR. ISENBERG: No, you're --

4   MR. NULTY: Oh, I'm one minute over, I

5   beg your pardon.

6   MR. ISENBERG: Thank you, Tim. Herman

7   Wagter from Citynet Amsterdam.

8   MR. WAGTER: Thank you, David. Thank

9   you very much for the invitation and the

10   possibility to tell a couple of things of what's

11   going on in Europe and what our experiences are.

12   Citynet Amsterdam - to be short, I've

13   been involved from the beginning in the idea of

14   creating a passive or a dark fiber access operator

15   in Amsterdam, which I've been doing for the last

16   seven years, including all the lawsuits, legal

17   issues, political and everything that goes with

18   it. So I've been seasoned with that, but not as

19   experienced as Tim and others. But what is

20   happening in the debate in Europe is that, in our

21   culture, we like our infrastructure to be quite

22   well, and you see that the governments and

1   municipalities think infrastructure as a

2   competitive advantage, and they know it takes a

3   long time and is very costly and difficult to do,

4   but once you got it, it is something which will

5   help you be competitive for a very, very long

6   time.

7   To give you an idea, our estimates are

8   that if we triple the capacity in the - market, it

9   will take ten years if you do your best to roll

10   out fiber to every home, which means that in the

11   meantime, for the people - it's very good that

12   these - or whatever is increasing its capacity

13   because the amount will increase over time.

14   But the real debate which is going on

15   is, if you look at the fact that we have

16   competition currently which we like, and nobody is

17   going for a utility owned infrastructure company,

18   how do we get to an investment, and after that,

19   again, to a level where competition is vibrant,

20   because that might not be so easy.

21   To give you a little bit idea of our

22   cities, they're all, going back, and the

     1   interesting part is that we have to dig, and that

     2   the density is quite high, but if you do look at

     3   the densities, there is an overlap with the

     4   densities in most urban areas in the U.S. And if

     5   you look at the cost of deploying fiber over

     6   there, and here I'm talking about our experiences

     7   of doing full point to point fiber, means homerun

     8   inside every apartment, then ten percent of the

     9   cost is fiber, ten percent of the other cost is

    10   other equipment, and 80 percent is labor, which is

    11   a good thing if you roll out - if you want to

    12   stimulate the economy because it's a lot of local

    13   labor. And if you go to more rural areas, less

    14   dense areas, what you see is that the amount of

    15   hard work grows and the amount of labor decreases,

    16   but essentially it's the same amount of money,

    17   which is approximately average for the

    18   Netherlands, 900 euros per connection.

    19   I've looked up some data from the FCC,

    20   from - what the densities are in the U.S., and you

    21   see also there in the right hand corner that for

    22   90 percent of the population, actually the

1   densities are quite high, so relatively

2   comparable.

3   The real hard question comes, like Tim

4   said, on will it be a natural monopoly or not or

5   how does it go. If you look at the average cost

6   of all the investment, you accumulate all the

7   investments done in - or, alternatively, from - to

8   a backhaul to - or the - network, the ratio is

9   approximately per connection one to three to ten.

10   Of course, there are exceptions, but this is, in

11   general, the ratio of costs. So the middle part

12   of the internet is actually the cheapest, which is

13   also true for electricity, gas and water, as soon

14   as you get closer to the home, the highest part of

15   the investment is over there.

16   The nice thing about the middle part or

17   left part is that you can allocate - reallocate

18   investments to use if you lose customers and you

19   can incrementally increase capacity.

20   However, for the last mile of the local

21   loop, there's only one potential customer who

22   either takes the services or not or uses the - or

1   not, and if you have an overbuilt, you have 50

2   percent if you divide it 50/50 of costs which is -

3   or 50 percent of utilization of the

4   infrastructure, which adds to the average cost.

5   So it's very clear that everybody has

6   been delaying the investment of fiber, but the

7   general idea is that it will need to be done in

8   this time. So if you do this, this money

9   question, and while utilization is such a high

10   part, brings up the real question - question is,

11   well, right now we have to access networks which

12   are completing, but it seems like it's a

13   historical accident. We used to have something

14   made for TV and something made for telephony, we

15   found out they both could do something called

16   packet switching and other things, so now they're

17   competing. But as soon as you start - somebody

18   starts rolling out fiber, will somebody else roll

19   out fiber in the same area? And in most cases in

20   Europe, there is no evidence that people are doing

21   that, there are more evidence of cooperations

22   coming up to prevent it, like in Switzerland,

1   where it's just dealing out with each other, you

2   do this part and you do that part, and maybe we'll

3   put in four fibers, because the fiber is not the

4   most expensive part.

5   So it makes - the real question is, how

6   do you get that cooperation, and after you get the

7   rollout, which also might be that a cable company

8   starts converting - fiber to the home, which we

9   see in some places in the Netherlands, small cable

10   companies do, do we end up with geographically

11   separated, isolated monopolies?

12   If that is the case, then the question

13   is the topology. I'm not talking about

14   technology, I'm talking about topology, how you

15   lay out fiber relates - makes competition easier

16   or more difficult. And the lower part is the -

17   what we call DPON and - network, which will make

18   it very difficult. The Japanese variation is in

19   the middle, and a point to point network is in the

20   top. We've chosen for a point to point, although

21   it's a little bit more expensive, because it will

22   give a very long lifetime because it - almost any

1   technology and any mix can be supported.

2   And the next thing is, if you do the E

3   calculations, there might be a five, ten, 15

4   percent difference in investment, but the most

5   dominating fact in any access network is

6   utilization ratios.

7   So if you have open access and you have

8   multiple users and you penetration goes up with

9   ten percent, it immediately economically

10   obliterates any CAPEX difference in investments,

11   and that's a very, very tough thing.

12   So every customer, every line used by

13   another operator is for - in infrastructure

14   company $12 cash flow per month per user, which is

15   a lot of money, which means that the real debate

16   is, how do we get there, and how do we influence

17   the fact that how we end up with a topology which

18   will support as much competition as possible.

19   MR. ISENBERG: Okay. Thank you very

20   much. Benoit Felton from Paris. Even though he

21   sounds like an American, he's really --

22   MR. FELTON: I'm from Yankee Group.

1   Okay. I'm actually going to very - okay. So the

2   slide on who I am got squeezed, it doesn't matter,

3   I'll tell you who I am. It's actually fairly

4   significant that I'm French in this context for

5   two reasons; the first one is that I live in

6   Paris, which is right now kind of in the middle of

7   all the fiber happenings in Europe; and the other

8   reason is that being French, I know all about

9   cultural arrogance, and so I want to highlight the

10   point that I'm not here to give you lessons, but I

11   am here to hopefully show you what's happening

12   elsewhere in the world, and I'll leave it up to

13   you to see if you want to see that as a lesson or

14   not.

15   There's been a lot said about the

16   various service levels that you can get out of

17   various technology choices, so I'm not going to go

18   back to that in any depth. I just want to point

19   out one thing, which is that there are many areas

20   in the network where you can have bottlenecks, not

21   just the access, but the access is the only area,

22   I'm going through this really quickly, but it's

      1   the only area where the technology choice actually

      2   makes a difference. All the rest is choices about

      3   how you manage your network, but it's not dictated

      4   by your technology choice.

      5   The second thing that I just want to say

      6   about this slide, and, in fact, I don't show LTE

      7   here, but I could have, because the message is,

      8   don't look at top line speeds, top line speeds

      9   tell you nothing, average speeds tell you

     10   everything. And very often technology choices and

     11   vendor discourse are focused on top line speeds,

     12   and that's not a sound measure of a technology

     13   choice.

     14   Now, interestingly enough, I'm going to

     15   contradict myself immediately by talking about

     16   available service speeds. I did this little

     17   exercise, having discussed it with David, to try

     18   and see, I hope the map is big enough for you,

     19   it's certainly not big enough for me, but to try

     20   and see how the availability of 100 megabit

     21   service evolved over time.

     22   Two years ago, in 2007, the only places

1   in the world where you could get the 100 megabit

2   service were Japan, a significant portion of

3   Japan, a significant portion of Korea, a few

4   cities in Taiwan, and Hong Kong, and Stockholm.

5   So that's the single red dot here in Europe.

6   Two years on, this is what the map looks

7   like. You can see that things have expanded in

8   Asia, you can get 100 megabit service anywhere in

9   Japan, more or less, anywhere in Korea, anywhere

10   in Taiwan, still in Hong Kong, obviously, but you

11   can get it in Paris, you can get it in Montpelier,

12   you can get it in - you can get it in Lisbon, you

13   can get it in Bucharest, Sophia, Moscow,

14   Amsterdam, of course, and most places or a

15   significant number of places in the Netherlands,

16   most places in Sweden, Denmark, Norway, and

17   Lithia, and in Helsinki, and Finland.

18   MR. ISENBERG: There's one dot in the

19   U.S.?

20   MR. WAGTER: Right; there's one dot in

21   the U.S., which is Cablevision's 101 megabit per

22   second service in New York City. I'm going to

1   come back to that in a minute. So this is only

2   two years, so we're not talking about a large

3   amount of time. Now, I'm assuming that if I do

4   this map again in two years, there will be red

5   dots more or less everywhere, and hopefully there

6   will be a lot more red dots in the U.S.

7   But I want to challenge you with this

8   view; this is where you can get one gigabit per

9   second service today. Hey, Japan, Korea, and Hong

10   Kong, and Taiwan, no, not Taiwan, soon, and

11   Sweden. So in two years time, if I do this map

12   for one gigabit per second, probably the whole of

13   Europe will be red dots, as well. Again, will the

14   U.S. be? I don't know, but this is what we're

15   talking about.

16   MR. NULTY: Burlington, Vermont.

17   MR. FELTON: One gigabit per second?

18   MR. NULTY: Yes.

19   MR. FELTON: Commercial offered to

20   customers?

21   MR. NULTY: Yes, offered if they want

22   it, yes. Not many people take it.

1   MR. FELTON: Okay. I'll add it to the

2   map.

3   MR. NEWMANN: -- service, right. I can

4   get a gigabit in the U.S. anywhere I want if I

5   want to buy OC --

6   MR. FELTON: Sorry, I should have been

7   clearer. This is end consumer packages. This is

8   services that homes can subscribe to at rates that

9   are certainly higher than your regular service,

10   but they're reasonable for a home. So, for

11   example, in Hong Kong, you can get that service,

12   one gigabit service for 250 Hong Kong dollars per

13   month, which is roughly $100 U.S. per month.

14   MR. NEWMANN: Okay. That's what I

15   wanted to find out, what you're defining as

16   available.

17   MR. FELTON: So the second question

18   inevitably is, why are we focusing on speeds, and

19   this question was asked in the first panel, and I

20   think there were some very good answers given.

21   What I wanted to do here is just map, not so much

22   by speed, but by what the technologies allow you

1   to do in terms of speed and latency. This is a

2   view in time of the services we're talking about.

3   So you might be able to do a single HDTV stream

4   with ADSL today, you can't do two HDTV streams

5   with ADSL, so you're already in VDSL territory or

6   DOCSIS-3 territory for that. If you wanted to

7   have your hard drive in the cloud, well, depending

8   on the amount of data that you shift in real time,

9   you might have enough services with VDSL, but you

10   might not, you might actually need fiber to be

11   able to do that.

12   And then, as you can see, all the rest

13   actually requires very high quality DOCSIS-3 or

14   fiber. If you want to be able to homework in

15   conditions that are equivalent to what you do in

16   the office, you need fiber, because the low

17   latency is crucial. And again, it's not

18   necessarily the speed. Using wordover network

19   doesn't use a whole lot of band width, but if you

20   don't see what you typed, then you don't use it,

21   that's what we're talking about.

22   And finally on this slide, the thing I

1   want to highlight is that video communication is

2   going to be a crucial part of what these networks

3   allow. Interestingly enough, it's maybe the only

4   service that we talk about in this context that is

5   something that kids were dreaming about 40 years

6   ago, thinking that they would have that in the

7   year 2000, well, they don't, and they might, but

8   we've still got to get there, and if we want to

9   get there, the networks have got to support that

10   and they don't today. The last thing I want to

11   talk to you about is price, because, of course,

12   this is crucial, as well. This is a comparison of

13   600 megabit download offers around the world. I'm

14   not going to go through each of them, but you can

15   see that, first of all, Cablevision's offer that I

16   mentioned today is by far the most expensive.

17   You can also see that the offers that

18   you see in Asia are significantly cheaper in

19   general than in the rest of the world. And I want

20   to focus finally on the Hong Kong broadband

21   network offer, which is the third here in that

22   line, and is also the cheapest in this set of

1   offerings.

2   This price is only very recent. Two

3   weeks ago, Hong Kong broadband network announced

4   that they were dividing the price of their 100

5   megabit offer by two and a half. It used to be

6   two and a half times more expensive. They shifted

7   it to what is the equivalent of now $17 U.S. Per

8   month price, sorry, purchasing parity directed.

9   Why are they doing that?

10   I mean it may sound like an insane

11   business decision, it's not. They know that by

12   doing that, their market share will go for 20

13   percent to 40 percent, and their revenues and

14   their margins will grow in the same proportion.

15   Once you have deployed the network, any strategy

16   is good if it gets you more customers hooked up to

17   that network. Focusing on getting more revenues

18   out of the customer is less efficient than

19   focusing on getting more customers on the network

20   at lower revenue points, and that's what I wanted

21   to conclude on.

22   MR. ISENBERG: Thank you very much,

1   Benoit. I invite my colleagues from the FCC, if

2   they have any questions. Jon Peha.

3   MR. PEHA: I want to follow up on a

4   comment you made, Herman Wagter, to anybody. You

5   said that you - you chose a point to point

6   architecture, or topology, excuse me, gave you

7   greater versatility, a greater potential for

8   competition, cost an extra five to ten percent.

9   You didn't talk about this, but I assume it also

10   matters where aggregation points if you would go

11   to it the GPON way.

12   What I was wondering is how reversible

13   such a decision is. How hard is it if you had

14   gone a different direction and then decide, you

15   know, decided at some point later that you wanted

16   that versatility and that ease of competition.

17   MR. WAGTER: We've done some rough

18   calculations based on what we know is that if you

19   subtract the part which is already inside the

20   building, because that's individual for each

21   customer, and it's a large part of the investment,

22   it would take us another five to 600 euro per

1   customer to reverse the decision, if you would

2   have deployed - with deep splitters, meaning

3   splitters and cabinets underground very close to

4   the customers. We cannot put cabinets in the

5   street, everything has to be on the ground. So if

6   you put splitters down there, you have to reverse

7   it to point to point, it will add another 600

8   euros.

9   The - we'd also note some calculations

10   on a life cycle. If, for instance, at some point

11   in time you'd have to do a mid life upgrade, would

12   it make sense financially, or if you had to write

13   off the - network and redo it again after 15 years

14   and the point to point could do 25 years, you

15   mainly see that the price points and the

16   investment levels economically are more or less

17   the same, so you trade off.

18   What really hits home every time, and I

19   cannot stress it enough as - as soon as you start

20   adding up, saying let's open this up, which we can

21   do because you can mix technologies, if you want

22   GPON and you want something else, because we don't

1   operate, we don't do the electronics. People come

2   in and stole electronics and deliver services. As

3   soon as the actual penetration goes up, which

4   means the utilization of the network, it

5   financially obliterates any extra cost you've

6   made. An extra ten percent is way more

7   economically viable with than anything else, and

8   that's the reason why our incumbent has joined

9   forces in this and is going to be operator on this

10   dark fiber network and is saying I'm actively

11   encouraging other operators to be joining me in

12   this network because it will make more money, it

13   just will make more money, that's what we learned

14   from - these are public statements from -

15   incumbent, is that it's - before the tooth and

16   nail, but in the end, it just makes more money if

17   you happen to have an access network - the rest is

18   closed.

19   MR. ISENBERG: Tim Nulty.

20   MR. NULTY: Because this issue is

21   extremely interesting, I mean I think it's

22   actually one of the most important questions in

          1   the whole debate, the desirability of point to

          2   point, to me, is a given and obvious. The numbers

          3   and the economics that Herman has quoted I would

          4   suggest are highly dependent on the densities,

          5   because we really looked at this stuff very

          6   intensively. When you have your normal head end,

          7   central office head end, a modern IPTV kind of

          8   world can easily in a building, you know, not much

          9   larger than this room, can service 100,000 people,

         10   and you want to have as many people as possible

         11   because you're spreading a large expense over the

         12   lot. A hundred thousand people in a rural area

         13   means you're going to be serving people 150 miles

         14   away, you can't do head end, you can't do complete

         15   100 percent pure homerun when you're serving

         16   people 100 miles a way, not only because of the

         17   cost of it, but just the sheer problem managing

         18   these cable runs, 864 cables running, it just

         19   can't work.

         20   So what you have to do, given that point

         21   to point is the desirable end, is to say how can

         22   we move the aggregation point as far upstream as

1   possible and as close to the central office as

2   possible, and that's driven by two things.

3   Our actual choice is to have the

4   aggregation points secure buildings, not cabinets,

5   I hate cabinets, won't have cabinets, so they're

6   forbidden. Any vendor who comes and tries to sell

7   me cabinets is shown the door. A secure building

8   that is lighted, heated and secure, 20 - 30 feet

9   square, like that, and to have a minimum, you can

10   manage comfortably up to five or 6,000 customers

11   coming into one of those things. On the other

12   hand, the DB loss of the lasers is typically, if

13   you want to be really reliable, no more than 20

14   kilometers. So you draw 20 kilometer, by root 20

15   kilometers, not just a circle, around these little

16   remote hubs, and you try and do that so you get as

17   close to 3 - 4 - 5,000 people in them as you can,

18   and that's where you get your best economy.

19   In a building like that, you can get

20   virtually all, but quite, but virtually all the -

21   80 or 90 percent of the benefits of true point to

22   point because in a building like that, you can

1   switch out your OLT's, you can put new stuff in,

2   you can have co-location, customers, you know,

3   other - or service providers who want to get onto

4   your network because you're open access. In our

5   area of 600 square miles, we'll have nine of these

6   things. It isn't very hard to get a person into

7   the --

8   MR. ISENBERG: Thanks, Tim. Okay. I'll

9   ask people to keep their answers a little bit on

10   the succinct side even though we all - we know

11   that here on this panel we have experts with

12   direct hands on experience, and, in part, we'll be

13   delving into that after the panel later on.

14   Stagg, did you have a follow on question?

15   MR. NEWMANN: Let --

16   MR. PEHA: I'm curious about Tim's point

17   and what the views of the other panelists are.

18   Has the equation changed for rural areas that we

19   can expect to see fiber deployment and investment

20   in the rural areas?

21   MR. LYNCH: I think the best way to

22   answer that question is, that as the technology

1   continues to improve, the optics improve, the

2   methods and procedures that we use improve, you're

3   going to continue to see that economic break point

4   moving out. And, for example, now with FIOS, we

5   don't have to put a head end in every central

6   office.

7   You know, I think Tim mentioned 20K

8   before as the logical reliability limit for fiber,

9   that's been stretched, that's well beyond 20 now.

10   And, in fact, I think on the first panel somebody

11   said it's up to 60 kilometers. I think it - maybe

12   that's a stretch as to whether I want to deploy

13   that far out today, but I think you will continue

14   to see the march towards the more rural area being

15   more economic, regardless of, you know, individual

16   opinions here on the panel, it will continue to

17   move on.

18   MR. WAGTER: Okay. Although I'm working

19   in the city where the densities are extremely

20   high, we do a lot of rural areas, and especially

21   in other countries like Norway. What you see over

22   there is that the cost of the fiber and the pipe

1   isn't that much of a problem, it's the labor. And

2   as soon as you can get people to dig themselves,

3   and communities, like fiber to the farm in Norway,

4   the equation changes enormously. Furthermore, if

5   you do it in cooperation, like many of the

6   cooperatives or energy that are existent in the

7   U.S., you have a 100 percent penetration which

8   helps also.

9   MR. FELTON: I just want to add one last

10   point, which is the question of how you define

11   economical then becomes crucial, as well.

12   Obviously, as Joanne was saying, municipals don't

13   have the same framework for what's economical as

14   most, you know, private companies who depend on

15   shareholder money.

16   Usually it's going to be very hard for -

17   and, in fact, you know, to me Verizon is a very

18   interesting example because they're one of the few

19   companies that has had the guts to turn to the

20   market and say, yes, this is a long term

21   investment, and we're doing it nonetheless, but I

22   see a lot of incomes around the world that can't

 1   or don't want to do that.

 2   But basically, in a three to five year

 3   time frame, even an urban deployment is not going

 4   to pay for itself, let alone the rule of

 5   deployment. If a municipal like the city of Pau,

 6   for example, is looking at a 15 year return, then

 7   yeah, sure, it works, and it's economical by their

 8   standards.

 9   MS. HOVIS: And I would add to that that

10   of the municipal networks that are out there,

11   perhaps the seven are in suburban areas, not as

12   urban, the rest are in small towns and their

13   surrounding rural areas, and they use different

14   kinds of technologies, topologies, architectures,

15   different business plans, all very local, but they

16   are making it work. There has to be something

17   happening, that's right.

18   And I should add that they're making it

19   work over some pretty tremendous odds, including

20   frequent threat and reality of litigation and to

21   competitive PR campaigns. And so there's some

22   networks that had to fight three years of

 1   litigation before they were able to even start

 2   construction. So there are costs and delays

 3   associated with that that they - that are not

 4   faced otherwise.

 5   MR. ISENBERG: Thank you. Stagg

 6   Newmann.

 7   MR. NEWMANN: First, an observation,

 8   slightly humorous but with a point to it. I have

 9   a three step proposal that Blair rejected to

10   dramatically change the U.S. adoption, that was

11   first put a teenager in every home, second,

12   construct pre-wired fiber high rises in all the

13   metro rings in the U.S. that will accommodate

14   about three million people, and then relocate all

15   but the two percent of Americans that are

16   necessary to maintain rural America to the high

17   rises, very low communications costs for that.

18   The point of that, and it's really a

19   plea, not a question to the panelists, is, we are

20   acutely aware of the cost problem to pushing fiber

21   deeper, and we want to come up with a whole set of

22   very specific policy objectives that can really

1   lower those costs, such as when trenches are open,

2   let's get fiber in them, et cetera, et cetera, and

3   so very specific suggestions on policy levers that

4   we can do to lower the cost of pushing fiber out

5   there, because it is primarily a civil and

6   political engineering problem, not a technology

7   problem would be most appreciated.

8   A question I do have for each of the

9   panelists, particularly those of you operating

10   networks, is, what applications or usage

11   characteristics are you seeing from your users on

12   the fiber network that we are not seeing on DSL or

13   HFC networks, these networks that support the

14   really high speeds, how has the usage or

15   applications changed?

16   MR. NULTY: Actually, the - although the

17   business plan of a fiber to the home network is

18   based currently on a triple play, that's actually

19   the most boring thing. And just an example we're

20   finding in Burlington, where people have, you

21   know, real fiber, an increasing number of people

22   who are dropping, just canceling their cable

1   service, even though the cable service is much

2   better than the alternative, we concurrently

3   provide 100,000 fully uncompressed HD channels.

4   That's much better than people canceling

5   it, because they're finding - one by one, it's not

6   happening mass, but it's happening, people are

7   finding, you know, they got their Roku box and

8   their Hulu, and the internet speeds are so good

9   and so reliable, they're finding that nobody

10   watches it anymore, including the kids, and

11   they're canceling it, which actually we like,

12   because the cable business is a lousy business,

13   and the quicker we can get out of it, the better,

14   which you may feel, as well, I don't know.

15   The other things that are really

16   happening and just beginning to take off are the

17   kind of things that you can't do without fiber,

18   and that's genuine, as he described before in the

19   last panel, genuine interactive education and

20   interactive health care. You simply can't do

21   interactive MRI's, real time doctor visits and so

22   forth on anything that isn't extremely high speed,

1   and that's beginning to happen.

2   MR. NEWMANN: Are these - the things

3   like that, are these business to business, home to

4   business, or home to home that you're seeing?

5   MR. NULTY: Both; I mean one of the

6   interesting things about the fiber network is,

7   although you're constrained with - in terms of

8   your access to the upstream internet by what it

9   costs to buy band width from tier one and tier two

10   people, so peoples' internet service is typically

11   in the seven, eight, nine, ten megabit, but to one

12   another, internally, inside the network, in

13   Burlington is 22.5 up and 45 down, which

14   effectively means 22.5 symmetrically, and a lot of

15   that is beginning to happen back and forth

16   internally.

17   MR. ISENBERG: Herman and then Dick

18   Lynch. But --

19   MR. WAGTER: Okay, I'll start.

20   MR. ISENBERG: Please.

21   MR. WAGTER: There's three observations,

22   the - or two observations, the I'm busy

1   investigating or getting my hands on the data of a

2   relatively small village where the fiber

3   penetration is up to 80 percent across all age

4   groups, which is about 7,000 users, and I got my

5   hands on a graph of the accumulated users of data

6   up and down over time, and to my great surprise,

7   the amount of data going up was equivalent to the

8   amount of data going down.

9   We haven't got our hands yet on it,

10   what's the reason behind it and why is that, but

11   that is a significant change in user - for the

12   small city. We're going to investigate what's

13   exactly happening there. Now, what we see in

14   Amsterdam, in the bigger cities, which is a

15   totally different arena, is that the first users

16   immediately start placing home servers, and also

17   bringing their small individual businesses to

18   their home.

19   So many people with a Mac, working for

20   the media, going with video files for commercials

21   want everything, and just being able to send these

22   files ten minutes before the deadline to somebody

1   is great.

2   Reporters on motor bikes with raw

3   cameras, who take raw pictures in a raw format

4   which are ten megabytes per each and dying to - we

5   had a place open with three - megabits wireless

6   connection, and they always went there for coffee

7   and - laptop open and sent the files because they

8   could send it. And so the home server and the

9   small business type thing dominates the first

10   wave, the second wave you have to see.

11   MR. LYNCH: Let me give you a little

12   comparison here. A typical FIOS user uses about

13   three to four times the capacity per unit of time.

14   MR. ISENBERG: Of the - three to four

15   times?

16   MR. LYNCH: Three to four --

17   MR. NEWMANN: Compared to DSL.

18   MR. LYNCH: -- compared to DSL. Now,

19   ask yourself why that is. And you can talk about

20   specific applications, but the essence of what we

21   see is that the FIOS user is much more comfortable

22   with the latency of the real time capability and

1   the up links performance, and so it drives two way

2   video, it drives two way music.

3   So it's essentially driving streaming

4   set in another way, which, you know, a DSL

5   connection or probably a typical - type cable

6   connection available today really strains the

7   capabilities of other systems to do that kind of

8   thing. So it's the consumer seeing - and I'm

9   talking consumer now, I'm talking the averages

10   that I personally - subscribe to peak numbers, I

11   like averages. So in terms of the average, you're

12   driving it through video, you're driving it

13   through the two way capability of the fiber.

14   MR. ISENBERG: Anybody else?

15   MS. HOVIS: This is to some degree

16   projected, but I can tell you what's driving a lot

17   of the municipal decision-making, and some of it

18   is already happening. So in Lafayette, Louisiana,

19   one of the key applications is distributed

20   development of software, of video, of gaming,

21   technology that people in multiple places can work

22   together as if they were sitting in the same

1   office working on a --

2   And the city of Lafayette has very, very

3   consciously cultivated that and brought its

4   business community in and extended open

5   invitations to people in other parts of the

6   country who'd be interested in using this and

7   experimenting on the network.

8   This, by the way, is also the thing that

9   drives the city of Seattle, that really set off

10   its planning toward fiber to the home several

11   years ago, was this concern of where are the

12   software developers going to go if they don't have

13   the kind of band width they need to be able to

14   collaborate with their partners and their

15   counterparts around the city, around the country,

16   and in the rest of the world, very importantly.

17   And what that means in terms of the distributed

18   development, the kinds of speeds we're talking

19   about here allows every home or business to become

20   the equivalent of the university. On a network

21   like that, you're able to function in the way that

22   a researcher or a university or a software - a

1   code writer at a university could over one of the

2   regional optical networks, where they have that

3   kind of capacity.

4   The other big thing that we see as a

5   driver, again, thinking from a municipal

6   perspective in which the focus is not on

7   entertainment is various forms of aging and place

8   and tele health applications.

9   So the city of Portland, Oregon, in its

10   fiber to the home pilot which is in the planning

11   stage, has been very focused on working with the

12   non-profits that currently have aging in place,

13   pilots, and require more band width.

14   In Case Western Reserve University, in a

15   partnership with about 50 local non-profits and

16   local communities, including in some areas of just

17   utterly extraordinary poverty that surround the

18   university, has had a real focus on tele health,

19   as well.

20   For example, the constant monitoring of

21   people with diabetes in their homes, that would

22   allow them to stay home and not have to make

1   constant visits to emergencies rooms or hospitals,

2   but also allow them to live at home, because in

3   some cases it takes just 24 hour monitoring of

4   various aspects of their health. So that's been

5   another key driver that we think is pushing toward

6   a lot of the non- profit municipal deployments.

7   MR. FELTON: I just want to add one last

8   thing. Service providers that offer fiber

9   services don't offer very differentiated services

10   from triple play today. So it's easy to draw the

11   conclusion people are not doing anything different

12   with fiber, but to a large extent we have to

13   realize that it's not being offered to do anything

14   different with fiber.

15   What's interesting to me is that I think

16   in the next couple of years we're going to see two

17   waves of new services emerging, one which will be

18   the service providers themselves as they need to

19   further the differentiation with DSL and cable to

20   accelerate migration of customers to the fiber

21   networks.

22   The other one is going to be the googles

1   and yahoos and twitters and facebooks of this

2   world as they start realizing that there's a

3   critical mass of customers there that's big enough

4   that you can start addressing them specifically.

5   The interesting consequence of that is going to be

6   that for existing DSL grade users, the internet

7   experience will degrade.

8   MR. ISENBERG: Tim.

9   MR. NULTY: Just adding two examples,

10   the largest private sector employer in the state

11   of New Hampshire is Dartmouth Hitchcock Hospital

12   which is located in Hanover. And a large

13   percentage of the medical staff at that place

14   actually live in Vermont.

15   We approached Dartmouth Hitchcock to

16   support our project and they did so, but they've

17   said they don't actually need it themselves,

18   they're not much interested, they've got all the

19   band width they need as an institution, what they

20   care greatly about is the fact that they can't

21   reach their medical staff, and that having the

22   kind of fiber network we're building to their

1   medical staff, to their home, is of intense

2   importance to them, and nothing else will do.

3   They cannot have real time analysis of

4   MRI's by a specialist doctor looking at somebody

5   who's just come into the emergency ward any other

6   way. Another example is the Vermont Law School,

7   which is in our area, has told us that they

8   suspect - they are quite fearful and they expect

9   that within five years, their ability to exist as

10 a free standing law school in rural Vermont, a

11 quite successful and well regarded one, will if

12 not disappear, certainly degrade badly because

13 they won't get customers, kids won't come where

14 this doesn't exist.

15   MR. ISENBERG: Thank you. That is

16 actually consistent with many things that I've

17 been hearing. The ability to work at home at high

18 res is just huge.

19   MR. NULTY: Right.

20   MR. ISENBERG: I have now - finally I

21 have time to take some questions from the audience

22 and from the internet, and I thank the audience

1   and the folks out in net land for hanging in there

2   and for their participation. So one question here

3   is, especially for Verizon, and it's about last

4   mile congestion, and the question is, do customers

5   see their speeds drop at any point, and if so, how

6   often does this occur? Do your end user networks

7   get congested? Start with Dick Lynch.

8   MR. LYNCH: Well, I have to I guess

9   answer the question in a couple of layers, because

10   sitting here as an engineer being asked the

11   generic question, do your networks ever get

12   congested, certainly you engineer them so that the

13   congestion is not seen by the end user, that's

14   your goal, you don't necessarily always get there,

15   so I'm not going to say that it's never happened.

16   On the other hand, if you're asking me about DSL

17   versus FIOS, I think we have to look at it from

18   the access point. The DSL connection clearly

19   aggregates back at the central office and no

20   sooner than that. So if you talk about the access

21   point on DSL, that remains uncongested because

22   it's yours. When you get back to the central

1   office, it's always imperative that we continue to

2   drive that aggregation technology for minimum

3   blockage, but there will be blockage, whether the

4   consumer sees it or not is all - the engineering

5   challenge.

6   In a FIOS environment, you're talking

7   about sharing a two point for gigabit down link

8   pipe, 1.2 up, among 32 consumers. So when you do

9   the statistical multiplexing that was mentioned

10   here earlier today, it is highly unlikely that

11   you're going to see congestion in that end link

12   using FIOS, as well. So again, you're back to the

13   back bone, you're back to the aggregation point

14   and beyond, and the challenge we constantly have

15   is that the growth sometimes surprises us, but the

16   engineering objective continues to be the deliver

17   to the end user customer, that which they are

18   paying for.

19   MR. ISENBERG: And as a FIOS customer at

20   home myself, I have to say that's mostly my

21   experience. But I do notice, and this is an

22   anecdote, so please treat it as only anecdotal,

1   but I've noticed several times around 3:30 or

2   4:00, when kids get home from school, that the

3   network responses do tend to seem longer.

4   MR. LYNCH: Again, a lot has to do with

5   where that point of congestion may be.

6   MR. ISENBERG: Okay, sure.

7   MR. LYNCH: Is that at the server, is it

8   in the back bone, is it at a point beyond the

9   network, network interface, somewhere else,

10   because it's a popular site, so it's hard to be

11   specific, but I'm not going to say that we've

12   never had congestion on the network.

13   MR. ISENBERG: Okay. Do you mind if we

14   beat up on you one more time?

15   MR. LYNCH: I'm used to it, go ahead.

16   MR. ISENBERG: Here's one that -

17   actually, I'm, you know, as a fiber to the home

18   advocate, and I guess I - I'm not sure whether I

19   can say that with my FCC hat on or not, but it's

20   better to ask forgiveness later as we in large

21   organizations know. So the question came in,

22   current demand for Verizon 50/20 is low, it costs

1    $150 a month, how much do you expect demand would

2   increase if it were $50 a month?

3   MR. LYNCH: I'm going to answer that by

4   saying that's a marketing question.

5   MR. ISENBERG: Fair enough.

6   MR. LYNCH: Look, I mean reality says -

7   I mean economics 101 says that if you lower the

8   price, you're going to get more people to buy it.

9   But the real question that we have to assess is,

10   what is the value proposition for the customer

11   versus the business, and that will always be the

12   balance point for the pricing.

13   MR. ISENBERG: Okay.

14   MR. LYNCH: So I can't directly answer.

15   MR. NULTY: Can I defend Verizon? It's

16   not something --

17   MR. ISENBERG: You're not supposed to do

18   that, but go ahead.

19   MR. NULTY: The point Dick Lynch made

20   about where the bottleneck occurs is extremely

21   important. Traditionally, the upstream network as

22   a whole has not been the bottleneck compared to

1   the final mile. With a fiber connection, exactly

2   the reverse happens. There's very little

3   bottleneck on the final mile, and the bottlenecks

4   upstream become the controlling factor. So, in

5   fact, in Burlington, we don't offer a service, an

6   internet connection service of more than eight

7   megs because if you do, they'll never find -

8   they'll never experience it because the upstream

9   bottlenecks, wherever they occur, will almost

10 always control and people will feel cheated

11 because you've told them you were giving them 20

12 megs and they can never get it because the

13 bottleneck is upstream, not downstream. It's an

14 extremely important point that is not commonly

15 understood.

16   MR. NEWMANN: Let me just put a point on

17 that. If you look at flows across the internet,

18 say California to the U.S., the TCPIP protocols

19 today can typically not support flows more than a

20 couple megabits per second, from what we've been

21 told. You said you were really high - streaming

22 applications are your local ones where they stay

1   within your network.

2   MR. NULTY: Right; well, but I mean the

3   point that's been made earlier about the

4   importance of latency remains in place even under

5   this condition. The lack of latency with the

6   higher speeds remains a characteristic.

7   MR. NEWMANN: Agree, and that's why a

8   thing like local content and delivery and all that

9   becomes so important to this environment, yeah.

10   MR. ISENBERG: There's a question from

11   the web about the longevity of your capital

12   investment in fiber and in other technologies, and

13   the analogy is made to the rural electrification

14   act, where we are still seeing the benefits of

15   infrastructure installed back in the 1930's, and

16   so the question is, what are the lifetime

17   expectancies of these various investments?

18   MR. NULTY: The single most stable and

19   inert substance I think known to mankind is glass.

20   I spent a part of my life as a senior official in

21   the disposal of nuclear waste. We dispose nuclear

22   waste; the primary and best way to do it is by

1   incorporating it in glass, because glass will last

2   more than the 25,000 years which the - is the half

3   life of the most dangerous elements in nuclear

4   waste.

5   Nobody knows how long glass will last.

6   As long as the copper network lasts, which is

7   wonderful, the fiber - the one thing we know is

8   it'll last a lot longer.

9   MR. LYNCH: I'm not going to argue, sand

10   is pretty good, it stays around. But I don't

11   think that the question is how long will the stuff

12   physically exist, it's how long will it have a

13   useful life. And I think that the fiber useful

14   life is yet to be found because I think it extends

15   well beyond the view and capabilities to envision

16   the future requirements from anybody in this room,

17   and I will take the liberty to speak for everyone

18   in that regard. The electronics is going to be

19   outdated very quickly. You can't expect any of

20   the electronics, any of the active elements in any

21   of these networks to last more than probably five

22   or six or seven years, and the reason I say that

1   is because were going to need lower latency.

2   We're going to need higher capacities. When you

3   have active elements, they do deteriorate and at

4   some point they will fail. So you take all of

5   those things into account, and the fiber doesn't

6   become the issue. The fiber I would agree with

7   Tami, it's going to be around a long time.

8   But you've got to watch your active

9   elements; watch your capacity; and you've got to

10   stay out of the plant. The more you move the

11   plant around, the more likely you're going to be

12   to break it. And we've learned that from 100 and

13   some odd years of copper. If you put copper in

14   and leave it alone and never move it around, it

15   lasts fairly well. It may not do what we want it

16   to do, but it does last.

17   So we've got to stay out of that fiber

18   plant.

19   MR. ISENBERG: Good. Okay. Question

20   that I have. I asked you earlier what about the

21   suitability of FIOS for non-residential services,

22   such as LTE backhaul, et cetera, and you said FIOS

1   can do that. And so my follow-up question is how

2   can -- what is it that gives FIOS the flexibility

3   and capability to do that because isn't, for

4   example, LTE symmetrical inherently? Could you

5   speak to the properties of LTE backhaul and

6   Verizon's fiber capability?

7   MR. LYNCH: Sure. Let me first of all

8   tell you that every wireless carrier today has a

9   vision and a desire to get to a fiber backhaul to

10   every cell site, and you don't need LTE to want to

11   do that. There's a wide --

12   MR. ISENBERG: And right now 20 percent?

13   MR. LYNCH: -- it's probably higher than

14   that.

15   MR. ISENBERG: Okay.

16   MR. LYNCH: It's probably higher than

17   that. My guess is 40 percent today, something

18   like that.

19   MR. NEWMANN: Yours or industrywide?

20   MR. LYNCH: Verizon Wireless.

21   MR. NEWMANN: Verizon.

22   MR. LYNCH: Yeah, but I know that the

1   industry is all that different that that.

2   But to your specific question of can

3   FIOS deliver backbone capabilities for LTE. Yes.

4   And, in fact, historically we as an industry had

5   this what I would call rather strange demarcation

6   between what we call inter- office capabilities

7   and endlink capabilities. And there is no

8   technical difference to the performance for the

9   user at the end. We just had this structure set

10   up that we did it one way or another way.

11   What we've said is, look, fiber is

12   fiber. It can perform just as well as any of the

13   old inter-office fiber or inter-office facilities,

14   and so for us delivering to a LTE backhaul,

15   delivering to a Femtocell, delivering to a

16   business is all about what the customer wants to

17   liver, and if you can do it over FIOS, do it that

18   way. And that, in fact, is the way we're

19   delivering most of the backhaul to customers

20   today.

21   MR. ISENBERG: Okay.

22   MR. LYNCH: Okay. Anybody have a

1   burning follow- up point or in the audience a

2   burning question? I knew Dave Burstein would

3   raise his hand at that. David, please?

4   MR. BURSTEIN: This is (inaudible)

5   talking about having minimal congestion.

6   MR. LYNCH: Is this a pick on Dick Lynch

7   meeting or?

8   MR. BURSTEIN: The best network

9   engineers in the world in this room, and I'm not

10   going to ask folks who are consultants when I got

11   a world-class engineer.

12   MR. LYNCH: Thank you.

13   MR. BURSTEIN: We're talking -- you're

14   saying that there's very little congestion in

15   FIOS; agreed. Can you put a number on it? About

16   how many hours, say, per month would a typical

17   FIOS customer see 20 percent degradation and, say,

18   50 percent degradation? Five hours a month? Five

19   hours a year? Five hours a week?

20   MR. LYNCH: To be perfectly honest, and

21   I do mean us honestly, I'm not trying to hide a

22   number. I don't have one that I can give you.

1   MR. BURSTEIN: Can I ask you to follow

2   up?

3   MR. LYNCH: You could ask me to follow

4   up. Yeah. But I don't really come prepared with

5   that kind of number. Yeah.

6   MR. ISENBERG: Okay.

7   MR. NULTY: I can give you an answer.

8   At Burlington Telecom, we did extremely close

9   traffic monitoring because we wanted -- we had a,

10   you know, a commitment that we would provide --

11   when we said we would provide X amount, that's

12   what you got all the time. And the problem was

13   never, actually never to my knowledge, the

14   downlink. The question is always -- the customer

15   experiences a degradation. Where did that

16   degradation come from? Was it in the downlink or

17   was it higher up? That's the problem.

18   Nowadays, in those few places that have

19   a fiber downlink, a fiber local link, a final

20   mile, in our case we never saw a single situation

21   in which experienced degradation was due to

22   congestion in the final link. It was always

     1   higher, and the way we dealt with it, because we

     2   had a constant dial-up, dial-down relationship

     3   with our tier two and tier three providers, the

     4   minute we saw any sign of usage getting close to

     5   the point where it would cause degradation, we

     6   dialed up the tier one, tier two, three bandwidth

     7   (inaudible) so that it went away.

     8   Now as an interesting fact, you know the

     9   old 80/20 rule with traffic. In Internet that's

    10   not that. At least in our network, in any given

    11   month, 10 customers, count them, 10, take up 85

    12   percent of the usage. It's never the same 10 --

    13   never the same 10.

    14   MR. WAGTES: This bandwidth usage thing,

    15   there is an interesting study by -- in Japan done

    16   by Mr. Cho, which also shows in aggregated over

    17   millions, five millions of users of 100 megabits

    18   or something like that, that approximately five

    19   percent of the users are very heavy users, but

    20   every second the five percent changes.

    21   MR. ISENBERG: Very good. Okay. David

    22   Reed has a comment.

1   MR. PATRICK REED: Yeah. My comment is

2   -- and maybe it's a question is that I was sort of

3   a little bit disturbed by Stagg Newmann's comment

4   that you can't get across the United States at a

5   rate more than about a megabit. In fact, I do

6   actually track that a great deal, and, in fact,

7   was also asked in the CRT hearings over the past

8   summer, which were about network management, to

9   dig into that, which actually was a big part of

10   the Canadian thing, and let me just finish. So

11   what is pretty clear is that, as everyone on the

12   panel has already said, is that congestion appears

13   at various points in the network; right? And

14   oftentimes it's dependent on how much built out

15   it's been and so forth.

16   But what seems pretty clear about the

17   U.S. Internet backbones and the U.S. Internet

18   services, that is, essentially the clouds or the

19   data centers that are run by Google and Amazon and

20   so forth is that those are capable well above 20

21   megabits sustained capacity across the United

22   States to almost every point. And what limits

 1   things today sometimes is the local network, but

 2   it's almost never a fiber-based local network, and

 3   it's not often the hybrid fiber coax networks if

 4   they are configured well.

 5   Where I think most end user experience

 6   today suffers is not very well provisioned

 7   servers. That's kind of a first order thing, and

 8   that was alluded to, and then where it will start

 9   to happen is in some cases those laggard end user

10   providers, the low-end DSL providers and so forth

11   that aren't investing to keep up with demand and

12   keep with the Googles and the Amazons and also the

13   service providers and so forth, and what seems to

14   happen is an economic progression. As you create

15   what Benoit talked about a distinct customer base

16   that is significant enough, you know, that service

17   providers will invest against it, you know, then,

18   you know, you'll see the ratcheting up, and the

19   expectations will continue to ratchet up to

20   whatever level we can predict.

21   So I just wanted to clarify that

22   process. It's a process. It's not any point in

1   the network that is driving it.

2   MR. ISENBERG: So thank you all for --

3   thanks to the distinguished panel. Thanks to my

4   mentor in ways of the FCC, Stagg Newmann. Thanks

5   to our other distinguished FCC participants, and

6   to our volunteers back there on the computer,

7   loading the viewgraphs and the timer, and the

8   question collectors in the room and on the Web.

9   Thank you all. I think it was a really great

10   panel.

11   (Whereupon, at 1:11 p.m., the

12   PROCEEDINGS were adjourned.)

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