

UNITED STATES
FEDERAL COMMUNICATIONS COMMISSION

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TECHNOLOGY TRANSITIONS POLICY TASK FORCE

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WORKSHOP

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MONDAY

MARCH 18, 2013

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The Workshop convened in the
Commission Meeting Room at the headquarters of
the Federal Communications Commission, 445
Twelfth Street, Southwest, Washington, D.C.,
at 9:30 a.m, Julius Genachowski, Chair,
presiding.

FCC COMMISSIONERS PRESENT
JULIUS GENACHOWSKI, Chair
AJIT PAI
JESSICA ROSENWORCEL

PRESENT

PANEL 1: TECHNOLOGICAL CAPABILITIES
HENNING SCHULZRINNE, Moderator, FCC
RALPH W. BROWN, CableLabs
MUNG CHIANG, Princeton University
DAVID ECKARD, Alcatel-Lucent
DINA KATABI, MIT
DAVID RUSSELL, Calix

PANEL 2: USAGE AND ADOPTION
JOHN B. HORRIGAN, Moderator, JCPES
CHRISTOPHER BAKER, AARP PPI
ANDREW M. BROWN, Levine, Blaszak Block &
Boothby, LLP
JESSICA GONZALEZ, NHMC
JENIFER SIMPSON, ATAC
PETER STENBERG, U.S. Department of Agriculture

PANEL 3: NETWORK EVOLUTION
REBEKAH GOODHEART, Moderator, FCC

JOHN CIVILETTO, Cox Communications
MICHAEL P. GOLOB, Frontier Communications
MATT GROB, Qualcomm Technologies Corp.
THOMAS MAGUIRE, Verizon
RANDOLPH C. NICKLAS, XO Communications

FCC STAFF PRESENT

JONATHAN CHAMBERS
JULIUS P. KNAPP
SEAN LEV
ERIC RALPH

ALSO PRESENT

PHILIP JONES

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

9:38 a.m.

CHAIR GENACHOWSKI: Well, good morning, everyone.

I am Julius Genachowski. I am the Chairman of the FCC.

Happy first day of March Madness.

(Laughter.)

Yes. Anyone caught filling out a bracket during this panel will have their smartphone confiscated. I just want everyone to know that.

(Laughter.)

But, seriously, welcome to the FCC's first workshop of our Technology Transitions Policy Task Force. I am so happy that Commissioner Rosenworcel and Commissioner Pai are here. You will hear from them afterwards.

Thank you all for joining us. I want to thank our panelists. I see many familiar faces who have come in from out of

1 town, yet again, the other Washington, not a
2 fast trip.

3 I want to thank Sean Lev and the
4 others members of the FCC staff who worked
5 hard to organize this panel and a lot of other
6 work that is being done on this important
7 topic; Rebekah Goodheart, who is serving as
8 the Task Force's Deputy Director.

9 When I arrived at the Commission
10 in 2009, it was clear that this was a time of
11 rapid technological change, and that change
12 has only accelerated. At the start of 2009,
13 16 percent of mobile subscribers had
14 smartphones; today that number is 55 percent
15 and climbing.

16 Back then, the commercial tablet
17 market didn't exist at all. And today,
18 roughly one-third of Americans have a tablet
19 or e-reader. Some analysts project that
20 tablet sales will surpass PC sales as soon as
21 this year.

22 The percentage of households

1 cutting the cord has roughly doubled, and more
2 than a third of U.S. households are now
3 wireless-only for phone service.

4 At the FCC, we have been working
5 to make sure our communications policies keep
6 pace with this change. We, of course,
7 developed the country's first national
8 broadband plan, providing a strategic roadmap
9 for the transition to all-IP networks. As
10 recommended in the plan, we have adopted
11 landmark reforms of the Universal Service Fund
12 and overhauled intercarrier compensation.

13 We had sped the transition to
14 next-generation 911. We have ensured that
15 VoIP service remains accessible to individuals
16 with disabilities. And just last week, I
17 circulated an NPRM proposing that VoIP
18 providers receive direct access to numbers,
19 phone numbers.

20 The proceeding on direct access to
21 numbers for VoIP was a recommendation of our
22 Technical Advisory Council, or our TAC. Led

1 by Tom Wheeler, the TAC had another early
2 recommendation relevant to today's session.
3 And it said the Commission should, and I
4 quote, "establish a task force to conduct a
5 thorough policy and regulatory review as it
6 relates to the PSTN, which results in policies
7 for the new communications environment".

8 Following TAC's counsel, in
9 December 2012, I announced the formation of an
10 agencywide Technology Transitions Task Force
11 to provide concrete recommendations to
12 modernize the Commission's policies,
13 recommendations that would build on the
14 Commission's previous work.

15 We said this process would be open
16 and data-driven. And consistent with that
17 promise, we are conducting a series of public
18 workshops, of which this is the first.

19 Today's main objective is
20 establishing a factual baseline for
21 understanding three key transitions. One, the
22 evolution of network protocols from TDM to IP.

1 Two, the replacement of copper networks with
2 fiber. And three, the shift from only-wire-
3 line service to greater use of wireless
4 service.

5 We have scheduled three panels
6 today's comprised of a broad sector of experts
7 from inside, and mainly outside, of
8 Washington, engineers, academics, and CTOs
9 from multiple facets of the industry.

10 The first panel -- and I see some
11 of you are up here already -- will examine the
12 technology capabilities of our communications
13 networks today and in the future, including
14 both wireline, copper, fiber, coax, and
15 wireless, and in the future.

16 This diverse panel includes
17 respected academics, including Mung Chiang of
18 Princeton and MIT's Dina Katabi, who I saw at
19 MIT last week, or two weeks ago, as well as
20 some of the vendors, CableLabs, Calix,
21 Alcatel-Lucent, that are developing products
22 to enable more reliable and innovative

1 services.

2 The second panel will examine the
3 adoption and use of various technologies
4 across different demographic groups. This
5 panel will be led by a former member of the
6 FCC family, Dr. John Horrigan of the Joint
7 Center for Political and Economic Studies, who
8 will both moderate the panel and provide a
9 general overview of the current usage and
10 demographics.

11 We will also have panelists
12 speaking about the unique issues facing
13 different demographic groups, including the
14 disability community, rural America, the
15 business community, as well as communities of
16 color.

17 Finally, panel 3 will examine the
18 timing of the technology for the technology
19 transition of different networks.

20 The panelists today represent
21 multiple facets of the communications industry
22 with representatives from Cox, Frontier,

1 Qualcomm, Verizon, and XO. And I want to
2 thank all of the panelists for joining us.

3 By gathering data about the
4 technologies themselves, the way Americans use
5 these technologies, and the drivers for
6 network investment and innovation, the Task
7 Force will be able to help the Commission
8 determine what policies are required in
9 today's and tomorrow's communications
10 networks.

11 While technological advances can
12 change markets, they don't change the FCC's
13 mission. So, as we move forward with this
14 effort, we will be guided by a set of constant
15 core principles and priorities.

16 First, competition. History has
17 shown that competition is our most effective
18 tool for driving private investment and
19 innovation, and that smart government policies
20 are vital for ensuring competitive markets.
21 Indeed, the benefits and choices brought by
22 the technology transitions exist because of

1 massive private investment and because of
2 policies that created and maintained the
3 conditions necessary for competition to
4 flourish.

5 As these transitions move forward,
6 they are changing communications markets,
7 often in ways that can increase competition,
8 particularly for voice services. But they
9 don't automatically ensure competition. So,
10 some like to refer to the, quote, "competitive
11 OIP world'" as if competition and IP are
12 synonyms. We know that is not true. We need
13 to take a sophisticated, data-driven approach
14 to determine which policies to keep for
15 today's markets, which to add or modify, and
16 which to eliminate, again, focusing on this
17 core goal of competition.

18 A second key goal, consumer
19 protection. Consumer protection is vital
20 because, even with strong investment and
21 innovation, even with competition policies,
22 competition won't reach everywhere. Because

1 even healthy markets with robust competition
2 can leave consumers subject to abuse, we have
3 a core responsibility.

4 That is why, for example, we have
5 rules to ensure access to communications
6 technology for Americans with disabilities, to
7 promote transparency and disclosure, and to
8 protect consumer privacy. These are just some
9 of the consumer protection issues that have
10 been important and remain important, even as
11 technologies change. Consumers need to know
12 that the FCC has got their back.

13 Third, and closely related,
14 universal service. The concept of universal
15 access to modern communications is at the
16 heart of our consumer mission and our founding
17 statute. And access to broadband is this
18 generation's universal service imperative.
19 Wired and wireless broadband have become an
20 indispensable platform for innovation,
21 commerce, and civic engagement. To leave
22 large swaths of this country without broadband

1 access in the 21st is as unthinkable as
2 leaving millions without access to electricity
3 or phone service in the 20th.

4 And the fourth core principle is
5 public safety. New technologies bring
6 tremendous potential to improve public safety
7 and help first responders, but they also bring
8 some new challenges like continuity of power.
9 Policies and industry standards need to evolve
10 to ensure that the resiliency of our networks
11 is not diminished as a result of technology
12 transitions.

13 We laid out these key basic
14 principles when we created the Task Force and
15 charged it with providing recommendations to,
16 quote, "encourage the technological
17 transitions, empower and protect consumers,
18 promote competition, and ensure network
19 resiliency and reliability". These values are
20 the compass that will guide us to the policies
21 and maximize the benefits of broadband for the
22 American people today and into the future.

1 So, today's workshop will help lay
2 a sound, factual basis for that work. I am
3 pleased that a number of my friends and
4 colleagues from around the country are joining
5 us today, including Phil Jones, President of
6 NARUC.

7 So, let me welcome all of you. I
8 think this will be a very productive day, as
9 we continue to seek to ensure that the FCC
10 responds in a smart, forward-leading, pro-
11 investment, pro-innovation way to changes in
12 technology while continuing to preserve and
13 promote our core values of competition,
14 consumer protection, universal service, and
15 public safety.

16 With that, let me introduce my
17 friend and colleague, Commissioner Jessica
18 Rosenworcel. Thank you very much. And I know
19 Commissioner Pai is here as well, and he will
20 be following Commissioner Rosenworcel.

21 So, thank you very much and have a
22 terrific day.

1 (Applause.)

2 Commissioner Rosenworcel?

3 COMMISSIONER ROSENWORCEL: Good
4 morning.

5 Thank you for being here for our
6 first Technology Transition Policy Workshop.
7 Thank you for being here so bright and early.
8 It is Monday morning, and we have got
9 something that passes for snow in Washington.
10 So, I hope you have had your morning caffeine.

11 And I will start by saying that,
12 when it comes to communications network
13 infrastructure, we are living in a
14 transitional time. Nothing demonstrates this
15 like the raw numbers.

16 About a decade ago, in 2001, we
17 had 192 million circuit switch telephone
18 lines. But, now more than a decade later,
19 that number has declined by more than 40
20 percent to 107 million.

21 In contrast, interconnected VoIP
22 subscriptions have risen by more than 50

1 percent since 2008 and now number 37 million.
2 And as you heard the Chairman just a few
3 minutes ago say, one-third of households have
4 cut the cord entirely, with their wireless
5 phone their only phone.

6 When you add this all up, we have
7 something. We have a trend. The ways
8 consumers are choosing to connect are growing
9 more diverse, and so are the networks over
10 which our content and conversations travel.

11 We are moving from the public
12 switch telephone to an emerging IP and
13 wireless ecosystem. All of these things
14 coexist today, and they are jointing
15 responsible for carrying our communications.

16 But going forward, we want to do
17 more than just apply the laws of the present
18 to the networks of the future. We want to
19 create an environment so that carriers are
20 confident and can invest in their networks.

21 And we also want to create an
22 environment so that consumers are confident

1 and have the ability to realize the potential
2 and opportunity that the digital world
3 provides. So, how do we do this?

4 Well, that is actually where you
5 come in. That is why your conversation today
6 matters, because we are looking at this grand
7 shift in communications technology and we need
8 your advice and we need your input.

9 So, as I said in my testimony in
10 front of Congress last week and in a speech
11 late last year, as we approach this
12 transition, I don't think it is the time to
13 get caught in legal minutia. Instead, it is
14 the time for all of us, everyone in this room
15 included, to ask big questions about the
16 enduring values in our communications laws.

17 So, for my part, I see four basic
18 values, which I appreciate the chairman has
19 also laid out for you and picked up on. But
20 let me list them and some of my thoughts about
21 them in a little more detail: public safety,
22 universal service, competition, and consumer

1 protection.

2 Now let's start with public safety
3 because it is paramount. In the very first
4 sentence of the Communications Act, Congress
5 instructed the Commission to make available to
6 all the people of the United States a rapid,
7 efficient, nationwide, and worldwide radio and
8 communications service in order to promote the
9 safety of life and property.

10 Now, in light of this directive, I
11 think any technological or network transition
12 must first and foremost be judged by its
13 ultimate impact on public safety and network
14 resiliency. But, as the numbers I just shared
15 with you demonstrate, we are migrating fast to
16 IP and wireless networks. That means we are
17 choosing to go without the independent
18 electrical source that traditionally powered
19 our copper plant.

20 Our new wireless and IP
21 technologies are dependent on commercial
22 power. When that goes out, so do our

1 connections.

2 But, as consumers switch to new
3 networks, I don't think we need to sacrifice
4 safety in the process. So, it is time for an
5 honest conversation about network reliability
6 and resiliency in the digital age. It is time
7 to ask hard questions about backup power with
8 our new networks and how to make sure they are
9 dependable when we need them most. And I
10 think the communications difficulties in the
11 aftermath of Hurricane Sandy made this point
12 with painful clarity.

13 Second, universal service or I
14 think, better put, universal access is still
15 essential. No matter where you live or who
16 you are, prosperity in the 21st century is
17 going to require access to broadband. So, the
18 Commission's ongoing efforts to promote
19 broadband deployment and broadband adoption,
20 they are built on this simple truth. But, as
21 we transition to new technologies, we need to
22 make it a policy imperative that no American

1 is left behind.

2 Third, competitive markets are
3 critical. Competition, after all, inspires
4 private sector investment and innovation. But
5 competition also requires special attention to
6 a key element of the Telecommunications Act
7 that has made our patchwork of competitive
8 networks work seamlessly, and that is
9 interconnection. It is something I hope you
10 talk about today.

11 Fourth, consumer protection is
12 always in the public interest. In a
13 transitional world, consumers rely on both old
14 and new technologies. We need to help them
15 understand what different technologies offer,
16 help them make informed choices, and ensure
17 that they are treated fairly in an evolving
18 marketplace.

19 So, as we assess changes in the
20 public switch telephone network, I think these
21 four principles, public safety, universal
22 access, competition, and consumer protection,

1 I think they are good guideposts. They don't
2 get at all the details. I think we are going
3 to leave that to many of you today. But I do
4 think they get to the heart of the big
5 questions we need to answer, the enduring
6 values we need to speak to, and the big
7 responsibilities that come with setting a
8 policy course in a transitional time.

9 So, thank you for being here
10 today. Thank you for being such an important
11 part of an important discussion.

12 And with that, I want to introduce
13 my friend and colleague, Commissioner Pai.

14 Thank you.

15 (Applause.)

16 COMMISSIONER PAI: Well, thank you
17 to my friend and colleague, Commissioner
18 Rosenworcel, for the warm introduction.

19 I would like to start off by
20 thanking all of our panelists for
21 participating in today's workshop. Last
22 summer I called for the creation of this Task

1 Force. And so, it is exciting, exactly eight
2 months later, to see such a distinguished
3 group of experts helping us here at the
4 Commission to grapple with and understand the
5 internet protocol, or IP, transition.

6 Today's workshop aims to gather
7 data and analysis to establish a factual
8 baseline understanding of the technological
9 transitions that are revolutionizing the
10 communications marketplace. I look forward to
11 learning from these panelists as they help us
12 reach that understanding.

13 There are a few things, however,
14 that we already know. Most obviously, we know
15 that the IP transition is already well
16 underway. Through millions of individual
17 choices, consumers are sending a message, a
18 clear message, about the superiority of IP-
19 enabled networks.

20 As my two previous colleagues have
21 noted, only one-third of U.S. households today
22 subscribe to what we used to call POTS, or

1 plain, old telephone service, over the public
2 switch telephone network. And that number is
3 dropping each and every year.

4 Copper wire networks operated by
5 monopoly providers and providing TDM services,
6 those services are literally becoming history.
7 Voice Over IP, or VoIP, service, by contrast,
8 is on the rise. In 2011, there were almost 37
9 million VoIP subscriptions in the United
10 States.

11 I believe that we at the FCC
12 should do what we can to accelerate the IP
13 transition. So, I hope that this Task Force
14 will develop a holistic set of recommendations
15 for moving forward with the IP transition, and
16 that these recommendations will be informed by
17 certain core principles; yes, four of them.

18 First, the SEC must ensure that
19 vital consumer protections remain in place.
20 If the consumer calls 911, it shouldn't matter
21 whether that consumer is using a wireless
22 phone, a landline, or a VoIP application.

1 Second, the SEC must make clear
2 that obsolete, 20th century regulations will
3 not be imported into the all-IP world. And to
4 do that, we are going to have to repeal some
5 of the obsolete rules that were designed for
6 the networks of yesteryear.

7 Third, the SEC must be able and
8 must retain the ability to combat market
9 failures and anti-competitive harms.

10 Fourth, and finally, we must stay
11 within the bounds of our statutory authority.

12 Now, in addition to holding
13 workshops, there is another important step
14 that we should take to gather data. We should
15 conduct an all-IP pilot program that will
16 allow forward-looking companies to choose a
17 discrete set of wire centers where they could
18 turn off their old TDM electronics and migrate
19 their consumers to an all-IP platform.

20 Now I hope that our panelists
21 today will share their views on how we should
22 structure an all-IP pilot program. A well-

1 considered pilot program would enable us to
2 make the broader IP transition with empirical
3 data in hand.

4 Now people have a lot of opinions
5 about how the IP transition will play out, how
6 it is going to affect consumers. But
7 prediction is no substitute for practice. As
8 Albert Einstein put it, quote, "A pretty
9 experiment is in itself often more valuable
10 than 20 formulae extracted from our minds."

11 In short, there is plenty for us
12 to discuss today and in the days to come. The
13 stakes are high. If we at the Commission get
14 this right, then we will give the private
15 sector the right incentives to build out next-
16 generation networks, to upgrade their
17 equipment, and to make more capital
18 investments. And that, in turn, would lead to
19 better and cheaper broadband, more jobs, and
20 a brighter economic future for American
21 consumers.

22 All of this is possible if we

1 adopt a modernized, deregulatory framework for
2 the all-IP world that lies just around the
3 corner. Maybe by the wisdom of today's
4 panelists, I am hopeful that we will do just
5 that.

6 Thank you very much once again for
7 participating.

8 And go Jayhawks.

9 (Laughter.)

10 (Applause.)

11 MR. LEV: Before we get going with
12 our first panel, we are going to have one more
13 distinguished speaker. That is Phil Jones,
14 who is the President of NARUC and a
15 Commissioner in the State of Washington. He
16 is going to speak for a moment or two.

17 Thank you.

18 MR. JONES: Good morning.

19 My name is Philip Jones. I am
20 Commissioner at, as the Chairman said, "the
21 other Washington". I call it "the real
22 Washington" State. And I flew in today to be

1 here and on some other business, and I am very
2 pleased to be at this conference.

3 Thank you for inviting me, to Sean
4 and Rebekah, the Chairman, Commissioner
5 Rosenworcel, Commissioner Pai.

6 I won't bore you with any details,
7 but NARUC has set up a task force as well. I
8 personally set up a task force last November
9 to look at federalism and telecomm.

10 As Commissioner Pai said, we are
11 moving to an all-IP world. We do have the '96
12 Act.

13 And NARUC actually published a
14 document in 2005 called "Federalism and
15 Telecomm" in which we set forth the values on
16 which regulation should look at the
17 telecommunications networks.

18 I personally feel we need to
19 update that. And so, we have seven
20 Commissioners looking at this, chaired by Orji
21 Isiogu of the State of Michigan.

22 We will be coming out with our

1 recommendations this summer. So, stay tuned.
2 All of our comments/principles are published
3 on the NARUC website, www.naruc.org. You can
4 get them there.

5 It is not ironic, but I think
6 Jessica had four, you had four principles, the
7 Chairman had four. We have eight.

8 (Laughter.)

9 So, I am not going to repeat the
10 four, other than to say, on public safety,
11 remember that these silos, these areas that we
12 regulate are interconnected. State
13 Commissioners like me are spending a lot of
14 time looking about reliable electric power
15 now. Interconnected VoIP devices, both the
16 end-use network and your device at home, if
17 you didn't know this, rely on electric power.
18 When electric power goes out, I am sorry, but
19 you can't use your end-user devices unless you
20 have some fantastic battery that we don't have
21 right now. So, public safety issues, I would
22 argue, rely a lot on another sector of the

1 economy, the electric power industry, and we
2 all have to be looking at this.

3 So, the other four that we are
4 looking at are interconnection, which is tied
5 to competition, but networks must remain
6 interconnected on a non-discriminatory basis
7 to ensure ubiquitous service.

8 We are looking at regulatory
9 diversity. Regulation should be functional
10 and decided after reviewing multiple points of
11 view. And I think it is very valuable that
12 this Task Force look at many points of view.

13 We believe that evidence-based
14 decisionmaking is important, not to rely on
15 anecdote, allegory, what some people call the
16 "Kool-Aid" on technology, but to rely on
17 evidence and data.

18 And the last is broadband access,
19 affordability, and adoption. State regulators
20 should play a lead role or an important role
21 in determining state requirements for
22 broadband deployment and consumer protection.

1 So, those are the additional four
2 areas that we are looking at. I look forward
3 to a robust dialog in the months ahead.

4 And thank you for inviting me
5 today.

6 (Applause.)

7 MR. SCHULZRINNE: Good morning,
8 and welcome to the first panel on technology.
9 I am delighted to have such a distinguished
10 group of participants here.

11 Before I get started, a few items
12 of logistics, and those will apply roughly to
13 the succeeding panels as well. We will have
14 each speaker give a presentation, in our case
15 about 10 minutes. Afterwards we will be
16 having an open discussion among the panelists
17 and among the FCC staff present here.

18 We also encourage our members of
19 the audience to ask questions. In order to
20 make that most efficient, please use index
21 cards, and you can bring those up to me. I
22 will try to distill those questions, so that

1 we can make best use of our time.

2 Let me start by echoing a few
3 remarks earlier on a technology perspective.
4 It used to be that we had separate panels and
5 workshops on wireless technology, on copper-
6 based technology, DSL, on unlicensed and
7 licensed spectrum, on fiber. All of those
8 were pretty much distinct industries, distinct
9 workshops, even to some extent distinct FCC
10 offices and bureaus.

11 That, among many other things, has
12 changed. The promise -- and that has been
13 really the goal of the internet protocol --
14 was always an internet, a network of networks
15 independent of technology. It has taken a
16 while before that really became technology
17 reality as opposed to textbook, but we are
18 getting -- and I believe this is one part of
19 our transition -- to the point that almost all
20 of our networks are hybrid networks.

21 There are very few networks that
22 are purely copper, certainly not purely

1 wireless, certainly not purely coax and fiber.
2 All of those tend to be combined into one
3 network, and one network that appears as one
4 network to the consumer. It is no longer a
5 voice network, a data network, a special-
6 purpose wireless network. That is taking
7 place both for consumer communication and, as
8 was mentioned several times, for public
9 safety. If you look at FirstNet, that is
10 another example of a transition to IP that
11 enables an integrated public safety network
12 outside the consumer space.

13 Thus, this first panel is ideally
14 suited to look at the network holistically.
15 We have representatives, researchers, and
16 companies that are looking at all of those
17 technologies. We will obviously focus in each
18 one on a specific set of issues that we
19 address.

20 Overall, we want to find out not
21 just what works, but also what are the
22 limitations. What are still the challenges

1 that we will have to face, and which of these
2 we can tackle in the next five or so years.

3 What are some of the cost
4 constraints that we will need to face, both in
5 terms of initial capital expenditures as well
6 as operationally?

7 What are the issues we have to
8 deal with when things don't go well, when
9 inclement weather or other, cyber attacks, for
10 example, interfere with network operations?
11 How can we assure, given the centrality of
12 these networks, that these networks are
13 resilient?

14 All of these issues and many more
15 we will be discussing in the next hour and a
16 half or so.

17 I am delighted to be able to
18 welcome our distinguished panelists here. We
19 will start with the two faculty, Mung Chiang
20 from Princeton University, a professor of
21 electrical engineering, and Dina Katabi from
22 MIT, who will both be talking about the

1 wireless side.

2 And then, we will have the
3 Director of Solutions Marketing from Calix,
4 David Russell, who will be talking, along with
5 David Eckard from Alcatel-Lucent, mostly about
6 the wireline side, both fiber and copper.

7 And then, sort to say the first
8 large-scale industry that has really been a
9 hybrid network, namely a hybrid fiber coax,
10 namely Ralph Brown as the CTO from CableLabs,
11 who will be addressing current and future
12 technologies in the cable space.

13 We also have a number of FCC staff
14 here that will be helping with questions
15 afterwards: Rebekah Goodheart, Sean Lev,
16 Jonathan Chambers, Julius Knapp, and myself.

17 And with that, let's get started.

18 Mung, if you want to get going?
19 And there is a clicker right next to you.

20 MR. CHIANG: I am just looking for
21 the slides because I need to see my own slides
22 in order to know what I am supposed to talk

1 about.

2 (Laughter.)

3 All right. Now that works.

4 Wonderful. Now I see it. Thank you. Thank
5 you.

6 Well, good morning, everyone.

7 Thank you, Henning, for the kind
8 invitation.

9 As I stepped out of Union Station
10 this morning, looking at this wonderful
11 weather, I said, "What a great day to start
12 the first day of spring break in Washington,
13 D.C., with the snow."

14 (Laughter.)

15 Some of my students at Princeton
16 might be enjoying the beach in Miami, but,
17 then, again, they won't be talking about
18 something as important as technology
19 transition policy, not something as
20 challenging as technology transition policy.

21 In fact, it is so challenging, I
22 need to actually have that hard copy. Thank

1 you very much.

2 (Laughter.)

3 Because this switched to my face,
4 which is not something I want to look at.

5 Well, how challenging is this?

6 This is mostly to wake myself up. So, how
7 challenging is this? Well, I will say it is
8 more challenging than a teenager getting in
9 and out of adolescence. This is more
10 challenging than just technology. Technology
11 transition is much bigger than technology. It
12 is even more challenging to phase out and
13 sunset technology than to roll out a new
14 technology.

15 And I will say that the top three
16 questions that always bother me a lot are the
17 following:

18 One is, is technology backward-
19 compatible? At some point, you have to
20 wonder. The decisions made a while back, as
21 they become obsolete, what is the cost of
22 maintaining those obsolete technologies?

1 Another is for the benefits that
2 are being promised to us, are they
3 incrementally deployable? If we deploy 10
4 percent of the technology today, are we going
5 to get 10 percent or more of the benefits?

6 And the third is, what about the
7 cost? There is human cost, the cost of
8 digging trenches, wiring posts, the cost of
9 training new people. There is equipment cost,
10 and then, there is spectrum cost.

11 And are these costs incentive-
12 compatible with all the stakeholders? If we
13 look at the evolution between ATN and IP,
14 between 1X and LTE, we see that, as is on the
15 next slide, whoever gets into this cycle will
16 succeed in technology transition.

17 And this cycle says that we are
18 going to make sure that the industry
19 stakeholders realize that there is incentive
20 certainty, and that there is a clear expectant
21 return on their investment. And then, they
22 will be willing to create a large market.

1 They will be willing to put their foot into
2 this arena.

3 And then, the vendors, some of us
4 sharing this panel, they will say, all right,
5 then we will be willing to ramp-up our
6 production. As the production volume
7 increases, the costs to consumers usually
8 drops substantially. And then, you have a
9 wide adoption because it is affordable enough.
10 And then, as the market increases, we keep
11 looping in a good way. Whoever cannot get
12 into this harmonization and scaling effect is
13 going to find it very hard to transition.

14 So, if you look at LTE today,
15 which is the focus of my 10 minutes, it is
16 great for many reasons; for example,
17 efficiency in using the spectrum measured in
18 bits per second per hertz. Thanks to hard
19 work by people in signal processing, in
20 communication theory, we have a much higher
21 speed, in part because of better efficiency.
22 It is IP-based architecture and, therefore, it

1 is a simpler one and less latency observed.
2 It is also much better than the first three
3 generations of wireless cellular standard in
4 putting a worldwide ecosystem into a
5 harmonized standard.

6 Now what about many other
7 possibilities? Henning asked me two
8 particular questions. One is, what about
9 fixed wireless through LTD? This is a very
10 challenging problem, and I think a lot more
11 experiments need to be done before we know
12 exactly what will happen. For example, in a
13 rural area, coverage is the challenge;
14 whereas, in urban dense areas, the terrain is
15 the challenge.

16 What about copper? And I do
17 believe that with technologies such as
18 vectoring and phantom mode, dilimit spectrum
19 management, copper has this potential to be an
20 expansive way to help with the backhaul
21 challenge of small cell. And I will come to
22 small cell in a minute.

1 What I would like to focus the
2 next six minutes is on the tomorrow of LTE.
3 Now, obviously, there will be many advances,
4 as has been planned, including carrier
5 aggregation through LTE Advanced, Voice Over
6 LTE, including turning from capacity-focused
7 orientation to more on coverage enhancement
8 through technologies such as SON, self-
9 optimized network.

10 But the biggest challenge there, I
11 think, is the supply/demand match, the grand
12 challenge of 1000X over the next 10 years.
13 And where did that come from? Well, if you
14 double the demand every year, then 10 years
15 later, that is a 1,000 factor. That is the
16 beauty of compound interest.

17 Then, there is also the challenge
18 and opportunities on the consumer experience
19 side. For example, creating new services,
20 such as M2M, including mobile M2M, such as
21 vehicular services. And over there, it is not
22 just about the data plane, but also the

1 control plane, the signaling complexity.

2 So, data plane/control plane
3 differentiation can be easily understood by a
4 simple analogy. At the airport control tower,
5 the control plane can be email, it can be
6 phone call, right? This flight, you can take
7 off now. The actual data plane in that case
8 are the airplanes themselves. And these two
9 are vastly different technologies in that
10 case. In this case, the technologies might be
11 similar, but control plane optimization
12 remains an understudied area.

13 And then, there is the consumer
14 quality of experience, okay, what I call from
15 smartphones to smart data. And I will show
16 you in the next five minutes how the
17 supply/demand match really tie into consumer
18 quality of experience.

19 Well, first of all, on the supply
20 side of capacity, I will say the trends are
21 smaller, denser, and wilder. So, smaller
22 means that the cell sizes are getting smaller.

1 And that introduced a lot of interesting
2 issues, including densification.

3 And some people say that we may
4 have even more base stations than phones or an
5 equal number of base stations as phones in the
6 future. And that introduces a lot of
7 challenges of the interference issue at air
8 interface, of the backhauling issues, and of
9 mobility control.

10 And related to that is what I call
11 coexistence of heterogenous network
12 technologies in a wireless area, what I call
13 the wilder side. If you look at this chart
14 here, there are at least three very different
15 columns: the unlicensed one, wifi; the
16 licensed and planned deployment with a core
17 network that is in charge of all the netware
18 management, all the control plane, and then,
19 the licensed but unplanned or underplanned
20 deployment, such as more cell. The
21 coexistence of these present very interesting
22 opportunities for consumers and carriers.

1 Now on the other side of the
2 equation is demand. I believe this is the
3 time to start looking seriously at smart data
4 pricing. In other words, the future of
5 cellular, in my mind, is not just about faster
6 and stronger and wider, but also smarter.

7 By smarter, I mean that, if we
8 look at tiered sharing and reuse, as in the
9 PCAST recommendation last year, as in some of
10 the FCC initiatives coming out, smart data
11 pricing is like application-layer-driven and
12 user-driven tiered sharing and reuse. And
13 thus, a lot of people, when they think about
14 5G, they think about user experience; they
15 think about personalization; they think about
16 application economics; they think about
17 bridging the divide between the pipe-owner and
18 the content-owner.

19 And, indeed, we already have
20 deployed a system coming from research, funded
21 in part by tax dollars, and taking that into
22 creating new technologies that are being

1 tested, for example, by our partner, MTA, a
2 rural Alaskan operator, in rolling out a trial
3 that just started March 1st, in order to
4 bridge the digital divide through smart data
5 pricing in that part of the country.

6 And this is driven by what I call
7 Jobs' inequality of capacity. As a professor,
8 I have to write one equation during each talk.

9 (Laughter.)

10 So, this is the equation: the
11 sense that on the lefthand side the gradient
12 or the rate of growth of demand for wireless
13 capacity is much, much bigger than on the
14 righthand side the gradient or the growth rate
15 of supply per dollar of investment. And that
16 is thanks to Mr. Steve Jobs, starting with
17 2007. I think people now realize that the two
18 sides of the equation are no longer in the
19 original order. Now the left is much bigger
20 than the right.

21 And all the driving factors are
22 here to say, from mobile video to Cloud to

1 data-hungry apps, to high-resolution devices.
2 And if you are a restaurant owner and a
3 customer keeps coming back to your buffet,
4 doubling the appetite every month, at some
5 point you say, "I am going to charge you a la
6 carte."

7 But, then, a smart restaurant
8 would say, how about happy hour, right?
9 Because I provision my capacity based on the
10 peak-hour demand, but I can never exactly
11 satisfy that, assuming this is a very popular
12 restaurant. Then, during the afternoon time,
13 nobody is here or very few people are here.
14 So, why not create the incentive to use that
15 time?

16 And that is the spirit behind
17 smart data pricing. If you look at this chart
18 on top, this is actually empirical data we
19 collected from a concluded trial with
20 Princeton students and staff last year and
21 reported a ACM CCOM paper last year. The peak
22 average discrepancy is very, very big, often

1 a factor of two or three, but not all is lost.

2 If you look at the lower chart
3 down there, you will see that on the X-axis,
4 it is the time axis; it is the delay
5 tolerance. Some of the applications can
6 tolerate seconds of delay; others can tolerate
7 minutes, and others can tolerate hours of
8 delay.

9 As the heterogeneity of consumer
10 experience widens, it is time to think hard
11 about what can we do with that heterogeneity.
12 And that is what we tried -- and I will be
13 wrapping up in two minutes -- at the Princeton
14 trial last year, trying time-shifting.
15 Skipping the details of all the research and
16 hard work in deploying this, what we saw are
17 two big numbers. One is that the peak-average
18 ratio dropped by 30 percent, and the other is
19 that the total overall usage on a weekly
20 average basis increased about 130 percent.
21 That means that the carrier's cost can be
22 reduced and revenue can be increased.

1 And the magic can be visualized in
2 this interesting picture, what I call "flashy
3 white space". It is not the white space that
4 FCC has been talking about, but the white
5 space like what you see with fireflies at 8:00
6 p.m. in, say -- I come from New Jersey -- in
7 a suburb New Jersey home. Okay? You see them
8 and, then, you don't see them. You see them;
9 you don't see them.

10 Over here, even on a busy street
11 corner during rush hour, you can still see
12 sometimes certain frequency time bins who have
13 live usage indicated by white or light blue
14 over there. And today, they are wasted, and
15 they shouldn't have to be wasted like that.

16 And indeed, I think this is the
17 paradigm shift I would like to highlight. We
18 should start just counting bites and start
19 living with quality of experience. We should
20 recognize and further leverage the
21 heterogeneity of applications and of network
22 conditions to create a win/win/win. Consumers

1 have more choices at lower cost per gigabyte.
2 Carriers have lower cost and higher revenue.
3 And content app providers have more engaged
4 eyeballs.

5 And how do we innovate there? I
6 would say that, in addition to all the focus
7 on physical layer, we should also look at
8 application layer. In addition to managing
9 wireless network from the core, we should also
10 look at the end-user device as a network
11 management tool.

12 And I will conclude with a
13 commercial, so that this is a complete
14 presentation. This is the advertisement of a
15 free IOS and Android app developed from my
16 lab, Princeton lab, called DataWiz. It is one
17 of the many apps out there that can help to
18 educate and empower consumers, what I call
19 network management by the user, of the user,
20 and for the users.

21 My time is running out, and I
22 think the commercial should stop. So, let me

1 stop right here, and that will be my contact
2 at the last slide.

3 Thank you very much.

4 MR. SCHULZRINNE: Thank you, Mung.

5 Let's move right along with Dina,
6 so that we can get back on schedule.

7 MS. KATABI: Okay. Good morning,
8 everyone.

9 My name is Dina Katabi.

10 The question that I would like to
11 start my presentation with is, can wireless
12 technology replace wireline broadband in
13 general and particularly in rural areas? So,
14 of course, this question is very hard to
15 answer. So, what we are looking for here is
16 not just an answer that is yes or no. We are
17 looking into more insights.

18 So, perhaps what is
19 technologically accurate is to say that,
20 technologically, we can deliver very high
21 capacity to communities that don't have
22 wireline connectivity. So, we can deliver

1 this with wireless, but there are caveats.

2 So, it doesn't mean that we can
3 deliver it to any communities. It means that
4 what we are looking for now over the next few
5 years is pushing the boundaries. It is like,
6 okay, so it is the difference between the guy
7 that is one person in the middle of nowhere
8 versus communities that have on the edges some
9 form of suburbs. So, keep pushing these
10 communities further and further to be able to
11 develop very-high-capacity wireless to them
12 without wireline connectivity.

13 The second caveat is that it is
14 not going to happen alone with 3G or 4G. We
15 really need to push further than that,
16 particularly as we have just seen that the
17 demands keep increasing exponentially. So,
18 just looking at 4G, actually, is not really
19 going to do it at all. So, we need really to
20 have more advanced technology and bring things
21 that are really way more aggressive in
22 exploiting the bandwidth that we have, and

1 acquiring more bandwidth for these services.

2 So, how can we do it? As I said,
3 there are two types of approaches. One, of
4 course, is to get the best of what we have,
5 get the best of the bandwidth that we have.
6 Can we get 10 times more data rate out of the
7 unit of spectrum that we have?

8 And there are many technologies
9 that have been developed over the last five
10 years that are very effective. I am just
11 mentioning a few here that have been developed
12 both in academia and research labs, like
13 interference alignment, distributed MIMO,
14 MegaMIMO, multicell MIMOs, 3D MIMO, all of
15 these technologies.

16 There are other approaches which,
17 as we push these boundaries, of course,
18 demands will keep increasing. So, we really
19 need to reach out to the FCC, also, to help by
20 repurposing some of the spectrum, hopefully,
21 and being able to use that spectrum very
22 efficiently, very dynamically, not just like,

1 okay, it is on the scale of a database that
2 changes on a very coarse scale, but having the
3 ability to dynamically immediately figure out,
4 okay, so there is a spectrum that is not used
5 in this particular area. Can I immediately
6 detect it and use it?

7 So, let me go over these two
8 things at the high level. So, the first
9 thing, how can we get more out of the spectrum
10 that we have? As I said, there are multiple
11 technologies. I am just going to give you one
12 single example of things that people are
13 looking at now.

14 So, if you are looking at a rural
15 community -- so let's go to the case where
16 that community doesn't have any wired
17 connectivity, but it is on the borders of some
18 other community that may have installation of
19 wireline.

20 So, today this community is
21 sitting at the edges, at the cell edge. So,
22 it is suffering. It is suffering because you

1 have these macro-cells that are very large, on
2 the order of, oh, we are talking are, 5
3 kilometers to 10 kilometers, even more. So,
4 the capacity there of that user is very low.

5 In addition to that, there are
6 interferences at the cell edge from
7 potentially other cells around. So, today
8 these users are going to be very unhappy.
9 They are not going to be able to get the
10 Netflix at home, as they are planning.

11 However, we can turn the equation
12 all the way around. You can say, okay, why
13 not having all of these towers around them
14 that are far away, so each one of them has
15 very poor connectivity to these guys, but if
16 they cooperate together, together they can
17 actually deliver much higher rates and
18 capacity to these guys.

19 And perhaps many of you guys have
20 heard the term MIMO and know what MIMO is.
21 But imagine MIMO, typically, we talk about
22 MIMO as like you have one base station and you

1 have multiple antennas on it or you have one
2 device and you have multiple antennas on it.
3 But imagine that you can have distributed
4 MIMO. Imagine that you can coordinate your
5 towers together, so that they act a humongous
6 MIMO node.

7 We know that if you can take a
8 single base station and you can double the
9 number of antennas on it, then you kind of
10 double the swoop or double the capacity. Now
11 if you can take and coordinate a large number
12 of distributed towers, then you can get a
13 humongous MIMO node that has all of these
14 antennas together. And these are some of the
15 ideas that are now possible nowadays.

16 So, for example, you can take all
17 of these towers, as I said, and coordinate
18 them in a technology called MegaMIMO or
19 distributed MIMO. If you can coordinate 10
20 such base stations, then you can get the sum
21 of all of their antennas. So, you get 10
22 times higher gains in your capacity.

1 So, these are actually not just
2 pure theory. There are implementations. Of
3 course, there are not implementations in the
4 lines in the field, but there are in the lab,
5 and they work. So, here you can see a picture
6 of 10 coordinated software radios, each acting
7 as a base station, and here are the results.

8 So, you can see the difference
9 between current technologies and what I call
10 here a MegaMIMO technology, which is this
11 coordination of distributed MIMO. And we can
12 get to 10 times as much data rate as we get
13 today. And these are actually 10 times data
14 rate, not just theoretical maximum, as
15 sometimes like LTE. Theoretical maximum is
16 great, but that doesn't mean that everyone
17 gets it.

18 So, what I talked about so far is
19 how can we get much more out of the spectrum
20 that we have. But there is more. We are
21 really looking for, hoping for the FCC that
22 the next stage is going to also include

1 repurposing some of the spectrum. And in that
2 case, you really want to have dynamic sharing.
3 You want to push dynamic sharing to the
4 maximum, as I said, and immediately recognize
5 that some spectrum is not used and be able to
6 use it.

7 Now the problem, actually, today
8 it is very hard to look at the spectrum, at a
9 big chunk of spectrum, what looks like on the
10 order of gigahertz or hundreds of megahertz,
11 and immediately be able to tell what is used
12 and what is not used.

13 So, today with the way you do
14 spectrum maps, it is that you sequentially hop
15 from like tens of megahertz to the next tens
16 of megahertz. Because you are hopping and
17 like sequentially trying to detect what is
18 happening in the spectrum, it is very easy to
19 miss a radar signal or fleeting signals.

20 But if we have the technology to
21 be able in real-time to see a wide spectrum,
22 then we wouldn't miss it. But this is not

1 because we really have no ability to do this.

2 We do have the ability to do this.

3 So, this picture actually is from
4 Seattle, showing that the spectrum is very
5 highly underutilized. This is the Seattle
6 urban area. This is from 2013, so recent,
7 from the Microsoft observatory.

8 Because the spectrum is very
9 sparsely utilized, actually, you can use
10 something called sparse recovery theory, which
11 is I am sure many of you have heard something
12 called compressive sensing. So, sparse
13 recovery compressive sensing, all of these
14 very new ideas are making a difference in the
15 way we can access a very large chunk of
16 spectrum.

17 One particular member of the
18 family of sparse recovery is a new algorithm
19 called the Sparse Fourier Transform, or Sparse
20 FFT. And what is cool about Sparse FFT is
21 that you can acquire a very large spectrum.
22 You can acquire it by subsampling. Because

1 you are subsampling, you can use low-speed
2 ADCs. So, it is going to be fast and cheap,
3 and it is going to be also low power.

4 So, we went ahead and used these
5 new, very new, actually, technologies. This
6 from 2012. And we used it with software
7 radios. We used three software radios to
8 build a gigahertz device that can capture the
9 spectrum.

10 So, imagine three software radios.
11 Each one of them has only 50 megahertz. So,
12 a total of 150 megahertz. We can get the
13 device that can acquire a spectrum of this
14 size of 1 gigahertz, so six times larger than
15 the sum of the additional bandwidths of all
16 the software radios' components.

17 And with this, we actually used
18 this. This is not like just, again, theory.
19 This is an actual device. We used it to
20 acquire 1 gigahertz in the Cambridge area, and
21 this is how the spectrum looked around MIT.
22 This also varies, then, between 2 gigahertz

1 and 3 gigahertz.

2 Actually, I have run out of time.
3 But I am just going to take the last minute to
4 tell you, yes, that really it is all about
5 pushing the boundaries. While this has very
6 big potential to deliver very high capacities
7 to a variety of communities, but we really
8 need to be open. We need to push for new
9 technologies, not simple evolution of the
10 existing technologies. And we, of course,
11 need pilots of these new technologies.

12 Thank you.

13 MR. SCHULZRINNE: Thank you, Dina.

14 David, do you want to transition
15 to --

16 MR. RUSSELL: If you could bring
17 up the first slide, please?

18 Hi. My name is David Russell, and
19 I am with Calix. And I am going to be talking
20 today about wireline networks, particularly
21 non-HFC cable networks.

22 Our perspective is on this

1 technology transition that during the next few
2 years the user experience is going to define
3 what happens on the edge. And that user
4 experience, as you all know, is characterized
5 by internet content, particularly video
6 content, and that that will drive the
7 technology-adoption curve.

8 If you look at the technologies
9 that a wireline carrier can use today in
10 meeting consumer demand, there are three
11 technologies: ADSL/2/2+, VDSL2, and fiber to
12 the home.

13 During the next decade, VDSL2 is
14 going to act as a key transition technology to
15 the destination network. And that destination
16 network is characterized by all operators as
17 fiber to the home.

18 VDSL2 is critical because it
19 allows operators to roll out networks that are
20 all IP-based, to put fiber deeper into the
21 network, and to meet the consumer demands of
22 this decade, but not future decades. In those

1 future decades, the capacities of the copper
2 network will be exceeded. So, it is a very
3 good transition technology.

4 Now, if you think about what is
5 driving this bandwidth consumption -- and the
6 first two speakers have spoken about that
7 bandwidth consumption -- we have three factors
8 going on. Not only do we have applications
9 that are driving that, we have demographics,
10 in that we have people that are not heavy
11 internet users passing away, and they are
12 being replaced by very heavy internet users.
13 So, even if we had no net increase in the
14 amount of bandwidth being consumed by the
15 applications, just demographics would drive
16 tremendous growth in bandwidth consumption.

17 And then, finally, as all of you
18 know in your homes, if you start to figure out
19 how many IP devices you have in your home, the
20 number in your home has exploded over the last
21 few years, and all of those are consuming
22 bandwidth.

1 So, a few quick definitions.
2 ADSL2+ is the technology that is the most
3 widely deployed technology in the U.S. today,
4 DSL technology. The beauty of DSL technology
5 -- and this is its real strength -- is that,
6 unlike cable systems, DSL technology is
7 dedicated bandwidth to the end-user. So,
8 essentially, it can act as kind of a
9 guaranteed bandwidth to that end-user, unlike
10 a shared system. But ADSL2 is being replaced,
11 and there is a major upgrade process taking
12 place all across the United States today to
13 introduce VDSL2 throughout the U.S.

14 The third technology that is
15 important to know about is that both ADSL and
16 VDSL have the ability to add pairs, so to
17 increase the number of pairs, and we call that
18 bonding. That increases both the bandwidth as
19 well as the loop length that you can deliver
20 that bandwidth.

21 The fourth key technology is
22 vectoring, and vectoring gives you the ability

1 -- and this is a VDSL2-only technology --
2 gives you the ability to use signal processing
3 to lower the noise on the loop and, thereby,
4 increase the bandwidth over that loop.

5 And then, finally, the last
6 technology -- and this is in contrast to VDSL2
7 -- which is called fiber to the node, fiber to
8 the home, which can be either a passive
9 optical network or a point-to-point gigabit
10 ethernet network. Fiber to the node, as I
11 said, VDSL2 can act as a transition technology
12 to that destination network, which is fiber to
13 the home.

14 Now the rest of the talk, I will
15 focus on VDSL2, since that is our transition
16 technology here. But VDSL2 is very
17 interesting technology, in that when it was
18 developed, they decided to focus on different
19 profiles. Those profiles are specifically
20 designed to adapt to the specific situation
21 that the technology finds itself in. So, you
22 can customize that VDSL2, provision it, on the

1 same footprint to wherever that technology is
2 deployed.

3 All of the profiles give you,
4 theoretically, the ability to get 90 or 100
5 megabits in the downstream, but they are
6 optimized depending on where they are in the
7 network. Now that would be a theoretical
8 application of the technology. If you were to
9 deploy ADSL2+ and VDSL2 in that theoretical
10 network, these are the kinds of bandwidths you
11 could expect without any noise disturbers.

12 And you can see that VDSL2 is
13 optimized for short loop lengths. And when
14 you add a second pair, you can not only get
15 slightly higher bandwidth, but you can also
16 extend to a longer loop the bandwidths over
17 that VDSL2.

18 However, as the loop lengths
19 lengthen, VDSL2's performance actually becomes
20 less than ADSL2+. And for that reason, all
21 VDSL2 systems that are deployed have an
22 automatic fallback to ADSL2+, which they can

1 use when those loop lengths or the noise in
2 the system gets too high.

3 Now the problem is that I have
4 been talking theoreticals and lab kind of
5 results. But these networks have to exist in
6 the real world, and in the real world all
7 loops have noise. And so, the VDSL2 case, you
8 can see that actual real results, VDSL2 is
9 probably going to operate at about 60 percent
10 of the theoretical maximums that I showed in
11 the previous slide. So, instead of 90
12 megabits at a short distance, you will maybe
13 get 40 megabits.

14 In my neighborhood in Minneapolis,
15 Century Link is delivering 40 megabits to my
16 home, but I am only 300 feet from the cabinet.
17 So, if you were further from the cabinet, you
18 would only be able to get maybe 20 megabits.

19 However, I talked earlier about
20 the technology called vectoring. What
21 vectoring allows you to do is actually bring
22 those bandwidths up closer to the theoretical

1 rates that we saw on the lab. But vectoring
2 has some limitations. One of the limitations
3 of vectoring is that, if you put vectoring
4 over a binder that already has ADSL2+ on it,
5 the performance of the VDSL2 in vectoring will
6 decline and become closer to what you see in
7 a non-vectored VDSL2 network.

8 So, when outside plan engineers
9 design these networks and configure the
10 bandwidths that they are going to be able to
11 deliver, they have to take into account all
12 the things that are already on that binder.

13 Now in a green-field situation,
14 they are not going to already have traffic.
15 So, they can deploy a VDSL2 vector to
16 everybody in that area. But in an existing
17 neighborhood, they have to take into account
18 all the existing traffic in that area.

19 So, in a green field we have a
20 situation where VDSL2 can probably perform
21 very close to the theoretical goals with the
22 implementation of vectoring. However, many of

1 these same areas are the ones that operators
2 would choose to deploy fiber to the home in.
3 So, that may limit the overall choice of VDSL2
4 in that areas.

5 A more likely deployment area
6 would be brown fields. And in this brown
7 fields, the goal would be to use VDSL2 with
8 vectoring for areas maybe between 1 and 3
9 thousand feet, and then to use VDSL2 without
10 vectoring between 3,000 feet to 9,000 feet.

11 Another thing you will see is that
12 operators will increasingly use fiber to get
13 to nodes to get them within 3,000 feet, and
14 that allows them to optimize the VDSL2 and to
15 prepare for their eventual migration to fiber
16 to the home.

17 So, in summary, these VDSL2
18 capabilities allow the network operator to
19 utilize this technology as a transition, but
20 it comes with a number of limitations that
21 they have to engineer around.

22 Now I would like to just close

1 with two slides. The first slide is kind of
2 a theoretical look at what the optimal
3 technologies are as we proceed through this
4 transition phase.

5 And in this case, we have green
6 fields and we have brown fields. You will see
7 that VDSL2 with vectoring is a very good
8 choice along with fiber to the home to urban
9 and suburban areas, where you have very short
10 loop lengths. Once you get out to more rural
11 areas, that is where the fiber to the home
12 becomes the strong candidate. And then, when
13 you get to extremely low-density areas, you
14 shift to wireless and satellite.

15 In a brown field, VDSL2 probably
16 without vectoring because of existing traffic
17 becomes probably the better choice. And then,
18 when we get to those remote areas, ADSL2+
19 because of the long loop lengths.

20 I wanted to give you one last
21 shot, and I decided to do this, knowing I was
22 coming here, when I was flying into

1 Minneapolis recently. I wanted to show you a
2 real-world example of what an exchange might
3 look like.

4 And so, this is taken from a
5 plane. This would be an example of a rural
6 exchange area. In the small town you see
7 there, which maybe is a town of about 2 or 3
8 thousand people, you will see the area that we
9 can serve with VDSL2. And many of the
10 operators do this. In town they will use the
11 VDSL2, and then they will create a concentric
12 circle around the town which will all be fiber
13 to the home because of the loop lengths.

14 And then, when they get out to the
15 really sparsely-populated areas, less than 10
16 folks per square mile, then you get into the
17 areas where a fixed wireless or satellite
18 would be the ideal.

19 So, I just thought that would give
20 you kind of a visual image of the concepts we
21 are talking about.

22 MR. SCHULZRINNE: Thank you,

1 David.

2 David No. 2?

3 MR. ECKARD: All right. Good
4 morning.

5 I am honored to be here. My name
6 is David Eckard. I am the CTO for fixed
7 networks for Alcatel-Lucent.

8 Well, if you look around the
9 world, governments view broadbands as a
10 necessity. It is a requirement. It is the
11 lifeblood of the 21st century of the
12 Information Age. And while many of these
13 broadband initiatives are not about high
14 speed, a lot of these initiatives are actually
15 about coverage.

16 And the reason why they are doing
17 this is actually to address certain needs of
18 their governments or their countries: job
19 creation, helping close digital divide,
20 location independence of their workers, and
21 productivity.

22 But what I want to spend some time

1 today is to talk about here in the United
2 States and looking at the challenges that our
3 Chairman has put in front of us, looking at
4 the first goal of 100 megabits to 100 million
5 homes and looking at the technologies to help
6 meet that challenge.

7 And so, today I am going to talk
8 about two topics. One is, can DSL meet the
9 needs of 100 megabits, very much what David
10 was talking about? And the other one is an
11 update of what type of services can an FTTH
12 network help enable.

13 So, the first question, can DSL
14 reach the 100-megabit? As talked about
15 earlier, yes, it can. VDSL2 is actually a
16 very fantastic technology. It was originally
17 standardized back in 2005, and the goal was
18 around 100 megabits per second. If you take
19 it to the lab, you can test it and, sure
20 enough, you will get 100 megabits.

21 This technology also has helped
22 transform the traditional telco operators into

1 becoming a provider of a triple-play services
2 for voice, video, and data.

3 But, as we take this technology
4 into the real world, we actually find that we
5 don't get the type of performance that has
6 been promised. If you look at the way the
7 copper is actually brought to the homes, they
8 are in binders and there are lots of copper
9 pairs there. Those copper pairs create
10 interference. What we find is we don't get
11 the full 100 megabits; we get closer to 40
12 megabits, as stated earlier.

13 Also, the performance is actually
14 not very predictable. Depending upon the
15 interference, you may get more; you may get
16 less.

17 Well, one technology that we have
18 been working on is vectoring. And vectoring
19 fixes this problem. You can think of it as
20 noise cancellation, noise-cancelling
21 headphones for DSL modems. We measure the
22 noise. We bias the signal coming from the

1 DSLAM, the receiver is able, actually, to
2 realize pretty much near optimal performances.
3 So, with vectoring, these lines act as if they
4 are in a perfect, noise-free lab environment
5 and you get the near-optimal results.

6 There is also a couple other
7 things to note about it as well. Whether it
8 is good lines with low crosstalk or with,
9 let's say, poor lines with a little bit more
10 crosstalk, they actually end up with the same
11 type of performance.

12 In addition to that, vectoring
13 also makes it more predictable in terms of
14 what type of performance the subscribers will
15 actually be able to receive.

16 And so, on this chart, we have
17 actually taken some readings from real-live
18 networks. This is actually in the lab as well
19 as in the field. As you can see, we are able
20 to achieve some very high performance. This
21 is, as I said, live networks.

22 And up to about 400 -- I am trying

1 to read the slides here -- but to around 400
2 meters is where we can get the 100 megabits.
3 But, as we go further and further, the
4 performance starts to drop off. So, in
5 addition to this, we need to actually utilize
6 bonding.

7 On the righthand side, we have
8 plotted out a chart that we believe is
9 representative of a North American FTTN type
10 of network and the type of coverage that can
11 be reached.

12 So, how do we get to 100 megabits?
13 Well, we need vectoring. We need the shorter
14 loops. And with that, we can get to about 28
15 to 30 percent of homes with just the vectoring
16 alone. If we want to go to 50, 56 to 60
17 percent, we will need to use bonding as well.

18 And again, this is technology that
19 is available today. We have been doing
20 multiple trials with over about 40 trials. We
21 have had a number of customers that we have
22 already been working with and have signed up

1 with. This is technology that is happening
2 today in 2013 to meet targets for 2020.

3 So, you can't count copper out for
4 meeting these needs or for meeting these
5 bandwidths, and it is an incremental upgrade
6 from a traditional FTTN node.

7 As you look at going deeper into
8 the network or going to achieve above the 60
9 percent, we will have to go a little further
10 with the smaller type of units. I have called
11 this a fiber to the distribution point, 48
12 ports or so. And that is how you can achieve
13 further coverage. But, beyond that, we will
14 actually have to go even deeper with these
15 nodes and get smaller and make the loops even
16 shorter.

17 Well, with that, we are actually
18 looking at technologies such as GFAST, and
19 this is being standardized in ITU as we speak.
20 This is to achieve around 500 megabits, but on
21 very, very short loops.

22 But by pushing these nodes deeper

1 and deeper into the network, there will be new
2 challenges that we actually will be facing.
3 There will be increased CAPEX. We will have
4 to figure out how we are going to power these
5 nodes. And we will also have to worry about
6 the management of these nodes deep in the
7 network.

8 So, to go even further than the
9 100 megabits per second, the obvious question
10 is, why not fiber? Fiber offers a significant
11 number of benefits. There is reduction in the
12 optics and maintenance. It also allows you to
13 move bandwidth between subscribers, so
14 differentiated bandwidth.

15 Longevity. Unless a backhoe or a
16 bulldozer attacks a fiber plant, it is going
17 to be there for a very long time.

18 And the one thing I would like to
19 talk about next is the ability to actually
20 overlay multiple networks on the same FTTH
21 network.

22 So, GPON is one of the fiber-to-

1 the-home technologies that is being deployed
2 around the world, including here in the United
3 States. Just a little bit of background about
4 GPON. It is 2.4 gig down, 1.2 gig up. And
5 typically, anywhere from 16, 32, 64 users on
6 one PON.

7 And those operators who have
8 actually deployed a residential network, they
9 do spend money on deploying this type of
10 network, but they are offering, they are able
11 to offer triple-play services. As they pass
12 by the homes, they are actually picking not
13 just one or two, but all these three services
14 up, and they are actually keeping their
15 customers on their network. They are
16 retaining those customers.

17 But, as they deploy this fiber-to-
18 the-home network, they pass businesses and
19 they may want to offer a wireless backhaul.
20 As mentioned before, it is possible that the
21 number of base stations would exceed the
22 number of subscribers. So, there is an

1 opportunity here that, if operators need to
2 have even more high-speed data, the services
3 may be symmetric and they may not want to
4 actually mix the actual residential and
5 commercial traffic on the same layer two
6 network. There are a couple of choices that
7 we have.

8 The first choice is to actually
9 pull more fiber, which, again, is additional
10 CAPEX and the civil cost of, the civil
11 investment of pulling the fiber.

12 And the other option is to
13 actually use the same fiber plant, but to
14 actually start using different colors. I
15 don't usually say it that way.

16 And so, between GPON, we actually
17 create a protocol called XG-PON. XG-PON was
18 a protocol, 10 gigabits down, 2.5 gigabits up.
19 It was more splits and more optical budget.
20 And the benefit of XG-PON was that you could
21 actually take a GPON network today, you could
22 actually overlay it on top of it, and both

1 networks would actually operate independent of
2 one another.

3 And you can go to YouTube. Some
4 of our customers have actually done this
5 coexistence and have demonstrated this. So,
6 we have shown that this is actually very
7 possible and is actually the right way to go
8 forward.

9 Now in ITU today, instead of just
10 having GPON and XG-PON, we are actually now
11 creating another protocol called TWDM-PON.
12 And now, we are actually using more and more
13 colors of light to actually turn on or to
14 enable multiple networks. So, now on the same
15 fiber-to-the-home plant, you actually can have
16 a residential network; you can actually have
17 a business network, and you can actually have
18 a small cell network as well.

19 Now we talk about technical
20 challenges. There are also other issues,
21 other challenges that we have, too,
22 organizational and operational challenges

1 within the operators themselves of how this
2 will actually come to pass. But this is
3 technology that is being developed today and
4 is being made available very soon.

5 So, to recap, DSL is very much
6 capable of providing the 100-megabits
7 sustained bandwidth to subscribers with an
8 FTTN type of architecture, using vectoring,
9 using bonding. And fiber, I think it is clear
10 that it will meet the bandwidth needs for the
11 2020 broadband plan. But, to help hasten the
12 return on investment for that type of network,
13 it is wise to actually start putting different
14 types of services on that same plant and
15 enabling operators to generate more revenue.

16 Thank you.

17 MR. SCHULZRINNE: Thank you.

18 And we will proceed to the final
19 presentation from Ralph Brown of CableLabs.

20 MR. RALPH BROWN: Thank you very
21 much, Henning. Thank you for inviting me
22 today.

1 I am Ralph Brown. I am the CTO of
2 CableLabs. For those of you who might not
3 know us very well, we are a nonprofit research
4 and development organization that works for
5 the cable industry. We were formulated under
6 the 1984 National Cooperative Research and
7 Procurement Act. If you have high-speed
8 broadband, digital voice, or digital video
9 services from a cable provider, you are using
10 technology that was developed through
11 CableLabs.

12 So, I thought I would start with a
13 little bit of an overview of hybrid-fiber coax
14 networks. This is a very abstract diagram,
15 but it shows you the general components of a
16 hybrid-fiber coax network.

17 First, there is a metropolitan
18 transport ring that originates signals at the
19 head end and distributes them over the
20 transport ring to numerous distribution hubs.
21 Going out from the distribution hubs are fiber
22 networks that go optical to electrical nodes.

1 Those nodes serve somewhere between 125 to 500
2 homes passed in a residential neighborhood.
3 And then, you can see that downstream of that
4 optical node are multiple amplifiers, trunk
5 amplifiers and line amplifiers, that amplify
6 the signal to carry it over the coax
7 throughout the network in the neighborhood.

8 I have also highlighted some small
9 businesses that often are in more residential
10 neighborhoods. These businesses can be served
11 with the hybrid-fiber coax networks using
12 DOCSIS technology for high-speed broadband.

13 In addition, many of our operators
14 are serving enterprise companies in the
15 business parks and other areas where they are
16 directly taking fiber to those, because,
17 traditionally, those areas haven't been wired
18 for hybrid-fiber coax networks. And so, it is
19 a bit of a green-field opportunity, and the
20 fiber capacity to those enterprises is
21 something that is used.

22 In addition, more recently, many

1 of our operators are deploying public wifi
2 access points to further enhance the broadband
3 service, adding a mobility component to the
4 broadband service they get at home. So, when
5 they are out going about their day, they have
6 the opportunity to take advantage of their
7 broadband connectivity provided through their
8 cable operator.

9 So, the hybrid-fiber coax network
10 was really designed to be a network for
11 growth. There were many fibers that were put
12 in place in those runs from the distribution
13 hub to the nodes, so those nodes could be
14 further segmented and additional services
15 could be added.

16 So, in the past 20 years, you have
17 seen the industry transition from a one-way
18 analog television service to introduce digital
19 television services, both standard definition
20 and high definition; switch digital TV
21 services, so, for example, video on demand,
22 switch digital video, other kinds of video

1 services that are one-to-many or one-to-one.

2 We also have introduced broadband
3 internet access services that we have been
4 talking about a lot today, voice over IP
5 telephony services. Home security services
6 are being offered over this network and, as
7 well, managed IP cable services. For example,
8 your television services stream to your
9 connected IP devices in your home.

10 And as I mentioned earlier, our
11 members have deployed many public wifi access
12 points, over 120,000 to date, and that is
13 continuing to grow.

14 And then, cable operators have
15 also been providing business services, data
16 and voice services to small, medium, and
17 large-sized businesses.

18 But it is important to point out I
19 think many people look at their cable operator
20 and say, "My cable operator is just like all
21 the other cable operators. And so, the
22 services that I get are just like anybody

1 else's." But, actually, there is a great deal
2 of variability among the cable operators.
3 There are over 1100 cable operators in the
4 U.S.

5 And there are some key hybrid-
6 fiber coax characteristics that impact network
7 capacity that can vary. So, for example, the
8 spectrum that the coax network was designed
9 and built to, they are typically 750 to 860
10 megahertz, but, actually, they can vary from
11 as low as 450 megahertz for some of the
12 smaller systems to as much as a gigahertz.
13 So, there is a fair amount of spectrum
14 variability that you will see.

15 Node size is another important
16 factor, and that is the number of homes passed
17 that share the same view of a particular
18 spectrum. So, those are the homes that are
19 sharing that same spectrum. It is typically
20 less than 500 homes, households passed per
21 node, but it can be as high as a thousand.
22 And so, a factor of two there.

1 Then, the number of amplifiers
2 that are in the cascade from the optical
3 network can vary, can be as low as zero. So,
4 the optical node is the last active component
5 in the network and it is passive coax from
6 there. Or you could have as many as five to
7 six amplifiers in cascade. And those affect
8 the signal quality and the noise level that
9 the signal will experience. It can affect
10 some of the capacity.

11 So, each cable operator is going
12 to assess how to optimize the deployed HFC
13 network, whether they choose to segment nodes,
14 whether they choose to upgrade their network
15 to expand the frequency limits, or reduce or
16 eliminate analog channels, which are not
17 necessarily the most effective use of the
18 spectrum. So, you will see many cable
19 operators taking different approaches for how
20 to achieve some of these goals.

21 This is a bit of an eye chart from
22 here. But this is really to show you the

1 evolution of the DOCSIS technology. We are on
2 our fifth iteration today, and it is in design
3 and development as we speak, DOCSIS 3.1.

4 Don't ask me about our numbering conventions.
5 I think the only thing I have been able to
6 figure out is that odd numbers are allowed a
7 minor increment, and everything else has to go
8 by major increment.

9 This is just an example to show
10 you how the technology has evolved since the
11 late nineties in terms of the development of
12 DOCSIS 1.0 with the types of services. With
13 DOCSIS 1.0, we were looking at broadband
14 internet services. With DOCSIS 1.1, we
15 introduced voice over IP. With DOCSIS 2.0, we
16 introduced more robust and symmetric capacity.
17 With DOCSIS 3.0, we really expanded the
18 capacity of the network. And then, with
19 DOCSIS 3.1, we are going even further.

20 So, with DOCSIS 3.1, we are
21 introducing technology that will enable, at a
22 minimum, 1 gigabits per second in the

1 downstream, but that is a minimum. As we see
2 with DOCSIS 3.0, we had originally targeted
3 the minimum capacity to be four-bonded
4 channels similar to the bonding that we are
5 talking about, but in VDSL and ADSL, except
6 that it is in frequency, not in physical
7 copper.

8 And you are seeing technology
9 today that is bonding 8, 16, and shortly 24
10 downstream channels, and we are going beyond.
11 So, you are seeing that these set a minimum
12 and that the technology will exceed that.

13 So, what is new in DOCSIS 3.1?
14 Well, we are using more efficient modulation
15 and forward error correction. So, OFDM and
16 OFDMA in the upstream and LDPC low-density
17 parity checking achieves increased efficiency.

18 We are enabling new downstream and
19 upstream spectrum allocations. So, in
20 anticipation of opportunities to shift the
21 symmetry of the network, allow for more
22 upstream capacity, ability to anticipate a

1 passive coax network where we could take
2 advantage of even more spectrum, are all
3 planned in the 3.1 spec.

4 We are reusing all of the work we
5 have done in 3.0, or many of them, and that
6 allows bonding across not only 3.0 channels,
7 but 3.1 channels.

8 Further, it is also adding even
9 more energy-efficient operations by varying
10 the energy consumption with traffic load. It
11 is backward-compatible with earlier versions.
12 So, a DOCSIS 3.1 cable modem can be upgraded
13 before the head end and coexist with older
14 versions. So, cable operators can begin
15 seeding the market with 3.1 technology before
16 they have actually upgraded their head end.

17 And as Dr. Chiang had pointed out,
18 this issue of backward-compatibility is one
19 that is well-recognized by the cable industry,
20 and you will notice that with every generation
21 of DOCSIS we have supported the older versions
22 of the technology.

1 And the specifications for DOCSIS
2 3.1 will be issued later this year.

3 So, in summary, cable is investing
4 in delivering the best broadband experience
5 possible. We are not resting on our laurels
6 with DOCSIS 3.0. We are continuing to invest
7 in the next generation of technology and using
8 the latest in technology to scale to multi-
9 gigabit speeds.

10 MR. SCHULZRINNE: Thank you.
11 Thank you for your diverse perspectives on the
12 technologies ranging all the way from next
13 generation yet to be implemented, industrially
14 wireless, to more near-term opportunities in
15 regard between full hybrid-fiber coax.

16 I want to give in a few minutes an
17 opportunity for the panelists to maybe follow
18 up with questions, but let me start a little
19 bit by asking one question that was mentioned
20 earlier in introductory remarks; namely, to
21 talk about network resilience a little bit.

22 As was mentioned, we are now

1 increasingly relying on IP-based networks,
2 both for business operation as well as,
3 obviously, for basic functioning as individual
4 citizens, as well as for public safety
5 applications, No. 1, and coordination of
6 public safety response.

7 So, I was wondering if any of you
8 would like to comment on, as we develop these
9 technologies, what we are doing, what we can
10 do to ensure that these networks can survive
11 both kind the normal outages, people digging
12 up cables, and so on, as well as larger-scale
13 power disruptions, as was mentioned earlier by
14 Commissioner Rosenworcel.

15 I don't know who would like to
16 speak to that. I think it affects just about
17 everybody in one way or another.

18 David?

19 MR. ECKARD: I will go ahead and
20 take the first one.

21 With a PON network, there are a
22 couple of options that we have. There are

1 different types of protection modes that we
2 have actually standardized and actually have
3 implemented. So, there is one called Type B
4 and one is called Type C.

5 Type B is typically to protect the
6 feeder fiber, the first fiber from the central
7 office to the first splitter. And Type C is
8 actually to have a full mesh or full parallel
9 network, a PON network.

10 And so, with those types of
11 redundancy schemes, you can actually protect
12 against the backhoe cuts, and so forth. So,
13 we have in the PON now, we have addressed
14 this, addressed that, but there is additional
15 cost to make that happen.

16 MR. SCHULZRINNE: Okay. Thank
17 you.

18 MR. RUSSELL: Yes, I was going to
19 say, with the VDSL2 technology I talked about
20 earlier, I didn't say it, but all of that is
21 network-powered. So, from a resiliency point
22 of view, that network should be as resilient

1 as what we see in today's network.

2 On the PON side, I wanted to add
3 one thing to David's comment. Pretty much all
4 the entities that deploy fiber to the home
5 today will always provide an eight-hour
6 battery backup at the customer premise. And
7 the greatest failure mode in these networks is
8 actually voltage differentials during
9 lightning storms. So, you know, I think
10 everybody here has experienced that most of
11 the time when you lose your power, it is
12 during lightning and thunderstorms.

13 So, we do provide an eight-hour
14 battery backup to essentially get people
15 through those most likely scenarios when their
16 power, and then their communications, might be
17 down. But that gives them eight hours until
18 the power comes back on.

19 MR. SCHULZRINNE: Okay. Just to
20 follow up on that, do you see opportunities?
21 I mean, most of the backup for eight hours
22 tends to be voice-only, at least for first-

1 generation systems. Do you see opportunities
2 for (a) maintaining backup power for more than
3 eight hours and for a full-fledged network
4 connectivity within the home as well?

5 MR. RUSSELL: Well, all I can
6 speak to -- David can maybe add to this -- is
7 in systems that I am familiar with, they can
8 provision the data service to also stay up for
9 those eight hours. So, people that have PCs
10 with battery could continue to use their data.

11 MR. RALPH BROWN: Yes, I was going
12 to add that the voice-over-IP service by
13 cable, also battery backup in the home, eight
14 hours, but it is also recognized by the NFP as
15 being equivalent to TDM circuit technology as
16 well. So, it has passed that muster today.

17 And with respect to the question
18 about providing data services, it is the same
19 for cable in terms of provisioning what
20 services are available in a power-outage
21 scenario.

22 And I think there will be an

1 increasing focus on energy efficiency in CPE
2 equipment, so more energy efficiency in wifi
3 networks and energy efficiency in the access
4 network as well. So, I expect we will
5 continue to see that, which will prolong
6 battery life in the home.

7 MR. SCHULZRINNE: Okay. Thank
8 you.

9 I have one audience question,
10 which actually we have more coming that
11 address more the wireless side; namely, how do
12 you see the role on the wireless side of
13 cognitive radio, in particular? I think,
14 Dina, you mentioned it briefly indirectly, but
15 I wonder if you or, Mung, you want to dive a
16 little deeper.

17 MS. KATABI: So, how do we
18 perceive the world with respect to cognitive
19 radios? That is the question?

20 MR. SCHULZRINNE: For cognitive
21 radio and for spectrum efficiency, possibly
22 deployment costs as well.

1 MS. KATABI: Yes. So, I think
2 this is a very interesting question. I think
3 there are two things that are happening with
4 cognitive radios. One of them is,
5 traditionally, we think of cognitive radios
6 as, okay, if the spectrum is used, then you
7 avoid it and you look for holes in the
8 spectrum and you use these holes.

9 Now, again, there is like a
10 difference between the primary and the
11 secondary, and if you have things even beyond
12 the secondary. But, technologically, it is
13 possible, actually, to use even a spectrum
14 that is already used without impacting the
15 entity that is using that part of the spectrum
16 by using MIMO across technologies that are
17 different. So, that is technologically
18 possible.

19 So, we are going here even beyond
20 what traditionally people thought of cognitive
21 radios, that, okay, find the unused holes in
22 the spectrum and lock onto them. So, this is

1 one thing.

2 Now, of course, you want to be
3 probably more conservative if that part of the
4 spectrum is used by the primary. So, we are
5 talking here about multiple secondaries
6 sharing even a shared part of the spectrum.
7 So, this is one thing.

8 The other thing is to be able to
9 do that very, very efficiently, very fast.
10 So, again, imagine the difference between a
11 database where, okay, so I might update that
12 database every now and then, and I might think
13 that I have a service deployed in a particular
14 region or a particular area. But, I mean, in
15 the rain, it is a different propagation model
16 than when it is a sunny day. Sometimes the
17 signal reaches; sometimes it doesn't reach.

18 In particular, if we are not
19 talking about TVs, we are talking about
20 weather; we don't really know when they are
21 on, when they are not. So, really, the next
22 thing is to be able to do it very real time or

1 we are talking about on the order of like
2 microsecond to millisecond detection.

3 MR. SCHULZRINNE: Okay. Thank
4 you.

5 Do you want to comment briefly as
6 well?

7 MR. CHIANG: So, there are at
8 least two different parts to a cognitive
9 radio. Cognition here involves both sensing
10 and using. And I just want to complement what
11 Dina just talked about in terms of sensing and
12 talk just for one minute about using it.

13 Because I think it is very
14 important to say what application, what end-
15 user experience are you delivering, are you
16 promising, are you generating revenue from, by
17 using these holes in the spectrum? If you
18 cannot have a clear business case to say this
19 is the service that I am providing to the
20 consumers, then who is going to roll out the
21 service?

22 So, I think we have to be very

1 cognitive with respect to not just the
2 physical layer condition, but also to the
3 application that consumers demand today. What
4 can wait, for example? What cannot wait?
5 What requires a steady speed? What can
6 tolerate up-and-down swing in the speed,
7 possibly interruption in the middle if the
8 spectrum suddenly becomes unavailable to this
9 particular class of users? So, that using
10 dimension I think has been underexplored
11 relative to the sensing dimension, and it is
12 essential.

13 MR. SCHULZRINNE: Okay. Thank
14 you.

15 Julius, I think we had two other
16 audience questions that you might want to --

17 MR. KNAPP: Thanks, Henning.

18 This question was actually
19 directed to Ralph, but I would take the
20 opportunity to also extend it to the others.

21 The question was that David
22 Russell mentioned limits on the ability of

1 hybrid-fiber coax networks to offer service-
2 level guarantees. "Can you comment on the
3 ability of cable networks to offer dedicated
4 and service-level guarantee services,
5 particularly to business customers?"

6 And I would extend it to the other
7 speakers as well, knowing that there are often
8 variations in the level of service of things
9 like noise and distance, the things we have
10 heard about.

11 And, Ralph, if you could kick us
12 off, and maybe we will hear from some of the
13 others?

14 MR. RALPH BROWN: Yes. With
15 respect to service guarantees on hybrid-fiber
16 coax networks, with DOCSIS 1.1, we introduced
17 a concept called service flows. And service
18 flows can enable the classification of a
19 particular flow to have a certain class of
20 service, so that it can guarantee bandwidth
21 and access to the network. So, there is a
22 very rich set of media access controls

1 contained within DOCSIS that can guarantee
2 delivery to particular subscribers or
3 particular businesses. So, that is
4 technically possible and it is used for voice
5 over IP and it is used for a number of other
6 services that cable operators provide, and
7 particular to businesses that are looking for
8 those kinds of service-level agreements.

9 MR. ECKARD: I guess I would add
10 to that. I mean, with a cable network, I
11 think one of the issues is that with business
12 services that, as they become more and more
13 symmetric in nature and the bandwidth needed,
14 there is a challenge on the upstream path,
15 actually, to achieve a high bandwidth there.
16 So, that is definitely one issue. But, again,
17 that is something that can be remedied.

18 But from a VDSL side, you know, as
19 David mentioned earlier, it is sustained
20 bandwidth. It is a 40-megabit, 100-megabit.
21 It is locked-in.

22 On the FTTH networks, we have DBA

1 algorithms that can give the guaranteed
2 bandwidth, but can also adjust based on how
3 much traffic the whole PON is using and give
4 up or redistribute that bandwidth
5 appropriately.

6 MR. RUSSELL: Yes, one of the
7 issues that I have seen is, again, going back
8 to the user experience, particularly on
9 streaming video. I think the DOCSIS
10 parameters -- and I am not a DOCSIS expert --
11 but the DOCSIS parameters were largely set up
12 around kind of bursty data service. And when
13 you get consumers streaming multiple HD videos
14 over the internet, then you really test these
15 networks in terms of their ability to offer
16 these sustained bandwidths.

17 I think all of us who have been on
18 cable systems know that, when the kids get
19 home from school or at night, the system can
20 get congested. And the user experience of the
21 DSL tends to be better as long as they have
22 sufficient bandwidth. So, I think most of the

1 news reports and the surveys you see, cable's
2 and the FCC's own reports, the cable was rated
3 higher in performance than DSL, but those were
4 largely ADSL2+ networks or even ADSL. I think
5 when you compare VDSL2 to cable, you will
6 probably see superior performance on the VDSL2
7 from a user-experience perspective.

8 MR. SCHULZRINNE: Okay.

9 MR. KNAPP: I have a couple of
10 questions I think that are directed for Mung
11 and Dina. So, you got exempted from the last
12 round, but not this one.

13 (Laughter.)

14 So, this is from the audience.

15 "Can you talk more about expected capabilities
16 of 4G LTE and fixed wireless, especially in
17 rural areas that may have old DSL as the only
18 broadband option?" Their impression, from the
19 comments, was some skepticism about fixed
20 wireless as a solution for rural areas. And
21 maybe if each of you can comment on that?

22 MS. KATABI: Okay. So, thinking

1 about the existing technologies, like the 4G
2 and 3G, the problem with reaching to the rural
3 areas is that you actually are not talking
4 about the strength of these technologies where
5 you have the small cells and, yes, you can
6 have spectrum reused.

7 When we talk about, for example,
8 STE Advanced and all of these technologies,
9 what they tell you about, the maximum
10 theoretical capacity, which is like multiple
11 hundreds of megabits per second. But this is
12 all assuming that you have a small cell, very
13 few users, and really be able to deliver at
14 very high power to these users.

15 Now, if you are talking these like
16 very large cells, and then the power will go
17 down at the edges of these cells when you are
18 reaching, because it is big, it is going to
19 encompass more users because you are not going
20 to deploy these small cells.

21 So, of course, that in the current
22 format is going to basically depend. You are

1 not going to get the same performance that we
2 are used to. Of course, we are not even
3 getting that hundreds of megabits per second
4 even in the urban areas in these much smaller
5 cells just because we share.

6 So, we are taking a lot of hit
7 based on the tower and reaching much longer.
8 Now that said, there are multiple technologies
9 that are in the pipeline when people talk
10 about Release 12 and all of that stuff. So,
11 it will improve the situation, but I don't
12 think that alone is sufficient. We really
13 need to push the boundaries even further.

14 MR. SCHULZRINNE: I just wanted to
15 follow up on that because it also reflects a
16 question that was asked on a different card I
17 got; namely, "What would you see, particularly
18 in those rural areas that you mentioned that
19 we have been discussing, for the kinds of
20 multi-base-station MIMO, MegaMIMO, as you
21 called it?" Do you see a time horizon, given
22 that we have seen, at least in the 3G-PP

1 world, very long lead times between technology
2 development and actual standardization when we
3 are still rolling out Release 9, or so? We
4 are now on Release 12. But do you see that as
5 something which can be done within a matter of
6 years or are we looking at a decade or so?

7 MS. KATABI: It is interesting
8 because like, if you think about LTE, like
9 people started talking about, it depends how
10 you count. But it is like definitely on the
11 order of 10 years. So, we are talking about
12 an industry that has a humongous amount of
13 inertia and doesn't move that fast.

14 Now I think let me flip the
15 question and ask the FCC, can you guys provide
16 incentive for the industry to move faster?

17 MR. CHIANG: Well, I am going to
18 make it easy on you, Henning. I won't ask you
19 a question.

20 (Laughter.)

21 But let me just quickly address
22 it. I think, as an engineering professor, I

1 hate to say this, but I believe that
2 technology in the end is a beast of economics.
3 If there is enough capital injection, a lot of
4 things can be done. For example, rural area,
5 right, what we are talking about is, per
6 square foot of deployment cost, how many
7 customers are there?

8 So, in the end, you can have high-
9 end solutions that are expensive. So, the
10 question I think, back to just now, is that
11 usually when the new technology rolls out,
12 they first look at capacity rather than
13 coverage usually. But there is a tradeoff
14 between capacity and coverage. Capacity is
15 defined as the mean or median type of
16 throughput and the coverage as, say, 95
17 percentile coverage for a normal speed.

18 So, I will say that the industry
19 for LTE is steadily moving towards thinking
20 more about coverage rather than just capacity
21 enhancement, and that is moving along the
22 right direction. At some point, people would

1 say, "Here is the best configuration that can
2 provide the kind of rural wireless access with
3 a reasonable cost." So, I think the cost
4 equation is really a big part of this
5 discussion.

6 We do have the technology
7 capability. The question is, who is going to
8 be willing to pay for that if it stays at this
9 cost?

10 MR. SCHULZRINNE: This is a very
11 good segue into maybe a question I can ask
12 everyone; namely, do we have good knowledge
13 for the reasonable next few years both on the
14 initial investment -- and I am talking
15 primarily green field as well as brown field
16 in some cases, as you mentioned -- deployment
17 and the comparison of operational costs in the
18 field, because that increasingly, obviously,
19 is also a concern for copper networks?

20 Whether you have numbers or
21 whether you have seen studies or not, because,
22 like you said, this is all in the end a

1 question of how much are we willing to spend
2 both initially and on an ongoing basis for
3 different capabilities. I have to say I have
4 seen beyond just kind of graphs which were the
5 Y-axis is always conspicuously devoid of
6 numbers. I have not seen much.

7 (Laughter.)

8 So, if you have insights as to
9 what you have seen or what you tell your
10 customers, and what you see in terms of
11 inherently the advantages or disadvantages of
12 wireless coverage, which clearly also still
13 needs backhaul to base stations, where you
14 find that we can't quite avoid that, since I
15 don't suspect that microwave backhaul is going
16 to satisfy all of our needs, I wonder if you
17 can comment on that, as to what knowledge we
18 have, what knowledge we need to acquire. Any
19 of you?

20 MR. RUSSELL: Well, it is
21 interesting you ask that because later this
22 week I am moderating a panel on cost

1 optimization of fiber-to-the-home networks.

2 I solicited quite a few operators to
3 participate on that panel.

4 (Laughter.)

5 In the end, I got one person from
6 Verizon, but everybody else is from a vendor.

7 (Laughter.)

8 So, I would argue that might be a
9 good question for the third panel today.

10 But, as we all know, those are
11 cost figures that the operators don't easily
12 give up. I have seen some from operators
13 under NDAs. They generally seem to be
14 yielding the predicted results, but, again,
15 the operators have to reveal those. I know
16 you have requested them in the past.

17 MR. SCHULZRINNE: Would you
18 speculate at least on the division between
19 kind of a hardware side, what you produce, and
20 the actual cost, once again? There seem to be
21 three components; namely, the civil
22 engineering component, digging, stringing, the

1 OLT component, and the consumer equipment
2 component.

3 MR. RUSSELL: Well, I can tell you
4 that on my panel that OFC and FOEC this week
5 I have one hardware vendor and I have five
6 construction people.

7 (Laughter.)

8 MR. SCHULZRINNE: Is that roughly
9 the ratio?

10 MR. RUSSELL: And I think that is
11 about the right number.

12 (Laughter.)

13 MR. SCHULZRINNE: Anybody else
14 want to chime-in on this one?

15 MR. RALPH BROWN: Yes. I was
16 going to say that I think what you are seeing
17 across the panel is a rational investment that
18 makes sense, given the particular technologies
19 that are being deployed. It is continuing to
20 grow.

21 I think you see the competition
22 between the various providers attempting to

1 try to match or beat the services that are
2 being delivered. So, you are seeing a
3 rational progression of the market from that
4 perspective.

5 So, as you see in the cable
6 networks, this continued growth in the
7 capacity of the network and the capability of
8 the technologies over time, it has just
9 continued to advance.

10 MR. ECKARD: I would also add that
11 my customers are always asking about how they
12 can actually monitor more of their networks,
13 how they can actually lower the cost, and not
14 just do it on a reactive basis, but on a more
15 proactive basis and actually monitor what is
16 going on before the problem actually really
17 happens.

18 So, yes, our customers or my
19 customers are very interested in how they can
20 actually reduce a lot of their operational
21 expenses, but for sure for a fiber network,
22 the CAPEX part of it, the civil costs are

1 extremely a big chunk of it, as I showed in my
2 slides, as well as the CPE cost, there is
3 definitely a big challenge as well.

4 MR. CHIANG: I believe in the
5 potential of a sweet spot in this
6 cost/performance tradeoff. I believe in a
7 potential win/win there because I don't think
8 we are operating either wireless or wireline
9 yet at efficient frontier points yet. And it
10 is hard to operate an efficient frontier,
11 which is a concept in economics.

12 For example, your 401(k)
13 investment, you look at average return. You
14 also look at the variance of return. And that
15 average or the variance, you can't get the
16 best out of both. There is a tradeoff.

17 So, whenever we are not operating
18 at an efficient frontier, there is a potential
19 to create a win/win, to get a better variance,
20 a smaller variance, and a higher return at the
21 same time by moving from a less smart money
22 manager to a smarter one. Now I think that is

1 the potential here.

2 For example, as we see a diverse
3 set of different consumer experiences and
4 application needed from bursty ones to steady-
5 streaming ones, this reminds me of the pizza
6 experience with my 5-year-old daughter who
7 loves the cheesy center, and I turn out to
8 love the crispy crust. So, we are very
9 complementary.

10 (Laughter.)

11 So, there are spectrum usage
12 possibilities where you can have a better
13 usage for everyone, so that it becomes a
14 win/win. I think that will certainly
15 accelerate the transition possibilities.

16 MR. SCHULZRINNE: Okay. Jonathan,
17 did you want to add any questions?

18 MR. CHAMBERS: Just to follow on
19 this same discussion about the economics of
20 it, I think it was in a Calix presentation you
21 got a grid, at least for population, density,
22 as to when it makes sense. And so, just

1 again, to focus on the wireless component of
2 that or wireless and satellite, which is fewer
3 than, if I recall, it is fewer than 10 persons
4 per square mile, is how you have it, and at
5 least 2 to 10 for wireless, and then fewer
6 than 2 as satellite.

7 That is pretty sparse, right? It
8 would imply that you wouldn't see wireless as
9 a replacement for fixed-line networks except
10 in the most remote areas of the country in
11 terms of population.

12 And I wondered if, it doesn't
13 quite sound to me from what Dina and Mong are
14 saying that that is quite the way you see it,
15 and that maybe it is just a question of
16 complementary versus substitution. But I
17 wonder if you could speak to, as you have
18 looked at this, is it just in those most
19 remote areas or do you see the substitution
20 possibilities creeping into a little bit
21 greater density than 10 persons per square
22 mile?

1 MS. KATABI: So, again, there are
2 two components here. One of them is a
3 business case, and the other one is a
4 technology. I can't claim that I studied the
5 business case, but I can tell you that
6 technologically, yes, I can see it in areas
7 that are way more populated than this.

8 Effectively, like when you asked
9 about areas, so, again, there are the areas
10 that have very few people and very dispersed.
11 Most likely, these are going to go to
12 satellite. It is not even the broadband that
13 we are talking about.

14 Then, you get to areas that now it
15 is hard to provide them with the high capacity
16 because of the technology. But, as the
17 technology gets pushed, then, actually, you
18 can support a much larger number of people per
19 cell and add to high capacity that allows them
20 to watch Netflix and do the stuff that they
21 would do with the wireline.

22 And I think that line would be

1 pushed significantly if the technologies that
2 are known to research labs and academia make
3 it to the market. Now we can ask where is
4 exactly that line. It is like, how many
5 people per -- like what is the size of the
6 town that you are looking at or the community?
7 Those numbers, if you want the exact number,
8 then that has to be a business study.

9 MR. SCHULZRINNE: Okay. Sure, go
10 ahead.

11 MR. ECKARD: Could I add to that?
12 I mean, I think it can be somewhat a slippery
13 slope to say, at this number of density, this
14 is the right technology; this density is
15 another technology. You really have to look
16 at it not on a case-by-case basis, but to
17 really see the demographic, the way that
18 network is going to be built. And the
19 economics of it is what is critical. Make a
20 solid business case to make it happen.

21 I mean, if you look even at the
22 maps on the website, you can see a lot of

1 rural areas covered by fiber. So, it is
2 pretty interesting.

3 MR. CHAMBERS: Yes. Now I think
4 where AT&T, for example, and Verizon are
5 looking at wireless substitutions, they are
6 looking at where they have got LTE networks
7 built today, where they think they can
8 leverage those networks, where they have got
9 maybe older copper networks that they are
10 thinking of replacing. So, I recognize that,
11 but the grid wasn't my grid as far as
12 population density.

13 So, I would maybe bring it back
14 to --

15 MR. RUSSELL: Yes, well, you know,
16 obviously, there are lots of variables here.
17 I think my position on this is that, again,
18 going back to the user experience and the
19 economics, if you look at the next six years,
20 are you, as a rural subscriber, going to pay
21 \$300 a month, say, so you can stream Netflix?
22 I don't think so.

1 And so, the problem with the
2 wireless substitution is everybody talks about
3 the technology, this wonderful technology.
4 But, unless the pricing structures change, if
5 you are downloading 5 gig a night, I don't
6 think you are going to do it over a Verizon
7 LTE network in a rural area because they can't
8 deliver the bits for the price that would be
9 affordable to a rural subscriber.

10 So, we all have to keep in mind
11 that what is the cost per bit. And my point
12 is that, for that user experience in that kind
13 of middle-density area, I think the wireless
14 is probably not going to be able to give the
15 operator what they want to make a business
16 case and to meet that consumer demand.

17 MR. SCHULZRINNE: Rebekah wanted
18 to kind of ask one question.

19 MS. GOODHEART: One final
20 question. The Chairman, when he opened his
21 remarks about the transition from copper to
22 fiber, to TDM to IP, I didn't know if the

1 panelists could speak sort of where you think
2 we are in the transition. How long do you
3 think the copper-to-fiber transition is going
4 to occur? And similar with the TDM to IP?

5 MR. RALPH BROWN: I think, to a
6 certain extent, in cable it has already
7 happened. The industry will continue to push
8 fiber deeper as demand requires. And
9 ultimately, if you get fiber to the home, then
10 we will get there, but it is an incremental
11 investment over time. Because the coax
12 network does provide a great deal of asset.
13 In fact, Verizon wireless is hybrid-fiber
14 coax, which is the coax to be short.

15 There are operators in the United
16 States who have done both, and for both it has
17 worked out very well. They have solved
18 business cases and actually helped transform
19 their wireline businesses.

20 But as you start going further and
21 further, as the bandwidth increases, as the
22 demand increases, the copper may be a poor

1 performer -

2 MR. ECKARD: I think on the voice
3 side, I always get a little frustrated with
4 this, the statistics that get quoted.
5 Because, as CableLabs mentioned, the delivery
6 of voice in a cable system is over IP. But I,
7 as the consumer, really look at it as a PON
8 service, right? It has lifeline capabilities.
9 It has all those things I want.

10 I think all the vendors today, we
11 all deliver that PON service has IP, but you
12 don't consider it IP. And so, I think we get
13 a little mixed up in our use of that term.

14 So, I don't see anything stopping
15 TDM-to-IP conversion except replacement of
16 circuits with switches, with IP soft switches.
17 And that is happening at a pretty rapid pace.

18 I think on the copper-to-fiber
19 transition, you know, we are going to be in a
20 20-year cycle, well, probably a 30-year cycle,
21 if we are 10 years in. It has been exactly 10
22 years since Verizon started their FiOS

1 deployment, and they probably have another 20
2 years to go.

3 MR. SCHULZRINNE: Okay. With
4 that, I would like to thank the panelists for
5 all their insights and contributions. I think
6 we all learned a lot, and it is clear that
7 many of the questions spoke on the research
8 side and how we transition research ideas into
9 practice, as well as just some better
10 understanding of the economics. It will still
11 pose challenges in the years ahead.

12 Some of those questions clearly
13 make good introductions, also, to the last
14 panel of the day. So, as they used to say,
15 stay tuned for that one.

16 We will now break for lunch. We
17 will resume promptly at 12:30, so that we can
18 start on time.

19 And again, thank you so much for
20 everybody here and, also, for those audience
21 members who provided questions to our
22 panelists.

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See you at 12:30.

(Applause.)

(Whereupon, the foregoing matter
went off the record for lunch at 11:42 p.m.
and went back on the record at 12:30 p.m.)

1 A-F-T-E-R-N-O-O-N S-E-S-S-I-O-N

2 12:30 p.m.

3 MR. HERRIGAN: Good afternoon,
4 everyone.

5 We are going to get our afternoon
6 session underway on looking at data and other
7 things, just what is going on for consumers
8 and people in this space.

9 So, my name is John Herrigan. I
10 am the Director and Vice President of the
11 Media and Technology Institute at the Joint
12 Center for Political and Economic Studies. I
13 also used to work here at the FCC for a short
14 time, helping to work on the development of
15 the National Broadband Plan.

16 It is a pleasure to be here, and I
17 thank my colleagues and friends at the FCC for
18 the invitation to participate in this panel.

19 We do have a very good panel today
20 of distinguished leaders and researchers in
21 looking at how consumers use technology. So,
22 we are about trying to figure out where

1 consumers are as we think about the
2 technological transitions that are underway.

3 We have, as I said, a great panel
4 here today. I am going to just tick through
5 the names of our panelists. And then, I am
6 going to take a couple of minutes to open up
7 with some stage-setting on the data of what
8 consumers do with their various consumer
9 technologies, consumer communications
10 technologies.

11 So, our panelists: we start with
12 Chris Baker from AARP's Public Policy
13 Institute. We have Jessica Gonzalez from the
14 National Hispanic Media Coalition; Jenifer
15 Simpson from the Assessable Technology Action
16 Center; Peter Stenberg with the Economic
17 Research Service of the U.S. Department of
18 Agriculture; Andrew Brown, a lawyer with
19 Levine -- and I cannot read the rest, but I
20 will let you introduce yourself with your law
21 firm. It is "L" and three "B's" thereafter.

22 MR. ANDREW BROWN: LB3.

1 MR. HERRIGAN: LB3.

2 And then, we have on the panel
3 staff from the FCC, who will be asking some
4 questions and engaging in conversation. To my
5 left, Rebekah Goodheart. We have Jonathan
6 Chambers, Sean Lev, and Eric Ralph.

7 So, what I am going to do, before
8 I get to my PowerPoint, is just emphasize that
9 this is a level-setting panel on data and what
10 is going on with what consumers are doing.
11 So, we want to focus on the facts and focus
12 less on policy issues. So, let me urge and
13 encourage panelists to remember Sergeant Joe
14 Friday from the old show Dragnet, "Just the
15 facts, Ma'am, just the facts." And we will
16 leave the policy discussions for another day
17 for the most part. And certainly, as the Task
18 Force works over time, obviously, the policy
19 issues will come to light more and more.

20 So, with that, I am going to take
21 a few minutes to go through some slides on
22 where we sit today with consumers and how they

1 communicate, looking at how people use cell
2 phones, the degrees of broadband adoption, and
3 so forth.

4 So, if I could get my slides up?
5 Excellent.

6 As I get going, I am going to just
7 point out to my panelists who will be coming
8 after me with slides that there is going to be
9 a short several-second transition between when
10 you would really want to see your slides and
11 the slides appear. So, it is not
12 technological glitches. It is just a little
13 delay in loading stuff up. So, we won't have
14 any worries there.

15 So, I am going to turn toward my
16 slides and get us underway.

17 What I want to do today, as I have
18 said, is look at data, at how people
19 communicate, by phone, by broadband, and in
20 various ways; examine the patterns in
21 demographic groups. And I have listed some of
22 my data sources there, the Centers for Disease

1 Control, Pew Internet's 2012 Survey, FCC's
2 Forms 477 Report, which the data was reported
3 in January 2013; data from the National
4 Telecommunications and Information
5 Administration, and some data from an FCC
6 survey of 2009.

7 So, I will be jumping across
8 different data sources. When you do that,
9 sometimes there is a couple percentage points
10 difference on data points that you think would
11 be the same. So, the number for broadband
12 adoption, according to NTIA in 2010, is a
13 little different from numbers I will show from
14 Pew for 2010 or the FCC from 2010. That is
15 just a consequence of different data sources.
16 Typically, the differences are just a couple
17 of percentage points, but I do want to alert
18 the people who are very attuned to looking at
19 slides closely that you will see that
20 discrepancy along the way.

21 So, at a very high level, we see
22 the rise of mobile. Again, using FCC data

1 from 2008 to 2011, there was an increase from
2 261 million to 298 million mobile
3 subscriptions in the United States. This is
4 for both business and residential customers.

5 For interconnected VoIP, the
6 numbers increased from 21.7 million in 2008 to
7 36.7 million. Retail switched access lines
8 fell from 141 million in 2008 to 107 million
9 in 2011. Again, this is for business and
10 residential. I will be shifting over mostly
11 to be talking about residential over the next
12 several slides, which means some of these
13 numbers will be a little different.

14 This is a slide I put together
15 from my friends and former colleagues at the
16 Pew Research Center, just looking at, at a
17 very high level, adoption trends over time
18 among consumers. These are for adults, unless
19 otherwise noted.

20 So, you can see, looking between
21 1998 to 2012, the steady rise in cell phone
22 use in the United States as well as internet

1 use. Interesting that pretty much all along
2 the way cell phone use exceeds home internet
3 use for Americans, and the internet use
4 numbers include internet use of any sort,
5 access via broadband, access via dialup, which
6 is more relevant in the years before 2006,
7 broadband at home going from just a speck of
8 people in 1998 having high-speed internet at
9 home up to what we see today, according to the
10 Pew data, about two-thirds of Americans with
11 broadband at home.

12 On the far right column is the
13 newest big thing in the space of consumer
14 information technology, smartphones. In 2009,
15 that 17-percent data point actually comes from
16 Forrester Research. Roughly 17 percent of
17 Americans had a smartphone. That number has
18 grown rapidly in the intervening years.
19 According to Pew, now about 45 percent of
20 Americans have a smartphone.

21 So, you have seen this
22 multiplicity of access to information really

1 take hold among Americans over the past dozen
2 years. Whereas, a dozen years ago, people
3 might have had a desktop computer with a
4 dialup connection at home, along with their
5 landline phone, and some people with a cell
6 phone, today we have a whole lot more stuff
7 and a whole lot more ways to get online.

8 Looking at wireline telephony at
9 home, this slide shows that we have seen the
10 decline in the number of end-users switch
11 lines over the 2008-to-2011 timeframe, overall
12 number of lines falling by about 15 million
13 between 2008 and 2011, but a lot of that
14 coming out of end-user switched access lines,
15 which stood at 78 million in 2008 down to 52
16 million in the latest data, 2011. And you
17 have seen this tremendous growth in VoIP
18 subscriptions at home, the majority of that
19 interconnected VoIP, going from 19 million or
20 close to 20 million in 2008 up to 31 million
21 nearly in 2011.

22 As part of all these changes, we

1 have seen this incredible increase in the
2 cell-only phenomenon in this country. Since
3 we have some people here in the Commission
4 room -- I can't ask for a show of hands out in
5 internet people streaming -- how many people
6 here in the room are cell-only in their homes;
7 you don't have a landline? Show of hands?

8 (Show of hands.)

9 Actually, a little less than you
10 might expect.

11 According to the latest numbers
12 from the Centers for Disease Control, we have
13 35.8 percent of Americans who are cell-only,
14 meaning the only telephone access they have at
15 home is their cell phone. And that is an
16 incredible rise about by a factor of 3.5 from
17 2006. So, the steady rise of cell-only is
18 certainly an important phenomenon in terms of
19 how people communicate by voice in this
20 country.

21 So, overall, this is sort of a
22 single review slide looking at the 2012 data

1 from CDC. We have 52.5 percent of Americans
2 with a landline and a wireless phone. We have
3 just 9 percent, 9.4 percent, of Americans with
4 a landline only in this country, which is half
5 the rate of just four years ago. And then,
6 finally, 35.8 percent of Americans are cell-
7 phone-only, doubling from 2008 and tripling
8 and then some compared with 2006.

9 The next couple of slides are
10 going to dig into the demographics in key
11 demographic areas that we might be interested
12 in for the cell-only phenomenon.

13 So, the first slide is race. You
14 can see that, for the cell-only phenomenon,
15 the big driver or really the most striking
16 data point there, in my view, is Hispanics.
17 Forty-six point five percent of Hispanics are
18 cell-only. Blacks come in second at 37.7
19 percent, and Whites are at 30 percent with
20 cell-only.

21 And what is interesting about
22 Hispanics, if you start to look across the

1 graph or the table from 2006 to 2012, is that
2 whereas in 2006 there was just a somewhat
3 greater incidence of cell-only among Blacks
4 and Hispanics, everyone was fairly close
5 together. The gap started to grow,
6 particularly for Hispanics, by 2009. By 2012,
7 we see Hispanics very substantially leading
8 the way in cell-only compared to the average
9 and compared to White Americans.

10 Turning to age, looking again at
11 the cell-only phenomenon, you can see that if
12 you are under the age of 35, more than half of
13 Americans below the age of 35 are cell-only,
14 meaning they don't have a landline at home.

15 It is still a fairly prominent
16 phenomenon for those between the ages of 35
17 and 44 years old. The real dropoff, as you
18 can see, occurs for older Americans. For
19 Americans who are 65 and over, just 10.5
20 percent are cell-phone-only.

21 And again, if you sort of piece
22 together the Latino slide, the Latino data

1 point on the prior slide with this, and given
2 also that Latinos in the U.S. tend to be a
3 younger demographic, you can imagine that if
4 you are thinking about the probability of a
5 young Hispanic person being cell-phone-only,
6 it is going to be pretty darn high. I would
7 suggest, without having been able to look into
8 the crosstabs on this data, probably chances
9 are two out of three, or something like that.

10 Socioeconomic status, looking at
11 wealth, poor Americans also lead the way in
12 cell-phone-only with nearly 52 percent of
13 Americans classified as poor having a cell-
14 only as their means of communicating by
15 telephone. If you are nearly poor -- and
16 again, these data are coming from the Centers
17 for Disease Control, so they are the ones
18 doing the classification of different strata
19 as poor, near poor, or not poor -- if you are
20 nearly poor, you are above average in terms of
21 the cell-only phenomenon. And if you are not
22 a poor American, you are close to the average,

1 but still trailing the average and well below
2 the rate for poor Americans.

3 One thing we wanted to do in
4 getting a look at the data overall was take a
5 look not only at broadband adoption rates, but
6 also at what are the technologies people are
7 using to go on with broadband at home. So,
8 this data point is from NTIA. It is from
9 their 2010 survey, which found that 68 percent
10 of homes have broadband. That number is a
11 little bit higher than the numbers you might
12 see from other sources, such as Pew. But,
13 again, things are roughly in that two-thirds
14 to 70 percent range for the share of Americans
15 with broadband at home.

16 And when you start to dig into
17 connection types, you can see that most often
18 people go online with broadband using a cable
19 modem, followed by DSL, and then, you start to
20 get into the single digits with these other
21 ways that people go online from home. Nine
22 percent use the internet outside the home.

1 Six percent of all Americans use mobile
2 broadband only or with other internet
3 services. Three percent of Americans with
4 fiber optics, 3 percent still with a dialup
5 connection, and then, 2 percent satellite, 2
6 percent other broadband. Overall, according
7 to NTIA, 80 percent of Americans are not
8 internet users according to their 2010 data.

9 Here is a comparison of rural
10 versus non-rural Americans when looking at
11 overall broadband adoption rates and how
12 people go online from home. So, you can see,
13 first of all, rural Americans trail urban
14 Americans in broadband adoption by about a 10-
15 percentage-point margin that you can see
16 there, 60 percent of rural Americans with
17 broadband at home.

18 Now that is mostly a combination
19 of three phenomenon for that lag in broadband
20 adoption for rural Americans. One is rural
21 Americans tend to be older than non-rural
22 Americans, and older Americans generally have

1 lower broadband adoption rates than everyone
2 else. Rural Americans tend to have somewhat
3 lower incomes on average than other Americans.
4 That depresses broadband adoption.

5 And then, there is the
6 availability issue. There are, obviously,
7 parts of rural America where people simply
8 can't get broadband, and that is going to be
9 a drag on the overall adoption figures. So,
10 those three combinations are the things that
11 pull down rural broadband adoption figures.

12 And when you start to look at the
13 connection types, you can see that rural
14 Americans are much more reliant on DSL than
15 other Americans, much less reliant on cable
16 modem. And just as rural Americans trail by
17 10 percentage points for broadband adoption,
18 they trail by 10 percentage points for overall
19 internet adoption, when you factor in non-
20 broadband ways that people may go online.

21 Here are a series of slides that
22 try to bring different services and devices

1 together in single slides, just to get a sense
2 of the sweep of devices people have in order
3 to communicate. So, this is overall national
4 average from Pew's 2012 data. That puts cell
5 phones next broadband, next to smartphones,
6 next to e-readers, and tablets. And you can
7 see that, for e-readers and tablets, just
8 about one in seven Americans, according to
9 Pew's early 2012 survey, have those devices.
10 I know subsequent surveys have shown an uptick
11 in tablet adoption in particular, close to or
12 maybe just a little bit above the 20 percent
13 range. But you can see that people certainly
14 have more gear with which to access the
15 internet these days.

16 As I said at the outset, most of
17 the data I am using come from or focus on
18 adult Americans, age 18 and older. This slide
19 focuses on teens, people between the ages of
20 12 and 17. This is hot off the presses from
21 a report the Pew Internet Project put out last
22 week.

1 And you can see that 78 percent of
2 teens have cell phones, 37 percent have
3 smartphones, which is a big boost from 23
4 percent in 2011. And on usage, 93 percent of
5 teens have a computer. For the most part they
6 are sharing that computer with someone else.
7 Seventy-four percent access the internet on
8 cell phones, tablets, or other mobile devices.
9 So, teens are certainly getting socialized to
10 on-the-go, mobile access to the internet.

11 And 25 percent of teens, in fact,
12 say that they are cell-mostly internet users,
13 meaning they mostly access the internet on a
14 handheld device. That is a lot higher than
15 the 15 percent of adults who are mostly cell
16 internet users. And among teens with
17 smartphones, that 37 percent of teens, nearly
18 half are cell-mostly internet users. So, if
19 you are a teen with an iPhone or an Android
20 device, half the time you are mostly accessing
21 the internet on a cell phone.

22 So, this slide shows some

1 comparisons across rural and suburban and
2 urban, using Pew data. The key takeaway here
3 is, perhaps not too surprisingly, rural
4 Americans are lower on the usage of cell
5 phones, broadband, and smartphones than the
6 average.

7 So, nearly 50 percent of Americans
8 or about 50 percent of Americans have a
9 smartphone who live in urban areas. That is
10 half again the rate for rural Americans, where
11 we have 34 percent of rural Americans using a
12 smartphone.

13 This is for tablet devices, and
14 the story is much the same. That is slightly
15 lower rate of adoption among rural Americans
16 of tablet devices, 12 percent, against those
17 averages of around 14 percent for all other
18 Americans in the surveys.

19 Here is a very busy slide looking
20 at age and the adoption of cell phones,
21 broadband, and smartphones. And again, a key
22 purpose for putting up this slide is to help

1 understand the differences that age make in
2 the adoption of these various technologies.

3 So, for smartphones, again, we
4 have talked several times about 45 percent
5 being the average for smartphone adoption in
6 the U.S. When you focus on older Americans
7 over the age of 65, just 13 percent have
8 smartphones. Similarly, with broadband, 35
9 percent of older Americans have broadband at
10 home against the average that is in the two-
11 thirds range.

12 Again, this is for devices. For
13 e-readers and for tablets, you are seeing,
14 again, younger Americans, particularly those
15 under the age of 34, being the more active
16 users of tablets and e-readers. But, again,
17 older Americans sticking more than likely to
18 traditional ways of reading books or the
19 newspaper, which is just to pick something up
20 in hard copy.

21 This is a slide that starts to get
22 into the racial categories. What is of note

1 here, which is familiar to many of us who
2 focus on technology usage patterns across
3 racial categories, is that you have this
4 phenomenon whereby Blacks and Hispanics trail
5 the average when it comes to broadband
6 adoption at home. So, that middle set of bars
7 shows you that Whites have broadband at a
8 higher rate than Blacks and Hispanics.
9 Hispanics, in particular, with lower home
10 broadband adoption rates at 45 percent, Blacks
11 at 57 percent.

12 But, then, things flip when you
13 start to look at smartphones. Forty-five
14 percent of Americans have smartphones, but the
15 number is close to 50 percent both for Blacks
16 and Hispanics. So, that is certainly an
17 interesting trend or an interesting finding
18 when it comes to technology use: African-
19 Americans and Hispanics trailing on broadband
20 adoption at home, but leading the way when it
21 comes to smartphones.

22 For tablets, you can see African-

1 Americans slightly leading the pack on tablet
2 computing, trailing with e-readers, with
3 Whites sort of taking the prize on
4 e-readership in the United States.

5 In talking about this panel, we
6 wanted to take a look at people with
7 disabilities. This slide comes from the 2009
8 survey that was done in connection with the
9 National Broadband Plan that looks at
10 technology adoption among people with
11 disabilities.

12 Seventy-four percent of those with
13 disabilities have a cell phone, which trails
14 the national average, which is in the mid- to
15 upper-eighties. Forty-two percent of those
16 with disabilities have broadband in the 2009
17 FCC survey. That was against an average at
18 the time of 55 percent. And then, just 18
19 percent had a smartphone, and again, compared
20 with the national average at the time.

21 We also wanted to probe
22 disabilities at a more granular level. So,

1 this slide comes from the NTIA's 2010 report.
2 The NTIA found that 37.5 percent of all people
3 with disabilities have broadband at home,
4 different from the FCC number from the prior
5 slide, which was 42 percent. But this gives
6 us an opportunity to, in part, due to NTIA's
7 very large sample size, to dig into broadband
8 adoption among people with disabilities by
9 type of disability.

10 So, you can see on this slide 27.9
11 percent of people who have difficulty dressing
12 or bathing have broadband at home. Thirty-six
13 point five percent of those who are deaf or
14 with difficulty hearing have broadband at
15 home. Those who are blind or have difficulty
16 seeing, 30.7 percent with broadband at home.
17 I am not going to read the rest of these data
18 points. But, obviously, people in the
19 disability community are interested in these
20 numbers at a granular level, and this is
21 probably the best source for it from the NTIA.

22 And these are just the final

1 couple slides. We wanted to talk a little bit
2 about the relationship between wireless and
3 broadband. Those of you who have heard me
4 speak on this topic before, the data shows
5 that, for the most part, thinking about
6 smartphones, you know, your iPhone, your
7 BlackBerry, your Android device, for the most
8 part, that is an additional pathway to getting
9 online for individuals. It is not a
10 substitute for a home broadband subscription.

11 So, among those with broadband at
12 home, 83 percent have a smartphone, showing
13 how those things tend to go together for
14 people. Flipping it in a different direction,
15 for those who do not have broadband at home,
16 the roughly third of the country who do not
17 have broadband adoption at home, 8 percent
18 have a smartphone. So, for a minority of
19 Americans, a smartphone is, in fact, the only
20 way they get online. They don't have a home
21 internet subscription. They don't have a home
22 broadband subscription. But it is not a big

1 number. Just 8 percent of Americans are
2 smartphone-only.

3 Those numbers are different when
4 you look at racial categories, as the final
5 couple bullet points show. Among Blacks
6 without broadband at home, 13 percent have a
7 smartphone. For Hispanics without broadband
8 at home, 19 percent have a smartphone. And
9 for seniors without broadband at home, just 4
10 percent have a smartphone.

11 So, in today's environment, again,
12 talking about a snapshot of today, not
13 necessarily how things may evolve in the
14 future, when you look at how consumers are
15 behaving, if you are looking at the adoption
16 patterns closely, the smartphone tends to be
17 a complement to people's suite of online
18 access assets, not a substitute for, say, a
19 home broadband subscription. So, I think that
20 is a data point worth keeping in mind as we go
21 forward.

22 So, I believe this may be my final

1 slide. This brings overall wireless use into
2 the picture. My prior data points, where I
3 said 46 percent of Americans have a
4 smartphone, was focusing, obviously, on the
5 smartphone. This slide kind of totals up
6 everything, how people go online wirelessly,
7 whether that is using a smartphone, whether
8 that is using a wifi connection with a tablet,
9 whether that is using a wifi connection with
10 a laptop.

11 And the data points at the very
12 top of the slide show that 63 percent of
13 Americans have at one point connected
14 wirelessly. Now that number is much higher
15 for younger American adults. Eighty-eight
16 percent of those between 18 and 29 years old
17 have done that. For older Americans, it is a
18 relative rarity; 21 percent have connected
19 wirelessly.

20 Wireless connections, again, of
21 any sort, whether it is on a smartphone,
22 whether it is on a wifi connection somewhere,

1 is fairly commonplace for relatively well-off
2 Americans, less of a phenomenon for lower-
3 income Americans.

4 And when you start to bring the
5 racial and ethnicity breakout into focus,
6 basically, all the same. So, whereas
7 Hispanics and African-Americans lead the way
8 on smartphones for adoption and usage, when
9 you start to bring in other means of going
10 online wirelessly, which require additional
11 technology assets, such as a laptop computer
12 or a tablet computer, things start to even out
13 because African-Americans and Hispanics are
14 going to be a little less likely to have those
15 other technology assets to go online. And
16 therefore, they are going to have fewer
17 opportunities to go online wirelessly. So,
18 the wireless equation kind of evens out once
19 you introduce other means of getting online
20 wirelessly.

21 So, that covers my data-driven
22 overview of things. There won't be quizzes

1 later on for all the numbers that have been
2 put up there. It is a good thing that the
3 slides will be made available to everybody for
4 consumption down the line.

5 But, again, I have tried to go
6 through some data points to try to set the
7 stage for where consumers are. And now, we
8 have a panel of experts to talk about some of
9 the issues that matter to specific
10 demographics in the slides that I have gone
11 over.

12 So, we will start with Chris Baker
13 from the AARP Public Policy Institute and, as
14 his slides come up, I would be remiss in not
15 saying that he is the second Texas Longhorn on
16 this panel; I am the first one.

17 (Laughter.)

18 MR. BAKER: All right. That came
19 up pretty fast.

20 As John said, my name is Chris
21 Baker with the AARP Public Policy Institute.

22 I want to thank the Commission for

1 inviting us to speak today and John as well,
2 although I would note the challenge here of,
3 first of all, speaking after John, who does
4 these comprehensive panels and excellent data.
5 So, I tried to pare down my stuff, so I
6 wouldn't duplicate him. But, then, also, not
7 speaking on policy, which, you know, it is the
8 Public Policy Institute. So, it is a little
9 challenging, but I really, really grateful to
10 be here.

11 So, I will start, hopefully. Yes.

12 We looked at a lot of data, and we
13 looked at the CDC data that John mentioned,
14 but noticed that, while they broke out the
15 wireless-only for older adults, they didn't
16 break out any of the other categories. And
17 so, we wanted to take a look at that.

18 The most recent data they have was
19 from 2011. It is micro data. So, we broke
20 that out and came up with a couple of charts
21 I wanted to show you.

22 I think the theme of the talk here

1 is, one, that the transitions take a while.
2 I think Sharon Gillett, a former colleague
3 here, brought up the telegram and how long it
4 went from when the first telegram was sent to
5 when the last Western Union telegram was sent.
6 It was, I think, 1844 to 2006, when, in fact,
7 the peak of the telegram industry was in the
8 twenties and thirties. So, it definitely
9 takes a while.

10 And then, the other point, too, is
11 how exciting the emerging benefits broadband
12 are for consumers. I think that comes out in
13 some of the data, the fast-growing number of
14 subscribers. But, then, also, how much they
15 value reliability, affordability, service
16 quality to use their communications.

17 So, with that, this first chart is
18 wireline-only households by age. It still
19 shows a significant number of households have,
20 particularly older households have, wireline,
21 use wireline-only, but that is certainly
22 shrinking.

1 The next chart here shows, I
2 think, what would describe a lot of older
3 adults now. The fast-growing number of adults
4 using wireless, but they also value wireline
5 service. And you see that by these higher
6 subscription rates for both. And that goes to
7 what I think John was saying about wireless
8 being more of a complement than a substitute.

9 So, this is households that have
10 wireline. Either they have wireline and
11 wireless, wireline alone; it is the total
12 effect. And this really shows you how
13 valuable wireline service is to older adults
14 and how they want to keep it whether or not
15 they have wireless or not.

16 And this is households that have
17 wireless. So, it could be cell-only or it
18 could be wireline and wireless together. And
19 again, this shows the increasing value of
20 wireless to older adults. If we looked at
21 this five or six years ago, it would be
22 significantly smaller. There is certainly a

1 growing population of older adults that want
2 to use wireless.

3 Okay. Now this is data from the
4 BLS's Consumer Expenditure Survey that shows
5 how spending has changed on telephone service,
6 which includes wireless and wireline, in the
7 past five years. As you can see, older adults
8 have increased their spending on
9 telecommunications, telephone service,
10 significantly compared to older adults.

11 And certainly, one factor,
12 probably significant factor, of that is that
13 older adults, again, are going wireline and
14 wireless. So, they are adding wireless to
15 their telecomm package, while the younger
16 adults, who more of them are going cell-only,
17 are dropping their wireline. So, I think that
18 sort of is probably a good indication of that
19 happening.

20 One reason for that I think is
21 that wireless is radio service and is not
22 designed to be, at least at this point, a

1 perfect high quality as wireline. So, this is
2 data from a Pew Internet Survey. It was
3 called Mobile Phone Problems and looks at cell
4 owners that experience dropped calls at least
5 occasionally or more frequently. And it also
6 looks at cell internet users and problems they
7 have had with slow download speeds, either at
8 some point or, down below, more frequently.

9 So, the service quality is
10 certainly an issue for wireline customers and,
11 then, also, the affordability and the
12 certainty or the transparency of the price.
13 Local calling is not metered. So, that is
14 probably an issue as well.

15 Then, quickly into high-speed
16 broadband, I think this shows the growing use
17 or interest of older adults in broadband. It
18 also shows that the Boomers, the younger
19 older, so to speak, are pretty close up there
20 to their younger colleagues in terms of use of
21 broadband.

22 The other thing about this is,

1 when we say broadband, what do we mean? The
2 capability of broadband can be different
3 depending on how you define it. It is hard to
4 come up with the data about the quality of it
5 if you don't have accurate numbers on what it
6 is. So, this slide from JD Power sort of gets
7 to that.

8 I am almost done here.

9 And I just put down some issues,
10 trends that are going that will make phone
11 service, telecommunications, internet service,
12 will ensure that it is valuable and valued by
13 older Americans for the future to come.

14 Aging, the need to or desire to
15 age in place, caregiver support, and so forth.

16 And lastly, just the growing
17 number of older Americans over time will have
18 a significant impact. So, communications is
19 an important part of that.

20 Thanks.

21 MR. HERRIGAN: Thank you very
22 much, Chris.

1 We move on now to Jessica Gonzalez
2 with the National Hispanic Media Coalition.
3 We are going to get her slides up and get her
4 going.

5 MS. GONZALEZ: Thank you.

6 We have got the shot clock over
7 here. I feel like we are ready for March
8 Madness.

9 (Laughter.)

10 MR. HERRIGAN: Yes.

11 MS. GONZALEZ: Okay. Well, I am
12 going to try to cover a very large and diverse
13 group in a very short amount of time. So,
14 please bear with me.

15 These are some of the data
16 sources. I will get this reposted with
17 specific links to the data. I was trying to
18 do this rather quickly.

19 Some basic stats: of the 308-
20 some-odd million people in the U.S., over a
21 third are people of color. One thing that I
22 think was important for the context of this

1 conversation is the increasing presence of
2 people of color in rural America.

3 This is a slide that comes
4 directly from the NTIA's Digital Nation
5 Report, and it shows that, unfortunately, the
6 digital divide still persists. Native
7 Americans, African-Americans, Latinos have
8 less access to broadband at home -- excuse me
9 -- less adoption of broadband at home.

10 My colleague from the Asian-
11 American Justice Center also wanted me to note
12 that, although it seems that Asian-Americans
13 have adopted broadband at very high levels,
14 once you dig into the different subgroups
15 within the Asian community, there is a
16 different story. And so, some of that data is
17 hard to get at because most data collections
18 are conducted in English. None are collected
19 in the various 20 languages and dialects from
20 the Asian community. In addition to this
21 data, one-third of tribal lands and one-half
22 of rural tribal lands have no broadband access

1 at all.

2 This is just some reservations
3 about datasets in general that come from
4 communities of color. Like I said, many are
5 gathered only in English. Some are also in
6 Spanish. But none, I believe, are collected
7 outside of those two languages.

8 A lot do a very good job of
9 providing racial and ethnic backgrounds. Some
10 do not. And many leave out Asian-Americans
11 and Native Americans. There is not a ton of
12 publicly-available data on landline use by
13 people of color.

14 And so, this is just to say, when
15 we are using this data to look at trends or
16 develop policies, that we need to be very
17 aware of the sort of discrepancies in the
18 data.

19 This is just an example that comes
20 from the Joint Center, at the bottom here,
21 that shows just the differences in how
22 English-speaking and non-English-speaking

1 Latinos are using the internet and adopting
2 broadband.

3 This slide, again, comes from the
4 NTIA report and looks at the gaps of people,
5 lower-income people, less educated people,
6 less likely to have a broadband at home. And
7 Blacks and Latinos are also less likely to
8 have broadband at home.

9 The U.S. territories are
10 broadband-starved. Over 4.1 million people
11 live in U.S. territories, most of them in
12 Puerto Rico. And you can see 54 percent don't
13 have broadband access at the speeds defined by
14 the FCC; 85.2 in rural territories, no access
15 to broadband. And you can see it is a pretty
16 scarey picture on the islands.

17 These are just some real basic
18 slides about percent of people of color that
19 owns mobile phones. You can see here
20 communities of color up here to be adopting at
21 a higher rate than White folks.

22 And some of this may overlap with

1 some of the data that John gave, but about 34
2 percent of U.S. people do not, are cell-only
3 households. The phenomenon appears to be more
4 likely in Latino and African-American homes.
5 However, I will note that, at the same time,
6 low-income families, which many people of
7 color are part of, are also more likely to
8 rely on fixed-line voice service or dialup
9 internet access. This is according to a Free
10 Press analysis of U.S. National Health
11 Interview Survey data.

12 In addition, many people of color
13 in rural areas rely on landlines only because
14 they do not have access to wireless services
15 or landline users in rural areas are starting
16 to experience problems with call completion to
17 wireless and VoIP connections.

18 Today, in 2013 -- and I will stop
19 because I don't want to talk too much about
20 rural -- but some people of color in rural
21 areas still do not have access to landline
22 telephone service.

1 Another chart. I think this
2 overlaps with John, except for maybe the
3 addition of the Asian data on percent of
4 people that own smartphones.

5 Another really basic chart. The
6 bar on the left side is people who go online,
7 of all internet users, the percent of people
8 who go online via their mobile phones. And
9 then, to the right is the percent of internet
10 users who go online with their mobile phones
11 only.

12 The next set of slides -- or
13 excuse me -- the next slide seems the same,
14 but, actually, this is of all people, not of
15 internet users, the percent of folks who go
16 online and have the mobile devices as their
17 only internet on-ramp. You can see that
18 Latinos and Blacks are leading Whites in that
19 category.

20 So, this seems like really great
21 news where communities of color seem to be
22 getting online through their mobile devices at

1 a greater rate. We have talked a lot about
2 the digital divide and the fact that people of
3 color do not have the same level of access or
4 level of adoption of broadband.

5 But I just wanted to take a moment
6 to pause and say that mobile is not a
7 substitute for home broadband connections, at
8 least not at this point. It is insufficient
9 for a number of various very important tasks
10 that people need to happen.

11 Obstacles include data caps.
12 Mobile devices do not have easy access to many
13 websites on the internet. Only about a
14 quarter of U.S. companies have enabled easy
15 access to their websites via mobile devices.
16 Sometimes they are slower speeds. It is not
17 universally available, especially in rural
18 areas. And the cost is also a barrier.

19 People of color tend to pay higher
20 monthly cell phone bills than White people.
21 They are also more likely to use the
22 competitive carriers, T-Mobile, Cricket,

1 MetroPCS.

2 In looking at the data, I notice
3 some trends. This is looking across a lot of
4 different datasets. And mind you, I think
5 when it comes to people of color, at the same
6 time there is too much data, but then not
7 enough in certain ways.

8 But some traits that they share,
9 that the unconnected share, they are poor,
10 older. They live in rural or on tribal lands,
11 disabled. They are born outside the U.S. And
12 in terms of the Latino community, a lot of
13 folks born outside the U.S. Non-English-
14 dominant, that is, again, a Latino community
15 stat. There is no Asian data, but I would
16 assume that would probably be -- that is an
17 assumption; I am not going to go there. Less
18 educated and, of course, U.S. territory
19 residents.

20 So, all that to say is some of the
21 neediest and most vulnerable people in the
22 U.S. are some of the least connected as well.

1 MR. HERRIGAN: Thank you very
2 much, Jessica.

3 We now turn to Jenifer Simpson.
4 Jenifer?

5 MS. SIMPSON: Good afternoon.

6 Thank you very much for inviting
7 me. I am very pleased to be here.

8 I don't have any PowerPoint, but I
9 am happy to make a statement for the record,
10 if that is what you want.

11 In thinking about the presentation
12 here, I looked at what the future of
13 disability would be about. It really depends
14 on how well America prepares for the
15 demographic, fiscal, and technological
16 developments that are unfolding over the next
17 three decades.

18 We know we are in a big period of
19 change right now with the Silver Tsunami
20 happening. I am a member of that. So, all
21 this discussion about what technologies we use
22 now, what seniors are using already, and what

1 I am going to be using, I think that is all
2 going to shift very quickly.

3 The three issues that still remain
4 for people with disabilities, and there's 50
5 million of us in America, are issues such as
6 availability, affordability, and
7 accessibility. So, availability does concern
8 the transitions in the networks and what
9 happens, for instance, in rural areas and what
10 you can access and what you can afford, and
11 then, whether or not the stuff you use with
12 the network is accessible or not.

13 And just a reminder, 1 in 10
14 incoming freshmen in college has a disability.
15 That is our next generation of people with
16 disabilities in the workplace. So, it is not
17 a fixed topic, disability, and who people with
18 disabilities are. It is constantly changing.

19 I think you did a great job
20 describing how incidents of disability often
21 correlate with rural living and ethnicity.
22 And I just want to remind everyone how

1 disability crosses all demographics. It also
2 exists across the continuum within multiple
3 domains, such as physical condition, sensory
4 disability, sight, hearing, mental health
5 abilities, intellectual abilities from severe
6 cognitive impairment to autism and other
7 cognitive limitations, across age and across
8 the somewhat the forgotten disabilities of
9 multiple disability. So, there are many
10 slices to disability. It is not just a single
11 issue that is easy to understand.

12 We know that broadband has greatly
13 benefitted people with different types of
14 disabilities. American sign language users
15 were early adopters of video-based phone
16 calling or video relay service. Blind people
17 have benefitted greatly from voice command
18 systems. When they use their smartphones,
19 there are software and databases that they can
20 access they didn't have before.

21 People with cognitive and people
22 with some mental health disabilities benefit

1 from literally the faster downloading of
2 websites, simply the less frustration. You
3 know, you just get to the information faster.
4 And I think that is probably true for some of
5 the older population members.

6 People with disabilities, like
7 everyone else, benefit from the free apps that
8 they can get or the ones they want to pay for,
9 particularly some of the ones that uniquely
10 address perhaps their disability and give them
11 access to information they would not have had
12 before. That may be monitoring their health
13 and things like that.

14 Another group we often don't talk
15 about in terms of the disability world is the
16 people associated with people with
17 disabilities among caregivers, but also
18 physical therapists, speech therapists, and
19 occupational therapists. With more and more
20 connectivity, we are going to see more and
21 more connectivity between people with
22 disabilities and the other professionals and

1 the paraprofessionals in their world. But,
2 overall, we would like to say at the
3 Accessible Technology Action Center that
4 broadband greatly benefits people with
5 different disabilities.

6 In regard to changes in the
7 network, we think the policy consideration
8 should always remain what we have had so far,
9 that consumers with disabilities expect
10 everything to work, just like everybody else
11 does, and they want it to work with
12 everything, no matter what the network is.

13 We do have that principle in the
14 statute. Section 251 has that in there.
15 Nothing can be in the network to bar
16 accessibility, and it must conform with the
17 requirements for accessibility that we already
18 have, and there must be coordination for
19 interconnectivity. We believe those stand
20 there very strongly for accessibility issues.

21 You asked what are the trends that
22 we are seeing about the groups that we work

1 with. There are three that I would like to
2 mention. One we are seeing is the bring your
3 own device; BYOD it is referred to. This
4 could be in the workplace or it could be in
5 the educational environmental. It could be in
6 the kindergarten. It could be in college.
7 This is often involving tablets, e-readers,
8 laptops.

9 Again, those three issues,
10 availability, affordability, and accessibility
11 impact that. And we know there are problems.
12 A younger, poorer kid with a disability can't
13 get it; whereas, maybe the richer kid with a
14 disability can get it. There are lots of
15 issues around that.

16 Another issue in the workplace is,
17 does the IT team support maybe your customized
18 device that you have loaded with all the
19 accessibility stuff on it that you would like?
20 Because it works for you, but does it work
21 with the company system?

22 We are also seeing increasing

1 wireless use by people who are blind. This
2 is, I think, because the iPhone that came out
3 was usable out of the box. You know, this is
4 the ideal, that it would be usable out of the
5 box, and how to access all the information and
6 materials you might need, particularly for
7 your job.

8 I think the issue of apps and how
9 accessible they are is an emerging issue is
10 for our community. Who is responsible for
11 making sure they are accessible? Who does the
12 consumer go to to make sure it is accessible?

13 I think you are already quite
14 familiar with the e-911 connection issues for
15 people who are deaf and hard of hearing. So,
16 I won't go over that one.

17 Another issue that we are seeing
18 emerging in the community is the IP-enabling
19 of all kinds of things that we haven't seen
20 enabled before, such as household appliances,
21 cars, transportation things, healthcare items,
22 things that sense your blood pressure, or

1 whatever, and it is IP-enabled to be sent to
2 your doctor, things like that.

3 And I think this raises issues of
4 accessibility around the controls to use
5 those, particularly if you have physical
6 limitations or if you have intellectual
7 limitations. So, that whole emerging trend of
8 IP enablement -- I have heard of
9 refrigerators; I have heard of all kinds of
10 things -- is really going to impact our
11 community, I think, as we try and have
12 controls over those and use them the way we
13 want to productively, like everyone else.

14 Another trend that we are seeing
15 is, obviously, there is more broadband
16 everywhere, more internet use everywhere, but
17 the companies are using -- and we focus on
18 employment at the Accessible Technology Action
19 Center -- companies are using systems that
20 previously we have never heard them using
21 before for hiring, recruiting people, the
22 onboarding of people, in promotion, in

1 tracking, in identifying applicants.

2 We are seeing all these systems,
3 even social media systems like LinkedIn,
4 Twitter, Facebook are being used for
5 employment recruiting purposes and to find
6 candidates for jobs. So, the accessibility of
7 those, of social media, is starting to be a
8 real issue in our community, whether they can
9 even be found by the recruiters.

10 I hate to mention this, but we
11 have a 12.3 percent unemployment rate in the
12 disability community, which compares to the
13 rest of the country at 7.9 percent. We always
14 have a higher unemployment rate. So, when we
15 see issues around technology used in the
16 workplace or by recruiters which is perhaps
17 not accessible, we say, you know, how are our
18 people going to be found? How are they going
19 to use these new online telephone interviewing
20 systems that are out there. There are a lot
21 of little things out there we are discovering
22 at the Center that we never even heard of

1 before.

2 Telework is an issue. We know it
3 is a reasonable accommodation for some people
4 with disabilities. So, we have concerns about
5 when it gets banned in the workplace.

6 Changes in communication
7 technology really benefit our community, and
8 we are really looking for the industry to be
9 very sensitive to what we want. But we would
10 like to see accessibility considered on par
11 with security, privacy, and reliability.

12 MR. HERRIGAN: Wonderful, Jenifer.
13 Thank you very much.

14 And now, to Peter Stenberg from
15 the U.S. Department of Agriculture.

16 Peter?

17 MR. STENBERG: Now I am going to
18 basically complement John's discussion already
19 on rural in regards to technology.

20 And I think I have lost my slide.
21 Okay, there.

22 And I am going to be talking on a

1 little bit more different focus. It will be
2 on more why the internet is not being used in
3 rural areas or looking at who is using it and
4 who is not using it, and why, a little bit
5 more in that category.

6 So, let's take a look at, one, in
7 regards to how things have changed over time.
8 You can see that the internet at the beginning
9 of a decade ago had increased rapidly and,
10 then, slowed down, and continued to grow,
11 though, over the last decade.

12 With the introduction of
13 broadband, that adoption of broadband
14 increased very rapidly during the decade, to
15 where it is nearly universal in both rural and
16 urban areas relative to those who are actually
17 using the internet. Still, broadband is not
18 available, of course, in many areas, but it
19 has increased rapidly, even in rural areas.

20 This has not been uniformly across
21 the country, though. There is a great
22 variation. And this is some of what for

1 reasons that John had mentioned earlier in the
2 other presentation.

3 And there are differences in
4 regard to the Deep South has always lagged
5 relative to the western or the New England
6 areas. And this occurs both in the urban and
7 the rural areas. But I wanted to make a
8 couple of points off of this graph or these
9 maps and show you that, even in some of the
10 rural areas of the West, it is higher than
11 rates in some of the urban areas of the South.
12 That has much to do with regards to income.

13 Now why households don't
14 subscribe, this is looking at just internet,
15 why they don't subscribe. Many people just,
16 apparently, don't want it, or at least that is
17 what they specify as their first or primary
18 reason.

19 And I want to make a point on
20 this. This is primary reasons, just one
21 reason they are allowed to answer, and they
22 may have multiple reasons that they are not

1 subscribing.

2 The too expensive is the second
3 most-common reason. They are very similar
4 between urban and rural areas for the reasons.
5 Slightly more are not interested in rural
6 areas, again, due to the age structure within
7 rural areas compared to urban areas. As John
8 mentioned, people in rural areas tend to be a
9 little bit older; also, a little bit less
10 income.

11 But, also, the internet
12 subscription across income levels varies
13 considerably. And this, again, is pointing
14 out that income or household wealth is a
15 factor in adoption of the internet.

16 And it is very similar between
17 rural areas and urban areas by income level or
18 within income groups, though there is still a
19 lag between rural areas or a dropoff between
20 rural areas from urban areas. That has to do
21 with regards to, most likely, availability.

22 Now broadband adoption has changed

1 quite a bit, as I had mentioned it in the
2 earlier slide. If you look at the 2007 slide,
3 there was a major gap between rural adoption
4 across the income levels and urban adoption.
5 This gap has decreased over time. Broadband
6 has become much more available in rural areas,
7 and it is also an example of, once online,
8 people are going to adopt broadband. Dialup
9 just is disappearing, if they can have the
10 alternative broadband.

11 So, I want to just conclude with a
12 number of things. Of course, broadband has
13 been rapidly adopted across the country. It
14 has varied quite a bit across the country.
15 There is a sharp difference in subscription
16 rates across the country, and it has changed
17 quite rapidly over the last 15 years.

18 There are differences, as John
19 just pointed out, in regards to the
20 technology. DSL is much more common in rural
21 areas. Some of our own studies have shown in
22 regards to the farm community that that is the

1 predominant technology of use.

2 We are still exploring some more
3 research in regards to the technology and how
4 this will be changing over time. But, again,
5 the technology is different in rural areas.

6 Thank you.

7 MR. HERRIGAN: Thank you very
8 much, Peter.

9 Last, but not least, on our panel
10 is Andrew Brown.

11 Do you have slides?

12 MR. ANDREW BROWN: I do have
13 slides, yes.

14 MR. HERRIGAN: Okay. Great.
15 Well, we will tee those up and turn the floor
16 over to Andrew.

17 MR. ANDREW BROWN: Thank you.

18 First, I want to thank the
19 Commission for putting this panel together
20 and, importantly from my perspective,
21 including the enterprise customer community on
22 the panel. Enterprise customers are

1 consumers, too. The Supreme Court said
2 corporations are people, too, or consumers,
3 too. But we operate in a slightly different
4 market and procure services a little bit
5 differently than your average residential
6 customer.

7 And a lot of the data that John
8 presented and that others have presented gives
9 some very interesting trends and insights, but
10 they are not really focused on business
11 customers and some of the trends that affect
12 business customers. So, I want to explain
13 some of those to you. And hopefully, the
14 Commission can use those when they start
15 considering some of the policy issues that we
16 are going to steer clear of today.

17 So, what are the services that
18 large enterprise customers buy? If you look
19 at the first three bullets, data, voice, and
20 wireless, those are things that everybody buys
21 and that we have been talking about. But
22 enterprise customers buys them very

1 differently, and they buy different versions
2 and varieties of those services.

3 Data services for a residential
4 customer is basically getting access to the
5 internet, and that is the end of the story.
6 For an enterprise customer, it is about
7 building a network with services provided by
8 a service provider. And I will look at some
9 of the characteristics in a minute of an
10 enterprise customer that are very different
11 from residential customers.

12 It is not just about access to the
13 internet. It is about using a network. MPLS
14 is the standard now for data networks. It is
15 the evolution from frame relay, which preceded
16 it, and before that, private point-to-point IP
17 circuits, private line circuits.

18 So, what they buy is a network
19 that they put together from a service
20 provider, the most important component of
21 which is class of service, which basically
22 orders the packets in a way that ensures

1 reliability and service availability and
2 satisfaction of certain minimum service
3 requirements. And that is just different from
4 the way a customer buys best-efforts internet
5 access, which is something that enterprise
6 customers buy, but in much smaller quantities.

7 They also buy a lot of special
8 access, access to the network, but special
9 accesses, a particular form of access that
10 business customers buy, high-speed connections
11 to ensure that the bandwidth levels that they
12 need are available.

13 Voice service, also very
14 different. Most large enterprises, if not all
15 of them, have 800 numbers. Unlike a small
16 business that may have one 800 number, they
17 have lots of them. They have features and
18 functions associated with those, time-of-day
19 routing. So, there is a lot of complexity
20 that goes into purchasing voice services for
21 business customers.

22 The biggest trend right now I

1 think among voice for enterprise customers is
2 something similar to what we are talking
3 about, but qualitatively different, which is
4 a migration towards something called SIP
5 trunking, which is the enterprise-speak for
6 interconnected VoIP for businesses. But that
7 is a service that is essentially moving
8 customers, enterprise customers, to a fully-
9 IP-voice world. And that is, as all these
10 trends, something that is happening slowly and
11 over time, but is happening.

12 Wireless services, customers in
13 the enterprise world buy a ton of wireless
14 service. That growth has been as dramatic as
15 in the consumer market, for mostly the same
16 reasons. But it is a complement to, not a
17 substitute for, wireline services, and we will
18 talk about that in just a second. That makes
19 for very different policy considerations about
20 what the Commission looks at when they see
21 that they are adding onto, not substituting.

22 Some of these other services I

1 have listed because they are things that
2 residential customers just don't buy. I won't
3 go through all of them. But many of them are
4 unregulated services that allow corporate
5 customers to run these very complicated
6 networks that they buy.

7 I will just say one thing about
8 the last point, which isn't really a service,
9 but a concept that people have been talking
10 about for a long time, that IP-enabled
11 networks will certainly permit and that we are
12 slowly moving toward, which is this notion of
13 different kinds of devices, different kinds of
14 access to the network seamlessly working
15 together. It is called unified communications
16 or fixed-mobile convergence, everything on a
17 data network, and you don't really care
18 whether you are on a tablet or a smartphone or
19 a Fablet, whatever that big phone is now
20 called, or a mini-pad. So, that is something
21 people have been talking about for a long
22 time, and it is something that IP-enabled

1 networks enable.

2 Here are the characteristics of a
3 typical enterprise that are also sort of
4 different from a residential customer. They
5 have got a lot of different sites of a lot of
6 different sizes, and you have got to
7 interconnect them seamlessly, which means they
8 are geographically-dispersed, they have
9 different bandwidth requirements. And, as a
10 result of that, two concepts that came up
11 earlier this morning are very relevant for
12 enterprise customers, ubiquity and
13 interconnection.

14 The ability to have a service
15 provider get you to all your sites and to have
16 those networks interconnect seamlessly across
17 other networks is key for an enterprise,
18 because they have got to get to all their
19 customers. They have got to get to all their
20 sites.

21 Enterprise customers -- some
22 people find this somewhat surprising -- they

1 are very technologically-advanced and they are
2 always on the cutting edge of technology, but
3 they are also very risk-averse in their
4 networks. So, as a result of that, they are
5 not implementing anything that isn't
6 bulletproof, tried, and tested. So, they are
7 not on the bleeding edge of technology in many
8 cases when it comes to their actual network
9 services.

10 And that is important to kind of
11 keep in mind because all of these things are
12 very evolutionary in the enterprise market.
13 Things don't happen on a flash cut.

14 They also spend a lot of money on
15 these services. Kind of like the government
16 now, corporations for a long time have been
17 required to do a lot more with as little money
18 as possible. So, even though they spend a
19 lot, their needs have dramatically increased.
20 So, they are trying always to use technology
21 in ways to improve efficiency and innovation,
22 but they are always having to see some cost

1 savings associated with that. So, advances in
2 technology that don't return cost savings
3 aren't going to be quickly adopted in the
4 enterprise market.

5 Businesses, again, unlike
6 residential customers, they buy a lot more
7 than just a service or a technology. They buy
8 support for that. You know, you can't call
9 the phone company if you are a large
10 enterprise and say, "You will be on hold for
11 three hours" or "We will get a truck to you
12 when we can."

13 There is a lot of support for
14 running these networks that residential
15 customers just don't buy. And the importance
16 of this is there are a limited number of
17 providers that can actually support an
18 enterprise network. So, the choice available
19 to enterprise customers is significantly
20 narrowed from some of the things we have seen
21 in the consumer market.

22 Let me talk about some trends that

1 just don't apply to the enterprise market.
2 Cutting the cord, we have heard some very
3 interesting statistics about 50 percent of
4 households with adults 18 to 35 are wireless-
5 only or 34 percent of households are wireless-
6 only. That just doesn't apply in the
7 enterprise market. If you are a Fortune 1000
8 company, the percentage of wireless-only
9 enterprise companies is zero percent. So,
10 that is my one statistic that I am putting in
11 here, and it is unscientifically arrived at,
12 but it is probably right.

13 It is just not an option. They
14 use wireless services as a complement to their
15 services, but wireless-only is usually going
16 to be an access issue or a complement. They
17 are buying a lot of wireless, but not as a
18 substitute.

19 The second issue you hear a lot
20 about is intermodal competition or
21 substitution, cable for telephone service,
22 VoIP from a cable provider. That doesn't work

1 very well in the enterprise market because
2 cable, for example, doesn't go -- it is an
3 availability issue -- to where businesses
4 mostly are. It doesn't have the reliability
5 and the scalability. So, cable is primarily
6 a residential play.

7 And lastly, there are some trends
8 that do apply. I mean, there is a huge
9 convergence of voice on data networks. It
10 just looks different, for the reasons that I
11 just talked about.

12 And I will say one last thing,
13 because someone brought up BYOD.
14 Consumerization, which Microsoft tells me is
15 not, in fact, a word by Spellcheck, but we
16 will make it one today, gets to this concept
17 of BYOD, people bringing their devices. And
18 that is we are early days on that, to see what
19 impact that is going to have, but businesses
20 are very conscious of it and are thinking
21 about it. So, we will see if that becomes a
22 trend in the enterprise world.

1 MR. HERRIGAN: Well, thank you
2 very much, Andrew.

3 Thank you to all the panelists for
4 a very rich set of data and observations about
5 what is going on for consumers and enterprises
6 with communications technology.

7 We have time for questions. And
8 what I thought I would do is let our expertise
9 assembled at the table among FCC staff have
10 some opportunities to ask some questions, if
11 there are any. Or I can start with the
12 questions.

13 I will start with the questions,
14 and certainly, I am sure there will be more
15 questions coming from the audience. If you
16 have questions, please fill out some cards,
17 and I will pose them to the panelists.

18 But a question that I will just
19 let the panel take a stab at, which is we have
20 heard a lot of great facts, what people are
21 doing and what things people have, what things
22 people don't have. But, at the end of the

1 day, it is about how people use technology and
2 about how people are going to adapt to this
3 transition that is underway.

4 So, the question for myself, for
5 all of us, I think, is, what else do we need
6 to know, not just about adoption patterns,
7 about which we know a good deal, but are there
8 specific behavioral or attitudinal questions
9 that we would want to know in order to better
10 understand how consumers or enterprises are
11 going to cope with a world where we are
12 undergoing rapid technological transition?

13 And I see Jenifer's hand up first.

14 MS. SIMPSON: I think this is one
15 of the question you sent us. So, I did think
16 a little bit ahead of time about changes being
17 made that would benefit or not benefit our
18 community.

19 And I think it is about things
20 being date-certain and understanding phase-in.
21 I think when we went through the digital TV
22 transition, it was very clear that there was

1 a date where it was all supposed to like
2 happen by. And there were a number of
3 activities associated with that.

4 So, I think if you are looking for
5 recommendations around transition, you want to
6 be very clear that, if something is going to
7 be ended or beginning, you know, in our
8 particular community it is very hard for us to
9 get the word out sometimes. We are a very
10 diverse community. So, we need to know plenty
11 advance notice.

12 And also, if there are changes
13 that are of a very significant nature, you
14 probably want to do phase-in's. I mean, we
15 did phase-in's with captioning for the
16 industry over time, when we told them that
17 they had to caption everything.

18 So, we could also do that with
19 other things, I think, so that our communities
20 and the people who are associated with our
21 communities can have a better chance to
22 understand what the transition is all about.

1 I was just using those two as
2 examples of, you know, if you have hard things
3 that have to happen, how it makes it more
4 tolerable for our community to understand.

5 The other thing I wanted to raise
6 was our community, our folks often invest a
7 whole lot in the devices and things that they
8 use. So, when everything gets changed on
9 them, it creates a lot of frustration and also
10 cynicism. And those are not good things,
11 obviously, for the marketplace.

12 So, that is why I am sort of
13 saying that education campaigns, awareness
14 campaigns, that help people understand
15 transitions are extremely important.

16 MR. HARRIGAN: I think that is a
17 very interesting observation, that to me, for
18 the observation about the disabled community,
19 prompts me to think about something Andrew
20 said about a new model for internal support
21 for IT and adoption issues -- critical at the
22 enterprise level, but I think it is important

1 when you start to think about specific
2 communities who are not as tech-attuned as the
3 rest of us may be.

4 For certain segments of the
5 disabled community, calling up and waiting a
6 couple of hours on the phone, that is just not
7 going to be the model that they can --

8 MS. SIMPSON: You can't do that if
9 you are on relay service probably.

10 MR. HERRIGAN: Yes, yes. And
11 especially looking across different
12 demographic groups, there is going to be
13 different degrees of friction to, oh, let's
14 just pick up the phone and figure out what is
15 going on and wait on hold for a while. I
16 think it is a challenge and a very open
17 question as to how you adapt user support to
18 a different technological reality.

19 Do I see a question from Henning?

20 MR. SCHULZRINNE: I just want to
21 follow up on the issue of user support because
22 it is an area that I have worked on as well.

1 One of the things that is happening, that it
2 increasingly seems to be difficult for users
3 to understand who does what. It used to be,
4 when the phone didn't work, where it was the
5 apparatus or the line, you called the phone
6 company. And that clearly doesn't work when
7 you have Netflix or over-the-top voice, and so
8 on.

9 So, are there models we can use
10 elsewhere to avoid the frustration of your
11 being handed off between the vendor of your
12 TV, the vendor of your service, the vendor of
13 your wireless modem? And you spend all day in
14 tech support hell. Are there models elsewhere
15 in other technology transitions or in other
16 areas, community support, in other areas we
17 can learn from?

18 MS. SIMPSON: I mean, what comes
19 to mind from our community perspective has
20 been how we had in Section 255 a point of
21 contact designated, a company who you could at
22 least gateway into the company on an

1 accessibility issue.

2 I think we sort of did a similar
3 thing with captioning. I don't know if it
4 extends to other consumer issues because,
5 obviously, there are far more very often
6 general consumer concerns than there are
7 specific accessibility concerns. But having
8 that available and having that well-known is
9 very useful and helpful.

10 MR. HERRIGAN: Sean Lev?

11 MR. LEV: Yes. Can you hear me?

12 So, we talked a little bit this
13 morning about the resiliency issues as we go
14 through these tech transitions. And I was
15 interested in whether the particular
16 communities represented here had different
17 concerns or experiences regarding resiliency
18 of IP networks and next-generation networks,
19 and whether there are particular things we
20 should keep in mind as we look to network
21 resiliency, disaster issues for those
22 communities.

1 MS. GONZALEZ: Sure. I mean, I
2 think resiliency is, of course, important for
3 probably all the communities represented here.
4 I know from the storms that happened recently
5 people just didn't have access to
6 communications. Especially I can speak to the
7 Latino community; there just wasn't as much
8 communication available, especially because a
9 lot of the communications were available in
10 English language only. And so, resiliency is
11 a very important issue that I think we have to
12 figure out as we make the transition.

13 If I may, since I have the floor,
14 just address John's issue. For us, the major
15 trends that we think are important, it is just
16 there are already so many people who are left
17 behind right now. How do we use this
18 opportunity as an opportunity to get those
19 people connected, but also to make sure that
20 the basic services that some people are just
21 getting access to now still work?

22 MR. BAKER: I would agree with

1 your points there. I would note, with
2 Hurricane Sandy, AARP did a couple of state
3 studies about responses to them. Sometimes I
4 will give the telecomm companies a hard time,
5 but not this time; they did pretty well in
6 their response rates, at least comparatively
7 to electric utilities, and so forth, according
8 to these surveys. So, I think that is
9 interesting and maybe worth further study.

10 MR. HERRIGAN: Andrew?

11 MR. ANDREW BROWN: Again, this is
12 maybe an example where in the enterprise we
13 really have a slightly different perspective,
14 although there is some common ground. You
15 know, the 911 access or the phone going out
16 when the power goes out is not really a new
17 concept to a business who the PBX would go out
18 when the power went out for years and years.
19 So, that is not a particularly new concept.
20 It is a huge new concept for consumers and a
21 real problem.

22 It affects businesses in a

1 profound way when the network overall, in
2 other words, a lot of their customers can't
3 get access to the network, which is the way
4 they are doing business and buying things now.
5 So, there is a tremendous amount of concern
6 about that.

7 But one thing that I know the
8 Commission is thinking about is that IP
9 networks as such and any technological advance
10 presents a great opportunity for enhanced
11 resiliency and redundancy. And you see that
12 in, I mentioned SIP trunking, which is the
13 enterprise class VoIP. There are a lot of
14 ways to reroute calls very quickly that were
15 unavailable with the prior kind of technology.
16 So, there are opportunities as well that the
17 Commission should definitely consider.

18 MR. HARRIGAN: Sean? Or is it
19 Eric Ralph with a question? And then, I am
20 going to turn to one that was submitted from
21 the internet.

22 MR. RALPH: So, we have talked

1 about who is left behind, and we have seen a
2 lot of slides of sort of the different cuts.
3 I know that we don't have the crosstabs, and
4 that is exactly what is missing.

5 But it strikes me that a lot of
6 this data could perhaps be mined a lot better.
7 I mean, one illustration was your slides with
8 how the age shifts occurred. Another one is
9 to think about what is going on that is
10 driving -- you know, obviously, we would like
11 to know to what degree people are being left
12 behind simply because of their incomes, rather
13 than other reasons.

14 But there might be other things
15 that are driving some of these differences.
16 Particularly, maybe in the Hispanic community
17 you have people who have much more recently
18 landed in the country or who moved more
19 frequently. And I see those as entirely
20 different reasons. The landing more recently
21 is a person who has sat down in a recent
22 period of time in today's environment and made

1 the, call it optimization decisions about how
2 to set up their household.

3 It may be that part of what we see
4 in the age thing is less to do with how -- I
5 mean, part of it may, it looks like, be driven
6 by how old you are, but part of it may be
7 driven by the fact that, you know, I am pretty
8 happy with what I have got. I sat down and
9 optimized how to run my household 10 years
10 ago, and I only redo it if I move house. And
11 then, I ask myself the question, do I really
12 need this landline, et cetera?

13 So, I was just thinking both in
14 terms of understanding who has been left
15 behind and why, so that we can get at those
16 issues, but also understanding where we are
17 going. Where will we end up in terms of the
18 percentage of people who are wireless-only, et
19 cetera? I think we could probably look at our
20 data and dig down a lot deeper than we have.

21 MR. HARRIGAN: I mean, I think,
22 collectively, for specific questions that the

1 Commission may have as this unfolds, we could
2 dig into those things and look at some of
3 those crosstabs or look at other data
4 resources.

5 I think the other observation has
6 to do with maybe thinking about new lines of
7 inquiry that have to be undertaken in the
8 coming months and years to understand better
9 consumer expectations in today's marketplace.

10 I have a colleague who kind of
11 shakes her head and says, "People just don't
12 care about call quality these days." Well,
13 why? I mean, in this person's view, people
14 tolerate dropped calls or fuzzy connections,
15 but it is okay if they can do a lot of
16 searches on the go with their smart device.
17 So, that is an anecdote.

18 I think, as a collective group of
19 researchers here, we would be happy to
20 entertain discussions with you all to figure
21 out what are the key questions to understand
22 in terms of consumer expectation going

1 forward, which will get you to different
2 places than just the crosstab analysis, but
3 potentially very useful ones, I think.

4 Let me, if I may, since I have one
5 question from the internet, get to it quickly.
6 And then, we will turn to Henning or I think
7 Jonathan is a remaining person who may have
8 some questions.

9 This question comes from Bret
10 Glass. His question reads, "Today several of
11 the panelists have used the term `wireless' as
12 if it were synonymous with mobile wireless,
13 neglecting to mention fixed-wireless as a
14 broadband solution. My WISP or terrestrial
15 fixed-wired ISP provides enterprise solutions,
16 business cutting the cord, as well as
17 residential broadband, all over IP
18 connections. The service is more reliable and
19 faster than DSL or leased lines, and the
20 infrastructure is far more cost-effective.
21 Would the panelists care to comment on the
22 role that fixed-wireless can play in the IP

1 transition and in broadband adoption and
2 deployments?"

3 Any takers?

4 MR. ANDREW BROWN: Well, I will be
5 a quick taker because that question seems to
6 come from someone interested in selling
7 enterprise services.

8 (Laughter.)

9 I wasn't using the term that way
10 at all. Fixed-wireless is an alternative, and
11 it is in some use by some enterprises, but it
12 has natural limitations on propagation and the
13 way it works. And it has simply not been an
14 effective substitute for wireline networks.
15 It is used a lot in backup. It is being used
16 in many cases, but let's not confuse that with
17 a primary service that people are using in
18 spite of wireline broadband access.

19 So, technology has its limits;
20 physics has its limits. We will see how that
21 moves along with all the spectrum
22 reorganization, but, you know, it is not right

1 now an adoption trend that we see in the
2 short-term.

3 MR. HERRIGAN: Great. Since we
4 have limited time, I am going to give Jonathan
5 an opportunity for a question.

6 MR. CHAMBERS: I have a quick
7 followup, similar to what Eric was discussing.
8 And I know John and I talked about this before
9 the panel began.

10 Within the CDC data, they ask not
11 only "Have you cut the cord?", but "What do
12 you consider to be your primary means of voice
13 communications?" And there, if you consider
14 both cord-cutters and primary mobile users --
15 I will use "mobile" instead of "wireless" --
16 you get well over 50 percent of the population
17 now considers mobile voice to be the way in
18 which they choose to communicate.

19 And so, my questions go to, again,
20 not only a continuation of this trend, but
21 also to pick up on data, because the questions
22 in the CDC data on that go to data usage. And

1 so, let me just step back. If you were to
2 look 20 years ago or so, most people would
3 have said that cell phone and, then, the
4 emerging PCS market was a complement to fixed-
5 line usage. That is how it was viewed.

6 The change occurred, I think, as
7 people got more and more minutes of use for
8 their money. The buckets got larger. Five-
9 hundred-minutes-plus seemed to become a
10 tipping point where people started cutting the
11 cord.

12 And then, sort of as Eric was
13 suggesting, young people, who didn't have to
14 make a choice as to whether to have a fixed-
15 line home; renters I think you find the same
16 kind of thing. Renters tend to be mobile-
17 only. Hispanics, the same kind of thing.
18 Immigrants, very similar to Hispanics overall,
19 new immigrants are much more mobile-only than
20 they are fixed-line.

21 This is a long-winded way of
22 saying, you know, that sort of 20-year

1 migration, and now you would say that POTS,
2 maybe we ought to be thinking of something
3 like POMS or something, you know, plain old
4 mobile service.

5 But for data, we are in a very
6 early stage of mobile data, especially with
7 the last couple of years of tablet usage. So,
8 as you talk to people or as you look at
9 surveys, might you start to see the same
10 trends in data usage? That is, now it is a
11 complement. It is clearly a complement now.
12 Most people use more tablets, smartphones.
13 Might you start seeing a lot more mobile-data-
14 only users?

15 MR. HERRIGAN: I mean, I think you
16 will have to get to the same tipping point.
17 I don't think we know enough to know what that
18 is at this point about data. If you are going
19 to do a wireless-only, you know, 4G home
20 internet access plan as your anchor home
21 broadband subscription plan today, the 4-
22 gigabit limit that a lot of carriers impose

1 may not do it for some households. So, that
2 will limit that transition that you are
3 suggesting did happen for minutes and cell
4 phone use over the past 20 years.

5 That could change. Business
6 models evolve. The capacity will certainly
7 increase and evolve. We heard a lot about
8 that this morning.

9 So, I think it remains an open
10 question as to how quickly that might occur
11 because it depends on business plans and
12 spectrum availability or more effective
13 spectrum usage coming online.

14 I think, I mean, the data just
15 suggests that it is, by and large, not the
16 anchor point for people's home broadband
17 experience. I think we are just a good ways
18 away before we can even hazard some guesses on
19 that as the principal home access point for
20 people.

21 I think if you think that that is
22 going to happen in some fashion in the near-

1 term, you are going to have to figure out what
2 else people are doing to get online. Are you
3 in the apartment building with your 4G
4 subscription as your main broadband or your
5 only broadband access point, but are you going
6 down to Starbucks? Are you being
7 opportunistic about getting access elsewhere?
8 I think that is a likely pattern you might see
9 today. It might not happen in five years,
10 depending on developments in the marketplace.

11 Peter had a comment? And I think
12 we will need to wind up shortly thereafter.

13 MR. STENBERG: Yes, I have,
14 actually, one more brief comment. We seem to
15 be dancing around one thing in regards to
16 adoption and why people adopt is, what is the
17 goal for the adoption? Is it to do some kind
18 of entrepreneurial-type activity or is it just
19 to talk to their grandmother? That makes a
20 big difference in regards to what this
21 technology change will mean and also the
22 costs.

1 MR. HARRIGAN: Sort of the what
2 drives the adoption?

3 MR. STENBERG: What drives the
4 adoption?

5 MR. HARRIGAN: I mean, in my
6 experience, looking at data on broadband
7 adoption, when you ask people, "What do you
8 want to do online?" or "What is the most
9 important thing that you do online?", it is
10 communicate with family and friends.
11 Entertainment is on the list. It trails
12 communicating with family and friends.
13 Usually, second place is sharing information
14 or content with family and friends. So, it
15 might be pictures. It might be video.

16 Increasingly, a survey I was
17 involved with for Illinois last year asking
18 new broadband adopters what pulls them online,
19 there was a high incidence of people saying
20 getting healthcare information. So,
21 consequential information searches is a big
22 deal.

1 To me, it is always the answer is
2 always plural to that question. And I have
3 been looking at that question for at least a
4 dozen years. The notion of the killer app to
5 me has always not sat real well with me.
6 Because when you look at the data, what drives
7 people to using these gadgets and these
8 services, it is the opportunity to do a lot of
9 different things that they want to do when
10 they want to do it.

11 MS. SIMPSON: I would just make a
12 point. I mean, for some people, voice is
13 totally unnecessary. So, you know, you want
14 to go to text and data right away. And to
15 have to pay for it is useless if you are a
16 person without speech or deaf or hard of
17 hearing, or whatever. So, if anything IP
18 enables stops to become what you want, you
19 don't need to pay for it.

20 I mean, we saw that with video
21 relay service adoption, you know, early
22 adoption in our sign language community. So,

1 there is no reason to think that that isn't
2 going to be true for other people. I, myself,
3 have split my voice completely from my data.
4 I just have a feature phone for voice. Who
5 sits on the phone anymore? You know,
6 everything now is text.

7 So, I think we are really seeing
8 the divergence of voice and data or text in a
9 new way, and it is going to continue for
10 everybody, whether you like voice or not.

11 MR. SCHULZRINNE: This is, again,
12 following up a notion what additional data
13 would be useful. Looking at your
14 presentations, one thing that struck me was
15 this relatively-bold discussion of budgets and
16 costs for consumers. It matters in a number
17 of dimensions; namely, somebody has to invest
18 based on revenue, and it can't just be all USF
19 money. It is hard to say that. But the
20 budget, clearly, given that median incomes
21 aren't growing that much at least for most
22 individuals, it has to be to some extent

1 either a displacement of something else or
2 bucket or possibly within other buckets.
3 Maybe you buy fewer books and you buy more
4 broadband, or something like that.

5 So, one of the questions -- and I
6 don't know if you collectively have data --
7 is, as the not-relevant fraction of the why
8 don't I have internet connectivity to some
9 extent may well be an age one, it is hard to
10 imagine that a 20-year-old of any income would
11 say, "Internet isn't relevant to me." I would
12 like to meet that person. Maybe I can
13 introduce him to my daughter who uses the
14 internet way too much.

15 (Laughter.)

16 Longer-term, that seems to be an
17 age demographic one. But the income issues
18 will remain with us probably for quite some
19 time. So, I wonder if it is a dearth of data
20 that we have in the sense -- you certainly
21 have dug a lot into your treasure chests of
22 data, and it didn't seem to have as much on is

1 displacement driven in some cases simply by,
2 well, my cable bill keeps going up, so
3 something has to give; landline is kind of a
4 low-hanging fruit. Or is it one where now
5 communication total is consuming a larger
6 share of my discretionary income or my income
7 overall? What do we know? What more data do
8 we need? Because, in the end, I think that
9 drives both consumer adoption as well as the
10 investment dollars that are available.

11 MR. HERRIGAN: Chris?

12 MR. BAKER: Well, first, I would
13 say I don't think it is an age issue
14 necessarily as an exposure issue. You know,
15 if you are in the workforce, if you are using
16 it all the time, you see the consumer benefits
17 towards that.

18 To your other question about
19 spending, The Wall Street Journal did a piece
20 looking at consumer expenditure survey data a
21 ways back and found that, over the years while
22 consumers had cut spending on entertainment,

1 on food, on a variety of things, their
2 spending on wireless plans had gone up.

3 In a way, communications is so
4 important for a lot of people, that that might
5 be one of the things that -- they may scrimp
6 on their medicines, or whatever, to be able to
7 talk to their grandkids or whoever.

8 Five years ago, to go back to my
9 other issue, you might have said, "I can't
10 imagine seeing older people on Twitter or on
11 social media." And now, there is a
12 significant percentage of the folks that use
13 that.

14 So, I think it is over time the
15 adoption of it. And the National Broadband
16 Plan looked into this and recognized that
17 affordability has a relationship to relevance,
18 which has a relationship to digital literacy.
19 You know, if something is more affordable, it
20 becomes more relevant. If something is more
21 relevant, you know, you may be willing to
22 spend a little bit more for it. So, those are

1 important, I think.

2 MS. GONZALEZ: I just want to say
3 this is a huge issue for communities of color.
4 And I did speak about cost a little bit as one
5 of the -- you know, people are making hard
6 choices about what they want to buy in terms
7 of communications packages. For some
8 families, it is coming down to scrimping on
9 food or making choices that I don't think we
10 want to see people making. And so, I think
11 that has a lot to do, and I think there is
12 data out there about that.

13 MR. HERRIGAN: And I will just
14 make an observation on the point particularly
15 about communities of color and things that
16 prevent them from adoption. If you look at
17 Hispanics, in particular, cost is the main
18 reason that that group says they don't have
19 broadband at home. It is a younger
20 demographic.

21 So, to your point, they are
22 younger on average. They understand the

1 relevance, but cost is the big deal.

2 And then, I will just have a
3 little "get on my methodological soapbox" for
4 half a second on the practice of asking to
5 people on the telephone, "What is your main
6 reason that you don't have broadband?" And if
7 that is one question and you don't have it,
8 you are just going to throw out an answer, and
9 it gets categorized into, well, it is not
10 relevant to people. I mean, that is, in fact,
11 how these things work when you are doing the
12 surveys.

13 What we did for the broadband plan
14 was, basically, allow people to check multiple
15 reasons for not having broadband, get the
16 reasons in their head, and then, follow up
17 with a question that says, "Well, what is the
18 primary reason that you don't have broadband
19 at home?" The results of doing that shrinks
20 the relevance number dramatically.

21 Lots of people say it is not for
22 them when they are given the opportunity to

1 choose more than one reason. But when you,
2 then, on the second take on the question,
3 "What's your main reason?", as we found in the
4 broadband plan work, cost rises to the top,
5 which includes both monthly fee, but also the
6 cost of equipment, of computer access. And
7 digital literacy comes in next. Relevance
8 comes in third.

9 So, I tend to bristle a little bit
10 when I see the single-shot question on trying
11 to understand reasons for non-adoption. You
12 need to do a little bit more in the survey,
13 which gets you, I think, a more nuanced
14 understanding of the phenomenon.

15 And I see Andrew pining. This
16 will be the last word. We have cut into the
17 break to some extent, but I will let Andrew
18 say something.

19 MR. ANDREW BROWN: Let me just say
20 that the cost, it is not so much about
21 adoption because enterprise customers don't
22 really have a choice about whether they are

1 going to be online. But cost is a huge driver
2 in their ability to innovate or move resources
3 away from their core businesses to the
4 telecommunications that they have buy. So,
5 cost issues are always a factor in enterprise
6 customer decisions.

7 And that is why it is so important
8 for the enterprise community to have
9 competitive choices for all the different
10 services they use and why that is kind of a
11 mantra, that the more choices they have, they
12 will be able to drive costs down, innovate,
13 create more jobs. So, it is a huge issue not
14 just for people adopting on the consumer side,
15 but on the enterprise side as well.

16 MR. HERRIGAN: With that, we have
17 cut into the break.

18 Let me thank the panelists for
19 their time and intelligence and thoughtfulness
20 today, and thank our friends at the FCC for
21 (a) having us here and for the wonderful
22 questions from the assembled expertise from

1 FCC staff.

2 MR. LEV: And thank you, John.

3 Thank you very much.

4 MR. HERRIGAN: Well, thank you.

5 It is my pleasure.

6 We will conclude. At 2:30, we
7 reassemble for the final panel of the day on
8 some of the business perspectives.

9 So, thank you all very much.

10 (Applause.)

11 (Whereupon, the foregoing matter
12 went off the record at 2:10 p.m. and went back
13 on the record at 2:30 p.m.)

14 MS. GOODHEART: Good afternoon.

15 This is our third and final panel
16 for our workshop today. I want to thank
17 everyone for coming. This panel will focus on
18 the timing of different technological
19 transitions, looking at different types of
20 networks.

21 So, My name is Rebekah Goodheart,
22 and I am going to be monitoring the panel.

1 I will briefly introduce the
2 panelists and my colleagues at the table, and
3 then we will have each panelists give a
4 presentation of eight minutes, followed by a
5 discussion with the audience and online.

6 For those in the audience, we have
7 cards that you can fill out and bring to me.
8 We will try to ask them.

9 First, we have Tom Maguire from
10 Verizon, Michael Golob from Frontier, Matt
11 Grob from Qualcomm, Randy Nicklas from XO, and
12 John Civileto from Cox.

13 With me is also Sean Lev, Henning
14 Schulzrinne, and Jonathan Chambers.

15 So, with that, we will start with
16 Tom Maguire.

17 MR. MAGUIRE: Thank you, Rebekah.
18 Thank you for inviting us here today.

19 Okay. I thought I was going to
20 take the award for the shortest presentation,
21 and then, Jenifer had zero charts, and it is
22 kind of tough to beat that.

1 (Laughter.)

2 Anyway, today I am going to focus
3 in -- I know we opened up the session this
4 morning talking about four key elements,
5 competition, consumer protection, universal
6 access, and public safety. And hopefully, I
7 will be able to address each of those as I go
8 through some of the things that we are doing
9 today to transition our networks for our
10 customers.

11 Today what I am going to talk
12 about is primarily focused on consumers and
13 small business. I am not going to get into
14 too much about the enterprise network. And I
15 am going to try my best to steer clear of
16 exactly what is going on from a statistical
17 perspective and talk more along the lines
18 about what is happening from a customer
19 experience.

20 So, looking at the first slide, I
21 think we discussed this quite a bit. Dr.
22 Horrigan did a very good job this morning or

1 just a little while ago talking about all the
2 different statistics from either the CDC or
3 the FCC or other folks who have looked at what
4 is happening in the network today.

5 But I think it is pretty apparent
6 that customers have a ton of choices available
7 to them today. Regardless of whether or not
8 we are ready for this transition, it is, in
9 fact, happening. If you look at some of the
10 statistics, for example, like the 105 percent
11 wireless penetration, I think it is pretty
12 clear that people are adopting different ways
13 to interact with each other.

14 And we are faced with the issue of
15 cord-cutters now, but I think we also have to
16 be mindful of the fact that there could be
17 cord-nevers on the horizon. And if I look at
18 my own family, I could see examples with my
19 kids of individuals who do not rely on wires
20 to communicate with each other or to view
21 content, or whatever it is that they want to
22 do.

1 The other thing that is a bit of a
2 reality in the telecomm world today is that
3 the copper network is pretty limited when it
4 comes to what it can do to satisfy the
5 requirements of the future customer.

6 Bandwidth capacity, as we have discussed a
7 number of times, is critical. Speed I think
8 will also equally be critical.

9 And Jonathan asked a question a
10 little while ago about that inflection point
11 at which more people start to adopt bandwidth.
12 I think that inflection point is driven by not
13 only price, but also by the devices and the
14 ease of which these devices work. That is
15 going to allow different people, regardless of
16 the age of the demographic groups, to adopt
17 more bandwidth. So, that is something I think
18 we need to be mindful of as we look towards
19 what network do we want to use today.

20 The last reality I wanted to point
21 out is that the traditional copper network is
22 aging. Much of it has been in place for

1 decades. Some of it even predates my joining
2 the company a number of years ago. And if I
3 go back to basic high school science, it is a
4 metallic network, and its strength I think is
5 also its weakness because, once you take a
6 metallic network and you introduce water and
7 oxygen, you are going to get service
8 disruptions, noise, and other things which
9 really kind of get to the whole network
10 resiliency issue, I think, that Sean Lev asked
11 a little bit ago about, and, also, the stuff
12 that Jenifer Simpson mentioned as well.

13 Resiliency to me is not only about
14 working during a power outage, it is just
15 working on an everyday basis. I think, as we
16 look at some of the alternatives we have open
17 to us today, I think it is critical to kind of
18 keep that stuff in mind.

19 This next slide I threw in there
20 just to give an indication. It is really sort
21 of a graphic that represents where we are
22 headed in terms of bandwidth consumption. The

1 chart, the lower portion, the light blue
2 portion of the chart, represents our copper
3 bandwidth network, and our fiber bandwidth
4 network is represented by the darker portion
5 of the chart.

6 As you can see, bandwidth
7 consumption has grown significantly since
8 September of 2002. The thing that is kind of
9 interesting is the chart I used towards the
10 end of last year at a NARUC presentation.
11 This particular chart does not even reflect
12 the launch of the iPhone 5 or the iPad Mini.

13 And again, I think it gets to all
14 those, if you look at the different noteworthy
15 events that are captured on this page, it is
16 a bunch of different things that are changing
17 the way people draw on bandwidth. And I think
18 this is something that is going to continue to
19 grow significantly as we move forward.

20 So, given this, I think it really
21 kind of plays into our decision of, if we are
22 investing in a network, what is it that we are

1 going to invest in? And I don't think copper
2 is the answer.

3 So, in any event, what we came up
4 with is -- and this is borne out of being in
5 the field a couple of years ago. I was out
6 with a few individuals, and we were trying to
7 correct a service problem in a copper network
8 at a customer's house. And the thing that
9 struck me is that, while we were trying,
10 pretty much unsuccessfully, to come up with a
11 suitable pair to serve this customer, we were
12 literally standing on top of a piece of fiber
13 that was bypassing this customer's house.

14 So, at that time, we decided to
15 leverage that fiber to provide the POTS
16 service to this individual. Up until this
17 point in time, we were using fiber primarily
18 just as a service platform for our FiOS suite
19 of products and services, which is typically
20 viewed as a triple-play.

21 But we realized that, given the
22 technologies, we could also use fiber to

1 deliver plain, old telephone service to
2 people. Now leveraging that particular
3 investment would allow us to save money on
4 maintaining copper in that particular area,
5 and it would also drive increased customer
6 reliability and satisfaction.

7 So, last year we started moving
8 people over. By the time the year was over,
9 it was somewhere in the neighborhood of a
10 quarter of a million people that we
11 transitioned off of a copper network onto a
12 fiber network. And we did that by focusing
13 primarily on people who had, up until that
14 point in time, a history of trouble on copper.

15 While we saw that program was
16 successful, the one thing that kind of struck
17 us was the fact that our success was limited
18 by the amount of fiber that we had out in the
19 field. And so, therefore, we started looking
20 to see what we could do to help individuals
21 that did not have fiber in their backyard.

22 And we started focusing on our

1 wireless voice network, specifically the 1X
2 network. We started working on a device which
3 is called Voicelink, which essentially
4 emulates copper dialtone for a customer.

5 One of the things, as we focused
6 on this entire transition, that we thought was
7 critical was the need to match the features
8 and functionality that a lot of our customers
9 rely on today; for example, e-911 or TTY
10 capabilities.

11 So, we came up with this device,
12 and it is a simple, little element that we
13 attach in a customer's home. We isolate their
14 outside plant, the troublesome outside plant,
15 from the inside wire. This essentially lights
16 up all the jacks in the customer's house. And
17 when they pick up the phone, they will hear a
18 dialtone. When they dial 911, unlike other
19 devices, it will give the PSAP the exact
20 address of the customer. So, this way, in
21 case emergency services had to get to
22 somebody, they would know where to go.

1 Essentially, if you were a
2 traditional copper POTS customer and we snuck
3 in there in the cover of darkness and yanked
4 out the copper drop-wire and placed this
5 device in there, you wouldn't really know the
6 difference. The big difference, in my mind,
7 is that you would not have the same troubles
8 that you had with the copper service up until
9 that point.

10 The other thing I think is pretty
11 novel about this, and it gets a little to the
12 resiliency part, is that there are no wires
13 attached to it. In the wake of Sandy, one of
14 the biggest issues that we had to deal with
15 was going out and putting all the wires back
16 up that were knocked over by trees. In this
17 case, you don't have to worry about that.

18 Now the other thing that this
19 thing does, one of the issues that was raised
20 as we transition customers off of copper and
21 onto fiber was the eight-hour battery backup,
22 which we talked about during the first panel.

1 Just as an aside, we are working on an
2 expanded batter backup, one that is customer-
3 friendly in that they will be able to use
4 commercially-available batteries to control
5 however long they want to have their optical
6 network terminal up and running.

7 We have leveraged that in this
8 particular device. The original version of
9 this came with a 36-hour battery backup, but
10 we worked with the manufacturer and this
11 particular device works off of plain, old AA
12 batteries.

13 So, with the version I have in my
14 hand, these are regular store-bought double
15 AA's. They will give you 36 hours of battery
16 backups. The thing that is interesting, it
17 will give you roughly double the amount of
18 talk time as the rechargeable version.

19 So, by calculation, if you have a
20 12-pack of batteries from your local drugstore
21 or big box hardware store, you will be able to
22 have six days' worth of battery backup. So,

1 from a resiliency perspective, I think it is
2 pretty good.

3 The other thing that I wanted to
4 touch upon just as a closing statement, I
5 think the work that we have done has been very
6 focused on the customer's experience. But one
7 of the things I think is critical to the
8 success of this or any other sort of
9 transition program, just to echo the comments
10 from the last panel, is customer education.

11 We have run into a lot of
12 individuals who have been hesitant to move
13 over to a new platform. We are not changing
14 their service. We are not changing the
15 pricing. As a matter of fact, when it comes
16 to Voicelink migrations, we are actually
17 looking at some packages that are going to
18 cost the customer less. None of these
19 migrations cost the customers anything to
20 actually move, and their monthly pricing could
21 never be any more.

22 So, from a financial perspective,

1 the cost is the same. From a service
2 experience, the cost is the same. I think
3 there is just a natural hesitation for some
4 individuals to change the way they receive
5 service today.

6 So, I think one of the things that
7 we really need to focus on as an industry is
8 an education process where we could start to
9 let people know this isn't necessarily a bad
10 thing. This could actually, from a service
11 perspective, help them out in the long-run.

12 Thank you.

13 MS. GOODHEART: Thanks, Tom.

14 Michael?

15 MR. GOLOB: Hand me the clicker?

16 MR. MAGUIRE: Oh, sorry about
17 that.

18 MR. GOLOB: Thank you, Rebekah. I
19 appreciate that.

20 So, I just want to spend a couple
21 of minutes talking about Frontier and our
22 challenges with moving our network forward.

1 So, Frontier, if you look at just some facts
2 about Frontier, one of kind of the overarching
3 things that we need to consider is we have
4 about 26 customers per square mile across our
5 network. So, not the density, although we
6 have a few markets that are dense, but
7 primarily we are in rural, very rural America.
8 So, our challenge is, how do we leverage and
9 make that conversion to an IP network in very
10 rural America?

11 So, some of the things that we are
12 trying to do, I think similar to just about
13 everybody here on the panel or that has talked
14 earlier today, is the capability to deliver
15 all services over a common pipe, all
16 applications over a common pipe. How can you
17 be as efficient as possible?

18 Just like the airlines, they are
19 trying to fill every seat; when we build
20 broadband, we are trying to fill that pipe
21 with enough revenue to justify, especially in
22 rural America, where it is very costly for us

1 to build out.

2 We want to be able to be flexible
3 enough. We don't know what the next
4 application is. We had a couple of smart
5 scientists up here this morning. Whatever
6 they are thinking down the road, we don't know
7 what that application is. I mean, right now,
8 if you look at Netflix, and it is driving the
9 network, but I am sure that in three or four
10 years it will be something different than
11 that. The one thing you can count on is that
12 change.

13 I think, for us, we are looking at
14 deploying fiber. I would love to deploy fiber
15 to the home, to the farm in our case, but we
16 are not going to be able to afford that.
17 There is just not the payback in that model to
18 be able to do that. But, certainly, we want
19 to deploy it to our DSLAMS in our network.
20 And where we are in the suburban markets, we
21 want to be able to deploy that to the curb,
22 and then, leverage the copper network from

1 that area.

2 It is very important to us, and as
3 to all public companies, that total cost of
4 ownership, you know, to drive the model that
5 gives us a payback. When we invest in a
6 network and we sink our precious capital into
7 that network, we have got to look at five to
8 eight years out and being able to make sure
9 that what we are putting in the network today
10 is going to service us that long, because to
11 come around and redo these networks again is
12 extremely costly.

13 Managing traffic on the network,
14 being able to proactively manage traffic on
15 the network, so that we can be as efficient as
16 possible, to optimize that traffic on our
17 network.

18 And then, finally, leveraging the
19 existing equipment we have, we are trying to
20 squeeze, you know, frankly, every last drop of
21 blood out of that copper network that we can.
22 Because, as just was stated, copper goes back

1 and it needs to be replaced. But, as long as
2 we have that copper and we have good pairs in
3 a network, we are going to continue to
4 leverage those.

5 So, I have got a specific example.
6 I thought it would be important to understand
7 what we think it is going to take us at
8 frontier in order to be able to transition
9 this network. So, as you look today, the top
10 portion of the slide, is this really our
11 current copper-based ADSL2+ network that is
12 out there? And it has got a lot. It has got
13 ATM boxes in it. It has got the copper. It
14 has got the DSLAM in it.

15 When you look at changing over
16 these networks, you really have to look at
17 end-to-end, from our national data backbone
18 where we pair with companies like Verizon and
19 AT&T and others, all the way down to the home
20 in order to consider how do we modernize this
21 network.

22 As we move forward with this IP

1 network, you can see from the bottoms slides
2 that many of these pieces of equipment come
3 out of the network. It becomes more
4 efficient. We drive fiber as deep as we can
5 into the network. In this case here, I
6 demonstrate DSLAM. We have talked about
7 voice-over-IP. So, now we have a switching
8 room that is probably half the size of this
9 room with an old Nortel DMS-100, and we
10 replace it with a VoIP gateway that takes up
11 one rack of space. So, it is just iteration
12 of building this network to bring it forward.

13 I think one of the things that
14 often gets overlooked as we talk about this,
15 the first part of this, and being an engineer,
16 I love to put new, shiny equipment out in the
17 network, but the real challenge I think for
18 all of us is the back-office support systems.

19 So, we have a provisioning system
20 for TDM. So, now we are running dual systems.
21 It is not only dual networks of the copper
22 network or the fiber network or a TDM switch

1 versus a VoIP switch; it is also the
2 provisioning system. So, many provisioning
3 systems, you have to buy a broadband module to
4 be able to do that. So, now you are paying
5 cost on those.

6 Separate equipment management
7 systems that you have to have in order to do
8 your TDM process or your IP process. So, the
9 quicker you can move to an all-IP network, it
10 takes some of these costs out of the business.

11 But, then, there is the staffing
12 and the training. So, as our veteran
13 workforce leaves us and retires, we hire a new
14 engineer or a new technician that comes in,
15 and we have got to send him to train him on a
16 Nortel DMS-100 because that person is gone,
17 and we still have those in the network. That
18 is very costly.

19 Plus, we know that is not where we
20 want to go. That is not our vision of where
21 we want to be. But, at this point doing this
22 transition, you have got to be able to train

1 that. And so, you have got to have employees
2 that know the TDM network and know the IP
3 network. And those are different skill sets.
4 Some people can make that migration, but a lot
5 cannot make that migration to the new
6 technology.

7 So, whether it is in your network
8 operation centers, whether it is in your
9 provisioning centers, or whether it is in your
10 field forces, you have got to be able to look
11 at both of those technologies and make that
12 graceful migration.

13 And then, the older equipment, it
14 is just dying. There are pieces of equipment
15 that we have on our network, like many others,
16 that the only way that you can get spare cards
17 is to send them off and have them basically
18 remade from scratch.

19 And so, we are going to have to
20 move this network, I think as you said,
21 whether we like it or not, we are going to
22 have to move this network forward. We really

1 don't have a choice. It is, how can we do it,
2 take care of the customers at the same, and do
3 it cost-effectively, also, for our
4 shareholders?

5 Thank you.

6 MS. GOODHEART: Thank you,
7 Michael.

8 Matt?

9 MR. GROB: Thanks. I am glad to
10 be here today.

11 And I am looking forward to talk
12 to you about the evolution of wireless and how
13 we are going to provide a lot more performance
14 and capability than we have today, to 1,000
15 times more.

16 So, the first point is -- this
17 kind of echos what my fellow panelists have
18 been saying -- there is a transition to
19 wireless in households. It is really taking
20 off.

21 I can tell you from personal
22 experience -- I have got family members now

1 living in a small town in Illinois that have
2 turned off their wirelines and have gone
3 completely wireless. This trend is just
4 accelerating. There is more and more of it.

5 The question is, what happens as
6 time goes on and the networks become more and
7 more loaded? So, we look at not only the
8 conversion of wireline services to wireless,
9 but the explosion of mobile services. And we
10 try to decide how are we going to engineer the
11 networks for the future; where do we need to
12 set the bar?

13 And there are a lot of statistics
14 that tell us that we need to brace ourselves
15 for something on the order of a factor of two
16 every year for maybe the next 10 years. AT&T,
17 in particular, as an example, their network
18 has gone up, the mobile data network usage has
19 gone up 250 times over the past four or five
20 years.

21 So, we look at how we are going to
22 do that, how are we going to handle that kind

1 of load. And the way we are going to do that
2 is with a combination of approaches. One is
3 going to be densification of the network.
4 Okay? We are going to improve the radios as
5 much as we can. We are going to get access to
6 as much spectrum as we can. But there is no
7 alternative, in addition to those things, but
8 to shrink the average cell radius and have
9 smaller and more dense cell sites.

10 We are going to continue to evolve
11 third-generation and fourth-generation
12 cellular, add new features to it, features
13 like LTE broadcast, which allow venue owners
14 and places with a lot of users to supply media
15 and content very efficiently.

16 We are also going to introduce
17 device-to-device communications, which have
18 some very powerful features for public safety
19 scenarios and can result in very high
20 efficiencies for certain types of user
21 exchanges when users are close together.

22 In terms of the spectrum, there is

1 a continuity or a spectrum, so to speak, of
2 options that range everywhere from licensed,
3 as we know it today, the way traditional
4 operators buy spectrum in auction, own it, use
5 it, all the way to unlicensed, such as what
6 wifi is used in, and everything in between.

7 In the middle of that, we have
8 something we call authorized shared access,
9 which means you have a primary user, which
10 could be a government or a military user, that
11 owns the spectrum. Maybe they have a lot of
12 it, but they don't use it all the time, either
13 spatially or temporally, and it would be nice
14 to have that available.

15 So, using a technique that we call
16 authorized shared access, the incumbent can
17 provide it to a secondary user. The secondary
18 user can yield it very quickly back to the
19 incumbent, either temporally or spatially,
20 when the incumbent needs that. This is a way
21 to get access to more spectrum and it is a way
22 to march towards our 1000X.

1 But the real answer, the solution
2 that is going to make the biggest difference
3 is small cells, reducing the average radius of
4 infrastructure and, therefore, allowing the
5 spectrum to be reused more often spatially.

6 I actually brought one here as an
7 example. So, I am holding up, this is
8 actually a small cellular base station. This
9 is a commercial reference design. It is not
10 a prototype. The chips on here have been
11 available for more than a year. It is a
12 pretty small device. The largest component on
13 here is the ethernet connector. You will
14 notice, compared to a phone, it doesn't have
15 a display; it doesn't have a camera; it
16 doesn't have a battery. So, it allows us to
17 have a cost structure at or below what a phone
18 costs, and it is actually going to keep going
19 down, as we start to combine this with other
20 radios.

21 This one I am holding is 3G. We
22 are working on a 4G one. We are working a 3G,

1 4G, and wifi all together.

2 So, what do you do with this?

3 Okay. This slide here, if there is one piece
4 of information from this talk to remember,
5 this one is it. This picture is a picture of
6 a neighborhood, and the little red squares on
7 there are homes that have already deployed a
8 femtocell. So, this is not a simulation.
9 This is an actual measurement of something
10 that exists today. It is in the San Diego
11 area.

12 And we went out and we drove up
13 and down the roads and logged the signal
14 strength from these femtocells. Now these are
15 femtocells that are closed. In other words,
16 the users have purchased them, put them in
17 their home to improve the cellular coverage.
18 They only work on their own phones, and they
19 use their internet service as the backhaul.

20 But, since they exist and they
21 radiate, we can go and measure and ask
22 ourselves, what would happen if they were open

1 and allowed other users to connect to them?

2 As you can see from that chart, if you look at
3 the colors, they range from green to red. The
4 worst is red. But, even at the bottom there,
5 minus 110 db, which is a very weak signal, we
6 can still get over 700 kilobits per second.

7 So, if you look at the colors on
8 the roads there, you can see that this ad-hoc
9 network created by users buying their own
10 small cellular base stations actually provides
11 a very, very good outdoor coverage, and that
12 is a very compelling piece of information
13 because a technique like this with open
14 access, in cooperation with a backhaul
15 provider, with licensed spectrum, can provide
16 a very low-cost, very resilient, very dense,
17 high-performance solution that can actually
18 carry up to 1,000 times the traffic.

19 This chart here shows what
20 happens, let's say, over a 10-year timeframe
21 if we use the latest radios available, we,
22 through techniques with the authorized shared

1 access, clearing more spectrum, combinations
2 of licensed and unlicensed, are able to free
3 up 10 times more spectrum. And in this chart,
4 9 percent, say 1 out of every 11 homes, puts
5 a small cell, then we get 500 times more
6 capacity out of that spectrum than we have
7 today, in today's vintage of technology.

8 If we, then, turn up the knob a
9 little bit more to one user, one residence in
10 five over a 10-year time horizon, which seems
11 achievable because, again, these things are
12 already very low-cost. The cost is just going
13 to go down, down, down. So, you can embed
14 them into wifi access points, cable models,
15 set-top boxes, game consoles, or you can
16 subsidize them or just buy them outright.
17 There are many different models there.

18 If one in five with 10 times the
19 spectrum, then our results show that you can
20 actually have 1,000 times more data-bearing
21 capability than you do today without
22 necessarily having to raise the price 1,000

1 times because the user is not going to pay
2 more than they are today. They would like to
3 pay a little less, actually. So, we have got
4 to lower the cost, and that is what this is
5 all about, lowering the cost.

6 So, just to summarize, we see a
7 demand for densification. We see solutions
8 with small cell radius, combining both
9 licensed and unlicensed technologies, and new
10 deployment models.

11 Thank you.

12 MS. GOODHEART: Thank you, Matt.

13 Randy?

14 MR. NICKLAS: Yes, thank you. And
15 thank you, Rebekah, and to the Commission for
16 the opportunity to speak.

17 So, I am going to talk about XO
18 Communications. I have a couple of slides
19 that I will go through very quickly, and then,
20 I will describe some of the things that we are
21 doing with our network. I think there are a
22 lot of parallels with what you have heard

1 already.

2 I have got to learn to use the
3 clicker first.

4 Okay. So, first of all, we are
5 CLEC, and we serve only businesses. So, this
6 distinguishes us from some of our customers.
7 I think on the previous panel we had a
8 representative who spoke to the needs of the
9 enterprise, and he made a lot of good comments
10 there.

11 One thing I would say is that we
12 serve a variety of enterprises, including
13 other service providers. We have a healthy
14 wholesale business. So, we are selling large-
15 scale infrastructure as well as serving a
16 variety of enterprises with telecommunications
17 needs.

18 The next slide, we just cover all
19 of our things. I won't go through this
20 taxonomy except to say everything here is
21 essentially IP-based. We have a legacy CLEC
22 tail that I will have some more comments about

1 in a minute, and we have a full portfolio of
2 IP-based services for businesses, exclusive of
3 mobility, because we don't operate in that
4 space, although we have a number of mobile
5 operators as wholesale customers.

6 This map just gives you an idea of
7 where we operate. We operate essentially in
8 the largest U.S. cities, the NFL-cities-plus-
9 plus, I like to call them. We don't have some
10 of the challenges that some of our rural
11 colleagues have, and we have got a variety of
12 physical assets. So, we are fundamentally
13 facilities-based, primarily fiber optic
14 networks, but we are also heavily dependent in
15 how we deliver our services today on the
16 legacy, copper-based access networks. And I
17 think access networks are the hardest part in
18 telecomm by far.

19 So, this next snapshot has a lot
20 of words on it. I will to get through it
21 quickly in my timeframe here.

22 If you look at what we are doing

1 now, I would say all of our new network
2 investment and product development is
3 exclusively on packet technologies. That
4 should come as no surprise to anyone that has
5 paid attention today.

6 So, all telecommunications
7 services can be delivered via IP and are.
8 Okay? Ethernet we would say is the best way
9 to carry IP on a link-by-link basis, and it is
10 on its way to becoming the dominant access
11 technology. Today we offer ethernet access
12 services from 2 megabits per second up to 100
13 gigabits per second.

14 Roughly 40 percent of our new IP
15 services sold today are turned up using
16 ethernet access, either through our own
17 facilities -- this is the ethernet-over-X
18 comment -- or using ethernet E-NNIs, which are
19 increasingly prevalent. So, we expect that to
20 climb, and it has been climbing year over
21 year.

22 But I have to also point out that

1 the legacy TDM network that was created to
2 serve narrow-band voice DS-1's -- and by
3 DS-1's, DS-3's on bundled copper pairs
4 continues to be quite important. You have
5 heard that from a number of the panelists
6 today. I think you heard it from some of the
7 electronics vendors in the form of VDSL and
8 other technologies that are becoming available
9 and are used to continue to mine this very
10 important national resource.

11 The last comment I have here is
12 kind of more towards network engineers at
13 MPLS. It provides a greater service provider
14 toolkit. It allows us to virtualize our
15 networks across public and private IP kind of
16 compartments, if you like. It is more than
17 just the internet. IP technologies are a
18 super-set of the internet, although the
19 internet is probably the best representative
20 there, certainly the best well-known. MPLS
21 also gives us things like fast protection
22 switching and traffic engineering.

1 This next comment is quite
2 important. We had a long legacy tail, even
3 though we are not that old, of TDM switches,
4 TDM infrastructure, that we continue to
5 harvest, and people still continue to buy
6 things like PRIs based on the nature of their
7 customer premise equipment. Okay?

8 New voice interconnect is
9 primarily in the form of VoIP exchange with a
10 variety of providers, although we still have
11 TDM trunking being installed at times.
12 Interestingly enough, we are in the process of
13 removing our Feature Group D network.

14 In terms of capacities, I would
15 say the IP traffic, public IP traffic, doubles
16 every 12 to 15 months. There are some
17 fluctuations there, depending on our success
18 in the marketplace, and so forth. This drives
19 success of overbuilds of our national IP/MPLS
20 network.

21 Private IP services, so-called
22 MPLS VPNs, are the foundation of service for

1 our enterprise customers. On top of that, we
2 like to layer VoIP-based voice services and a
3 variety of other things. Okay

4 The second-to-last bullet speaks
5 to the physical layers that are in use by our
6 network. And copper, as I have already
7 mentioned, continues to be important. Except
8 for some corner cases, we don't operate those
9 copper networks; we lease them from other
10 providers. But the vast majority of the
11 existing customer base is built over those
12 things.

13 Using things like ethernet over
14 copper, as well as VDSL, there is still plenty
15 of bandwidth to be gleaned out of these
16 things. We want to make sure that they
17 continue to be available for us and others.

18 The statistic I quote here by the
19 Vertical Systems Group said that -- and this
20 is March 2013 -- "Only 36 percent of
21 commercial properties are passed by anybody's
22 fiber network."

1 Now I am sure, if you looked at
2 the GDP percentage that was passed by
3 somebody's fiber network, you would get a
4 higher number. But the point would be, if you
5 are not inside that fiber service area, then
6 you are relying on something else. And the
7 only thing else is copper or, in an
8 increasingly sort of way, radio networks,
9 mobile networks as well as fixed-wireless.
10 Okay?

11 In terms of new services and
12 platform developments for us in this snapshot
13 of 2013, 100-gigabit-per-second is here in
14 both the long-haul and metro fiber optic
15 networks. We are not the only ones,
16 obviously, that are doing those things.

17 The same thing on the IP networks,
18 that equipment is commercially available and
19 being deployed. And the very largest service
20 providers and enterprises are interested in
21 such things.

22 Cloud-based services are

1 increasingly important to IT departments
2 across the nation and to telecomm service
3 providers like XO.

4 So, I have got two minutes here to
5 get through another couple of years. So, I
6 will try to be brief.

7 In 2016 now, three years hence,
8 how do things look? Okay? Well, I think they
9 look pretty much the way they are now with
10 more. More what? More IP/MPLS backbone
11 growth, multiple IP networks on a common MPLS
12 and DWM core are very, very common. They are
13 common today. Okay?

14 But what I am saying here is that
15 many people operate standalone networks for a
16 variety of reasons. We are seeing those
17 things collapse, if I follow the industry
18 properly.

19 Our SONET infrastructure we think
20 will be at an apogee in terms of spent. It
21 will still be there; we will still lease
22 DS-3's and things like that.

1 Our decommissioning of our circuit
2 switch platforms will continue, but there will
3 still be some of those DMS-500's in our case,
4 not quite as many as Frontier and certainly
5 not in the Verizon network. There are many,
6 many of these switches still out there. Okay?

7 The five layers haven't changed.
8 Okay? But I think the percentage of fiber
9 penetration has certainly gone up. What it
10 will be remains to be seen. It is hard to
11 tell because no one publishes their plans.

12 We expect the microwave
13 backhaul -- we own a lot of LMDS spectrum. We
14 will start to take off as this cell
15 proliferation that my colleague to my right
16 just mentioned starts to take off. I don't
17 think the fibering-out of all these sites will
18 have happened.

19 I will skip now to the next page
20 because I am running out of time.

21 Now we are five years out. Things
22 are getting a little blurrier, at least in the

1 XO crystal ball. We think we still have got
2 a couple of circuit switches left, increased
3 fiber penetration, but copper continues to be
4 important. And I can't overstress that
5 because primarily we haven't seen any
6 timelines from the copper operators in terms
7 of when you are going to have essentially
8 equivalents in terms of passing of the
9 customer premises that are important to
10 companies like XO Communications. So, it has
11 to still be there; plus, it is incredibly
12 laborious to continue to deploy these things.

13 We use today 3G networks, mobile
14 networks, for IP backhaul, for IP services.
15 As a backup, we are going to start using 4G
16 networks as a primary access method. We think
17 in certain bandwidth regimes for certain
18 customers this is a very viable access
19 technology. Okay?

20 But, again, we still have to
21 eventually get on a wireline network. And
22 fiber is not as pervasive as anybody would

1 like it to be.

2 I have one last slide, a couple of
3 comments. We are seven years now in the
4 future. Okay? The IP networks I think at
5 some stage have kind of leveled off in terms
6 of their growth rate. I can't imagine what is
7 going to continue to grow, you know, doubling
8 periods every year or so. I don't see that
9 that far out.

10 Copper I think will still be
11 around. It has to be around until we see the
12 plans, the detailed plans, and perhaps the
13 regulatory regime that might be developed
14 around access networks to take its place.
15 Okay?

16 New services. All we know is that
17 there will be a set of interconnected and
18 sophisticated packet networks running IP
19 Version 4 still and Version 6.

20 Improvements in reliability and
21 cost basis are never-ending in companies like
22 mine.

1 Thank you.

2 MS. GOODHEART: Thank you very
3 much.

4 John?

5 MR. CIVILETTO: Thank you, Rebekah
6 and the Panel, certainly for inviting us here
7 today.

8 I am with Cox's technology team,
9 and I wanted to speak for just a few minutes
10 about how we deliver on Cox's vision of
11 connecting our consumers with the things that
12 are most important to them.

13 I will start off with talking just
14 for a moment about how we approach our
15 planning. And really, just two thoughts here
16 that are kind of on top of mind for today.

17 The first is just the evolution of
18 technologies and how we deal with that.

19 Certainly, we are living in a time where there
20 is very rapid innovation in our space. And I
21 think we see over and over that innovation
22 comes from multiple places. Sometimes it is

1 using capabilities that you already have to
2 solve new business problems, and sometimes it
3 is deploying new technologies. I think it is
4 the mindful balance of those two that enables
5 us to compete effectively in the marketplace.

6 The second part here that I will
7 just highlight very briefly is just the focus
8 that we are putting now on consumer behavior.
9 Historically, we might have tried to
10 understand the needs of our consumers and be
11 more predictive of those technologies and
12 trends that we would expect them to be looking
13 for. But, more and more, with the pace of
14 evolution now measured in months, not in
15 years, we look more to the consumer as a
16 directional guidepost for the services and the
17 offerings and how they are going to utilize
18 them. And this has become a very key,
19 important part of our planning process and how
20 we plan our investments.

21 Moving along, I wanted to share
22 just a little bit about our voice platform.

1 I think this is something that is interesting
2 for Cox. Cox was one of the first cable
3 providers to enter the telephone marketplace.
4 In 1997, we entered the marketplace using what
5 I would call certainly typical technologies of
6 that time, TDM-based, circuit switching, TDM
7 interconnect. We built out a robust platform
8 and offered services to many, many of our
9 marketplaces on that platform.

10 Later on, in 2004, we transitioned
11 over to packet cable-based technologies and
12 utilized a converged access architecture built
13 on top of our DOCSIS OP infrastructure. This
14 brought along the opportunity to combine both
15 voice and data services together on a single-
16 access technology, simplifying our
17 architectures. And this drove the bulk of our
18 expansion since then.

19 Beyond that, we have also built
20 out a robust set of enterprise and business
21 offerings that are based on both these
22 technologies as well as cable packet

1 multimedia or SIP-based services. These
2 services, broader in their offering, include
3 other access technologies, our hybrid-fiber
4 coax technologies, as well as passive optical
5 networks, as well as point-to-point fiber
6 technologies. So, really a broad basis of
7 different access technologies.

8 As we talk about the transitions
9 that are going on in our voice services
10 platform right now, there is really a couple
11 of key ones as we look to converge on our IP-
12 based technologies.

13 The first is we will continue the
14 transition of our customers from our original
15 TDM infrastructure over to the packet-cable-
16 based infrastructures, and the convergence
17 that that brings in our access network. That
18 is a key opportunity for us.

19 The second is the continued
20 migration towards IP interconnect. Cox has
21 been moving down this road for some time.
22 Approximately 50 percent of our long-distance

1 traffic is now handled via IP interconnect.

2 We certainly have a large amount of local TDM
3 interconnects still in place, but we would
4 continue to look to make that transition over
5 time. As we think about these continued
6 evolutions in the voice marketplace, we will
7 continue to look for opportunities to converge
8 towards IP-based technologies.

9 Next, I wanted to talk just
10 briefly about our video services platform. In
11 many ways, our video services platform shares
12 a very similar legacy to our voice services
13 platform. It was built on a number of
14 technologies a while back. And frankly, these
15 technologies, while some were proprietary in
16 nature, enabled it to grow and to scale very
17 rapidly, and even today, provide a very robust
18 set of services that our consumers continue to
19 find and enjoy a lot of benefit in.

20 That being said, much like our
21 voice platforms, there are opportunities,
22 through convergence on IP-based technologies,

1 to extend the reach of this platform. IP is
2 certainly reshaping the marketplace in video.
3 Certainly, the ubiquitous reach of IP access
4 networks is changing the way consumers are
5 consuming our products and services.

6 Our top priorities are to expand
7 content and bring very compelling experiences
8 to our consumers. That being said, IP
9 technologies are certainly a core of how we
10 are doing that going forward.

11 At each layer of our network,
12 starting five-plus years ago, at each layer of
13 our network we began to evolve our core
14 technologies underneath, enabling, where
15 possible, based on IP open technologies. The
16 benefits of this our consumers are now
17 enjoying today, as they are able to enjoy our
18 live video services across a broad number of
19 devices, including tablets, phones, computers,
20 laptops, as well as the traditional TV set.

21 As we think about how we are
22 achieving this, the keys here are focusing on

1 open IP standards, where applicable. This has
2 enabled a great opportunity for reusability
3 across our technology stacks, speed to market.
4 We have been big proponents of supporting open
5 standards, where applicable, such as HTML5 and
6 DLNA. And we will continue to do so to
7 further this cause.

8 As we think about the evolving
9 video marketplace, I am sure that it will
10 continue to evolve dramatically over time.
11 However, I feel pretty confident that the
12 choices that we have made are enabling us to
13 be prepared to compete in the future.

14 Lastly, I wanted to talk for just
15 a brief second about our evolution in our
16 networking technologies. I am not going to
17 really dive off into many of the technologies.
18 Certainly, the group here has done a great job
19 of setting that stage, but, really, we will
20 just talk about one trend that is really
21 impacting the consumer. And that is the
22 ongoing innovation that is going on here.

1 Consumers are benefitting
2 tremendously from the technology innovations,
3 many of which this group has touched on
4 already, whether that is our DOCSIS
5 technologies, 4G in the marketplaces, wifi
6 services. These are all great examples of the
7 innovations that are going on in the
8 marketplace.

9 Parts of the Cox network operate
10 at 100-gigabit-per-second. But these are
11 transitions that the consumer is largely
12 unaware of. And that is really the point that
13 I would like to spend just a moment and talk
14 about. That is, it is the role of the service
15 providers to bring these technologies to the
16 consumers in a manner that is seamless, brings
17 compelling services, and transparent to the
18 user.

19 Reflecting on all the conversation
20 and the transitions that we are talking about
21 consumers are going to undergo, it would be
22 very easy to lose the focus on what it means

1 to the consumer. So, stewarding them through
2 these many changes across our voice platforms,
3 our video platforms, our network
4 infrastructure, bringing new technologies like
5 DOCSIS 3.1 that Ralph shared with us this
6 morning to our consumers, and greater and
7 greater speeds, or Matt's new small cell
8 solutions are all great opportunities for the
9 consumers, but ones that we must help them
10 through in a seamless manner.

11 As we proceed, we are very focused
12 on fulfilling the needs of the consumer,
13 focusing on simplicity, consistency, and
14 reliable solutions. These plans, as we focus
15 them, will deliver on bringing the best
16 customer experience, enabling the most
17 advanced technologies, and connecting people
18 with the things that they care about the most.

19 Thank you.

20 MS. GOODHEART: Thanks, John.

21 We will have an interactive
22 discussion with all of the colleagues at the

1 table, but I think I will start off by asking
2 -- XO presented sort of a snapshot of where
3 the network is going to look in three and five
4 years. If the other panelists could do so?
5 And, in particular, for Verizon and Frontier,
6 XO talked about both copper and TDM being
7 present in their network for the foreseeable
8 future, in the next three to five years. So,
9 how do you see that transition and what is the
10 key driver of the technology transitions?

11 MR. MAGUIRE: One of the things
12 that we are focusing-in on is looking at
13 copper infrastructure where it is not working
14 up to the standards that we want it to work
15 at. We are not necessarily going out and
16 ripping copper out of the network right now,
17 but one thing has kind of struck me. And I
18 wrote down, you said, "Right about now, we are
19 at about 36 percent of enterprises pass that
20 fiber." And then, four years out, that grows
21 by probably about 100 percent or so, up to
22 about 65 percent.

1 The one thing that struck me is,
2 if we have to maintain copper where nobody is
3 using it, which some folks have talked about,
4 I really don't see even potentially hitting
5 that 65 percent because all of our money is
6 going to be tied up in maintaining a network
7 that is somewhat limited in technology.

8 So, I think one of the things that
9 we need to look at is, in areas where it does
10 not make sense for us to maintain copper, is
11 to accelerate the movement off of that copper
12 onto other technologies that are available.
13 To go out and support a network that is both
14 environmentally-sensitive and somewhat limited
15 in scalability doesn't really make a lot of
16 sense.

17 So, I think, collectively, as an
18 industry, it is probably in our best interest
19 to figure out how we could leverage additional
20 technologies today and see what we could do to
21 try to accelerate the shift over to newer
22 technologies, but to do so while involving the

1 customer and making sure that they are
2 comfortable with that transition. I am not
3 suggesting that we go in there and just roll
4 over everybody, but I think we need to kind of
5 look at the best way to approach the future.

6 MS. GOODHEART: And just to follow
7 up about the TDM, sort of what is the pace of
8 you switching out your TDM switches and
9 different architecture?

10 MR. MAGUIRE: Well, I think a lot
11 of people are moving themselves off of TDM.
12 I will just talk about it from a consumer
13 perspective. I know a lot of the people that
14 are out there who are adopting our triple-play
15 packages, for example, are taking advantage of
16 the fact that they can move over to a VoIP
17 product.

18 So, at some point in time, we are
19 reaching a juncture where the TDM switches are
20 really becoming obsolete. I know we talked
21 about a lot of manufacturer discontinued
22 equipment. I have been focused a lot on what

1 has been manufacturer discontinued or tough to
2 support from an outside perspective. But the
3 same holds true for some of our network
4 elements as well. And so, I think looking out
5 a couple of years, I think the TDM switch is
6 kind of going to fade off into the distance.

7 MR. GOLOB: So, I will start with
8 on the TDM. Certainly, it is going to be in
9 parts of the network for, I think, in the next
10 five to eight years easily, and maybe in some
11 places beyond that.

12 But there are going to be certain
13 triggers that cause us to move forward. I
14 don't know what all those triggers are, but
15 they could be simple things like, you know, a
16 storm like Sandy that says, "I'm going to go
17 back and replace. Why would I go back and
18 replace stuff with 20-year-old technology?
19 Why don't I take this opportunity to move
20 forward?"

21 It could be in a particular area a
22 simple thing like a road move. So, if I am

1 going to have to be forced to put in a new
2 network, maybe I put that new network in as
3 fiber to eliminate some of my copper problems
4 in the area.

5 It could be things like power
6 consumption. These large, old TDM switches
7 are power hogs. I mean, they suck down the
8 power like crazy. So, that may be the driver.

9 But I think, more than likely, it
10 is going to be all those things that are
11 drivers that add to the tipping point that
12 causes us to move forward in a particular
13 area. So, there will be some areas of our
14 network and some markets that will tip before
15 other areas or other markets tip, just because
16 we are fortunate in some areas, and we are not
17 fortunate and Sandy comes along in another
18 area.

19 MS. GOODHEART: Anyone else want
20 to speak about sort of a snapshot in five
21 years?

22 MR. NICKLAS: Well, I will say a

1 couple more things in the XO context. So, my
2 colleague from Frontier mentioned some of the
3 drivers. For us, some of the drivers are
4 things as mundane as real estate leases and
5 things like this, which will drive us to
6 essentially decomm a circuit switch.

7 But, then, there is a desire to
8 maintain the revenue that is flowing through
9 the switch. In some cases, that is still
10 pretty substantial. And nothing is more
11 uninviting, if I can put it that way, to my
12 great existing revenue base off of a TDM
13 switch onto a soft switch or another TDM
14 switch, you know, the next popover sort of
15 thing.

16 So, there are lots of factors; I
17 agree with that. And there is this fine
18 economic balance that has to be struck. I
19 just continue to remark that there are
20 thousands of these devices in operation in the
21 United States today, and it is not going to
22 get any better. Certainly, no one, I don't

1 think, is spending any money on them in the
2 sense of augmenting them or anything else.

3 Maybe it is a business opportunity
4 at some stage for people to remanufacture
5 cards and to take them over, to operate them
6 on behalf of the current operators. I don't
7 know. It is a tough thing.

8 MR. CHAMBERS: I want to go back
9 to something Tom was talking about in his
10 presentation. The last panel we had, there
11 was some discussion about cutting the cord.
12 Thirty-four, I think the most recent figure is
13 36 percent of the population has cut the cord.
14 But that is a consumer choice to go mobile-
15 only rather than having a fixed-line at the
16 home.

17 The kind of cutting the cord that
18 Tom was talking about is different. It is a
19 network cord-cutting, based, as I understand
20 it, on where Verizon already plans to have
21 FiOS or where they plan not to have FiOS in
22 the future.

1 So, if you can speak a little bit
2 more to the decision that goes on as to where
3 and at what pace you might be deploying fixed-
4 wireless solutions, as the one you were
5 showing us earlier?

6 And then, I guess related to that
7 -- and then, maybe at this point Matt can jump
8 in as well -- you were talking about putting
9 this on your 1X network. So, it is a voice
10 solution. But for those customers in those
11 areas who want data service as well, what are
12 you looking at there? Is it, you know, again,
13 eventually the kind of thing that Matt was
14 talking about, leveraging your existing mobile
15 network, putting small cells in? I am not
16 going to answer the questions for you.

17 MR. MAGUIRE: Well, that is okay.

18 As we look to where we are going
19 to deploy the Voicelink product, we are
20 focused on areas where we are spending a lot
21 of money on maintaining the copper plant. In
22 addition to spending the money on the plant,

1 we also have customers who are not very happy
2 with us. So, we are essentially giving them
3 a reason to leave us. As you point out, it is
4 a voice-only device at this point in time.

5 So, we are looking specifically at
6 offices or at customer locations where they
7 are just completely aggravated and we are
8 spending a fortune to make them aggravated,
9 which doesn't make a lot of sense from a
10 business perspective. And we can easily
11 identify those areas or clusters of customers
12 where they have a bad service experience.

13 The reason we decided to go this
14 route, as opposed to just telling them, "Hey,
15 we're not going to do this anymore" -- let's
16 throw COLR obligations on the side for the
17 time being -- is we wanted to maintain the
18 relationship with that customer. I think
19 Henning pointed out earlier there is a big
20 discussion or a question out there of who does
21 what. We are looking to maintain that same
22 relationship so the customer will customer

1 will always come to the people that they have
2 gotten used to coming to in order to check
3 billing issues or to report a service issue or
4 to have a general question about what is
5 happening.

6 So, we wanted to deploy this in
7 their homes and make it almost a transparent
8 device, where it essentially just does the
9 same thing that copper does. And again, we
10 are focused on areas where we don't presently
11 have fiber today and areas that do have a bit
12 of a copper problem.

13 As far as looking forward to the
14 future, we are having discussions about people
15 about how we could incorporate data into this
16 as well. There are some areas that we have
17 gone to, interestingly enough, where we have
18 deployed this device, where it is a very rural
19 device. It works very well from a voice
20 perspective, but the folks who are out there
21 are still using dialup to a certain degree.
22 And so, we are looking to see what we can do

1 to leverage some of the technology that we
2 have available in the wireless world, but
3 maintain that same relationship I spoke to a
4 minute ago, and create that same sense of
5 comfort with the customer, so they kind of get
6 the best of both worlds.

7 Those discussions are just kicking
8 off. Hopefully, we will be able to pull
9 something out within the next couple of
10 months.

11 MR. CHAMBERS: So, would that mean
12 in your networks at some point in the future
13 -- you don't have to pick any date -- that you
14 will either have FiOS or you will have some
15 fixed-wireless solution, but you won't have
16 ADSL/VDSL?

17 MR. MAGUIRE: Well, actually, I
18 think we are going to have at some point a
19 combination of all three. It depends on the
20 demographics of the area, what the customer
21 requirements are. In some cases, we might not
22 have a very good wireless signal, for example,

1 but we will have a copper infrastructure out
2 there. So, we will maintain the copper. So,
3 I think we are going to have all three
4 elements working at some point, at least for
5 the foreseeable future.

6 MR. SCHULZRINNE: I wanted to
7 follow up on the kind of transitions that are
8 going on that we have talked throughout the
9 panel; namely, one is at the access network
10 the last mile, and then, on the physical
11 infrastructure, and then, it would be TDM IP
12 on the access network side, on the consumer-
13 facing side, and then, TDM 2 IP on the core
14 network side.

15 These all seem to be happening,
16 relatively speaking, on independent timescales
17 and on geographic diversity. So, I wonder if
18 we can more closely look at each one of those
19 now. If we look at the backbone, if you
20 would, to say, just ignoring access, consumer
21 or business access, in 2016 or so, or maybe
22 five years down the road, will we still have

1 kind of Class-4-type network switches, kind of
2 a classical route? Or will it basically be,
3 even if business still themselves have PLI,
4 everything else on the backbone side will be
5 IP? Is that still too early?

6 Anybody want to venture that?

7 MR. NICKLAS: So, you know, this
8 will vary by network, obviously, but I will
9 speak for our company. We have essentially
10 been VoIP on the inside for LD traffic since
11 2001, because we had a big enough and capable
12 enough IP MPLS network with class of service,
13 and we had a large-scale national soft switch
14 deployment. So, we have been VoIP on the
15 inside for a long time. And I guess you could
16 us on a soft switch a Class 4, if you so
17 desire, but it is not like a DMS-250 or
18 something like this.

19 MR. SCHULZRINNE: Right. Okay.

20 The others, anyone want to comment
21 now, too?

22 MR. GOLOB: So, I think that what

1 you will see is a transition where maybe we
2 will use the frames or some of that to serve
3 those customers that don't want to move, but
4 the guts and the brains are going to move all
5 to IP.

6 I mean, there are several vendors
7 out there that are working on that very
8 strongly now. I think that is probably what
9 you will see happen. Because these networks
10 are like oil tankers; you don't turn them
11 quickly.

12 (Laughter.)

13 And so, you know, it is a step-by-
14 step process.

15 MR. SCHULZRINNE: Anybody else?

16 MR. CHIANG: And the other
17 component that I was wondering about is,
18 indeed, one you were talking about it on the
19 Verizon side, on the wireless side. We are
20 talking, roughly, about 25 gigabytes today for
21 median home usage for broadband users. That
22 seems challenging to do in a 4G type of

1 environment, given the average consumption.

2 So, do you see that primarily as
3 -- you mentioned hybrid networks -- that light
4 users would migrate to 4G and others, if they
5 can not get fiber, obviously, would be using
6 DSL? Or how would you envision that?

7 MR. MAGUIRE: I mean, we haven't
8 divided it into different tiers depending on
9 the usage of the end-user. Right now, again,
10 we are just getting into the discussion about
11 the capabilities.

12 I think a lot of it, as we pointed
13 out on one of the earlier panels, a lot of it
14 is going to come down to the cost to the
15 subscriber. Some subscribers might be willing
16 to pay for like LTE costs. We have a base of
17 customers out there who are paying for all-
18 you-can-eat DSL very competitive rates. And
19 by that, I mean dirt cheap.

20 And so, just from a business
21 perspective, it is going to be tough to get
22 those people to get off of one and onto a more

1 expensive network. So, this is something I
2 think we are going to have to look at very
3 carefully.

4 MR. GROB: I would like to comment
5 on that as well. If you have a 4G network on
6 a cellular band or a PCS band of today with a
7 large coverage radius, and it covers a couple
8 of kilometers, and there's a bunch of users
9 there, and you ask, "Can you supply 25
10 gigabytes?", then that is challenging.

11 But the reason it is challenging
12 is more because of the radius rather than the
13 modem. If you are able to reuse that spectrum
14 much more often, then it is not challenging at
15 all. You can definitely achieve it.

16 In fact, that is exactly what is
17 happening with wifi today. I just read a
18 Cisco report recently about the total amount
19 of the entire internet traffic that is carried
20 that way, and it is getting to be a pretty
21 substantial fraction.

22 So, if you normalize to radius,

1 then you can actually outperform with 4G
2 versus some alternatives, if you normalize the
3 amount of spectrum and the amount of radius.
4 So, that is the model that we want to get to.

5 It is certainly true, what you
6 said today; if you have a tower and it is
7 covering a large swath, which used to be the
8 goal of cellular, and every one of those users
9 has got devices like these and are trying to
10 pull 25 gig a month, then you are going to
11 have trouble. But that is why we have got to
12 densify, and that is why we have got to shrink
13 the radius.

14 MR. CHIANG: But, then, you have
15 kind of a chicken/egg problem where that works
16 if you have fiber deep in the network because
17 you are not going to run one of these. I
18 mean, 100 megabit 4G out of ADSL, that doesn't
19 seem like a good model.

20 MR. GROB: Right. There is no
21 doubt that -- I am not sure I would call it
22 chicken and egg. I would just say the demand

1 for backhaul is just going to be there. We
2 have got to have it. You are going to need
3 that for any of these class of solutions,
4 absolutely correct.

5 MR. CHIANG: So, what radius would
6 you anticipate? If you were to design this
7 densification model, particularly in the areas
8 that are unlikely to have fiber, so they are
9 not the densest or wealthiest areas, but they
10 are the ones where you could deploy backhaul
11 fiber through some, I guess, aggregated number
12 of households. How many would you serve out
13 of each one of the small cells, roughly
14 speaking, in order to make that model work,
15 and not run fiber to every household, in which
16 case you haven't really saved any money to
17 begin with?

18 MR. GROB: Right. You know, to be
19 able to put specific numbers, you would have
20 to give us some figures, and so forth. But it
21 is definitely the case that, for a given
22 backhaul, if you have got a certain amount and

1 you want to serve users with that, and you
2 compare, whether it is 4G or wifi or 3G, they
3 are really all going to be limited by that
4 same backhaul. That is going to be the
5 determining factor for all three of those
6 last-segment solutions.

7 MS. GOODHEART: I wanted to talk a
8 little bit about, one of the things we are
9 looking at is sort of the resiliency and
10 reliability of the networks as we transition
11 from copper to fiber. So, Tom and Michael and
12 XO, if you could speak a little bit about, as
13 you move from copper to fiber, how has been
14 the difference with the reliability of the
15 lines, like the troubles that you are getting
16 per line from fiber versus copper, and if you
17 have been able to quantify the cost savings of
18 doing so from the OPEX side.

19 MR. MAGUIRE: Well, as I said,
20 last year we moved about, it was actually
21 about 222,000 customers off copper and onto
22 fiber. We think we have saved -- we haven't

1 saved an equivalent number of dispatches
2 because some of that had to do with
3 provisioning work. We were going in and
4 putting the customer right onto fiber in the
5 first place.

6 But we saved well over 100,000
7 dispatches. These things really kind of add
8 up, depending on whatever the cost, the labor
9 cost, happens to be in a particular area.

10 I had my folks do a little bit of
11 a study prior to Sandy. We looked at the
12 copper infrastructure. We looked at people
13 who had chronic issues with copper, and we
14 looked at people that we have migrated over to
15 fiber.

16 And in the month of September, we
17 had nearly three dispatches per 100 lines in
18 service on the copper side. When we looked at
19 people who had chronic history, it was over
20 5.5 dispatches per 100. And when I looked at
21 the folks that we migrated over to fiber, it
22 was .61 dispatches per 100. And again, that

1 is outside plant troubles to outside plant
2 troubles.

3 And so, we have gone back and we
4 have done not only from a dispatch savings
5 perspective, but also from a customer
6 satisfaction perspective, and I think it has
7 more than offset the cost of migrating these
8 people over to the fiber network. It has been
9 pretty significant.

10 MR. GOLOB: So, I would say the
11 stat of the troubles are similar to what we
12 see. Our challenge is getting the fiber out
13 into these very rural areas and the distances
14 that we have to build that fiber. So, the
15 cost of doing that, it is not a very quick
16 payback at this point. That is really the
17 biggest challenge.

18 And then, the other second-biggest
19 challenge is people want to continue to dig
20 our fiber up, you know. So, if you could
21 solve that one for us, it would take a lot of
22 the troubles out of the network.

1 MR. MAGUIRE: Now can I add one
2 little thing? It is an interesting point in
3 terms of the cost to build out. The beauty of
4 what it is that we are doing is that this is
5 part of the fiber rollout that we started, you
6 know, I think somebody said this morning it
7 was 10 years ago. It was nearly 10 years ago.
8 So, this infrastructure is already out there,
9 and it was really just a matter of deciding to
10 take that infrastructure that is literally in
11 place next to the copper and use that to
12 provide other services. So, that helped us
13 pretty significantly.

14 MR. GOLOB: And we are certainly
15 leveraging where we are providing the backhaul
16 to the towers for our customers; they sit on
17 both sides of me here. I mean, we are
18 certainly leveraging that to try to overcome
19 that copper network. So, it is all about
20 trying to leverage what you have and maximize
21 it.

22 MR. NICKLAS: So, I would agree

1 with everything my colleagues have said. We
2 are certainly very familiar with the
3 difficulties in getting copper loops kind of
4 turned up when we put our own electronics on
5 them. Once they are up, they tend to be quite
6 reliable, except when they gets submerged and
7 things like that, as has already been pointed
8 out.

9 The problem -- and I just have to
10 go here for just a little bit, and I apologize
11 in advance perhaps -- but the problem,
12 everybody wants to get to a fiber network if
13 they are just a pure engineer. That is for
14 sure. A fiber network serving very dense
15 cellular systems for the mobile subscribers,
16 but also serving pretty much everywhere for
17 all of these gobs of bandwidths that we want
18 to have everywhere, in the workplace, at home,
19 and to serve our mobile devices.

20 The problem we see, though, is --
21 and we have said this; we have said this to
22 our current copper loop providers, T1

1 providers -- we would like to get to a stage
2 where we can just buy on an equivalent or
3 better basis ethernet virtual circuits across
4 an ethernet-based, fiber-based access network
5 with the same cost basis that we can achieve
6 through unbundled copper elements with our own
7 electronics on them, which are available to
8 us, of course, because of the good work of the
9 Commission and others. Okay?

10 But you don't see any of that in
11 the new next-generation networks. That, in a
12 nutshell, is our difficulty. Okay? So, I
13 think we would all agree that the end-point
14 from a technical perspective, it is going to
15 be a combination of fiber and radio with
16 vestigial use of copper.

17 But what happens to alternative
18 access? What happens to competitive
19 providers? It is unclear.

20 MR. LEV: So, if I understand the
21 discussion so far, all the investment going
22 forward is in IP-based networks, but TDM-based

1 switches are going to exist for quite a while.
2 And so, you will have some aspects of that for
3 eight or ten years, I think Michael says. Tom
4 is somewhere on the order of eight or ten
5 years you will be supporting some form of a
6 TDM network, roughly.

7 And I understand that there are
8 costs of that duplication. What would be
9 helpful to understand is how you quantify or
10 subdivide those costs? You talked about back
11 office. Can we put a little more meat on the
12 bone as to what the key cost drivers are in
13 having to support two networks?

14 Because it could be the
15 maintenance of the physical facilities. It
16 could be the training. In terms of informing
17 policy going forward, it would seem to be
18 helpful to know, for this fairly long period
19 when we are going to be supporting two
20 networks, what the key cost drivers are.

21 MR. CIVILETTO: I might start real
22 quick.

1 MR. LEV: Sure.

2 MR. CIVILETTO: So, for us, I
3 think it comes into a couple of buckets, and
4 I don't know if I can give you a specific
5 percentage breakdown. But I thought Michael
6 did a great job of telling the story of the
7 legacy of maintaining those plants.
8 Certainly, that personnel and that skill set
9 is an evaporating quantity in this phase. And
10 so, maintaining that is certainly one of the
11 challenges.

12 For us, I think some of the other
13 challenges really come down into other big
14 buckets, just platform obsolescence. The
15 whole conversation around getting the hardware
16 is increasingly becoming challenging. We do
17 have sources today, but over time that
18 continues to be challenged.

19 And then, the third one is the
20 physical reality. They do take up a
21 significant amount of our physical space, and
22 I think we would like to repurpose that for

1 better technologies. And so, over time in
2 some cases that is driving the transition for
3 us. Where we face a facility expansion
4 project and the alternative is to remove the
5 TDM infrastructure instead and create the
6 space, we have gone that route.

7 So, I would say those are three
8 pretty good examples of where it is impacting.

9 MR. GOLOB: So, I think there are
10 probably more data points out there, but one
11 data point I just looked at. So, I just took
12 our cost per customer for our TDM switches
13 that we pay for maintenance over the last
14 three years, and that cost per customer has
15 gone up a million dollars. Because, as we
16 have lost customers off of that network, then
17 the cost per customer goes up. So, that is
18 just one data point. I think if you sit down,
19 you could analyze a number of data points in
20 the network.

21 MR. LEV: Yes, I think as we go
22 forward, and not necessarily today, it will be

1 helpful to understand, because this is going
2 to be a reality it sounds like we are going to
3 be living with for quite a while, that there
4 are a variety of costs, because there are
5 going to be two networks for a decent amount
6 of time. It may be very helpful to understand
7 what imposes costs of that reality that is
8 going to exist.

9 Tom?

10 MR. MAGUIRE: Yes, I mean, the
11 only thing I would add is, you know, I just
12 kind of grouped them together in some big
13 buckets. Power costs are one we discussed;
14 personnel; the whole training issue;
15 maintaining in some cases duplicate field
16 forces or even switch forces to maintain the
17 stuff; the availability of parts; real estate;
18 taxes. You know, a lot of the stuff adds up.
19 Pole attachment fees. A lot of little things
20 add up.

21 MR. LEV: Yes, and I think it will
22 be helpful to get as much detail as we can as

1 we go forward on that because, you know, if
2 there is a way to spend money otherwise that
3 would allow innovation, I think, that would
4 not harm other policies, then we should look
5 at that.

6 MR. MAGUIRE: Very good.

7 MS. GOODHEART: A question for
8 John. So, this morning Ralph from CableLabs
9 identified that DOCSIS 3.1 is going to have
10 more opportunities for business. On the last
11 panel, we heard that cable really isn't or it
12 didn't appear to be a big player in the
13 business market. Can you speak to how one of
14 your slides talked about sort of a focus on
15 the business market, how the technology
16 transitions have enabled this, or what is your
17 focus and what type of services are you
18 providing to the business community?

19 MR. CIVILETTO: Sure. So, Ralph
20 touched on this morning a number of the
21 capabilities that have come over time in the
22 DOCSIS roadmap. With each release, there have

1 been more and more capabilities, and many of
2 those have been aimed at driving the feature
3 set into more of what an enterprise-based
4 customer would want.

5 That being said, I think 3.1
6 primarily provides more speed capability, more
7 than other feature sets. So, as I think about
8 how it will step into the enterprise space and
9 be a solution, I think it will help us to
10 address probably some of the concerns around
11 peak speed offerings as well as symmetrical
12 services. There are a couple of areas where
13 3.1 would be a good solution in the commercial
14 space.

15 Certainly, while we look forward
16 to 3.1 and what it can do for us, you know,
17 those needs today we also offer other access
18 technology solutions, where appropriate. Our
19 HFC network is the most prevalent, and it
20 passes the most businesses today. But we also
21 have fiber networks that are in front of many
22 of those businesses as well.

1 And so, we offer, whether PON-
2 based architectures as well as point-to-point
3 fiber services, to solve some of those other
4 business needs. So, I think, for us, it is a
5 suite of products that help address those
6 issues.

7 MR. SCHULZRINNE: All right. Just
8 to follow up on that one, in another
9 conversation I was actually somewhat surprised
10 -- I don't think it was your company -- but
11 another company in California was offering
12 wholesale access on their network to address
13 as an additional big pipe, so to say, into
14 businesses, in particular.

15 Is DOCSIS 3.1 enabling that type
16 of separation as well, so that you could, at
17 least theoretically, offer an independent IP
18 connectivity where the IP part -- where you
19 are essentially offering ethernet or packets
20 of some sort, and a third party offers the
21 end-to-end solution? Or you don't really see
22 that as either attractive or possible?

1 MR. CIVILETTO: So, I think there
2 are lots of things that are possible. I think
3 it comes down to, what is the most economical
4 solution to meet the needs of the consumer?
5 And so, in some cases, DOCSIS may be a great
6 solution for consumers in that space. A lot
7 of times, it comes down to their requirements.
8 Typically, depending upon, again, the symmetry
9 of the service and the peak speed rates that
10 they are looking for, that will determine what
11 solutions we will be offering the customer.

12 MR. SCHULZRINNE: I wanted to also
13 follow up. You had made an interesting
14 statistic on the number of businesses passed
15 by fiber over time, but you hinted at that is
16 not, should I say, weighted by business size
17 or revenue. And so, it is a count. I am
18 curious if you had any insight in the sense
19 that, will it be that essentially it is a
20 combination that in your most long-term
21 projection 100 percent of, let's say, large
22 business tower type of commercial real estate

1 in big cities will be fiber, which is probably
2 pretty close to what we have today already,
3 but maybe only 10 percent of small, more rural
4 business, your gas station, your medical
5 complex, somewhere on the strip mall, those
6 types, your hospitality organizations on a
7 county road, those would be passed by fiber.
8 So, I think there seemed to be a very diverse
9 number of situations all lumped into that one
10 statistic.

11 MR. NICKLAS: I agree, Henning.
12 That one number kind of suppresses a lot of
13 information. So, my sense today is that, for
14 very large enterprises in major metropolitan
15 areas, the central business district, there
16 are multiple fiber alternatives. Certainly,
17 that is the case in Manhattan.

18 But even in Manhattan -- and Sandy
19 showed this -- there were lots of buildings
20 that were served by copper and copper only
21 that were impaired. I won't speak for
22 Verizon, but we have some understanding of

1 this because we were lessees of the copper
2 plant down there, not all buildings were
3 served by fiber in lower Manhattan, which I
4 guess surprised myself, if no one else. Okay?

5 So, I think it will be the case,
6 and I understand this completely, if I were
7 building fiber networks -- and we are to some
8 degree -- you go where the money is. There is
9 just no question about that. Okay?

10 So, there will always be
11 underserved areas. We heard that earlier on
12 the panel in terms of more rural areas and
13 demographics, and so forth and so on.

14 So, that one number, 36 percent,
15 which will grow, suppresses a lot of
16 information. It avails you nothing if you are
17 not inside the circle. Okay? But you might
18 still contribute significantly to the Gross
19 Domestic Product of this nation.

20 MR. SCHULZRINNE: So, is there any
21 way to get better estimates on kind of a
22 distribution on that?

1 MR. NICKLAS: So, I hope so,
2 because, you know, we rely on third parties
3 like the Vertical Systems Group and others to
4 collect those. I think it would be wonderful
5 if the Commission itself could extract that
6 sort of information from the network
7 operators.

8 MR. CHAMBERS: Yes, I have a
9 couple of separate, related questions, both
10 for Michael I think. Based on some
11 presentations earlier today, it was the
12 suggestion that by 2020 any of the DSL
13 technologies, even VDSL, wouldn't be
14 sufficient to meet consumer demand. I know it
15 is based on a projection of consumer demand,
16 and that only fiber would meet those needs by
17 then. So, I wanted to talk to a little bit
18 about whether you think 2020 in your plans,
19 are they consistent with that kind of
20 projection?

21 And then, again, a very different
22 question, but also in that same presentation

1 it was suggested that the sort of right
2 technologies to deploy depended on population
3 density, and that below a 10-persons-per-
4 square-mile population density, it was more
5 economic to deploy wireless or even satellite
6 technology.

7 You had mentioned that, if I
8 recall correctly, you said that your average
9 population density is 26 people per square
10 mile. So, based on a simple sense of
11 averages, that means you have got a lot of
12 areas that are fewer than 10.

13 And yet, unlike Verizon, unlike
14 AT&T, you don't have a large mobile network to
15 leverage. Tom mentioned, and I know AT&T has
16 written about, taking some of the areas in
17 which they believe it is too expensive to
18 maintain copper and too expensive to deploy
19 fiber, that wireless seems like a better
20 solution.

21 So, for you and for some of the
22 other local exchange carriers that don't have

1 a wireless alternative, I mean, do you see it
2 somewhat differently? Or do the economics not
3 quite work as well for you or work better?

4 MR. GOLOB: Well, the economics
5 are challenging. There is no doubt about
6 that.

7 And I think we saw several years
8 ago, when Verizon went down the path of
9 building fiber to the home, that a lot of the
10 vendors kind of stopped with the copper
11 technology. But, then, if you look over the
12 last couple of years, I think everybody
13 realized that you are never going to build
14 fiber to every home in America. So, then, all
15 of a sudden, there was a lot of money put into
16 research. And over the last couple of years,
17 if you look at the leaps and bounds that have
18 taken place in how much you can do over
19 copper, it has changed quite dramatically.

20 So, I don't know about 2020, if
21 that is going to be the tipping point where we
22 have to have fiber to the home. I think there

1 are going to be many other areas that we
2 talked about before, whether it is building
3 fiber to the cell sites, it is building fiber
4 to the small cells that are out there, that
5 are going to get fiber closer to a lot of
6 homes. And so, that distance is going to
7 become shorter and shorter.

8 And then, maybe there is a
9 technology that we develop with fiber on how
10 to deploy fiber that, all of a sudden, is the
11 breakthrough. So, it makes deploying fiber --
12 if you could cut the cost of deploying fiber
13 in half or a fourth, in many cases, man, that
14 really tips the business case around.

15 So, I really think that somebody
16 could make a pretty penny if they could figure
17 out and concentrate on how you could deploy
18 fiber much more economically than we have in
19 the past.

20 So, I think there will still be
21 copper in the network at 2020. I think there
22 will be far less by that time. So, it is

1 going to be, I think, a fairly slow migration,
2 just because of the cost factors, unless we
3 come across a technology that says, okay, now
4 I can put something up and I can shoot fiber
5 five miles down the road and connect it to
6 something else and drop it, and off you go.
7 If you don't, then I don't think you are going
8 to get customers that can afford to pay for
9 it, if you don't do something else.

10 Now the way we have approached
11 this is we did a partnership with Hughes for
12 satellite. So, right now, we have about 12
13 percent of our homes that we can't pass with
14 a DSL solution. So, we rely on Hughes to
15 cover those very, very rural homes. And that
16 is combinations and partnerships, and I think
17 there is going to be more and more of those
18 partnerships.

19 I mean, if you look at the
20 wireless backhaul, there are partnerships with
21 both of these guys on my left and right right
22 now. If they had to go rebuild fiber out to

1 every one of these, there would have been a
2 lot less 4G rolled out today than there is.

3 So, I think there are a couple of
4 areas there. That is kind of what we see. We
5 are going to take every opportunity we can to
6 try to get fiber deeper in the network. And
7 if we get some other reason to do and build
8 that, then we will certainly try to leverage
9 that to get it to the home.

10 But, from that curve or from that
11 road that is running outside the farmhouse,
12 you know, down the lane four miles to the
13 house on a farm, that is a costly proposition
14 unless somebody wants to pick that cost up.

15 MR. SCHULZRINNE: Just to follow
16 up on the fiber cost, we were trying to get a
17 little bit more detail on that during the
18 first panel, but that was probably not quite
19 the right group because they didn't have the
20 task of actually digging; they just ship
21 boxes. UPS does the hard work, so to say, the
22 delivery for them. You don't have that

1 luxury.

2 So, I am curious if you have a
3 notion, just as a rough order of magnitude, if
4 you are looking at fiber buildouts,
5 particularly in more rural areas -- and this
6 would, presumably, apply both to Verizon and
7 like having FiOS covered in more urban and
8 suburban areas at this point, as well as
9 certainly Frontier -- do you have a notion, if
10 you could wish for a breakthrough, is your
11 notion that the costs are 30/70, which is what
12 I have heard, hardware versus digging, when 70
13 percent is digging or civil engineering or
14 stringing, presumably, and 30 percent is the
15 fiber and the electronics? What is the main
16 cost driver that, if that were changed, you
17 would suddenly say, "Hey, this is starting to
18 look attractive again."?

19 MR. GOLOB: Well, I think your
20 figures are pretty close. If I go into a new
21 area, if I have a new housing development, I
22 am going to put fiber there. It is cheaper

1 than trying to put copper there. There is no
2 doubt about it. So, in new areas it is
3 definitely the route to go with fiber.

4 There are a lot of factors that we
5 run into. So, you know, if I have to put in
6 the ground, then it is at least 3X more than
7 if I have to put it up. But if I put it up,
8 then I am susceptible to more storm damage.
9 So, there are tradeoffs everywhere you go.

10 Also, terrain is a huge factor.
11 If I am building it in West Virginia versus
12 Iowa, the cost is dramatically different in
13 those areas. So, there is a tremendous amount
14 of factors. I mean, we can certainly come
15 back with some average costs for you, but a
16 lot of factors to consider.

17 Rights-of-way, I mean I can't tell
18 you how many times we have been stopped by
19 trying to get across a railroad, to bore
20 underneath a railroad or something like that.
21 I think everybody probably here has got that
22 same experience. You know, held up months on

1 a project trying to just sort out the
2 paperwork to go through. So, there are just
3 a lot of factors.

4 MR. MAGUIRE: The only thing I
5 wanted to toss in there is I think you hit the
6 nail on the head. We are trying to figure out
7 new ways to do things. We just started
8 microtrenching in New York City, because as
9 difficult as it is to try to get something out
10 to a farm, it is no piece of cake working in
11 New York City.

12 So, we are looking. We literally
13 travel to other areas where they have had some
14 success, whether it is over in Europe. We are
15 talking to people in the Pacific Rim to see
16 how they have done things, to see if there is
17 anything that we could leverage to potentially
18 make things a little bit easier.

19 And we were talking a little bit
20 earlier, just before the panel, about the
21 different ways to get fiber even closer into
22 the apartment or closer into the home, so we

1 can move equipment further up, to reduce the
2 cost or even the footprint of the equipment
3 that is necessary today to provide fiber.

4 So, I think it is going to be a
5 constant battle to always kind of chip away at
6 the cost and figure a better way to get it out
7 there.

8 MS. GOODHEART: We have one
9 question from the audience, which I think
10 might build on something, Randy, you mentioned
11 in your opening remarks, but I am not 100
12 percent sure.

13 It says, "For the operators, can
14 you elaborate how you will mix fixed-access
15 and wireless networks and generate additional
16 revenue?"

17 MR. NICKLAS: Sure, I will take a
18 shot at that. So, for us, we tend to -- first
19 of all, back to the notion that IP is the
20 fundamentals bearer plane or transport for all
21 services, right? So, I have got to get an IP
22 path to the customer premise.

1 And then, it comes back to, well,
2 what are the requirements? What is it the
3 customer is trying to do? How many people are
4 they trying to support in their business, in
5 our case? Okay?

6 So, this kind of quickly drives
7 you towards what are the access methods that
8 one might use -- so, it is kind of like a
9 decision tree that we use today -- along with
10 the availability of the various alternatives,
11 copper, radio, or fiber. In certain regimes,
12 clearly, you are only going to use fiber. If
13 somebody wants an ethernet connection to do
14 something, then you are on fiber or maybe
15 fixed-microwave. Okay? If they want a 10G,
16 you are definitely on fiber. Okay? But if
17 they only need 3 megabits, 10 megabits per
18 second, you have got pretty much all three of
19 the physical layers are open to you, and we go
20 by least cost. Surprise, surprise.

21 MR. CHAMBERS: All right. Just a
22 quick one for Matt. Your thousand-fold over

1 10 years challenge is something that sounds a
2 little Moore's Law-ish, a little more
3 aggressive, you know. Is it something that
4 you figure you can report on, keep people
5 apprised as time goes by? Like how do you
6 think you will measure it other than --

7 MR. GROB: How do you measure it?

8 MR. CHAMBERS: Yes.

9 MR. GROB: I think we can report
10 on it and those sorts of things. You know, it
11 helps to define what we actually mean by that.
12 If you think of like, let's say, a
13 metropolitan area like, say, this area, the
14 Washington area, and you draw a line around
15 the whole area. And you ask, how many bytes
16 are delivered to cellular data services? That
17 is the number that we think will go up a
18 thousand-fold. That doesn't mean that a
19 particular model is going to get a thousand
20 times faster.

21 It is the product of the number of
22 users that are using these kinds of devices

1 times which fraction of them are data-
2 consuming devices and how much they are
3 consuming, and how many there are, and how
4 many hours a day, and all that. That is what
5 is going up dramatically.

6 And it is going up very
7 dramatically, actually, around the world.
8 There are enormous cities in Asia that are
9 just getting started with 3G. They are going
10 to go to 4G. That amount is going to go up.

11 If you drill down to any
12 particular area, it is not just going up in
13 one particular residence; there are more
14 residences. There is more construction.
15 There is more density of population.

16 So, some of those factors are
17 accounting for a several-fold increase just
18 with a given vintage of technology. Just more
19 of it is being built out.

20 So, anyway, I think we can
21 actually measure it. We can go out -- and we
22 have -- and it comes down to the cost. If you

1 put in "X" investment, and you get "Y"
2 throughput out, we want it to be in the future
3 you put in "X" and you get hundreds of times
4 more performance at the same cost, because we
5 kind of feel that the users aren't going to
6 tolerate a monthly plan to be higher than what
7 it currently is.

8 MS. GOODHEART: So, with that, I
9 want to thank our panelists. This was a very
10 interesting discussion.

11 And I thank all of my fellow
12 colleagues here.

13 I think that concludes our
14 workshop. So, thank you for everyone.

15 (Applause.)

16 (Whereupon, at 3:58 p.m., the
17 workshop was adjourned.)

18

19

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This is to certify that the foregoing transcript

In the matter of: Technology Transitions Policy

Before: FCC

Date: 03-18-13

Place: Washington, DC

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