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FUTURE OF SPECTRUM POLICY

HEARING

BEFORE THE

COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION UNITED STATES SENATE

ONE HUNDRED EIGHTH CONGRESS

FIRST SESSION

MARCH 6, 2003

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COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION

ONE HUNDRED EIGHTH CONGRESS

FIRST SESSION

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FUTURE OF SPECTRUM POLICY

THURSDAY, MARCH 6, 2003

U.S. SENATE,
COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION,
Washington, DC.

The Committee met, pursuant to notice, at 9:35 a.m. in room SR–253, Russell Senate Office Building, Hon. John McCain, Chairman of the Committee, presiding.

OPENING STATEMENT OF HON. JOHN MCCAIN, U.S. SENATOR FROM ARIZONA

The CHAIRMAN. Good morning. We will begin the hearing. Virtually every form of communication is being changed by technology that uses spectrum. Cell phone usage is exceeding the forecasts of just a few years ago. Wireless e-mail messaging is rampant. Satellites bring us television, Internet services, and telephone services. Wi-Fi networks offer home network mobility today, and hold the promise of broadband speeds over greater distances in the future. Ultra wideband technology offers multiple benefits for government, public safety, and commercial users. New technology promises to increase exponentially the efficiency of today's commercial wireless networks.

Spectrum policy clearly has a broad impact not only in communications but throughout our entire economy. Spectrum impacts many of the issues that this Committee has spent years examining: public safety—and more recently—homeland security, broadband, local telephone competition, competition to cable television, 3G services, the transition to digital television, broadcast ownership limits, and air time for political candidates.

Today, we will examine the future of spectrum policy. Every year, we put more demands on the use of the radio spectrum. We must ensure that our Federal policies maximize the utility of this finite resource. Federal Communications Commission Chairman Michael Powell has called spectrum policy reform a "crucial initiative." Last year he commissioned a Spectrum Policy Task Force to consider future spectrum policy. It proposed significant fundamental change to spectrum policy. I look forward to hearing more about their recommendations.

One of its legislative suggestions was the establishment of a spectrum relocation trust fund that would streamline the process of paying for the relocation costs of Federal spectrum users and would get spectrum in the hands of commercial users more quickly. The Administration has also advanced this proposal. I look forward

to working with my colleagues on this Committee to introduce such legislation in the near future.

Finally, I would like to commend the recent Spectrum Agreement between the Department of Defense and private industry to share spectrum in a manner that will protect sensitive military functions while providing more opportunities for Wi-Fi services. Last summer, I joined several of my colleagues, including Senator Hollings, urging these parties to address sharing and interference concerns in this band. Likewise, Senators Allen and Boxer have actively supported these discussions. I am pleased that these parties were able to reach an agreement, and hope that the FCC will act quickly on implementing that agreement.

I thank the witnesses for joining us today and look forward to their testimony, and I want to thank the witnesses.

Senator BURNS.

STATEMENT OF HON. CONRAD BURNS,
U.S. SENATOR FROM MONTANA

Senator BURNS. Thank you very much, Mr. Chairman, and I think the report in front of us today that we are talking about captures the essence of the challenges that we have before us as policymakers. The topic of spectrum management is one of the most important telecommunications issues of today. The U.S. is "spectrum-challenged" in that we face serious obstacles when it comes to identifying available spectrum to meet government and private sector needs. To keep pace with all the advances in wireless technologies and maintain a global competitiveness though, we have to find ways to do more with less.

Clearly, the demand for spectrum appears to be limitless both on the Federal and on the commercial levels. Reform of the process of spectrum management remains one of the greatest challenges that we face as policymakers. If done correctly, however, spectrum reform has the potential to create numerous high-tech jobs and jumpstart a currently ailing technology sector in the United States.

I would like to applaud the tremendous effort in the process made through the excellent coordination between the Commerce's Assistant Secretary Nancy Victory, and Administrator of the NTIA and the FCC Chairman Powell. While I am very pleased with the current cooperation between the NTIA and the FCC in dealing with these highly complex issues, I remain concerned from an institutional perspective, that fracturing spectrum management authority among two agencies presents serious operational difficulties. The most recent GAO report on spectrum management, issued late in January, reinforced my concerns and convinced me that it is time to take a hard look at a coordinated process that began over 75 years ago.

The most recent GAO report also gave an excellent overview of the current flaws of the U.S. preparation for the critical World Radio Conferences. These conferences have grown dramatically in size from nine countries in the first conference in 1903 to 148 nations in the year 2000.

Decisions at the conference are made by votes of participating members. In recent conferences, regional alignment and bloc voting have become the norm to advance regional positions. The GAO

found the U.S. preparation suffered from separate and often differing positions developed by the FCC and the NTIA, and the 6-month short tenure of the head of the delegation. In contrast, other countries count on permanent or long-term officials to build working relationships and to develop a deep understanding of the process.

In short, I am convinced that our Nation's spectrum management process is fundamentally broken, and I intend to work with my colleagues on a comprehensive spectrum reform bill. In considering how to frame my spectrum reform bill, I will be guided by the following principles. Some form of a market-driven allocation of spectrum is desirable. In a period of economic downturn in the telecommunications industry, outright bidding on spectrum may not be the best approach. Instead, a hybrid royalty-based approach where the risk of spectrum assignment and ownership are shared between government and the user is likely the best way to achieve an efficient spectrum use. A single regulatory agency, or, at best, more formalized cooperation between the FCC and the NTIA, will better control wasted resources and contribute to a better state of preparedness for the World Radio Conferences. Financial incentives, through tax structures and guaranteed future use, should be considered for technology innovation that seeks to develop devices which would operate in underutilized areas of the licensed spectrum, particularly in the range above 3.1 gigahertz.

As the need for spectrum grows, more efficient spectrum use should be required by Federal agencies. I also believe more critical research is needed in the area of evaluating potential interference for emerging wireless uses or current uses. I will push harder to ensure that the NTIA has sufficient resources at its laboratory in Boulder, Colorado to perform interference research and that the FCC labs in Columbia, Maryland also should be upgraded.

Finally, I would like to touch on a challenge that faces broadcasters in rural States during the transition to digital. I have always been skeptical of hard and fast digital buildout requirements that were more a product of budget politics than engineering reality. I should note that most broadcasters are ready and willing to move forward in this area. Indeed, many broadcasters have already invested many millions of dollars in creating the infrastructure necessary for a rapid transition to digital programming.

In Great Falls, Montana, KFBB Television has spent over $1.5 million for a transmitter and tower. In Billings, KTBQ is spending $532,000 on a transmitter, and our Montana television network stations, KTBQ, KPAX, KRTV, KXLF, and KBZK have budgeted an additional $3.3 million to convert control rooms. While these numbers might not raise too many eyebrows in this room, in many of these markets, these expenditures represent nearly 100 percent of the value of some of their physical plants.

Additionally, many of these small stations have no way to offset these costs or to add on an analog spectrum fee. An unauctioned spectrum user fee might well put some of the smaller stations out of business.

Clearly, we have many challenges to face in this critical issue of spectrum reform, but the potential rewards are great, and I look forward to working with the Chairman of this Committee and all

the colleagues on the Commerce Committee as we wander down this road, because no other issue faces this country more importantly than the issue of homeland security.

I thank the Chairman for holding this hearing today.

The CHAIRMAN. Senator Brownback.

STATEMENT OF HON. SAM BROWNBACK,
U.S. SENATOR FROM KANSAS

Senator BROWNBACK. Thank you very much, Mr. Chairman. Thank you for holding the hearing. Thank you to our witnesses, for presenting their views. I am going to have to slip out to another hearing on North Korea shortly, so I apologize for not being able to hear all of your comments.

Mr. Chairman, I am encouraged by some of the things that have been happening recently, particularly the FCC's Spectrum Management Task Force Report. To the degree management breakdowns have occurred due to neglect, I feel at this time that the FCC is finally looking forward in an innovative manner, and I am interested in working with Chairman Powell to provide him with the tools he needs to get the ball moving forward in this regard.

While some of the concepts in the FCC's report are more long-term in nature, there are some legislative items we can move right off the bat. The Administration has requested that we create a government user auction revenue trust fund. I think that is very appropriate. I also think we can take action to do away with statutory barriers to the development of real secondary markets for spectrum. Secondary markets are especially important for rural communities where spectrum all too often lies dormant, fallow.

Later today, I will be joining my colleagues, Senators Burns, Dorgan, and Hagel, on the floor to introduce a bill called the New Homestead Act, which would help to revitalize rural communities that have experienced significant outmigration over the last 20 years. Spectrum can play an important role in helping to revitalize these rural communities. In that regard, I hope that we can move forward at least with that limited legislative concept to help in their redevelopment.

Again, Mr. Chairman, I thank you for holding the hearing and look forward to working with my colleagues on some of these concepts.

The CHAIRMAN. Thank you, Senator Brownback.

Senator ALLEN.

STATEMENT OF HON. GEORGE ALLEN,
U.S. SENATOR FROM VIRGINIA

Senator ALLEN. Thank you, Mr. Chairman, and thank you for your leadership in calling this hearing today on this important matter. Your visionary leadership and that of Senator Burns is really great, and I look forward to working with you. I thank our witnesses, and we look forward to hearing your comments on spectrum policy from your task force.

I am one who will always be supporting a spectrum policy that encourages and fosters the power of technology, rather than arcane government regulations that are stagnant and inflexible. The existing command and control policy was established 90 years ago.

They, in my view, in many cases unnecessarily constrain our innovators and entrepreneurs, and limit their ability to change and respond to consumer demand for wireless devices.

As Chairman McCain alluded to earlier, Senator Boxer and I introduced legislation, the Jumpstart Broadband Act, and our bill is a very positive and proactive measure to strike a balance between Government regulation and the need for our technologists and engineers to innovate in response to the market. I am pleased to see that one of the recommendations included in this spectrum report is for the FCC to identify and allocate additional spectrum for unlicensed devices. Our legislation, of course, tries to create that environment for Wi-Fi, which is gaining popularity, but clearly has to get into another section of the spectrum that is unlicensed.

The proliferation of unlicensed devices is truly one of the only success stories in the telecom industry over the past year. According to the Wi-Fi Alliance, worldwide sales for Wi-Fi-related hardware are estimated to total $2.1 billion this year and more than $3 billion next year. However, I believe that Wi-Fi is just one example, and really only the beginning of future technologies that will significantly change broadband communications and stimulate the economy.

I want to commend Chairman Powell for his leadership in this area in establishing the Spectrum Policy Task Force. I want to publicly thank the work of the NTIA, the Department of Defense, and the FCC with industry on the recent announcement, on the agreement for interference protections on the 5-gigahertz spectrum band, and for recognizing not only consumer business goals in this agreement, but also, most importantly, the larger goals of protecting our national defense systems.

So again I thank you, Mr. Chairman, for calling today's hearing, and look forward to our witnesses' testimony.

The CHAIRMAN. Thank you. Senator Lautenberg.

STATEMENT OF HON. FRANK LAUTENBERG,
U.S. SENATOR FROM NEW JERSEY

Senator LAUTENBERG. Thanks, Mr. Chairman, and I commend you on the fact that we are getting to this subject, and I also want to say thanks to the Federal Communications Commission, particularly Chairman Powell, for having selected Dr. Kolodzy, professor in the Schools of Engineering and Technology Management at Stevens Institute of Technology, one of our premier institutions.

Dr. Kolodzy, your service to the country in the area of spectrum policy reform, your educational service to bright and talented students in New Jersey, of which we have an abundance, are very much appreciated, and I commend your dedication to both public service and education.

The report of the Spectrum Policy Task Force is the first comprehensive review of our domestic spectrum policy and the regulation that began under the Radio Act of 1912. I have been asked if I remember that date so clearly and what the weather was like at that time.

[Laughter.]

Senator LAUTENBERG. That was over 90 years ago, and before the creation of the FCC in 1934. Spectrum policy reform is an impor-

tant issue for commercial and public safety reasons. It does not lend itself, as we have come to find out over the years, to easy solutions based on either economic or political ideologies.

In fact, one of the Task Force's major findings is that there is no singular regulatory model, not one-size-fits-all, that should be discussed or used to improve the management, accessibility, and allocation of the spectrum without recognizing the fact that you could leave out some very important aspect, so the review, though long and tedious, I think is a very positive thing to do, and I am glad to see that all of you are on this now.

I was pleased to see the FCC's recommendation embracing a hybrid regulatory model whereby the traditional command and control model is not discarded outright. Instead, some consumer-driven, market-driven mechanisms, exclusive usage rights, and a more inclusive commons approach are proposed to address the needs of consumers, in most instances wireless service providers.

The decisions that this Committee is going to make will affect the future development of spectrum technology, the rights and responsibilities of licensed and unlicensed spectrum users, and the availability of spectrum, and that is a question, frankly, that seems to mystify people, whether or not spectrum is a finite body, a finite amount of availability, or whether technology changes, as we have seen over the years, changes the volume of availability of spectrum bandwidths and reach.

I would like to share a few thoughts and observations regarding the direction and the development of our spectrum policy. I think throughout this hearing, we ought to remember that the spectrum, with all of its electromagnetic waves, is a public resource, a public good, a public asset. With that in mind, spectrum should be treated the same way we treat the Nation's other natural but limited resources. We manage them through some joint public-private partnerships, but we are forever mindful that the resource belongs to all of the American people.

Now, as a former businessman, I appreciate the necessity to eliminate inefficiencies in bringing a good or a service to market, but when you are dealing with a public resource, the reduction or elimination of market inefficiencies cannot be the primary goal. The public's interest has got to be protected. Commercial development and use of a public resource ought to provide a public benefit.

Thank you, Mr. Chairman.

The CHAIRMAN. Thank you.

Our witnesses are Mr. Steven Berry, the Senior Vice President, Cellular Telecommunications and Internet Association; Dr. Gregory Rosston, Deputy Director of the Stanford Institute for Economic Policy Research; Dr. Kevin Kahn, Intel Fellow at the Intel Corporation; Dr. Paul Kolodzy, who is the author, or certainly a leader in the Spectrum Policy Task Force; Dr. Michael Calabrese is the Director of the Spectrum Policy Program, New America Foundation.

I think it appropriate we begin with you, Dr. Kolodzy. Thank you for appearing today, and please proceed.

STATEMENT OF DR. PAUL J. KOLODZY, DIRECTOR, CENTER OF WIRELESS NETWORK SECURITY AND PROFESSOR IN ENGINEERING AND TECHNOLOGY MANAGEMENT, STEVENS INSTITUTE OF TECHNOLOGY

Dr. KOLODZY. Good morning, Mr. Chairman, Ranking Member, and members of the Committee. Thank you for this opportunity to appear before you today. Until December of this last year, I served as Director of the Spectrum Policy Task Force at the FCC. I currently serve as the director of the Center of Wireless Network Security and also professor in both engineering and technology management at Stevens Institute of Technology in Hoboken, New Jersey.

Although I am under a contract as a part-time expert consultant at the FCC, I am here today in my own capacity, pursuant to the kind invitation from this committee. I appreciate this opportunity to testify on this important topic of the future of U.S. radio spectrum policy.

Chairman Powell established the Task Force to develop policies to advance spectrum reform, one of his six strategic goals for the agency. The Task Force has only just begun the processes of reexamining 90 years of spectrum policy to ensure that the Commission's policies will evolve with the consumer-driven evolution of new wireless technologies, devices, and services.

I will focus on the key findings and recommendations contained in the Task Force report today. Please accept the Task Force report and my written testimony for the record.

The CHAIRMAN. It will be made a part of the record.

Dr. KOLODZY. Thank you. Chairman Powell established the Spectrum Policy Task Force to assist the Commission in identifying and evaluating specific changes in spectrum policy to increase the public benefits derived from the use of the radio spectrum. The Task Force initiated the FCC's first ever comprehensive and systematic review of spectrum policy. The Task Force report concluded that the regulatory structure governing spectrum management is outdated, cumbersome, and lacks requisite flexibility to foster technological innovation and economically efficient spectrum use. Here are some of the key findings and recommendations that the Task Force made to the Commission.

First, we are aware in just the last decade that there has been a dramatic increase in the overall demand for spectrum-based services and devices, accompanied by particular demand for mobile and portable spectrum-based applications. At the same time, the speed of technological change has increased. We found that the growth in demand for spectrum-based services and devices requires many spectrum users to seek additional spectrum. This leads to the appearance that spectrum demand is outstripping spectrum supply.

The Task Force determined that the spectrum access is a more significant problem than actual scarcity. If there were ways to facilitate greater access to the vacant white spaces of the radio spectrum, the effects of physical scarcity of the spectrum resource could be minimized.

Second, the radio spectrum can be parceled in space, frequency, and also time. Due in large part to technological limitations in radio performance, the Commission's spectrum policies have par-

celed or assigned spectrum according to particular operational frequencies and geographic regions. Smart technologies, or smarter technologies, potentially allow operators to take advantage of the time dimension of the radio spectrum.

Third, technology advances are allowing systems that use radio spectrum to be much more tolerant to interference. Spectrum policies can and should reflect this increased ability to tolerate interference.

Fourth, all spectrum users really require clear rules governing their interactions with spectrum users and the Commission. Spectrum users' rights and obligations are often not defined with sufficient clarity. An example of this is defining harmful interference, which is one of the primary parameters of the bundle of spectrum rights granted to licensees.

Based on these key findings, and many more, the Task Force made three core recommendations, and a total of 39 recommendations. I will focus on the core recommendations today.

The Task Force's first recommendation is to migrate from the current command and control regulatory model to a more market-oriented exclusive rights and unlicensed device and commons model. The Task Force agreed with the consensus view expressed by the participants of the Task Force process that one size does not fit all in spectrum policy. The Task Force recommended that the Commission base its spectrum policy on a balance of three basic spectrum rights models, the exclusive use model, a commons approach and, to a more limited degree, a command and control approach.

Second, in order to be responsive to increased technological capabilities, the Task Force concluded that while the Commission's spectrum policies can and should remain technology agnostic, they should not be technology antagonistic. The Task Force suggested that the Commission strive wherever possible to eliminate regulatory barriers to increase spectrum access as new technologies and market approaches provide new and innovative means for consumers to use the spectrum.

The Task Force's third recommendation was to suggest the development and implementation of a new paradigm for interference protection. Ensuring adequate interference protection has been a key responsibility of the Commission since its inception, and continues to be one of its core functions. The Task Force believes that the current interference management approaches and tools need to be reexamined in light of the dramatic changes in technology and uses of spectrum.

The Task Force recommended that as a long-term strategy the Commission shift its current approach for assessing interference based on transmitter operations, focusing instead on the interference environment at the receiver locations. Specifically, on an ongoing basis it was recommended that the Commission adopt a new metric, the interference temperature, to quantify interference. The interference temperature would be a localized measurement defining the interference environment in or around the device.

These three recommendations are a fraction of what the Task Force provided to the Commission, but its report is a culmination of an analytical and transparent process designed to carefully ex-

amine the status of our national spectrum policy. I appreciate Chairman Powell's bold vision. He recognized the critical need to undertake a comprehensive review of this area.

The work of the Task Force was systematic and thorough, and involved participation of an extensive array of interested parties, but the work has just begun. It is my hope and expectation that the work of the Task Force, as well as the contributions of many others, including those sitting at this table with me, will provide the basis for important policy changes that will lead to technological innovation and, more importantly, increased consumer benefits.

I am excited about the building momentum and ongoing debate for rethinking this decade-old policy. Again, I appreciate this opportunity to appear before the Committee, and I will be pleased to answer your questions.

[The prepared statement of Dr. Kolodzy follows:]

PREPARED STATEMENT OF DR. PAUL KOLODZY, DIRECTOR, CENTER OF WIRELESS NETWORK SECURITY AND PROFESSOR IN ENGINEERING AND TECHNOLOGY MANAGEMENT, STEVENS INSTITUTE OF TECHNOLOGY

Mr. Chairman, Ranking Member, and members of the Committee:

Good morning. I am Dr. Paul Kolodzy, and I would like to thank you for this opportunity to appear before you today. Until December 2002, I served as the Director of the Spectrum Policy Task Force at the Federal Communications Commission. I currently serve as the Director of the Center for Wireless Network Security and as a Professor in the Schools of Engineering and Technology Management at the Stevens Institute of Technology in Hoboken, New Jersey.

At the present time, I am under contract as a part-time expert consultant to the FCC, but I want to emphasize that I am here today in my own individual capacity pursuant to the Committee's invitation. Accordingly, my testimony is based on my staff level work with the Spectrum Task Force and does not necessarily reflect the views of the Commission. I was fortunate to have the support of my FCC colleagues, some of whom are behind me, in preparing for this hearing today.

I am very grateful to the Committee for this opportunity to testify on the important topic of the future of U.S. radio spectrum policy. In my position as the Director of the Spectrum Policy Task Force from March to December 2002, I oversaw a comprehensive assessment of the Commission's current spectrum policy models, the development of new approaches to "managing" the spectrum resource, and the completion of the Task Force's report. Chairman Powell commissioned the Task Force to develop policies to advance spectrum reform, one of his six strategic goals for the agency. We have been overwhelmed by the positive response to our Report so far, as well as the tremendous interest in the important work of the Task Force.

The Task Force has only just begun the process of reexamining 90 years of spectrum policy to ensure that the Commission's policies evolve with the *consumer-driven* evolution of new wireless technologies, devices, and services. A close examination of current spectrum policies, even with the innovative legislative and regulatory changes that occurred in the 1990s, shows that government spectrum management is still based on the environment that existed in the 1920s and 30s: AM broadcast radio, ship-to-shore communications, and Ham operators. Although those uses are still important components of the communications mosaic, these services no longer represent the majority of the systems nor are they indicative of the technologies that comprise modern telecommunications services.

My testimony will first provide some brief background on the Spectrum Policy Task Force. Then I will summarize the key findings and recommendations contained in the Task Force Report.

Background

FCC Chairman Michael Powell established the Spectrum Policy Task Force in June 2002, to assist the Commission in identifying and evaluating specific changes in spectrum policy that would increase the *public* benefits derived from the use of radio spectrum. Chairman Powell directed the Task Force to analyze spectrum allocation, assignment and use and to develop a plan of action for review by the Commission. The creation of the Task Force initiated the first ever *comprehensive and*

systematic review of spectrum policy at the FCC. In announcing the formation of the Task Force, the Chairman set forth its core mission:

- Provide specific recommendations to the Commission for ways in which to evolve the current "command and control" approach to spectrum policy into a more integrated, market-oriented approach that provides greater regulatory certainty, while minimizing regulatory intervention; and
- Assist the Commission in addressing ubiquitous spectrum issues, including interference protection, spectral efficiency, effective public safety communications, and international spectrum policies.

The Task Force is composed of a team of seasoned professionals from across the FCC's Bureaus and Offices, including engineers and economists, as well as lawyers and public policy experts. The Task Force recognized that our work could not be completed without significant input from sources outside of the FCC. We endeavored to create a transparent process that encouraged and facilitated substantial public participation and tapped all available expert resources. As soon as the Task Force announced its official organization and work plan in June 2002, we released a Public Notice seeking comment on a wide range of spectrum policy issues.

We received over 200 comments and reply comments from many individuals and entities, including equipment and consumer electronics manufacturers, wireless Internet service providers, radioastronomy interests, satellite and broadcast companies, consumer groups and individual consumers, fixed and mobile wireless service providers, academics, economists, scientists, engineers, public safety organizations, state and local governments, consultants, journalists, telecommunications bandwidth brokers, energy and transportation interests and rural telephone companies.

In August, the Task Force held public workshops over four separate days and utilized the services of over 70 expert panelists from government, industry, academia and the public. Each workshop focused on a specific aspect of spectrum policy: (1) Spectrum Rights and Responsibilities; (2) Spectrum Efficiency; (3) Interference Protection; and (4) Experimental Licenses and Unlicensed Spectrum. Approximately 75 expert panelists and outside moderators participated, representing a cross-section of all interested parties.

With the benefit of this tremendous public input, the Task Force developed several findings and made 39 specific recommendations to the Commission. Before submitting them to the full Commission, these recommendations were presented to and vetted by the members of the FCC's Spectrum Policy Executive Committee, which is made up of the Bureau and Office Chiefs from the internal FCC organizations engaged in spectrum activities. On November 7, 2002, I appeared before FCC Chairman Powell and his fellow Commissioners at an open meeting and presented the Task Force's findings and recommendations. We released the Report in November and the full Commission issued a Public Notice seeking public comment on the Report. In the first round alone, the FCC has received over 80 formal comments on the Report.

The Task Force Report ultimately concluded that the regulatory structure governing spectrum management is outdated, cumbersome and lacks the requisite flexibility to foster technological innovation and economically efficient spectrum use. Addressing these matters is particularly important because spectrum-based services play such an essential role in the Commission's other strategic goals, including broadband, competition, the DTV transition, and homeland security. I will now highlight some of the key findings and recommendations that the Task Force made to the Commission.

Task Force Findings

There has been a dramatic increase in overall demand for spectrum-based services and devices, accompanied by particular demand for mobile and portable spectrum-based applications. This is true for both traditional, licensed services and for services offered through unlicensed devices. This increased demand is propelled by a host of factors: the economy has moved towards the communications-intensive service sector, the workforce is increasingly mobile, and consumers have been quick to embrace the convenience and increased efficiency of the multitude of wireless devices available today. Today, a myriad range of unanticipated innovations and changes continually challenge the ability of regulators to keep pace. It has become readily apparent that the speed of technological change has increased over the last few decades, creating an environment where flexibility and innovation should guide regulatory policies.

While the Task Force recognized the societal trends that have contributed to the increased demand for spectrum-based services and devices, we also understood that it is difficult to make accurate projections of future demands. Historically, both in-

dustry and Commission projections for spectrum use have significantly and consistently underestimated the demand for additional spectrum resources and the public's utilization of new technologies and applications.

Four principal findings of the Spectrum Policy Task Force provide the foundation for our recommendations. These and other findings were used to formulate recommendations to the Commission. Let me briefly outline these four findings and discuss some of the issues related to our work.

Spectrum Access versus Scarcity

The growth in demand for spectrum-based services and devices requires many spectrum users to seek additional spectrum. This leads to the appearance that spectrum demand is outstripping spectrum supply. Indeed, most "prime" spectrum has already been assigned to one or more parties, and it is becoming increasingly difficult to find spectrum that can be made available either for new services or to expand existing ones.

The Task Force determined that spectrum *access* is a much more significant problem than *scarcity*. The Task Force collected and reviewed preliminary data regarding spectrum usage that show that significant spectrum capacity remains untapped. Currently, no federal agency or other organization systematically measures actual spectrum use. While additional and more comprehensive spectrum measurements can and should be undertaken to improve the understanding of actual spectrum use, these preliminary measurements are quite revealing. If the Commission were to facilitate greater access to the vacant "white spaces" of the radio spectrum, the effects of the physical scarcity of the spectrum resource could be minimized.

The Task Force concluded that improving access to the spectrum can be achieved through permitting licensees greater flexibility. Licensees often have variable needs and therefore do not use their spectrum for particular periods of time or in certain geographic areas. At the same time, due to regulatory restrictions, licensees are usually unable to make their spectrum available to others, even if a market exists to do so. Granting licensees additional flexibility to make their licensed bands available to others would increase access to the spectrum and, correspondingly, minimize the real prospect of spectrum scarcity.

New Methods as a Solution to Access

Second, the radio spectrum can be parceled in time, space, and frequency. Historically, due in large part to technological limitations in radio performance, the Commission's spectrum policies have parceled—or assigned—spectrum according to particular operational frequencies and geographic areas of operations. Past policies also dictated the power at which radio transmitters must operate. Smart technologies, such as low power processors, frequency agile transmitters, digital receivers, and other technologies potentially allow operators to take advantage of the time dimension of the radio spectrum. That is, because their operations are so agile and can be changed nearly instantaneously, they can operate for short periods of time in unused spectrum.

The Commission's current policies generally do not take into account the time dimension of spectrum use. In addition, the Commission's current policies do not effectively support the ability of new technologies to take advantage of geographic white space. In order to be responsive to these increased technological capabilities, the Task Force concluded that, while the Commission's spectrum policies can and should remain technology agnostic, they should not be technology antagonistic. As a result, the Task Force suggested that the Commission should strive, wherever possible, to eliminate regulatory barriers to increased spectrum access as new technologies provide new and innovative means to access the spectrum.

Interference Tolerance

Third, technology advances are also allowing systems that use radio spectrum to be much more tolerant to interference. While technological advances are contributing to the increased diversity of spectrum-based consumer applications, the Task Force acknowledged that there are technological advances that also are providing some potential answers to current spectrum policy challenges concerning interference avoidance and mitigation.

Growth in the use of digital spectrum-based technologies not only increases the potential throughput of information, it also has potentially significant ramifications for interference management. Digital signals are inherently more robust and resistant to interference than analog signals. Moreover, digital signal processing techniques, such as coding and error correction, are more effective at rejecting interfering signals. Thus, spectrum policies can and should reflect this increased ability to tolerate interference. Moreover, given the increased ability of new technologies to monitor their local RF environment and operate more dynamically than traditional

technologies, the predictive models used by the Commission can be updated, and perhaps eventually replaced, by techniques that take into account and assess actual, rather than *predicted,* interference levels.

Need to Define Rights and Responsibilities

Fourth, all spectrum users require clear rules governing their interactions with the Commission and other spectrum users. Regardless of how or to whom particular rights are assigned, ensuring that all rights are clearly delineated is important to avoiding disputes, and provides a clear common framework from which spectrum users can negotiate alternative arrangements. Currently, spectrum users' rights and obligations are often not defined with sufficient clarity.

An example of this is in defining "harmful" interference, which is one of the primary parameters of the bundle of spectrum rights granted to licensees. But stakeholders in spectrum policy debates can subject the standard of "harm" to multiple subjective opinions and use it to block or delay new services and devices from being introduced into the market. Given the increasing flexibility in the types of spectrum-based services and, correspondingly, more intensive use of the radio spectrum, the spectrum user and the potential interferer need more certainty about the metrics that determine rights of protection and access. This is particularly important for incumbent providers who have invested substantial sums in building their networks and providing highly valued services to the public. Therefore, the Task Force concluded that there needs to be, wherever feasible, a more quantitative approach to interference management. Quantitative standards reflecting real-time spectrum use would provide users with more certainty and, at the same time, would facilitate enforcement.

Task Force Recommendations

Based on these key findings, the Task Force set forth four key recommendations and a total of 39 separate recommendations to the Commission.

Modernizing the Regulatory Model

The Task Force's first recommendation is to migrate from the current command and control model to the more market-oriented exclusive rights *and* unlicensed device/commons models. The Task Force agreed with the consensus view expressed by participants in the Task Force process that "one size does not fit all" in spectrum policy. An examination of the exclusive use and commons models as they have been applied suggests that each model has encouraged beneficial types of technical and economic efficiencies. The Task Force recommended that the Commission base its spectrum policy on a balance of the three basic spectrum rights models: an exclusive use approach, a commons approach, and (to a more limited degree) a command and control approach. Specific recommendations in furtherance of this objective include:

- Permit maximum flexible use of spectrum by both licensed and unlicensed users. This would enable spectrum users to make fundamental choices about how they use spectrum, taking into account market factors such as consumer demand, availability of technology and competition.
- Clearly and extensively define spectrum users' rights and responsibilities.
- Provide incentives for efficient spectrum use.
- Investigate rule changes that promote the lowering of permitted power in congested areas and the increasing of permitted power in uncongested areas, particularly rural environments.

Increase Access to Spectrum

The Task Force's second major recommendation was to implement ways to increase access to the spectrum for both unlicensed and licensed users. Advances in technology that provide access in time, as well as in frequency, bandwidth, and space, of the spectrum also provides a window to new opportunities for using the radio spectrum. The Task Force recommended that the Commission consider the use of time in permitting more dynamic allocation and assignment of spectrum usage rights. Four of the recommended methods to use time are: (1) to act in its pending secondary markets proceeding; (2) to permit the use of more dynamic allocations and assignment of spectrum usage rights; (3) to permit more flexible use, albeit within technical parameters, of the allocations under licensee control; and (4) allow traditionally narrow services, such as public safety, to lease excess capacity to other non-related services.

New Interference Management Techniques

The Task Force's final "core" recommendation was to implement a new paradigm for interference protection. As the Commission considers how to provide opportunities for an ever-increasing array of spectrum-based technologies and services, one recurring and often thorny issue is how to protect users against harmful interference. Ensuring adequate interference protection has been a key responsibility of the Commission since its inception and continues to be one of its core functions. The Task Force believed that, although the Commission's rules and processes for managing interference have historically been effective in many bands, current interference management approaches and tools need to be reexamined in light of the dramatic changes in technology and uses of the spectrum.

The Task Force suggested that, as a long-term strategy, the Commission shift its current paradigm for assessing interference—based on transmitter operations—toward basing policy more on what results at receiver locations. The Commission currently performs detailed calculations of expected interference environments, and determines transmitter requirements based on "worst case" analysis. This methodology has generally been adequate and has been the foundation for successful spectrum management for the past several decades. With more intensive use of the spectrum, coupled with highly mobile devices, a more dynamic, *in-situ* methodology will be necessary. Specifically, the Task Force recommended that, on a going forward basis, the Commission adopt a new metric—the "interference temperature"—to quantify and manage interference. The interference temperature would be a localized measurement defining the interference environment at or around the device. The Commission could use the interference temperature metric to establish maximum permissible levels of interference, on a band-by-band basis, thus establishing a clearly defined expectation of the noise environment in which the receiver would be operating. To the extent, however, that the interference temperature in a particular band is not reached, other users could operate more flexibly—with the interference temperature serving as the maximum cap on the potential RF energy they could introduce into the band.

Legislative Recommendations

In furtherance of the broader goals for changes in spectrum policy outlined by the Task Force, it also advised that the Commission should consider making legislative proposals for submission to Congress. These recommendations to the Commission are the result of a thorough examination of the current statutory structure contained in the Communications Act of 1934, as amended, as well as related laws. The Task Force proposals were intended as a blueprint for the Commission to use in its interactions with Congress to reexamine the broader U.S. spectrum policy regime.

Conclusion

The FCC's Spectrum Task Force Report is the culmination of an analytical and transparent process designed to carefully examine the status of our national spectrum policy and make recommendations for modernizing it to match current and future technological and market environments. I am extremely honored to have been a part of this endeavor and grateful for the bold vision of Chairman Powell, who recognized the critical need to undertake a comprehensive review of this area. The work of the Task Force was systematic and thorough, and involved the participation of an extensive array of interested parties.

But the work has just begun. It is the my hope and expectation that the work of the Task Force, as well as the contributions of many others including those sitting at this table, will provide the basis for important policy changes that will lead to technological innovation and, most importantly, increased consumer benefits. I am excited about the building momentum and ongoing debate for rethinking these decades-old policies.

Again, I appreciated this opportunity to appear before the Committee and I would be pleased to answer your questions at this time.

The CHAIRMAN. Thank you, and Doctor, thank you for the great work that was done by you and the rest of the Task Force. It has provided us with a very important blueprint. We thank you.

Dr. Rosston.

STATEMENT OF DR. GREGORY L. ROSSTON, DEPUTY DIRECTOR, STANFORD INSTITUTE FOR ECONOMIC POLICY RESEARCH

Dr. ROSSTON. Mr. Chairman and members of the Committee, I am honored to appear before you today. I am the Deputy Director of the Stanford Institute for Economic Policy Research, or SIEPR. SIEPR is dedicated to using economic analysis to provide input to policy decisions. SIEPR itself does not take stands on policy issues, but it encourages its scholars to do so. As a result, my remarks about spectrum policy and the Task Force report reflect my own opinions.

As you all have pointed out, spectrum policy is crucial to the overall communications sector in our economy. Ultimately, good, competitive spectrum policy may alleviate the need for regulation of local telephone service, and provide more facilities-based competition for broadband services.

While my written testimony points out a lot of the problems that I see in the Spectrum Policy Task Force, my hope is that the report and these hearings today will lead to fundamental changes in the way the Federal Government approaches spectrum policy so that we will allocate and assign spectrum rights and responsibilities in a way that improves consumer welfare.

I want to commend the FCC staff for their hard work on the Spectrum Policy Task Force report, and hope that the Commission uses this as a first step in its spectrum policy reforms, and goes much further than the Task Force report suggests.

I have three main points that will be interwoven through my testimony today. First, to increase the supply of spectrum available in the marketplace with as few restrictions as possible, second, spectrum users should have incentives to use spectrum efficiently, and third, there may be a place for a spectrum commons, but there should be a market test to determine the size, place, and spectrum devoted to commons use.

The main issue with respect to spectrum policy is interference. If there were no interference when multiple parties were trying to use the same frequencies, we would not be here today, but contention and interference are not unique to spectrum. These issues arise with all scarce goods in our economy. The occupancy of a house by one family interferes with the occupancy of the same house by another family. To resolve these issues, we generally rely on the market, or price system. This provides a reasonably efficient allocation of scarce resources.

But spectrum has been treated very differently, and consumers have suffered as a result. Much of the usable spectrum has constraints on flexibility today. The Task Force report addresses this issue, and says the Commission should have a goal of increasing flexibility for 100 megahertz within 5 years.

On the same day the Commission released the Task Force report, it also released an OPP working paper by Evan Kwerel and John Williams that stated the Commission could grant additional flexibility for 438 megahertz within 2 years, more than four times as much spectrum, and 3 years sooner. This could lead to substantial benefits that will be lost if the Commission sets its sights too low.

I hope that this Committee moves rapidly to enact any necessary authority for the Commission to pursue the auction ideas in the Kwerel-Williams proposal and increase secondary market rights, because alternatives requiring more government intervention in spectrum allocation, as has been done in the past, are likely to substantially reduce the benefits that can come from increased flexibility for spectrum users.

For licensed users, the report is relatively clear: get the spectrum out, and make it flexible. Unfortunately, in the first significant spectrum decision since the release of the report, the Commission reverted to its old ways and restricted the use of MSS spectrum, ultimately harming consumers. There needs to be a way to ensure that the Commission does not treat every rulemaking as a special case. The best way to do this is to tie its hands so that there are no special cases, and spectrum is in the market with maximum flexibility.

The report also addresses unlicensed and noninterfering uses. While Wi-Fi has recently made a splash, it is not clear that the regulatory framework currently in use is the best way to make tradeoffs between licensed and unlicensed uses, or even the best way to manage a so-called commons. It is not surprising that unlicensed proponents are clamoring for additional spectrum. It is free to them, but it may come at a huge cost to the public. There is no market test of the value of the spectrum used in unlicensed, compared to the value that could be generated in precluded licensed uses.

Private companies could create their own open entry commons by participating in spectrum auctions. This puts commons allocation to a market test. In addition, some degree of private ownership would reduce substantially some of the problems that have plagued some of the open entry common systems; overcrowding, and an inability to facilitate a rapid transition to new technology.

These commons problems are in stark contrast to the cellular PCS and SMR bands, where multiple market-mandated technology transitions have occurred in the past 10 years without government involvement. For example, the transition from analog to digital in cellular, and consumers are spending upwards of $70 billion per year to access this spectrum. Overall, the most important step is to get complete spectrum rights into the market. Spectrum is no different from other scarce resources, and should be treated like them for allocation purposes.

Thank you very much. I am happy to answer any questions.

[The prepared statement of Dr. Rosston follows:]

PREPARED STATEMENT OF DR. GREGORY L. ROSSTON, DEPUTY DIRECTOR, STANFORD INSTITUTE FOR ECONOMIC POLICY RESEARCH

Mr. Chairman and members of the Senate Commerce Committee, I am honored to appear before you today. My remarks are about the spectrum policy in the United States and in particular some issues that were addressed in the recently released Federal Communications Commission "Spectrum Policy Task Force Report."

Since 1987, I have been involved extensively in spectrum policy issues. I have written numerous academic articles on the subject of spectrum policy, including a 1997 FCC staff working paper with Jeff Steinberg entitled "Using Market-Based Spectrum Policy to Promote the Public Interest," that was subsequently published in the Federal Communications Law Journal.

My attached testimony is a draft of an article prepared to discuss the Spectrum Policy Task Force Report for the National Academy of Sciences Journal, *Issues in Science and Technology*. Although I have advised governments and private parties on spectrum issues, these remarks are my own views.

To summarize my conclusions:

- As much spectrum should be made available to the public as possible.
- Spectrum should be made available to the market with maximum flexibility. The Spectrum Policy Task Force Report sets a very modest goal of 100 MHz in 5 years; an FCC Office of Plans and Policy Working paper shows that it would be possible to give additional flexibility for more than 400 MHz in less than 2 years.
- The Commission should set initial interference rights for licensees and then allow negotiation.
- The Commission should set up rules to allow licensed owners to create "commons" where the market shows that commons are valuable.
- The Commission should rely heavily on the market to determine uses for this scarce resource just as we use the market to allocate most scarce resources.

Draft for submission to "Issues in Science and Technology"

Today it is relatively easy to get wireless high-speed access along with your high-octane latte at Starbucks, but not cheap. The combination will set you back more than $10 if you use the T-Mobile Wi-Fi network. In addition, licensed wireless services like Blackberry or advanced cellular (3G) service provide other ways of connecting to the Internet without wires. These modes of communication were not around 10 years ago. And in 10 years, modes of communication are likely to be substantially different than they are today. These new innovations create billions of dollars of benefits to consumers, but the realization of these benefits are dependent on the availability of spectrum which, in turn, is dependent decisions by the federal government.

The Commission should set forth guidelines to tie its hands to a marketplace solution. This will eliminate the current inefficiencies from lobbying for rules regarding each individual band of spectrum. The Commission also should to use market forces to determine how much spectrum should go to commons (or unlicensed) versus traditional licensed use. Finally, the Commission should ensure that new innovative and truly non-interfering uses can gain access to spectrum.

Demand for spectrum has been relentlessly increasing since Marconi's time. At the same time, technology has increased the ability to use spectrum. But advances in technology have not eliminated the fundamental scarcity of usable spectrum, and are unlikely to in the near future—demand for spectrum will exceed supply of spectrum if the price of spectrum is set at zero and there will be contention for the use of spectrum. Spectrum is "scarce," but so are lots of resources in the economy; the government's job should be to set forth policies to alleviate that scarcity as much as possible by getting flexible spectrum into the market, and to allow the market system to allocate the remaining scarce resource just as we do with most other scarce resources in the economy.

Because of contention, there is a need for an allocation system just like other scarce resources are allocated in our society. In addition, interference concerns have been one of the hallmarks of the justification for continued government involvement in spectrum policy. How the government addresses spectrum policy is critical to the success of wireless services and ultimately to the competitiveness of the communications sector overall.

The government should fully commit to an open, transparent and predictable spectrum policy that will maximize consumer welfare. Such a pro-consumer spectrum policy will allow consumers and companies to invest in radio equipment with an assurance about how they will be able to use the spectrum and what their protection from interference will be. To date, the government has failed to adopt a comprehensive pro-consumer spectrum policy because it continually "balances the interests" of different parties rather than attempting to maximize consumer benefits.

The FCC recently released a Spectrum Policy Task Force ("SPTF") report detailing some of the ideas that it hopes to pursue in the near term with respect to spectrum policy (*http://www.fcc.gov/Daily__Releases/Daily__Business/2002/db1115/DOC–228542A1.pdf*). This report is a very good primer on the background of the current issues in spectrum policy. The report reads like many of the studies that have come before it, including some FCC staff papers: it talks about the benefits of market allocation; it sets up ways to define interference; it stresses the need for more spectrum for licensed and unlicensed uses, and to allow for more "underlay"

or non-interfering uses; and it talks about how to deal with scarcity and transaction costs.

However, in a backhanded compliment, Ebert and Roeper would probably review it as "The Feel Good Report of the Year." While the SPTF report provides a reasonable background on spectrum issues, it does not set forth any aggressive goals, does not change the nature of the debate about spectrum policy and ignores a lot of crucial issues. Tom Hazlett, in the 2001 *Harvard Journal of Law and Technology,* documents the long and tortured history of the FCC knowing the "right" thing to do with regard to spectrum policy, but not doing it. (I provide more recent examples in a forthcoming article in *Telecommunications Policy.*) Unfortunately, the SPTF report is set up to be another in the series of FCC actions that "talk the talk," but do not compel the Commission to "walk the walk" and really improve spectrum policy to alleviate the artificial portion of the spectrum scarcity that have been created by years of misguided regulation.

The Commission needs to get congressional support to be much more aggressive about spectrum policy than the Task Force report. Without congressional support, the Commission is unlikely to be able to implement a comprehensive pro-consumer reform of spectrum policy. But with it, the Commission could promulgate rules to get more spectrum into the hands of the public and improve the quality and competitiveness of all communications services.

Spectrum Policy Background

To vastly oversimplify, the main concern with spectrum policy is interference. If I use a band of spectrum for a transmission, my use may interfere with your communication and vice verse. If there were no problems with interference, virtually all spectrum policy would be unnecessary. Kevin Werbach, in a New America Foundation Working Paper, provides an "ocean" analogy where there are few rules necessary for ships at sea because the ocean is so vast relative to the room required for a ship so it is relatively easy to avoid other ships. Unfortunately, in the world of spectrum today, there is "scarcity" and communications do interfere with each other. Instead of being the wide open ocean, the situation resembles a congested harbor. As a result, there is a wide body of spectrum policy. The ultimate goal of spectrum policy should be to make the ocean analogy apt or at least to reduce the scarcity rents accruing to spectrum, but it may also be important to set rules to allow for a congested harbor to function smoothly.

In an optimal world, spectrum policy would make tradeoffs, or even better set up frameworks so that marketplace participants could dynamically make the tradeoffs, between different uses of the spectrum. Today's spectrum policy is far from optimal: it evolved from the command and control days where specific frequencies were set aside for specific uses (including a specific channel for ice delivery!) and doled out as political favors—the original television license for Austin, Texas was awarded to Lady Bird Johnson.

There is a vast amount of spectrum—NTIA provides a spectrum chart at *http://www.ntia.doc.gov/osmhome/allochrt.pdf* for those who are interested in seeing the various allocations. Most of the spectrum that is used for mobile communications throughout the world is below 3 GHz. Fixed wireless communications can occur at much higher frequencies. Most of the spectrum has already been allocated, but there has been a push to re-assign spectrum from the government and television broadcasters.

There are still frequencies set aside for inefficient specific uses and it is difficult if not impossible to change the use of those frequencies. For example, the United States devotes more than 400 MHz of prime spectrum to over-the-air broadcast television while more than 80% of households get their television signals from cable or satellite. Two FCC staff members, Evan Kwerel and John Williams have put forth a novel proposal in a recent Office of Plans and Policy Working Paper to increase the amount of spectrum available to the public as well as to increase the flexibility for licensees. They identify more than 400 MHz of spectrum that could be made available to the market with flexible use within 2 years. The SPTF report sets a much more modest goal of 100 MHz within 5 years.

The ideas about what to do about licensed spectrum are pretty clear and straightforward—get the spectrum into the market with well-defined initial rights and responsibilities and then allow secondary trading and renegotiation of these rights. Economists, engineers and lawyers have written about these issues for decades. However, it has been much harder to get Congress and the Commission to implement these steps. It has been hard because there are strong entrenched interests that profit from the restrictions and would be harmed by a more market-oriented spectrum policy that reduced the artificial scarcity rents. For example, the FCC recently issued a decision to increase the rights of mobile satellite providers to use

terrestrial repeaters to enhance service. Cellular and PCS ("Personal Communications Service") providers strenuously objected to the additional rights and may appeal the decision, but not on interference grounds.

While the drumbeat for spectrum reform on the licensed bands continues and small progress is made on that front (*e.g.,* the PCS licenses that were allocated in 1994 do not mandate technology or service except in relatively minor ways), there are two additional fronts that may dramatically change the nature of spectrum policy: unlicensed spectrum and ultra wideband technologies. There is a fundamental difference between the operation of these two policy or technology approaches. Unlicensed spectrum use requires a specific allocated band of spectrum like a national park. And that park has to be truly national (if not international) given the portable nature of wireless devices. Wi-Fi technologies use unlicensed spectrum; so do cordless telephones, garage door openers and a variety of other devices.

Ultra wideband (UWB) technologies do not require dedicated spectrum. Instead, they spread signals across wide swaths of spectrum, radiating only miniscule amounts of noise in any specific frequency so as not to interfere with other transmissions on the same frequency. This so-called "underlay" transmission operates under the "noise floor" so that other users do not notice the transmission and it causes no harm. It is as though a mosquito flew across your backyard—as long as it does not bite you or buzz your ear, you are unlikely to be bothered by it. As a result, UWB technologies can potentially operate within licensed and unlicensed bands without causing any harm to other users. The FCC recently set forth some rules for UWB technologies, so they are just beginning to take shape.

The common thread between unlicensed operations and ultra wideband operations is that they operate at relatively low power over relatively small geographic areas so that theoretically they do not cause contention with other users. One way they do this is through mandated or regulated etiquettes and protocols. Essentially, these rules are like those you try to teach your kids—"listen before you talk" and "don't take more than you need." The FCC sets etiquette rules for the band (in the unlicensed case) or technology (in the UWB case), so that the use of these potentially disruptive technologies is not free of regulatory involvement. In addition, for unlicensed bands, the FCC needs to determine the amount of spectrum set aside for unlicensed use.

So far, the FCC has allocated more than 400 MHz for unlicensed use and has just set forth the initial rules regarding the status of UWB technology. As might be expected neither of the issues is without controversy—the Defense Department, among others, is concerned about the interference potential of vast numbers of unlicensed and UWB devices that push the edges of the agreed upon protocols. And licensed users are concerned that UWB devices may cause interference to their licensed operations. Not explicitly stated, but underlying this as well, may be the concern that the new technologies could seriously devalue the licenses for which some companies paid billions of dollars, the same concern that prompted the objections to the expansion of mobile satellite spectrum rights discussed above.

Theoretically, unlicensed protocols will prevent interference, but there have been reports of areas where there is interference between different uses of the unlicensed band even though Wi-Fi has been in use only a short time. In addition, protocols themselves can be thought of as mechanisms to ration usage because demand exceeds supply at the zero price. This may be one reason why commons proponents argue for more spectrum for unlicensed use—one way to reduce contention is to increase supply of spectrum. But overuse of unlicensed spectrum (the "Tragedy of the Commons") is still a likely outcome when demand for a scarce resource priced at zero is greater than the supply. I should note that proponents of additional spectrum for zero priced commons use like Yochai Benkler of NYU argue that technology will ultimately lead to a lack of contention and increased capacity to avoid this pitfall.

Substitutes and Complements

Spectrum policy will have impacts on all forms of communications, whether they use spectrum or not. Much of the current debate at the FCC has been about local competition. Most of the projections of the cost of providing new wire (or fiber) based connections to homes are extremely high. High capacity wireless "connections" may be the answer to having multiple facilities-based competitors for residential customers. In this respect, regulators and antitrust enforcers should be cognizant of these potential competition effects when assessing mergers that involve wireless and wireline providers and ensure that there is sufficient incentive and ability to provide competitive services. The first step to ensuring competitive service provision is to get as much spectrum out into the market as possible and to make sure that the

spectrum in the market is allowed to provide any type of service subject to interference constraints.

Economists often divide products into substitutes and complements—coffee and tea are used as examples of substitutes; if the price of coffee goes up, the demand for tea goes up. Coffee and cream are examples of complements. They are used together; if the price of coffee goes up, the demand for cream goes down.

With communications technology, this simple delineation is not so straightforward. Rapid technological advances, changing relative prices and the introduction of completely new products blur the lines. For example, early car phones were complements to the landline telephone network—calls from car to car were an extremely rare use of car phones. But now, many people are using wireless phones as a complement to their existing wireline telephone service as well as using it as a substitute for toll and long distance calling, and, in some cases, for local telephone service.

Wi-Fi and UWB technologies provide similar quandaries as to whether they will be complements to or substitutes for traditional wireline telephone service, wired high speed access services and licensed wireless services. Wi-Fi and UWB can be used within the home to enhance the value of wired services, or they can be used to connect multiple homes to a single wired connection, competing with wired services to each home.

There are also for-hire systems like Boingo and T-Mobile that have begun to deploy lots of access points and allow the public to use them for a fee. Within range of one of these "hot-spots" one can log on to the system for a daily or monthly fee possibly including some fee for bandwidth used.

Spectrum policy has historically set aside specific frequencies for specific types of use. The Commission has frequently determined allowable uses for spectrum depending on whether the use was to be a complement or substitute for existing uses. Some spectrum is available only for backhaul for television signals when it might be much more highly valued in other services. The uncertain nature of the complementarity or substitution from the new services that will be provided wirelessly means that the Commission will have to be more agnostic with respect to the services that advocates propose to provide on spectrum made available to the market. Instead, the Commission should put spectrum on the market as rapidly as possible, and move rapidly to increase the flexibility of spectrum already on the market.

The Near-term Future of Wireless Communications

Licensed wireless service has experienced phenomenal growth since cellular service was first introduced about 20 years ago. At the time, McKinsey and Co. made the bold prediction that 1 million people would have cellular phones by the year 2000. They only missed by about 2 zeros. At more than $70 billion a year in service revenues, the wireless industry is quite large. There are a whole series of quotes from other technology visionaries that have missed the mark by at least as much for computers and other information technology. These missed projections show that it is important to implement policies that are flexible enough to adapt to changing technology and changing demand without starting the regulatory process over again. The SPTF Report is sufficiently vague in its specific recommendations that one could argue that it is well-suited to provide the flexibility necessary for change. However, because it leaves open the window for continued regulatory involvement, it is much more likely to hamstring efforts to adapt rapidly to changing market needs.

There will be differentiated competition between businesses based on different models of service provision to customers and the competition and ultimate consumer benefits from these depends on spectrum policy decisions made by the FCC.

Some licensed wireless carriers are implementing 3G (third generation) wireless systems. Advanced 3G services include high-speed Internet access, and video communications as well as other features that have not been thought of, but could be layered on the 3G architecture. Some carriers have adopted interim solutions such as so-called 2.5G systems that do not have the same capacity, but also do not have the same capital expense. To increase voice traffic capacity, carriers face a tradeoff between the introduction of new technology, purchasing additional spectrum or splitting cells so each cell covers a smaller geographic area. 3G technologies offer substantially more capacity as well as advanced services. To recoup the additional cost of the upgrades to the 3G technology, many of the carriers believed they would be able to offer and charge premiums for advanced data services. To make this profitable, they may need a reasonable fraction of their subscribers to pay for these data services.

Consumer demand for on the move broadband access promised by 3G networks is unclear, but carriers are betting that at least some will materialize. However,

with the rapid introduction of Wi-Fi services, consumers may be less willing to pay the premium prices for data access through the 3G networks. For example, demand for connection at the airport seems to be quite high—everyone has experienced the din of cell phone conversations as the plane taxis toward the gate and been nearly bowled over by people talking on the cellphone as they wheel their oversized carryon through the airport at breakneck speeds. The demand to check e-mail and websurf while waiting for planes may be high, but the 3G networks will be limited by the airports own Wi-Fi networks as a competitor. Granted the airport authorities have the opportunity to make Starbucks look like amateurs when it comes to overcharging for specific services, but they will have some competition from the 3G networks as well.

In the near term, there will be competition among the various forms of wireless communications—there is not a neat bucket of unlicensed use in the home and licensed use on the road. Both forms will compete for consumer use and spectrum policy should ensure that the mode that provides the greatest overall consumer benefits is allowed to flourish. The SPTF report is very vague about how it proposes to make the tradeoffs, but it seems clear that the implication of the report is that the answer is an administrative decision. Instead, the Commission should try to set up a market framework to adapt to the changing circumstances.

Implications of Spectrum Policy for Wired Networks

Local telephone companies have been losing retail lines the past couple of years. Wireless technologies have the potential to increase these line losses or to prevent price increases. In the late 1990s, local wireline growth was quite high with the demand for second lines to allow for connection to the Internet. Since then, the local telephone companies have been losing lines, both because of competition and because of new high speed access services from cable companies and DSL offerings that have obviated the need for a second line to have dedicated Internet access.

Wireless provides additional threats to the local telephone companies. First, as discussed earlier, people are using wireless as a substitute for voice communications. On the data side, it may be possible for wireless to provide direct high-speed connections. Companies such as IP Wireless and SOMA networks are developing high-speed, high capacity wireless technologies using different licensed frequencies that can connect homes and small offices in competition with wired solutions.

In the longer term, there are other wireless solutions, using either licensed, unlicensed or UWB technologies, that can transport broadband signals further than the next door neighbor. Companies like SkyPilot and others have been trying to develop "mesh network" solutions that allow many subscribers in a network to transmit across town to an access point, becoming transmitters, receivers and relays for the signals of the neighborhood.

Allowing competing networks to get access to the spectrum necessary to implement competitive alternatives to the landline network is likely to bring substantial consumer benefits. In addition to the increased competition, if these forays are successful, there is likely to be a lessened need for regulation of local communications services.

Implications for Spectrum Policy

Clearly spectrum policy has an impact on the nature of the market for communications services. In addition, the superabundance of possible uses and the concomitant competition implications will have an impact on spectrum policy.

There may be a legitimate role for trying to understand the future trajectory of technology and consumer demand in developing a spectrum policy. The SPTF report implicitly makes part of this argument by claiming that it is important to look at the nature of transmission and match up "good neighbors" to reduce interference. Given the already balkanized nature of the spectrum and the paucity of new places to shoehorn users in, this makes for a good sound bite, but is unlikely to have any real implications in the future of spectrum policy. Much more important for their argument is to ensure that spectrum neighbors abide by the interference rules that are set up and can negotiate new tolerances between them.

The future trajectory of technology and demand may be more important in the current spectrum policy debate regarding the dividing line between licensed and unlicensed bandwidth under an administrative allocation. It is fundamental that any allocation of spectrum to unlicensed use precludes the use of that same spectrum for licensed use. If future demand for licensed use would lead to higher social value, then that spectrum should be used for licensed use; if unlicensed use would provide greater benefits, then it should be allocated that way. However, the current method of spectrum allocation does not provide any mechanism for determining the relative values in the two different uses; instead, it relies on the ability of different interest

groups to lobby the Commission to allocate spectrum to their uses. The SPTF report states that "the exclusive use model should be applied primarily, but not exclusively in bands where scarcity is relatively high and transactions costs associated with market-based negotiations of access rights are relatively low" and the commons (or unlicensed) model should be used when the conditions are reversed. This provides the Commission plenty of room to do what it wants in each band on a case-by-case basis, subject to lobbying pressure rather than to have any real test of value.

An alternative to the use of lobbying to get additional spectrum set aside for different uses would be to stick to and increase the use of the auction mechanism. In fact, a commons model is consistent with private ownership, competition and auctions. There is no reason why, if there is such a huge demand for unlicensed devices, a single operator or consortium of operators and equipment manufacturers could not bid in an auction for spectrum and then operate a "private commons." The licensee could sublicense equipment manufacturers and users to operate in the band and try to maximize the use of the band. This would lead to a marketplace solution to the determination of how much spectrum should be available for commons use.

Many of the proponents of the "commons" approach to spectrum policy decry private ownership of the spectrum because they feel that such private ownership will stifle innovation. The best way to ensure that private owners do not have such an incentive is to make sure that the market for spectrum is open and competitive—that there are sufficient numbers of owners of spectrum so that no owner has an incentive to block innovation because entrepreneurs with the next "killer app" could easily go to another spectrum owner and get access to spectrum. The SPTF report does not address this answer to the innovation question.

There are real coordination effects that may be necessary to solve in order to get nationwide or even international access to spectrum. Two advances may mitigate this problem. The first is improvements in auction design. The FCC is moving toward allowing "package bidding" so that potential spectrum licensees can make all or nothing offers to get specific bands of spectrum across the country. This would facilitate the operation of a nationwide private commons. In addition, the auction advocated in the Kwerel and Williams FCC OPP Working Paper would get a large amount of spectrum on the market at the same time to help solve some of the coordination problems.

The second advance is the development and advancement of software defined radios. These radios are designed to be able to transmit over a wide range of spectrum and to modify dynamically their transmission modulation and other technical parameters to minimize interference with other transmissions. Software defined radios can be used in conjunction with UWB technologies, for higher-powered licensed use, or for unlicensed use, depending on the availability of spectrum at the time and location. With software defined radios, the need for a commons to be on the same frequency across the country is not as great.

Advances in technology are a boon to the use of wireless devices. The amount of information that can be transmitted on the same amount of spectrum is much greater because of advances in digital signal processing, microprocessors, etc. And future advances will increase substantially the carrying capacity. At the same time, demand for spectrum-based services will increase also, partially due to advances in capabilities and services offered and partially due to price decreases from cost reductions.

However, the advances are unlikely to eliminate scarcity and interference concerns in the use of the spectrum. While it would be wonderful to have the spectrum be as bountiful as the ocean, the fact is that there is likely to be contention for the use of the spectrum in many areas. The increasing demands for extended area Wi-Fi use is likely to increase the amount of contention in Wi-Fi spectrum. Proponents argue that users will have the incentive to adopt efficient technologies that minimize the problem.

However, in a similar, open-entry, non-propertized band for land mobile radio (the so-called "private radio" bands that are typically used for intracompany radio communications like taxicabs), users are stuck with old, technically inefficient equipment. Why? Because none of them has the incentive to adopt new equipment on their own that would free up spectrum for use by others. Instead, they came to the FCC with a proposal to transition over 27 years to equipment that was not quite state of the art at the time of their proposal.

In the unlicensed bands, upgrades to reduce spectrum scarcity and contention are likely to require the same type of coordination that was required to begin to clear up the congestion in the private radio bands. There is no clear reason why this congestion and difficulty in coordination for upgrades will be absent in a shared unlicensed environment too. A private operator of an unlicensed commons would have

incentives to require its tenants to upgrade equipment to provide better or higher capacity service.

Many of the large licensed PCS and cellular providers have been migrating their networks to 3G (third generation) technologies that promise higher network capacity and much higher bandwidth to the consumer. This is the second transition for cellular carriers without any real government involvement or prodding—they transitioned millions of subscribers from analog to digital handsets because they had the incentive to conserve on spectrum use.

Most of this has focused on unlicensed operations. There are also some concerns about UWB. For small numbers of users in a geographic area, it is almost assuredly possible to stay under the noise floor. However, when there are thousands or millions of users in an area, even if each is operating at low power, there is a real possibility that the amalgamation of their signals will cause interference above a noise floor for a licensed user. For both UWB and unlicensed broadcasters, it may also not be possible for the transmitter to know if it is causing interference.

The UWB/underlay concept is very important for the introduction of new wireless uses. To the extent that a user can transmit without technically hurting the transmission of a licensed user, that is a true social benefit. (It may cause economic harm to the licensed user because of increased competition, but that should be considered a benefit). Spectrum policy should encourage the additional use of spectrum. However, when setting up the rules for non-interfering use, the Commission needs to have a system in place so that users understand the rights and responsibilities of ensuring against interference to licensed users. The tradeoffs are to set up a system where new users have to ask first and go through a process to prove they will not interfere in advance of beginning service, or where they can begin and then be shut down if they do cause interference. The SPTF report is silent on this important issue.

Conclusion

The SPTF report lays out the major issues for policy makers: interference and allocation. But it does not set forth a very aggressive agenda, nor does it tackle many of the key issues that face Congress and the Commission. The recommended policy should be to get spectrum into the marketplace as quickly and flexibly as possible and set forth a way to deal with interference disputes in the marketplace. That would increase substantially the effective supply of spectrum in the marketplace and create the appropriate incentives for spectrum conservation.

In areas where there truly is no contention, the Commission should allow entry so that consumers can benefit from the additional suppliers of communications services. Entry and the provision of new services has created billions of dollars of value to consumers and the Congress and the Commission should focus on ways to facilitate this happening in the future. The best way is to ensure that companies with innovative ideas can gain access to spectrum without having to go to the Commission and reveal their business plans and then wait for five years while the Commission works on a way to release the spectrum is to get more spectrum into the market.

That spectrum should be released to the market in a way that will allow the market to determine the highest value use—exclusive use or commons. The best way to do this is to start with de facto property rights with broad flexibility and then to let owners of spectrum determine what consumers will demand.

Hopefully, the SPTF report will cause some positive movement in spectrum policy, but it took a very small and tentative first step, and not completely in the right direction.

The CHAIRMAN. Thank you very much. Dr. Kahn, welcome.

STATEMENT OF DR. KEVIN KAHN, INTEL FELLOW, INTEL CORPORATION

Dr. KAHN. Mr. Chairman and Senators, thank you for the opportunity to be here both on my personal behalf and on behalf of Intel Corporation. I am a senior technologist with Intel, and in addition to that, I am director of a research lab whose primary function, or one of its primary functions, is to look at issues having to do with wireless technologies.

While we certainly are also very interested in increased flexibility in the licensed part of the spectrum problem, if you will, I

would like to focus my comments today really on two major points. The first of those is the special sorts of opportunities that we see being made available to us now by what is happening in radio technology, and that transition that is going on in our technological capability is actually a major inflection point in the history, I believe, of wireless technologies.

And then the second point I would like to cover is our view on how those changes in the technology ultimately will require further fundamental spectrum reforms in terms of how we actually regulate the use of spectrum.

Before I do that, though, I would like to reference the 802.11 story. I think it is an interesting situation. 802.11b, Wi-Fi, has really been exploding around the world. Just in the last month, I personally have accessed wireless hot spots on three continents while traveling on business. This is a major opportunity for consumers, business people, and travelers to access Internet capabilities in all the places that they inhabit on a regular basis, whether it be cafes, airports, or even in their homes.

A recent count estimated that there were over 14,000 Wi-Fi access points on the island of Manhattan. If you compared the proliferation of this kind of data service to even the roll-out of 2.5 and 3G services, it is fairly clear that Wi-Fi really is quite an interesting phenomenon, and all of that has happened really in only 83 megahertz of spectrum normally considered to be pretty dirty spectrum. We are about to see the same sort of capabilities moving into the 5-gigahertz band, where there is considerably more spectrum available, and hopefully, as a result of the recent agreement between the DOD and industry players, we will see even more spectrum made available there.

So let me go on to the comments about the current interesting inflection point we find in radio frequency technologies. For nearly all of its history, radio technology has been primarily an analog phenomenon. This is changing in fundamental ways today. Basically, what we are seeing is a collision between Moore's Law and Marconi's transmitter.

Moore's Law has been the guiding light of the semi-conductor industry for over 30 years, based on observations made by one of Intel's founders, Gordon Moore, that the doubling rate of capability on chips was about an 18-month cycle. If you think about the history that that has led to in the computer industry, we have gone in a very short period of time from massive mainframes with limited actual capabilities to the situation where pretty much anyone can buy for under $1,000 an enormous amount of computing power.

That same transition is in front of us on the radio side. Old radio technology was very limited because of the capabilities of analog design, because of our ability to design radios in terms of how flexible they could be. New radios will be much more agile, much smarter, and I think these are some of the things the Spectrum Policy Task Force observed.

If you look at the difference in the functions that users were used to using old analog wireline telephones and compared them to what users are used to today using digital cell phone technology, you can see the sorts of changes that that movement from analog capabilities to digital capabilities can mean to consumers. Enormously dif-

ferent function and capability. We believe that that technology, applied particularly in the short- to medium-range distance arena, will make a major change in the ability that consumers have to enjoy the capabilities, the convenience of wireless communication.

So if those are the technological issues that we see ongoing, what does that mean when we consider the state of licensed and unlicensed spectrum? Well, the current regime for spectrum allocation really is fairly cumbersome, fairly litigious. It basically operates on bureaucratic time scales, and for good reason. The problem is that the cost of delaying change and innovation has increased because the fundamental rate at which technological innovation goes on within the semi-conductor and computer industries has increased. If you look at the rate of transition, at the rate of improvement and innovation in the PC industry and the hand-held industry, and compare that against the typical regulatory time frames that we see, there is a real mismatch.

Even looking at the recent ultra wideband proceedings that led to making ultra wideband an available technology, if you look at the period of time that that proceeding took, and many people consider it a relatively rapid proceeding, there were probably two to three generations of PC technologies rolled out within the time frame of that one set of discussions. Clearly, that innovation rate and that regulatory change rate are quite mismatched.

Intel applauds any efforts to make available more unlicensed spectrum and, in that regard, we certainly are very happy about the recent negotiations between the Department of Defense and industry toward getting another 255 megahertz of spectrum available in the 5-gigahertz range, and we are also very much supportive of the Jumpstart Broadband Act, which makes the same point.

As we go forward, though, we would like to look at a number of changes. In the short term, we believe that there are the possibilities for much more optimistic re-use of spectrum, and things like spectrum underlays. These are the sorts of things pointed out, I believe, in things of the sort, the recent FCC proceeding on broadcast TV notice of inquiry, and the ultra wideband proceeding, basically the opportunity to use some of the white spaces in space or in time, or to utilize spectrum at very low power that overlays other allocations.

Longer term, we think that the real transition will be toward much smarter, much more agile radios, and this is the sort of change that is anticipated by the FCC Spectrum Policy Task Force, whose result we applaud greatly. We believe that the focus, moving toward interference, actual interference as seen by receivers, is a major improvement over the notion of a conservative approach of allocation command and control.

Certainly, all these changes require a lot of research, but we are headed down the right direction and, in order for that research to actually go forward, it needs the possibility of actually being realized in the marketplace.

In closing, I would like to say that I think serious spectrum reform is going to require hard work. There really are technical challenges that we have to solve. All the answers are not on the table. Certainly, incumbent users of spectrum have legitimate rights and interests that must be protected as we make this transition. How-

ever, I think policymakers must keep consumer interests front and center in this process.

Certainly, existing holders of spectrum, while having those concerns, at the same time simply cannot use those concerns as a way to avoid the possibility of future competition. We have to balance incumbent rights, but at the same time not freeze the process of innovation because of the fear of the competition against those rights. Protectionist efforts of all sorts need to be resisted.

It is certainly our belief that, just as the public and the U.S. economy has seen great benefit out of the revolution the computer industry has seen, that we will see great benefit out of the coming revolution in the spectrum space.

Thank you again for the opportunity to testify this morning. I will be happy to answer any questions.

[The prepared statement of Dr. Kahn follows:]

PREPARED STATEMENT OF DR. KEVIN KAHN, INTEL FELLOW, INTEL CORPORATION

Introduction

I am Kevin Kahn, Intel Fellow and Director of Intel's Communications and Interconnect Technology Laboratory. In my current position, I manage a research and development lab that explores future technologies in optics as well as wired and wireless communications. During my 26 years at Intel, I have worked in a variety of areas including software design, processor and systems architecture, and data communications. Intel Fellows, our company's highest technical position, provide strategic technical guidance to the company. Therefore, I have been deeply involved in the development of Intel's technology policy positions in broadband and wireless communications.* I have also served on advisory Committees and panels at the Federal Communications Commission, the National Science Foundation, and the National Academy of Sciences.

As the Committee Members know, Intel is the world's largest semi-conductor manufacturer and a leader in technical innovation. Since one of our founders first articulated it over 30 years ago, Moore's Law has guided the semi-conductor industry. Less well known, Intel is also a leading manufacturer of communications and networking chips. We believe that, in the future, all computers will communicate and all communications devices will compute. Our mission is to drive or to accelerate that convergence through silicon-based integration. The revolution in converging computation and communications has brought amazing benefits to the American public and the rest of the world.

It is an honor to appear before this Committee to testify on the important topic of how the FCC's management of the electromagnetic spectrum can be improved. We are at the dawning of what will likely be the most significant technical revolution in radio technology in 70 years. Put briefly, Moore's Law is going to meet Marconi's transmitter. Rapid improvements in microprocessors will soon make possible radios that are much smarter and more flexible than those in use today. In the not too distant future, any device that might benefit from being able to communicate will have a radio designed into it.

One of the biggest obstacles in the path of this revolution is the artificial scarcity created by the current spectrum management system. Thus, spectrum reform represents a substantial opportunity to promote technical innovation, foster competition and benefit the American public. Today I would like to address three topics: (1) the benefits of making spectrum less scarce—using the Wi-Fi** market as a case study, (2) the problem with the current spectrum management system and (3) suggestions for reform, particularly increased reliance on unlicensed spectrum use.

Spectrum Reform Benefits—the Wi-Fi Case Study

All of the benefits from innovative spectrum usage are illustrated by the marketplace and technical success of Wi-Fi. Wi-Fi is the name that the Wireless Ethernet Compatibility Alliance (now the Wi-Fi Alliance) gave to the wireless standards collectively known as 802.11—defined by the Institute for Electrical and Electronic En-

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** Other marks and brands may be claimed as the property of others.

gineers (IEEE). Wi-Fi devices operate today in the 2.4 and 5 GHz unlicensed bands. The key to Wi-Fi's astonishing success has been the regulatory regime that prevails in these bands—which allows anyone to sell and use equipment in these bands without first obtaining a license from the FCC, provided only that the equipment meet certain technical specifications. This regime allowed manufacturers enormous freedom to innovate and to respond to changing market forces—knowing that no government licensing process would create a roadblock between their technology and consumers. This regime also allowed consumers, schools and businesses to build their own Wi-Fi networks by spending their own money as quickly or as slowly as they wished, without the need for government approval or having to navigate any kind of licensing process.

As result of the freedom enjoyed both by technology manufacturers and technology users, the pace of Wi-Fi innovation has been brisk. The speed of Wi-Fi equipment has jumped from 1–2 Mbps to 54 Mbps. The range of the equipment has also improved, while its costs have plummeted. Products have moved from 4 to 5 chip solutions in 1999 to the 2-chip solutions prevalent today with much more of the radio frequency circuits integrated, allowing broad expansion into a number of products. In 1999, only 802.11b PC cards and enterprise access points were available. Today, users can choose between 802.11a, 802.11b, or dual-band (802.11a and 802.11b) products for enterprise, small offices, or homes.

The pace of Wi-Fi deployment and the expansion of Wi-Fi product lines has also been brisk. Wi-Fi products have extended beyond PC cards and access points to PDAs, printers, and a host of consumer electronic goods. In addition to providing portable Internet access, Wi-Fi home networks are enabling consumers to use multiple computers with their broadband connections and peripherals. One company already incorporates a Wi-Fi (802.11a) transmitter in its personal media center allowing video streaming to TVs. These technological innovations have and will continue to generate a strong consumer response. Although 802.11 products did not begin shipping in significant volume until 1999, the growth has been staggering. Sales have increased from 7.9 million wireless LAN chipsets in 2001 to a projected 23–25 million chipsets in 2002, according to Allied Business Intelligence.[1] Gartner estimated that over $2 billion worth of wireless LAN equipment was sold last year.[2] In-Stat projects that the Wi-Fi hardware market will grow to nearly $4 billion in 2004.[3]

The Wi-Fi Alliance, the leading Wi-Fi trade organization, has grown to over 200 companies and certified over 500 products in just three years. *PublicInternetProject.org* detected the presence of nearly 14,000 access points in Manhattan alone.[4] According to the Yankee Group, over 700,000 U.S. companies are now using more than one million access points.[5] Public access locations are multiplying worldwide from airports to hotels to neighborhood coffee shops, and most recently, onboard commercial aircraft. In the United States, AT&T Wireless, Wayport, T-Mobile and others sell access for notebook users with wireless networking capability.

And we believe that this is just the beginning. Many in the high-tech community believe this technology—and the license exempt regulatory model—can be used to create wireless broadband networks to the home. From Athens, Georgia to Dartmouth University to Tacoma, Washington to San Jose, California, "WLAN clouds" providing wireless access for entire neighborhoods are appearing.

The Wi-Fi phenomenon is also going global. Korea, already the world's broadband leader, also seems ready to lead in wireless networking. Leading Korean telecom providers have rolled out over 10,000 public access locations since their launch last year. The 2003 World Radio Conference, to be held in Geneva this June, seems poised to make a global spectrum allocation at 5 GHz for wireless data networking. From the U.K. to France to Hong Kong, regulators have already considered, or are now considering, the ability of this technology to provide a wireless broadband connection to the home or office. The Wi-Fi Alliance recently announced the creation of Wi-Fi Zone, a logo program/database directory for Wi-Fi public access worldwide.[6]

Intel has been a leader in the effort to accelerate Wi-Fi adoption worldwide. We will continue to actively participate in multiple standards bodies that are working on further improving this technology. We will soon introduce Intel Centrino™ Mo-

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[1] *http://www.alliedworld.com/prhtml/wlic03pr.pdf.html*.
[2] "Wireless LAN Equipment: Worldwide, 2001–2007", Gartner, January 2003.
[3] "It's Cheap and It Works: Wi-Fi Brings Wireless Networking to the Masses", Instat, December 2002.
[4] *http://publicinternetproject.org/research/research_sum.html*.
[5] *http://www.nwfusion.com/news/2002/0801wlan.html*.
[6] *http://www.wi-fizone.org*.

bile Technology branded products, which will include a microprocessor (code-named "Banias"), related chipsets, and Wireless LAN networking capability. These components are designed, optimized and validated by Intel to maximize the wireless mobile computing experience. Over the past three years, Intel has increased our investment in wireless technologies fourfold. In addition to our research and development investments, Intel Capital's Communications Fund plans to invest $150 million in wireless networking technologies. We are making these investments in an attempt to accelerate the deployment of Wi-Fi networks and remove technical barriers to Wi-Fi growth and adoption.

We are undertaking these efforts because we are excited by the promise that Wi-Fi holds. Especially noteworthy, recent Wi-Fi-related innovations may accelerate broadband adoption nationwide. Cometa plans on creating a network of wireless LAN access points in the top 50 metropolitan service areas so that users will always be within five minutes of connectivity. Additional locations will be added as customer and usage grows. Technologies like Vivato's smart antennas offer promise by extending the range of wireless Internet access to up to 4 miles. In the future, mesh configurations of access points could enable Wi-Fi to deliver Internet access over even longer distances in competition with DSL and cable modem service.

I believe Wi-Fi is a success because we can operate in unlicensed bands, which allows technologists to innovate, while it allows consumers, businesses, schools and carriers to build their own networks at their own speed without government intervention. I invite Committee Members to visit our lab in Oregon to see the future of wireless computing. I am certain that you will share my excitement about the possibilities.

General Critique of Current Spectrum Management

As recognized by the FCC's Spectrum Policy Task Force, the current "command and control" spectrum management system is cumbersome, litigation-prone and politicized. Its tendency to "lock in" inefficient uses and technologies has become more costly with the burgeoning demand for diverse wireless uses and the increased ability of technology to minimize interference. The existing spectrum management approach was not illogical when created. But it was based on a technology in which the tuning range of a radio was necessarily quite limited, and the designs of radio were fixed and tightly tied to the specifics of the application they were intended for. Today, the advent of incredible computational power in microprocessors and related semi-conductors has revolutionized what is technically possible. Moore's Law is moving us inexorably toward a technology in which extremely flexible and adaptable radio will become the standard. Shackling these advanced radios with the static spectrum management of the past will severely limit the benefits that can be gained from them.

The Spectrum Policy Task Force identified some promising spectrum management techniques—for example, the creation of largely unregulated, unlicensed bands and the grant of increasing use and technical flexibility to exclusive licensees—that can serve as a guide for reform. These techniques give users more freedom to innovate and respond to changing market forces without seeking government approval. But they also require that the FCC specify interference and other rights and obligations objectively and in a manner designed to foster industry planning and private cooperation. These reforms need not be mutually exclusive and should be considered simultaneously.

Unlicensed Band Reforms

Today, I want to focus on two unlicensed band reforms. First, there is an immediate need to allocate additional spectrum for unlicensed use to foster new applications and accommodate growth. Second, the FCC should follow-through on the proceedings it has begun to determine whether spectrum "non-interfering easements" or "underlays" for new technologies such as agile radios could be created that would not impose significant interference on existing licensees. Both reforms would create valuable new uses without creating significant interference to other users.

1. Additional Spectrum

As a starting point, an additional 255 MHz in the 5 GHz band should be allocated to unlicensed uses to facilitate growth and harmonization. In this regard, Intel supports the "Jumpstart Broadband Act" introduced by Senators Boxer and Allen. If enacted, this legislation would make the needed 5 GHz spectrum available for unlicensed use. This legislation recognizes the importance of Wi-Fi broadband access to the economy and ordinary citizens.

The main obstacle to the allocation of additional unlicensed spectrum at 5 GHz had been concerns that unlicensed devices in part of this band could harm US military radars, thereby posing a threat to our troops and homeland security. However,

Intel and other high tech companies worked closely with the Department of Defense to find a technical solution to these concerns—and did so. We believed it was possible both to protect our military assets, and at the same time allow consumers to reap the benefits of innovation in wireless technology. A solution was possible because a Wi-Fi system can be designed with sufficient intelligence to identify when military radar begins to operate in its channel and rapidly move its operation to a different unused channel—thus avoiding interference to the radar.

With this technical solution in place, the United States has now joined other countries in calling for a global 5 GHz allocation for Wi-Fi and similar systems—but with a regulatory regime that would incorporate the technical solution to protect our military radars around the world. We believe that with industry and the U.S. Government jointly advocating this position at the World Radio Conference, common worldwide rules can be created to our mutual benefit. Intel applauds the efforts of those at the NTIA, FCC and DoD to develop acceptable technical parameters that will increase the amount of spectrum available for Wi-Fi operation at 5 GHz.

2. Non-interfering Easements

The FCC should also determine whether non-interfering easements for new technologies such as agile radios could be created that would not impose significant interference on existing licensees. Much of the spectrum has already been allocated to dedicated uses, but at any instant little of the spectrum is typically being used, even in densely populated cities. Many applications use spectrum only intermittently or only in certain places, but foreclose all other uses because current radios have limited tuning range and use simple encoding methodologies. Moore's Law has begun to change that. Soon radios will be spectrally agile and very flexible in how they encode information in their signal. As a result, radio systems will be able to share the spectrum in much more efficient ways, thereby greatly relieving spectrum scarcity.

For example, the FCC recently opened a Notice of Inquiry considering unlicensed use on broadcast television and the 3650–3700 MHz bands. Given the current limitations of television receivers, most of the TV channels in any geographical area are unused. Advanced radio techniques, however, might permit unlicensed use, without any adverse impact on the broadcasters. Indeed, because the channels "in use" seldom change, agile radios within current technical capability may be able share these frequencies. Another method under consideration is to use Global Positioning System receivers built into the unlicensed devices to determine the device location relative to fixed broadcast transmitters. Experience in these bands could facilitate the development of more advanced applications where use varies much more rapidly over time and space.

For this approach to work, the FCC will have to set interference limits for particular technologies specified in objective terms. Radio use of spectrum is not an "all or nothing" proposition. Rather, radios add to the background noise over which other radios must "shout" to be "heard." By analogy, someone whispering in the hallway creates far less "interference" than would someone shouting in the first row of this hearing room. The FCC will have to determine the amount of interference that a particular radio system adds to the environment and when that is too much (that is, when it should move elsewhere). These limits could define the boundaries of a non-interfering easement. For example, a user of a particular frequency would be required to shut off within a few micro-seconds once it detects an incumbent user begins transmitting.

Together with limitations on the amount of power such underlay radios might use, this approach could allow valuable transmissions with virtually no impact on the allocated users of the various bands. Using my previous analogy, we don't prohibit people from talking in the hallway—we just don't want them doing so during the hearing! The current FCC rules allow a person to scream here, a person to scream in Pittsburgh and everyone else has to remain quiet. Clearly, there are better ways to utilize a precious resource like spectrum. Given the pace of innovation in the electronics industry, we should begin reworking our regulatory structure to anticipate the future now.

Conclusion

In closing I would like to make two points. First, serious spectrum reform is going to require hard work. The technical questions before the FCC are formidable. And incumbent users have a legitimate interest in assuring that their use is not significantly interfered with. The policy and political issues will also be difficult. But thanks to the work of the FCC and its Spectrum Task Force we are off to a promising start.

Second, policy makers should always keep the consumer interest front and center. Some of the existing holders of spectrum or businesses that might face competition as a result of technological innovation may oppose these reforms. Let me be clear. Protectionist efforts should be resisted. In the end, the public and U.S. economy will benefit enormously if improved spectrum management techniques can eliminate the artificial scarcity created by the current system.

Thank you.

The CHAIRMAN. Thank you, Dr. Kahn. Mr. Berry.

STATEMENT OF STEVEN K. BERRY, SENIOR VICE PRESIDENT, CELLULAR TELECOMMUNICATIONS AND INTERNET ASSOCIATION

Mr. BERRY. Mr. Chairman, it is always interesting how different the room looks from this particular venue than from those uncomfortable seats behind the dais.

The CHAIRMAN. They are uncomfortable in order to keep them awake.

[Laughter.]

Mr. BERRY. I will try to do my best. I ask that my full testimony be included in the record, if I may.

The CHAIRMAN. Without objection.

Mr. BERRY. Mr. Chairman, members of the Committee, thank you for the opportunity to appear before you today. I am Steven K. Berry, Senior Vice President of Government Affairs at the Cellular Telecommunications and Internet Association, CTIA. We represent all categories of commercial wireless telecommunication carriers, including cellular, personal communications services, manufacturers, and wireless Internet providers.

Chairman Powell established the Spectrum Task Force in June of 2002, and he should be commended and congratulated for that effort. The good thing is that the Task Force initiated a comprehensive, systematic review of spectrum policy at the FCC. The bad thing is that the Task Force was the only comprehensive review of spectrum policy at the FCC in memory.

Mr. Chairman, the wireless industry continues to experience incredible growth, from 16 million customers in 1994 to 140 million customers in 2003. The wireless industry has invested more than $118 billion in building out networks on top of the $22 billion spent acquiring spectrum licenses in Government auctions. Competition continues to drive wireless prices down, by 32 percent in the last 4 years, and competition continues to drive wireless use up, but these are also challenging times for the wireless industry. We have lost 75 percent of our market cap in the last 18 months, more than $.5 trillion. We have also experienced the first reductions in wireless employment in the history of the industry. For these reasons, the Committee's review of our Nation's spectrum management policies could not come at a more important time, or confront more challenging circumstances.

Allow me to suggest three fundamental principles of sound spectrum management: Certainty. The certainty that carriers will continue to have exclusive use within their licensed spectrum is vital to continued investment. Predictability, predictability that spectrum rules and spectrum availability will permit future growth, and flexibility, flexibility within spectrum assignments so that we can continue to innovate. Spectrum management policies that meet

these three principles will allow our competitive industry to grow, to improve quality, to offer innovative services, create new jobs, and yes, contribute to the American economy.

Let me also offer that the issues brought before this Committee should not be presented or seen as a false choice between stability on one hand and innovation on the other hand. For the competitive wireless industry, where billions have been invested and more will be invested, stability is the necessary element to promote innovation, but it is equally true, and it is essential, that stability not be the enemy of innovation.

We need to have spectrum laboratories necessary for new models, new technologies to be tested and proven. I will be explicit. The wireless industry supports Wi-Fi technologies. The wireless industry is developing and providing Wi-Fi applications today. Wi-Fi and wireless are complements, not competitors.

In the few minutes remaining, let me highlight some of the study recommendations that are positive, some that need work, and some that may be missing in action. Positive developments. Since Congress is most directly affected, I highlight the Task Force's strong support for the creation of the relocation fund. I thank the Chairman for his comments in that regard. The concept has strong bipartisan, Congressional, Administration, and FCC support. I urge the Committee to quickly act to streamline the relocation process.

Auction funds would pay relocation expenses for Government users, particularly the Department of Defense. I would also recommend that the Committee consider expanding this concept to apply to commercial and public safety relocation initiatives.

The need to clearly define rights and responsibilities of spectrum users was a recommendation. I concur. Licensees should have full use of their licensed spectrum, including the right to sell on the secondary market, but defining interference temperature thresholds will require much additional work.

Flexibility of spectrum use. I concur. The flexibility, allocation, and service rules established before spectrum assignments balance the needs for both predictability and flexibility, but flexibility should not be an excuse to avoid tough allocation decisions.

Interference protection. I concur. It must happen. It must be based on actual, real world tests, and require a great deal of additional work.

Promoting spectrum efficiency. I concur. Grouping like services during the allocation and assignment phase will reduce interference, promote efficiency, and save spectrum resources.

Global harmonization. I totally concur. It is important that we allocate spectrum and promote spectrum use in a globally harmonized manner.

Policy recommendations missing in action. Congress delayed the auction of the 700 megahertz ban in order to help facilitate a more comprehensive solution to enhance spectrum for public safety. The broadcast policy and the public safety policy are intertwined. Public safety must be given access to the additional spectrum Congress authorized in 1995 to meet these urgent, enhanced public safety and emergency response needs.

Broadcast spectrum was virtually not addressed. We can no longer support such inefficient uses of large chunks of spectrum. Underutilized or inefficiently used spectrum should be reallocated.

I concur that we should also enhance planning for the World Radio Conference.

And finally, the report should have recommended a national spectrum policy plan. The president should make its findings and report to Congress. In the 1993 Omnibus Budget and Reconciliation Act, and again in the Defense Authorization Act of 2000, Congress directed the development of a national spectrum policy plan. It is time to have a national spectrum strategy.

In conclusion, Mr. Chairman, spectrum management is, indeed, an important national security issue. It is important to our economic well-being, and I thank you for the opportunity to speak to you today and I will answer any of your questions. Thank you.

[The prepared statement of Mr. Berry follows:]

PREPARED STATEMENT OF STEVEN K. BERRY, SENIOR VICE PRESIDENT, CELLULAR TELECOMMUNICATIONS AND INTERNET ASSOCIATION

Mr. Chairman and members of the Committee:

Thank you for the opportunity to appear before you today. I am Steven K. Berry, Senior Vice President of Governmental Affairs at the Cellular Telecommunications & Internet Association (CTIA) representing all categories of commercial wireless telecommunications carriers, including cellular and personal communications services (PCS), manufacturers, and wireless Internet providers.

CTIA is pleased that the FCC's Spectrum Task Force has chosen to examine comprehensive spectrum management and believes that this report is an important first step towards positive spectrum management reform beneficial to wireless consumers and the wireless industry. Spectrum is the key ingredient. Efficiently and effectively managed, it will enable us to continue to build out our service areas, improve service quality, offer innovative new services to help wireless technology touch the lives of all American consumers, and contribute to our nation's economy.

In my testimony before you today I would like to discuss the wireless industry reaction to the Task Force Report. First, the Report positively addressed many issues and I would like to highlight some of these. Second, I would like to discuss the particular issues of spectrum rights, interference and the need for additional spectrum. Last, I would like to talk about some of the issues that were not addressed in the Report and discuss where the wireless industry would suggest spectrum policy go from here.

Reforming our nation's spectrum policies is of paramount importance to the wireless industry because additional spectrum will be necessary to serve consumers needs in the future. Reform of the spectrum management process, particularly how spectrum is allocated, is an essential step in ensuring that the wireless industry will have a known, predictable path to more spectrum over the next decade and beyond. A certain, sure path for spectrum allocation is vital to our plans to meet the increasing demands of consumers for mobile wireless voice and data services. The tremendous effort that the Spectrum Policy Task Force has expended in developing the Task Force Report—a significant first step in the spectrum policy reform process—must be applauded. At the same time, a great deal of challenging work remains to be done because the benefits of reform can only be realized if critical details are resolved effectively. The need for spectrum policy reform cannot be overstated, however, and CTIA believes such reform can, and indeed must, occur in the near future.

In general, CTIA supports the key elements of new spectrum policy identified in the Report. First, CTIA supports maximizing the flexibility of spectrum use through the adoption of "flexible" allocation and service rules established before spectrum is assigned or made available to new uses, so that these rights can be factored into auction decisions. However, the grant of unbridled flexible use to incumbent licensees who do not have a market incentive to use spectrum efficiently may cause interference with third-party operations, create inequities that harm competition and consumers, and perpetuate—instead of fixing—inefficient allocation and assignment schemes.

Second, CTIA has traditionally supported, and continues to support, incentives designed to promote efficient use of the spectrum. Certain basic mechanisms for promoting efficiency, such as rigorous pre-allocation cost-benefit analyses and licensing practices that encourage applicants with concrete and realistic spectrum use plans, can and should be applied to all spectrum bands. CTIA also agrees that in those instances where market forces are lacking, alternative measures to improve efficiency should be considered.

Furthermore, CTIA concurs with the Task Force that clearly defining the rights and responsibilities of spectrum users, especially the rights and responsibilities regarding interference protection, is a key element of reform. CTIA believes that a periodic review of the Commission's rules is also essential, provided those reviews are timed and executed in a manner that does not undermine efforts and resources invested by licensees in bringing communications services to the American public.

Spectrum Rights

CTIA generally agrees with the Task Force's conclusion that "one size does not fit all" when it comes to effectively managing spectrum and supports the Task Force's recommendation that future spectrum policies should move away from command-and-control regulation towards an increased reliance on both the exclusive use and commons models, where appropriate. The exclusive use model, with its "property-like" rights of exclusivity, flexibility and transferability, creates a strong incentive to put spectrum to its highest valued use and should be applied to most spectrum bands. The potential for harmful interference from unlicensed systems raises a possible conflict with the exclusive use model. For this reason, the authorization of unlicensed "underlay" operations in licensed spectrum should be approached with extreme caution. Clear and explicit policies and procedures must be in place to protect licensed users from harmful interference caused by these types of operations prior to authorization and widespread deployment. In a similar vein, the secondary markets mechanism of increasing access to licensed spectrum—rather than an "easements" approach—will best fulfill the Commission's goals of encouraging more efficient, more effective use of the spectrum.

The wireless industry sees new and innovative growth in the marketplace each day. Some Members of this Committee have shown an interest in advancing deployment of Wi-Fi and many of our members have acquired this new technology and are making it part of their business plan. We understand that additional "commons" spectrum may be needed to accommodate these new unlicensed technologies. Recently, the NTIA, FCC, Department of Defense and industry representatives came together and agreed to modify the United States' position on unlicensed devices in the 5 GHz band for the World Radio Conference. The agreed position provides 255 MHz (between 5470 MHz and 5725 MHz) for unlicensed devices by resolving the interference concerns of federal users, principally the Department of Defense. This also provides globally harmonized spectrum for unlicensed technologies. CTIA is pleased that this consensus has been forged. This would appear to satisfy additional spectrum needs for unlicensed technologies. We note, however, that providing yet more unlicensed spectrum is still under consideration in or near spectrum bands where CMRS licensees operate. Thus, it is essential that the existing right of licensed users to remain free from interference and the existing responsibilities of unlicensed users to remedy any such interference should it occur must be made explicit if any additional unlicensed allocations occur. Unlicensed users should gain no new rights above and beyond the current circumstances under which they operate, including the right to protection from interference. Additionally, as encouraging as these new technologies are, we must not lose sight of the fact that obtaining increased access to additional *harmonized* and *licensed* spectrum is the most pressing challenge facing the CMRS industry, both in the near and far terms.

Interference

CTIA supports the broad concept of understanding interference and protecting users. Especially, as CTIA member companies and others examine the issue of unlicensed spectrum, there is strong emphasis on the importance of guarding against harmful interference. CTIA agrees that it is essential to establish a more quantitative approach to interference management that accurately reflects real-time spectrum use and provides incumbent licensees with greater certainty regarding the right to be protected from interference. While CTIA supports the general concept of establishing of a clearly defined "threshold" to set maximum permissible levels of interference, the precise meaning of the Report's "interference temperature" approach remains unclear, and CTIA cannot support the concept without understanding how the theory would be rendered into practice. Any proposed interference

threshold must be conclusively demonstrated, based on actual tests, to protect licensed operations from interference before being implemented in any band.

Additional Spectrum

Currently CMRS carriers have access to only 189 MHz of spectrum. In November of last year, the Federal Government—with the help of many members of this committee—affirmatively allocated 90MHz of additional spectrum for licensed wireless use. We are very pleased with this decision and would like to commend the NTIA and FCC for their extensive efforts on this issue. The best way to boost growth to the economy is to make wise and practical spectrum allocation decisions based on a clearly demonstrated need. Wireless minutes are growing by an average of 68 percent over the past three years, and tens of millions of new cell phone users are expected to enter the market in the next several years. The wireless industry will surely need more spectrum over time to accommodate consumers' appetite for improved quality and new services—including limitless data capabilities, and ubiquitous service areas.

Other Issues Must Be Addressed

The wireless industry believes that this Task Force Report addressed many issues of great importance; however, perhaps what is as important are several issues that the report did not address. The Task Force highlights the importance of sound spectrum decisions, spectrum efficiency, and rational planning, yet doesn't address these very important spectrum management issues. First, no thorough examination of spectrum can be conducted that ignores big blocks of spectrum. We do not believe that inefficient users of spectrum should be let off the hook—including broadcasters, federal users, satellite, etc. Positive market incentives are needed to maximize this limited resource. These efforts should include positive incentives for users who are not typically forced by market pressures to make their spectrum more efficient.

The 2 GHz Mobile Satellite Service (MSS) proceeding is a good example of the importance of spectrum reform for such users. Prior even to obtaining their initial licenses, MSS proponents requested an ancillary terrestrial component ("ATC") for their businesses to be viable. CTIA has argued that the Commission should consider such requests—the proposal to provide an entirely new and separate service, combined with evidence that the original service is not economically viable—to be a signal that the spectrum at issue should be a candidate for reallocation. In spite of this evidence, the FCC recently granted the surviving MSS licensees the right to provide ATC (albeit, under significant conditions). In essence, this allows them to provide some form of terrestrial service in the satellite spectrum they obtained for free. The FCC should not reflexively resort to the "easy fix" of giving inefficient or commercially non-viable incumbents flexibility to provide any service under the guise of increasing innovation.

CTIA recognizes that the underlying problem here is the lack of market incentives to use spectrum efficiently. Therefore, CTIA strongly supports the Task Force's recommendation that the Commission consider a statutory proposal for Congress to assess whether the Open-Market Reorganization for the Betterment of International Telecommunications Act of 2000 (ORBIT Act) should be clarified to permit the Commission to utilize competitive bidding when considering applications for global and international satellite services.

Second, I believe this report underemphasized the importance of systematic long-term spectrum planning. The report needs to examine the importance of harmonizing our spectrum allocations with the rest of the world and think ahead as to how to accommodate the growing needs of the spectrum users, including the public safety community.

We were pleased that NTIA recognized the importance of this goal in making their affirmative decision in the 3G Viability Assessment, and wish the Task Force report had shown greater emphasis on harmonization in its blueprint for the future. Harmonization is crucial to the wireless industry. Wireless manufacturers, in particular, need to create products that possess the flexibility to operate globally. Harmonization is more efficient, is vital to economies of scale, and enhances the United States position as a global competitor.

Third, I find it inexcusable that the Task Force failed to address in this report how to facilitate a long-term plan to improve public safety over the next twenty years. Since September 11th, we have heard the calls from our public safety community for updated 21st Century technology so that they can effectively communicate with one another in the event of another terrorist attack on this nation. Yet, this report fails to explain how and where public safety will be able to evolve to new technology that will provide interoperability, security, video streaming, as well as data and voice communication. The public safety community awaits a way to com-

municate with each other at all levels of government, as well as interface with national security apparatus. New demands for homeland security have intensified the pressure for money to spent by those on the local, state and federal levels. Throwing money away to create an uneven patchwork of updated systems makes no sense. When we discuss spectrum policy in this country, we must layout a practical blueprint to accommodate the needs of all spectrum users—especially public safety—over the next few decades.

Last, the wireless industry strongly supports creation of a relocation fund to provide reimbursement to federal entities that are relocated from their spectrum assignment. Last year, the President called for the creation of a relocation fund in his FY03 Budget, and the Administration submitted legislation to the Senate and House. We anticipate that the Administration will not only support the concept again in their Budget for FY2004, but also will quickly resubmit draft legislation. We hope the Senate will introduce it and work towards passing the bill into law. A relocation fund injects certainty into our current reimbursement process. It streamlines the spectrum management process by creating a migration plan for the federal entity that is beneficial to not only the government but to the wireless industry and the consumer. Auction revenues are used to directly fund relocation and modernization. Costs are identified with clear rights for both parties ahead of time, creating definitive timelines to expedite relocation. The practical effect is that the federal entity can upgrade and transition to more modern and efficient systems, while freeing up valuable harmonized spectrum that will bring new and innovative services to the marketplace for consumers. Again, we hope that each of you will lend your support.

Future Wireless Needs

To close, I would like to emphasize what the wireless industry feels is necessary to achieve a spectrum policy that makes sense for all. First and foremost, we heartily advocate the creation of a spectrum relocation fund. The Task Force put forth a list of legislative recommendations, and the creation of a spectrum relocation fund was one suggestion. This mechanism is a critical part of the delivery of the 90 MHz to the marketplace and will assist in injecting practicality to the spectrum reimbursement process. Creation of such a reimbursement process would help the Department of Defense to receive compensation as they migrate out of their existing spectrum and upgrade their aging and spectrum inefficient systems, establish concrete timelines and certainty for the wireless industry, and ultimately expedite innovative services to the market for the consumer. This report does look at many of the vexing problems facing the current process of spectrum allocation. However, we must look to all blocks of spectrum, examine how they are used and what future needs will be. Large blocks of spectrum held by the broadcasters, satellite providers, federal government and public safety community need to be addressed in a comprehensive, deliberative manner, as well. Policymakers must scrutinize these incumbents for efficient use, just as those in industry have: current and future needs, how efficiently they utilize what has already been allocated, etc. Flexibility should not be used as an excuse to avoid making tough spectrum decisions.

I thank the Committee for allowing me to be here today and again applaud the Spectrum Task Force for their Report. The Task Force proposes innovative and constructive means to address many of the shortfalls of historical spectrum planning and we look forward to hearing more detail in how to pursue real reforms. Thank you.

The CHAIRMAN. Thank you. Mr. Calabrese.

STATEMENT OF MICHAEL CALABRESE, DIRECTOR, SPECTRUM POLICY PROGRAM, NEW AMERICA FOUNDATION

Mr. CALABRESE. Thank you, Mr. Chairman, and especially for awarding me that honorary doctorate in your introduction. I should confess I am an attorney with an MBA, and I hope you will not hold that against me.

[Laughter.]

My name is Michael Calabrese, Director of the Spectrum Policy Program at the New America Foundation, a nonpartisan policy institute here in Washington. My testimony today summarizes comments we filed with the FCC task force on behalf of a coalition of

national consumer arts and other nonprofit groups. Although we agree with the goals outlined by Dr. Kolodzy and the Task Force, we strongly disagree with the means by which the Task Force would pursue them.

Our consumer group coalition strongly endorses what are perhaps the report's two most central recommendations. First, we agree that the traditional licensing system, which is based on rigid zoning of the airwaves, should be modernized by granting licensees more flexible and marketable usage rights. Second, we agree that the Nation should expand unlicensed spectrum sharing and thereby facilitate low-cost broadband wireless networking. Progress on the second objective, expanding wireless broadband access, is already being made thanks to bipartisan efforts such as the Jumpstart Broadband Act sponsored by Senators Allen and Boxer.

However, although we agree that flexibility will enhance economic efficiency, the staff's proposed means to this end suggest a path at odds with the fundamental principles of the Communications Act and of the First Amendment. The Task Force report and the paper by senior FCC economists released along with it, which was referred to by Dr. Rosston, embraces a blueprint for the biggest special interest windfall in American history. The Task Force essentially recommends giving today's incumbent licensees permanent and exclusive property interests in their frequencies with no compensation at all to the public.

Although we strongly favor more flexible, market-driven license rights, we believe this Committee should reject any transition to flexibility that is premised either on giveaways at taxpayer expense, or upon the vesting of permanent property interests in frequencies. We believe this for two very fundamental reasons. First, it is completely unnecessary. The benefits of flexibility can be achieved within the basic framework of the Communications Act, which is licensing for limited terms, reserving residual rights to the public, and obtaining a return to taxpayers for the exclusive commercial use of this public asset.

Unless license terms are limited and conditional, as under current law, policymakers will lose the ability to accommodate the dynamic sharing of frequencies, or to otherwise reorganize access to the airwaves as technology and social needs evolve in the future.

The second reason is that the transition to flexible, market-oriented licensing can be accomplished without conferring a windfall worth hundreds of billions of dollars. The Task Force recommends that Congress amend Section 309(j) to authorize what it calls two-sided auctions with simultaneous exchanges. Although dressed up as an auction, this unprecedented process would allow incumbents to acquire permanent ownership of their licensed spectrum, as well as ownership of adjacent guard bands and white spaces, at little or no cost. Because incumbents can decide after the last bid is made not to sell their spectrum, to remove it from the auction, and still receive ownership of the frequencies they now license, the incumbent would be the only likely bidder in most bands.

The Task Force fails to consider alternatives that achieve the efficiencies of flexibility without giveaways. One alternative is the spectrum leasing idea that Senator Burns referred to at the outset. Fully flexible licenses can be assigned in exchange for modest an-

nual payments by all commercial licensees. Today's incumbents can be given the option either to accept a new, fully flexible license in exchange for paying rent, or to return their license at its expiration for reauction.

The precedent for this approach is current law governing the allocation of TV channels for digital broadcasting. Congress granted broadcasters the flexibility to use their DTV channel, which is the one they will keep going forward, to sell ancillary services, but only in exchange for a market-based fee the FCC set at 5 percent of gross revenue. We call this the 5 percent solution to the problem of spectrum reform. Although spectrum is not a tangible public resource, to the extent that competing commercial users value exclusive access to prime frequencies, which do remain scarce, leasing fees for fixed periods can best optimize the policy goals specified in the Communications Act.

First, it avoids unjust enrichment, and returns ongoing revenue to the public.

Second, fees create a market-based incentive for spectrum use efficiency, particularly by licensees that pay nothing now.

Third, a fee system would reduce the upfront cost of auctioning new license rights, since companies would not be bidding for permanent cost-free control of the band. As Senator Burns mentioned, because the future value of the airwaves is unknown, leasing shares the risk between industry and Government, as we do with off-shore oil-drilling leases.

Finally, leasing encourages capital investment, or protects capital investment, by giving incumbents an option to convert after the initial license term to a leasing arrangement with expectation of renewal.

One final reason is what can be done with the revenue. Congress and the States have often chosen to earmark revenue from a public asset for broad public benefit. Examples include the Land and Water Conservation Fund, which is funded by royalties collected for offshore oil drilling, and the Alaska Permanent Fund, which pays an annual dividend to every citizen of that State from income earned on State oil royalties.

Perhaps the most relevant way to think about reinvesting spectrum revenue is for the purpose of fulfilling the public interest obligations that originally justified giving broadcasters free access to the airwaves. One of these obligations, free air time for candidates, which could be financed by a small spectrum fee, is embodied in the legislation introduced last year by Chairman McCain and Senator Feingold.

Another compelling use for spectrum revenue, focused on modernizing American education for the digital era, is the digital opportunity investment trust proposed by former FCC Chairman Minow and former PBS President Larry Grossman.

Finally, with respect to the future of unlicensed spectrum, we were disappointed by the report's tepid commitment to expanding unlicensed spectrum in the low frequencies below 5 gigahertz, and by its restrictive approach to the opportunistic sharing of underutilized spectrum. As smart radio technologies facilitate bandsharing, we should keep in mind the public interest at the very core of this Nation's communications policy, which is the First Amendment.

The proper balance between exclusive licensing on the one hand and unlicensed sharing on the other must not be decided only, or even primarily using economic criteria. Because only the practical need to manage scarcity can justify exclusive licensing at all, we believe Congress should seek to minimize the need for licenses and facilitate bandsharing wherever that is practical.

Whereas the analog era may have justified exclusive rights, digital and smart radio technologies will make it feasible for individual citizens, entrepreneurs, and local governments to dynamically share underutilized bands of the spectrum. The burden should rest with licensees to demonstrate that actual and harmful interference will result when low-power devices seek to share empty spectrum space.

In conclusion, we urge this Committee to achieve the benefits of spectrum flexibility and marketability without a big giveaway, and without converting the public asset of the airwaves into private property.

Thank you.

[The prepared statement of Mr. Calabrese follows:]

PREPARED STATEMENT OF MICHAEL CALABRESE, DIRECTOR, SPECTRUM POLICY PROGRAM, NEW AMERICA FOUNDATION

Good morning. My name is Michael Calabrese, Director of the Spectrum Policy Program at the New America Foundation, a nonpartisan public policy institute here in Washington. I actively participated in the FCC Task Force process, primarily by speaking at two of the public workshops last August and by filing three sets of comments on behalf of a coalition of national consumer and other nonprofit groups. My testimony today reflects the substance of the comments we filed in January, with the Media Access Project, on behalf of the Consumer Federation of America, Consumers Union, the National Alliance for Media Arts and Culture, and other citizen groups.

Before highlighting our concerns about the Report, I'd like to congratulate Dr. Paul Kolodzy and the rest of the FCC staff who served on the Task Force for the dedication and high-caliber professionalism they contributed to this policy review. As an outside participant, I can attest that the staff process was as thorough, thoughtful and open to diverse views as any I have seen in Washington.

We generally agree with the Task Force's "Major Findings" and consider them to be important building blocks for comprehensive spectrum management reform. Particularly significant is the finding that "spectrum access is a more significant problem than physical scarcity of spectrum, in large part due to legacy command-and-control regulation . . .". The Report finds that emerging technologies—such as frequency-hopping "smart" radio technologies—create "the potential for development of services and uses that are not tied to specific frequency bands," or which can dynamically share "white space" within and between existing allocations that currently lay fallow.

In particular, the consumer group coalition strongly endorse what are perhaps the Report's two most central recommendations:

- First, that the traditional licensing system, based on rigid zoning, be replaced by new, more valuable usage rights with enhanced service, technical and market flexibility;
- Second, that allocations of unlicensed spectrum for open and shared access by the public should be expanded—particularly for broadband wireless networking.

Concerning this second objective—expanding the share of spectrum open to the public for unlicensed sharing—important progress is already being made, most recently thanks to the bipartisan efforts of Senator George Allen and Senator Barbara Boxer. Their Jumpstart Broadband Act, which calls for additional unlicensed bands to facilitate high-speed and low-cost wireless Internet access, has already helped to facilitate the recent agreement between the Department of Defense and industry that will enable unlicensed wireless networking in the 5 GHz band without harmful interference to military radar.

A. The Future of Licensed Spectrum

While we agree with the Task Force that a new balance between the "exclusive" rights model and the "commons" model is needed, the staff's proposed means to this end suggests a path at odds with the fundamental principles of the Communications Act and the First Amendment. The Task Force essentially recommends giving incumbent licensees exclusive and permanent property interests in their frequencies (with no compensation to the public) and also designating additional unlicensed "parks" for shared public access (perhaps, if needed, but primarily on less desirable high frequencies). In the future, access to the airwaves would be a commodity traded on secondary markets and free of all obligations except to avoid harmful interference with other users.

However sensible such a "balance" between private property and public parks may sound in theory, in practice the staff Report has embraced a blueprint for the biggest special interest windfall at the expense of American taxpayers in U.S. history. The Report implicitly endorses two transition mechanisms—one based on a proposal by two of the Commission's senior economists, who served on the Task Force, released concurrently with the Report—whereby permanent and exclusive rights to frequencies would be given away to incumbent licensees at no charge.

We believe this Committee should reject any transition to "flexibility" that is premised either on giveaways at taxpayer expense, or upon the vesting of permanent property interests in frequencies, for two fundamental reasons:

First, the economic benefits of "flexibility" can be achieved while maintaining the Communications Act's basic framework of granting exclusive licenses only for limited (and relatively short) terms, reserving residual rights to the public and obtaining, as appropriate, a return to taxpayers for the exclusive, commercial use of frequencies.

Unless license terms are limited and license rights are conditional, as under current law, policymakers will lose the ability to accommodate greater sharing of frequencies, or otherwise reorganize access to the airwaves, as technology and social needs evolve in the future. Just a few years ago, the possibility of facilitating low-cost, wireless Internet access using frequency-agile, software-defined radios capable of dynamically sharing underutilized bands across wide ranges of the spectrum was virtually unknown. Without the ability periodically to review and refashion the rights of both licensed and unlicensed users of the public airwaves, the ability of Congress or of the Commission to exploit such advances for the general public interest could indeed be squandered.

Second, the transition to a more flexible, market-oriented licensing system can be accomplished without conferring a windfall worth hundreds of billions of dollars on incumbents at taxpayer expense—and also without "selling" spectrum at a one-off auction that imposes massive up-front payments on bidders. The consumer coalition comments submitted to the Task Force argued that auction and user fee methods are available to accomplish the goals of spectrum allocation policy mandated by Congress. These statutory goals include the efficient assignment of new license rights among competing firms, securing a fair return to the public and avoiding "unjust enrichment."[1]

In contrast, the Task Force recommends two options that would deprive the public of a return on the airwaves and confer unearned windfalls on incumbent license holders to the detriment of competitors. Under one option, "the Commission grants expanded flexible rights directly to incumbents through modification of their existing licenses."

The other option, noted above, is dressed up as an "auction," but one in which incumbents can opt to sell a permanent property interest in the spectrum they now license and retain 100 percent of the revenue—money that under current law would flow to the public treasury.[2] Because incumbents can decide after the last bid is made not to sell their spectrum—and still receive ownership of the frequencies they now license—the incumbent is the only likely bidder in most bands. The practical effect of the unusual two-sided auction and band restructuring process proposed by the FCC economists is to allow incumbents to acquire permanent ownership of their licensed spectrum, as well as of adjacent guard bands and "white space" (reserve

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[1] With few exceptions Section 309(j) of the Communications Act requires the FCC to use auctions to award mutually exclusive applications for spectrum license rights assigned to commercial users. The enumerated objectives of spectrum auction policy specified by Congress in the 1996 Telecommunications Act include "recovery for the public of a portion of the value of the public spectrum resource made available for commercial use and avoidance of unjust enrichment through the methods employed to award uses of that resource." 47 U.S.C. § 309(j)(3)(C).

[2] *See* Evan Kwerel and John Williams, "A Proposal for a Rapid Transition to Market Allocation of Spectrum," OPP Working Paper Series, No. 38 (FCC, November 2002).

spectrum), at little or no cost. This is not only unfair, but inefficient. When the government fails to get market value for the commercial use of public assets, the foregone payments increase other taxes, or increase the deficit. A conservative estimate, based on the economic literature, is that for every three-dollar increase in income taxes, there is an additional dollar of lost productivity—a deadweight loss on top of the windfall to incumbents.

Because the Commission does not have the legal authority to pursue the two-sided giveaway transition described above, the Task Force Report recommends "that Congress amend Section 309(j) of the Act to include an express grant of authority to the FCC to conduct two-sided auctions and simultaneous exchanges." The logic of both giveaway proposals favored by the Task Force appears to be that spectrum incumbents have so much clout that the only practical way to reduce scarcity is to bribe them to bring their spectrum to market. We urge this Committee to deregulate spectrum management using a mechanism that is consistent with the current legal framework of public ownership, limited-term licensing and increased allocations of spectrum for unlicensed sharing.

A Modest Proposal: Spectrum Leasing

By embracing a false choice between "property" and "commons," the Task Force fails to consider an alternative that achieves the efficiencies of "flexibility" without abandoning other statutory and Constitutional values. Fully flexible and hence more valuable licenses can be assigned *in exchange for* modest lease payments to the public by all commercial licensees. Rather than giving away valuable new spectrum rights to incumbents for nothing, or "selling" spectrum at one-off auctions that impose massive up-front payments on bidders, the Commission should "lease" spectrum for a set term of years, allowing commercial users complete flexibility during the term of the lease.

We recommend that Congress adopt a process that combines limited auctions (for new assignments) with annual lease fees that would attach after the initial license period (*e.g.,* after 8 or 10 years), or sooner in the case of current incumbents. All commercial incumbents could be given the option to either accept the new, fully flexible license in exchange for paying an annual lease fee, or to return their license at its expiration for re-auction.

The precedent for this approach is current law governing the allocation of TV channels for digital broadcasting. When Congress granted broadcasters the flexibility to use a portion of the new DTV channel under the 1996 Act for ancillary services (for paid services separate from the obligation to broadcast a primary "free" signal), it provided that licensees must pay a market-based fee the FCC has set at 5 percent of gross revenue. Similarly, the "rent" on spectrum could be calculated as a percentage of the revenue generated through the use of spectrum, or imputed based on the value evidenced by secondary market transactions for spectrum with similar propagation characteristics.

The giveaway proposed by the FCC Task Force is contrary to all federal and state practice. Where scarce and valuable public assets are made available for commerce, a combination of auctions and lease fees generate billions of dollars in public revenue. The Bureau of Land Management and most states administer combinations of auction and leasing fees for the commercial use of public lands for extracting minerals, logging timber, grazing animals and securing rights-of-way for pipelines.[3] For example, in the early 1980s Congress authorized a method known as "intertract competition" to auction mining rights to federal coal tracts in a similar situation, where incumbent owners of adjacent tracts were the only logical bidder.[4] This auc-

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[3] An example of auction, lease and royalty fees paid on a public asset is the Outer Continental Shelf Lands Act of 1953, which has yielded over $122 billion in revenues to the federal government and coastal state governments since 1954. The OCSLA aims to provide "orderly leasing of these lands, while affording protection of the environment and ensuring that the federal government receives fair value for both lands leased and the production that might result." Successful bidders for tracts pay a combination of "bonuses" (up-front cash payments to secure a lease tract), rent of leased tracts (to incent active use of the tract), and royalties (on oil or gas production). Congressional Research Service, "Outer Continental Shelf: Oil and Gas Leasing and Revenue," May 2000. Federal OCS revenue is earmarked for investment through the Land and Water Conservation Fund, a trust fund established in 1964 for the purpose of acquiring new recreation lands, and the National Historic Preservation Fund.

[4] *See* Michael H. Rothkopf and Coleman Bazelon, "Spectrum Deregulation Without Confiscation or Giveaways," New America Foundation, Working Paper (forthcoming, April 2003). Intertract competition complete reviewed favorably by the Linowes Commission established by Congress in the wake of scandals that shut down federal coal leasing. *See* Report to Congress: Commission on Fair Market Value Policy for Federal Coal Leasing, David F. Linowes, Chairman (1984).

tion process forces incumbents to compete with each other and with potential market entrants to acquire the new flexible license rights proposed by the FCC Task Force.

Although spectrum is less tangible and less exhaustible than most other public assets, to the extent that competing commercial users value *exclusive* access to prime frequencies, which remain scarce, then leasing fees for fixed periods can best optimize the policy goals specified in the Communications Act. Leasing fees would serve several important objectives: first, to avoid unjust enrichment and recover for the public an ongoing and market-based return on the public resource of spectrum; second, to provide a market-based incentive for spectrum use efficiency, particularly by incumbent licensees that now use the resource completely free of charge; third, to reduce the up-front auction cost of the new flexible license rights (and of new commercial assignments generally), since bidders would not be anticipating permanent cost-free control of the frequency; and, finally, to encourage capital investment by giving the new incumbents an option to convert, after the initial license term, to a leasing arrangement with expectation of renewal. All commercial licensees would end up on a level playing field, benefit from a more flexible and valuable licensing arrangement, and in return pay a modest annual lease fee back to the public.

Our consumer group comments outlined a possible transition based on flexible licenses, secondary markets, protecting incumbent capital investments, and putting all commercial licensees on a level playing field with respect to the cost of spectrum. One mechanism, most favorable to incumbents, would give current incumbents an option to renew their license with enhanced rights, including service flexibility and the ability to sell or sublease (for the period of the license), in return for paying a market-based user fee. If an incumbent declines to participate, then these additional flexibility rights would be auctioned as an "overlay" license, initially permitting any use that did not cause harmful interference to the incumbent service already operating on the band. Ideally the incumbent's protection from harmful interference would "wear away" after a reasonable number of years. In any case, auctions should be used only for the competitive assignment of the initial term, which could be quite short (and therefore not prohibitively expensive). After the initial license term, the holder of a new flexible license could choose to renew the license subject to a modest annual fee, or return it for re-auction.

Reinvesting Spectrum Revenue in New Public Assets

Finally, when our Nation monetizes a common asset, Congress and the states have often chosen to earmark that windfall to pay for new public assets of broad public benefit. Examples include the Land and Water Conservation Fund, which is funded by a portion of the more than $122 billion that has been collected under the federal Outer Continental Shelf Lands Act, and the Alaska Permanent Fund, which pays an annual dividend to every citizen of that state (nearly $2,000 per Alaskan last year) from income earned on public royalties from North Slope oil.

Perhaps the most relevant way to think about reinvesting spectrum revenue is for the purpose of fulfilling the "public interest obligations" that originally justified giving broadcasters free access to the airwaves. These unmet public needs include quality children's programming, educational innovation, local public service media and free media time for political candidates to communicate with voters. Of course, this last purpose—free airtime for federal candidates, financed by a modest spectrum fee on broadcast licensees—was introduced last year by Chairman McCain. We were proud to host the policy forum where Senators McCain and Feingold first described the proposal.

Another compelling use for spectrum revenue focuses on modernizing American education. The "Digital Opportunity Investment Trust," initially proposed by former FCC Chairman Newton Minow and former PBS President Lawrence Grossman, would support innovative uses of digital technologies for education, lifelong learning, and the transformation of our civic and cultural institutions. Under their proposal, an initial $18 billion in future spectrum revenue would be allocated to capitalize the trust fund, yielding a permanent revenue stream of $1 billion or more for investments. We urge the Committee to earmark future spectrum revenue for this important purpose.

B. The Future of Unlicensed Spectrum Sharing

Although we applaud the Task Force recommendation that "the Commission should consider designating additional bands for unlicensed use," we were disappointed both by the Report's tepid commitment to reallocating frequencies below 5 GHz for unlicensed consumer devices in the future, and by its restrictive approach to the opportunistic sharing of underutilized spectrum.

As technology facilitates the sharing of frequencies, it becomes critical that Members of this Committee keep in mind the public interest at the very core of this nation's communications policy: the First Amendment. The proper balance between what the Task Force calls the "exclusive rights" model and the "commons" model for access to the airwaves cannot be decided only, or even primarily, using economic criteria. We must keep firmly in mind that when government requires a license to communicate—or grants certain parties instead of others "exclusive rights" to frequencies—this is a form of intrusive regulation that necessarily burdens the ability of other citizens to communicate.

Accordingly, where government does grant exclusive licenses to communicate, it must do so for a good reason and in a manner that promotes First Amendment values. Because only the practical need to manage scarcity can justify licensing exclusive access to the airwaves,[5] Congress should seek to minimize the need for licenses wherever possible. This Committee should therefore adopt an *express preference for unlicensed access* over exclusive licensing. And when the FCC considers additional unlicensed allocations or band-sharing arrangements, the burden should fall to licensees to demonstrate that actual harmful interference will result.

The Task Force's own findings support the conclusion that whereas the analog era may have justified a government grant of exclusive rights to a band of frequencies, the development of digital and software-defined ("smart") radio technologies will make it feasible for individual citizens to dynamically share wide ranges of underutilized spectrum without imposing harmful interference on licensed or on other unlicensed users. Unfortunately, however, rather than embrace this opportunity to expand unregulated citizen access and more efficient sharing of frequencies, the Task Force recommends "that in the first instance" the Commission should rely on private secondary market transactions to facilitate shared access by citizens, entrepreneurs and local governments. The Report opines that licensees "will generally find it advantageous to allow others to use unused portions of their spectrum if they are adequately compensated" and that this will occur "at reasonable transaction costs."

We agree with this approach to the extent that the access sought would result in *actual harmful interference* to a licensed incumbent's ongoing operations. To the extent that the unlicensed user would cause harmful interference, the concept of enhancing license rights with complete service, technical and market flexibility anticipates the licensee's ability to negotiate compensation in return for sacrificing (i.e., subleasing) its own access.

However, the Task Force recommends initial and primary reliance on negotiated private transactions whenever the user seeking shared access would be operating above a hypothetical "interference temperature threshold"—a new quantitative measure that would define the total level of RF emission a licensed operator must tolerate in a given band. To the extent this "interference threshold" is more restrictive than necessary to protect against actual harmful interference—or to the extent the threshold concept is not applied to today's incumbent licensees (as the Report implies), or is not reviewed and adjusted upward periodically to reflect advances in receiver technology—it will deter access and sharing.

Moreover, the efficiency of requiring private secondary market transactions breaks down precisely in the situation where dynamic sharing will be most beneficial to the public interest—that is, with low-power, relatively short range and spread spectrum transmissions associated with sharing high-speed Internet access on a wireless basis. Although the Report rather summarily concludes that private secondary market mechanisms can be developed "at reasonable transaction costs," this will be least true for individual consumer devices, similar to Wi-Fi and emerging "smart" broadband networks, that could easily be deterred by access charges.

The 'Special Case' of Broadcast Spectrum

The Task Force Report expresses skepticism concerning the Commission's ability to reallocate to unlicensed citizen use another band comparable to the 83.5 MHz available for a variety of consumer devices (from cordless phones, to Wi-Fi, to microwave ovens) at 2.4 GHz, observing "there is little 'low-hanging fruit' left for unlicensed band use." Yet with only 12 percent of U.S. households still relying on terrestrial over-the-air broadcasting to receive their primary TV signal—and with such a small share of the upper UHF channels in operation nationwide—the broadcast TV bands may be the ideal space to evolve in a controlled manner, over a period of years, into a new "national park" for open citizen access to the airwaves.

In this regard, the FCC's current Notice of Inquiry on the compatibility of spread spectrum unlicensed uses in the broadcast bands makes a good beginning. This NOI

[5] See *Red Lion Broadcasting Co., Inc.* v. *FCC*, 395 U.S. 367, 387–95 (1969).

has the potential to open more space to unlicensed uses without 'propertizing' the spectrum first or disrupting existing uses. It focuses on expanding the current benefits of the broadcast bands to the American people, such as through the potential delivery of new broadband services on an unlicensed basis. As the combination of cellular 3G and unlicensed networking makes mobile, high-speed Internet access a reality, consumers and companies will be clamoring for more low-frequency airwaves that penetrate walls, trees and bad weather. The TV bands are the "national spectrum park" that in the not-too-distant future could boost the economy by facilitating high-speed broadband access for both mobile and "last mile" connections.

Yet our nation's outdated industrial policy concerning broadcast spectrum will keep the broadcast bands encumbered for a decade or more. We are making the wrong DTV transition; nearly 90% of American homes rely on cable or spectrum-efficient satellite subscriptions for their primary TV signal. Rather than subsidize broadcasters to continue analog broadcasts indefinitely for fewer than 10% of the country, a hard giveback date could be combined with a refundable tax credit for consumers still relying on analog over-the-air. Paid for with just a fraction of the potential auction or leasing revenue from the returned spectrum, a credit on the order of $150 could give consumers the choice to buy a converter box, or connect to a lifeline cable or satellite subscription service.

This alternative—subsidizing *consumers* with a fraction of the spectrum revenue—is opposite the Task Force approach, which suggests both bribing the broadcasters with spectrum ownership *and* relieving the broadcasters of their statutory public interest obligations. Last June, this Committee wisely shepherded through last-minute legislation to cancel the FCC's scheduled auction of TV Channels 52-to-69—auctions designed to allow a handful of broadcast companies, led by Paxson Communications, to pocket two-thirds or more of the billions that wireless phone companies seemed willing to bid for space on Channels 60-to-69. The FCC action would have pared as much as $20 billion from the President's budget. Senator Hollings, then Chairman, wrote in a letter to FCC Chairman Powell that allowing firms to "transfer spectrum and earn profits on the spectrum through such arrangements is outrageous" and violates the FCC's role as "public trustee of the spectrum."

Now, less than a year later, the FCC Task Force returns with essentially the same posture, stating that "the continued application of command-and-control policies to commercial broadcasting spectrum could be substantially relaxed, or may not be needed at all, . . ." This ignores the fact that the 1996 Act gave broadcasters additional spectrum valued at $70 billion on the specific condition that it be returned after the DTV transition for public auction. We urge this Committee to reject this giveaway approach and instead to move affirmatively to hasten the return and reallocation of broadcast spectrum—ideally to create a new unlicensed band for shared access and high-speed wireless networking.

The CHAIRMAN. Thank you very much, Mr. Calabrese. The great $70 billion spectrum rip-off by the broadcasters still stands to this day as a monument to the lobbying power of the National Association of Broadcasters, one of the more disgraceful chapters, I think, of our legislative history and by the way, as you know, Mr. Calabrese, there is still no movement to give that analog spectrum back that they were supposed to, again exercising their political clout.

Dr. Kolodzy, you have heard basically comments and suggestions and not a whole lot of criticism about the work of the Task Force here. I would like you to take a minute and sort of respond to some of the other witnesses' comments, but I would also like for you to couch your response in the aspect of all this that bothers me a great deal, and that is that how can we be sure that what we do today will not be overtaken by advances in technology?

If you look at the 1996 telecom deregulatory act, many of those provisions have been rendered obsolete because of advances in technology. Two years ago, I never heard of Wi-Fi. You probably did, but I was struck by Dr. Kahn's statement that there are 14,000 Wi-Fi installations just in the island of Manhattan. The last

mile used to be our critical issue here, and it still is a critical issue, but certainly the dynamics of it have been changed.

And specifically, would you also address what Mr. Calabrese and others have discussed concerning leasing versus auction versus giveaway, since I think that will be a very critical part of any spectrum management policy that we adopt, and then I will go down and let the other witnesses respond, too.

Go ahead.

Dr. KOLODZY. Okay. That is a large list. First of all, I will start with the technology issues.

You do not want a spectrum policy that actually gets overtaken by events in technology, and one of the reasons I think that the Commission may have brought me onboard is because I was developing, like Dr. Kahn, a lot of advanced technology pieces. I was working at DARPA, Defense Advanced Research Projects Agency, in advanced telecommunication technology, and so we were always looking 20, 30 years out and asking what is going on in materials and all of the technologies.

So what we did when we actually did the Task Force, we stepped back a few steps in trying to ask the questions, what kind of policies would we try to put forth to make sure they were not overtaken by technology change, so in a sense, we were not trying to be agnostic with it. We were trying to make sure we were not also antagonistic. We wanted to make sure that technology could adapt, the policies could adapt with the technology, and that is one reason that we came up with stuff like the interference temperature and the like, trying to get things on a more localized basis and more adaptive to whatever occurs in a localized area, so in some sense, we did try to pull that into place, but we have 90 years, what we have currently. It takes a little while to bring forth some of those new changes of technology into the policies.

Second of all, in the sense of the differences between leasing and auctions and giveaways, the Task Force actually looked at a variety of mechanisms in which to try to transition from where we are currently to this new era where we have actually a balancing act between the command and control sides. Therefore what we did when we looked at the Task Force is basically a variety of mechanisms, and not picking any one mechanism as being the appropriate mechanism. So in some sense, we actually looked at four possible mechanisms in a sense of transitioning. Auctions are just one mechanism associated with that. There is a variety of other ways of actually providing flexible rights and transitioning those out to the users.

The CHAIRMAN. Dr. Rosston.

Dr. ROSSTON. I think you are absolutely right when you say we need to have a spectrum policy that can adapt to technological change. This is something that the FCC has done in the old command and control system, when private radio moved from 60 kilohertz technology to 30 kilohertz technology, the FCC had to help mandate the transitions. I think that what you want to have is a spectrum policy that does not have somebody have to go to the FCC, or a group of people to say, "We have a mess. We have this band that is overcrowded. We need you to tell us what technology to adopt."

You want to have users and technology people determine what technology they think is best, and to adapt to the new technology. Just as Intel has adapted technology for the PC industry, we want to have the communications industry do its own technological change as well.

The second thing I want to address is the so-called windfall that may or may not occur because of an auction for additional spectrum flexibility. I think the most important thing is that if we do get a lot more spectrum in the marketplace, and by more spectrum, that can either mean additional new, unused spectrum, or rights for additional flexibility, which is effectively more spectrum, that that will hopefully drive the price of spectrum down so that it becomes much more affordable, much more plentiful. I think that is probably the key that is making spectrum so scarce, is that the price is high because the rights are restricted, and we should try to figure out a way to increase spectrum supply.

The auction mechanism that was proposed would get spectrum out in the marketplace, and the other thing is getting new consumer value out of it is really important, and the way the auction is designed, it would not necessarily be a windfall to the existing users, especially if the spectrum price goes way down.

And the other thing, as you have mentioned, it is extremely difficult to take spectrum back from people who already have it. The OPP working paper says we can increase supply within 2 years. If we try to take spectrum back from people if they are not using it, or not doing the flexibility, we could be here forever, not getting the benefits of spectrum.

The CHAIRMAN. Is that an argument for Mr. Calabrese's idea of leasing?

Dr. ROSSTON. Well, leasing has a couple of things. One is, if you do—you can think about, an auction, the auction combined with the lease payment, essentially people will bid less in the auction to pay it off, and the lease has another risk, which is, I think the FCC should not be in the business of being business partners. The NextWave debacle proved that point, I think, and I worry extremely about the FCC sort of being business partners with people in these things.

The CHAIRMAN. Thank you. Dr. Kahn.

Dr. KAHN. Well, I think not being an economist, I will stay away from the leasing question, but I think it is important to realize that if you look at all the kind of prime real estate, if you will, in the spectrum space, I think the estimate is it is something less than 5 percent that is currently available. It is unlicensed, and something like 5 percent or less is actually available in sort of really flexible licensed spectrum, so our main conclusion from that is that there is a lot of room for experimentation here.

As far as the kind of obsolescence of policy by technology, I think what we are seeing right now is sort of a major kind of continental shift here on the technology as we go from primarily analog to primarily digital. Those kinds of changes do not happen that often. You know, I believe, as Dr. Kolodzy was saying, that we are able to anticipate the general shape of the technology at least for a window of 10, 15, 20 years, as we go into the digital domain.

I certainly would not be so bold as to say we could be sitting here 100 years from now with the same policy in place and being very happy with it. We will have to reexamine the question on a continuing basis. I hope we can do better than the sort of half-life, if you will, of the 1996 Act, and I think we should be able to, but our main concern is that a lot of these things are going to require quite a bit of real hard work and experimentation with how this affects innovation in the marketplace.

I do not know that any of us have complete answers. It is pretty important to set up a regime under which those experiments can take place, and up until now, it has been pretty hard to do that, with very few exceptions.

The CHAIRMAN. Mr. Berry.

Mr. BERRY. Thank you, Mr. Chairman. I guess I would say that one of the strengths of the Task Force was that it had a healthy mix of options that you could apply, and techniques you could apply to very complicated spectrum management issues. That is why in some cases, you may want to remain with command and control. For example, if it deals with public safety, you may want to sacrifice some flexibility there to have dedicated capability.

On the other hand, the spectrum task force very astutely identified exclusivity and exclusive rights as a way that actually creates certainty, the predictability, and the flexibility, and I think leasing does have a role in the sense that it can help encourage people getting off a spectrum which is not being efficiently utilized.

I do not think that leasing the entire—the process of leasing spectrum throughout the gamut, bringing everyone back to the FCC in order to say "Mother, May I," encourages innovation. I think it is another step in a process to a regulatory fiat.

What I would like to see is spectrum prices go down so the consumer, the end user actually improves, or receives the benefit of it, not money coming back to the Federal Government which—and I know in Mr. Calabrese's testimony I understand there would be a whole series of discussions on how you would expend the funds after the additional money would come into the Treasury. There is a place for leasing. I do not think it is the panacea offered up.

The CHAIRMAN. Mr. Calabrese can defend himself, but I do not think he offered it up as a panacea, did you?

Mr. CALABRESE. No, Mr. Chairman. There is no single best solution, and I think we need to find a balance that, as you said, preserves our flexibility to adapt to technology as it changes.

I mean, it may well turn out, the way technology is going, that freezing today's spectrum zoning right, which is based on analog technologies, we have sliced the spectrum into these thin strips, and now freezing that into private property may turn out in the future to be as inefficient as requiring that land be sold only in circular plots, where you cannot use all the pieces in between.

You will notice in the Task Force report that one word that is never used is the word, licensing, because it is the clear intent of the Task Force that there shall be no licensing in the future, that spectrum will be owned as private property by licensees, because they believe that is most efficient, and as I said, I just think it is not necessary to achieve the efficiency goals that they have.

Several of us, and most of the senior staff at the FCC, just spent a weekend at Stanford hearing from companies like Intel and Microsoft, Alvarion and others, about all of these smart radio technologies that are coming online in the next 3 to 5 years that will allow a dynamic sharing of the airwaves without creating harmful interference.

Bands, particularly the broadcast bands, which, for example, the fifties and sixties channels now are operating—only in about 20, at most, 20 percent of the markets is there a station operating on those 20 channels, so there is lots of white space that could be shared, but rather than embrace this opportunity, the Task Force recommends a reliance on private secondary market transactions to facilitate broadband networking, but this would have enormous transaction costs and really be a detriment precisely in a situation where dynamic sharing would be most beneficial to the public interest, and that is with low-power, short-range, and spread-spectrum transmissions associated with sharing high-speed Internet access.

The CHAIRMAN. Thank you. We have a vote on. If it is agreeable to Senator Burns, I will leave and go and vote, and you can proceed with the questioning, and I will either get back or we will take a brief recess until I get back, if that is agreeable to you, Senator.

Senator BURNS. That is fine. Tell them we are on our way.

The CHAIRMAN. Thank you. I think there is about 10 minutes left in the vote.

Senator BURNS. Thank you, Mr. Chairman.

I want to ask a pretty direct question. In the first place, I am one of these people, and a minority of one, who has had a hard time accepting the fact that spectrum is a national resource. I think it is a technology, and our charge is that once it is developed, that everybody kind of stay in their lanes. That was the original concept that formed the FCC, is to make sure that everybody stayed in their lanes, and that is not the majority thought now, and we will work in the concept of the majority, and if you are looking into leasing, I came up with that idea a couple of years ago as I was sitting and thinking about spectrum and how important it was. How many of you have ever heard of the Taylor Act?

[A show of 1 hand.]

Senator BURNS. It is the Taylor Grazing Act. When you mention that in this little club, your eyes sort of glaze over, but basically it has been pretty successful in managing a national resource, so that is kind of what I have taken as my pattern, and it is not the answer.

I want to ask a very specific question and get your response. The U.S. industry spent considerable time and effort to obtain international spectrum allocation at the International Telecommunications Union World Radio Communication Conferences. Unfortunately, there has been a considerable gap between when the U.S. obtains all-important allocation at the ITU and when the FCC implements that allocation domestically.

While the regulatory gap serves neither the wireless nor the satellite industry, it is particularly harmful to the satellite industry and the availability of new services due to the unique treaty requirements that all proposed satellite systems must follow. U.S.

satellite operators' applications often remain pending for years, putting them at a severe disadvantage in relation to other countries and the operators in those countries. What should the FCC commit to doing to minimize the regulatory gap of the international and domestic process?

I am concerned about these conferences that are coming up, and our inability to have any effect on those conferences with regard to how we manage our spectrum domestically, and I would like just a response to that, please, and anyone can start who wants to, but everybody can comment.

Mr. BERRY. I will take a stab at it. Since the FCC is an independent entity, I think they have to be able to address the issues as they come before the Commission and have their own opportunity to consider the issues, but we can improve this gap by improving our coordination and cooperation with the WRC ambassador.

Janice Obuchowski, I think an excellent appointment, just got named to the ambassadorial slot for the WRC. I think if we improve the SHERPA process, the process that goes on before the actual negotiation, we can actually close that gap. I would be very much favor of appointing either a permanent ambassador to WRC, or an ambassador with longer than a 6-month tour of duty that normally is assigned to that slot, so that you can, in fact, work these issues at the FCC, at the State Department, at DOD and NTIA long before we have to work the 183 other countries that are members of the ITU.

Senator BURNS. Dr. Kolodzy.

Dr. KOLODZY. This is an area that really we did not go into great detail, and I do not really feel like I am the right person to answer that question. However, if you would like to, I will take the question back to the Commission and try to get back to you on that one.

Senator BURNS. I would like some response to this, because we are losing out on the international scene, and here we go in there and we only appoint an ambassador for 6 months. There is no institutional knowledge, it is a quick study, and so I am very much concerned by that.

Dr. Rosston.

Dr. ROSSTON. I have some comments not necessarily about the international process, but you mentioned the delay in satellite licensing that occurs at the FCC. I may sound like a one-trick pony, but the way the process works is, they try to accommodate everybody in the satellite bands and to have people trade off. The FCC evaluates which system needs how much spectrum and how they can share the spectrum, and it goes through this incredibly long and drawn-out process, instead of doing something like they did in the satellite DARS band, or other bands, where they had an auction. They said, put up or shut up, and we will allocate it to the people who actually have a real business plan.

The way it works now, they allocate spectrum and then satellite companies go through this process and then go out of business, so then other people have less spectrum than they would have gotten in a regular process of going to the marketplace.

Senator BURNS. We have been notified we have got about 4 minutes, and this is a cloture vote on Mr. Estrada, and they said they

are cranky over there, so we do not want to miss the vote. I will just put the Committee in recess and—subject to the call of the Chairman.

Thank you very much.

[Recess.]

The CHAIRMAN. I want to thank the panel for their patience. We had an important vote, and I expect that maybe one or two of the other Committee members will be back to ask you questions, and then we will try and complete the hearing.

Dr. Kolodzy, Mr. Calabrese suggests your report embraces a blueprint for the biggest special interest windfall at the expense of American taxpayers in U.S. history. How do you respond to that?

Dr. KOLODZY. I think that if you look at the report and what actually that group worked on, which was the rights and responsibilities group, they actually showed a variety of mechanisms to go after in the sense of trying to do this transition.

One of them was a two-sided auction and the like, and they actually pointed out during the two-sided auction that there was some balancing that had to take place, and especially worrying about possible windfalls, so that actually was looked at and recognized by the report and by the Task Force, but there was also other mechanisms that we actually looked at that could actually be balanced against that to see which ones would be more appropriate for which bands and for what applications.

So my response is, yes, that is a possibility, we recognize that possibility, but there are other mechanisms that could be employed versus just that one, depending upon what the Commission thought was the most optimal way to go about that transition.

The CHAIRMAN. Mr. Berry, what is the expectation of current commercial wireless licensees when the licenses they won at auction expire? What is their expectation? In other words, do you believe they should have to pay usage fees, as suggested by Mr. Calabrese, or should they be automatically renewed, or put up for auction? What are your expectations?

Mr. BERRY. We would hope that if we are meeting the terms and conditions identified by the FCC when the licenses were originally bought, for the most part bought at open auction, that they should continue to be renewed.

The CHAIRMAN. Free of charge?

Mr. BERRY. We paid a spectrum price at an auction for a defined right, and the expectation was that if you continued to meet the terms and conditions, that the FCC provided you that right, that you would in fact have—the FCC would actually have an obligation to continue that license.

The CHAIRMAN. Why do you think the licenses had an expiration date on them?

Mr. BERRY. They had an expiration date in the sense that it at the end of a certain year the license would be reviewed for renewal. If the FCC would have said, the license at the end of 10 years expires and you have no guarantee of renewing that license, I suggest that there would be no one wanting to invest billions of dollars to acquire that license in the first place.

The CHAIRMAN. Dr. Kahn, I would be interested in your response to that, and what effect would you expect expanded availability of unlicensed spectrum bands to have on the value of the licenses?

Dr. KAHN. Well, again not being an economist, I am not sure I am very credible on the value of the licenses. I do think that what we are seeing—I mean, it has been interesting, I think, from our perspective, being concerned primarily with unlicensed, to see the reaction of the licensed cellular providers to Wi-Fi, which I think has changed, as I think was pointed out, from originally, I believe, a reasonable amount of—I do not know, hostility, but certainly distance, to one where I believe most of the operators see Wi-Fi as an adjunct to the kind of services they offer.

It is certainly the case that in a local area, they can offer much higher bandwidth and much better services to their subscribers using technologies like Wi-Fi, and the future technologies that follow on from Wi-Fi.

At the same time, it is unlikely that Wi-Fi is ever going to be a cost-effective solution to provide coverage over huge tracts of distant territories, and so they are actually quite complementary technologies, and I think that the real question here is the value that the consumer puts upon the kind of access that they would get, say, when they are sitting in an airport waiting room waiting to get on an airplane and have, perhaps, a laptop open and are using it, versus when they are perhaps in motion in a car on a highway, where the modalities with which they can interact with information are quite different.

So we may actually find that there is a very nice match in terms of the kinds of applications that want to run at the data rates that will be supportable in the licensed long distance regimes from the sorts of applications that are more likely to run in local hot spots.

So I think they are very complementary, and I think most of the operators I speak with these days see them that way.

The CHAIRMAN. Dr. Rosston, you said that the Task Force report does not set forth any aggressive goals. What goals would you advocate?

Dr. ROSSTON. Getting much more spectrum out. The Task Force report has a goal of 100 megahertz of spectrum within 5 years. They said this should be a goal to get that out, whereas the OPP working paper said we could get 438 megahertz out for flexibility within 2 years. To me, that is a much different goal and the magnitude is sufficiently large that consumer benefits could be substantial in that period of time and with that much more spectrum available. That would be the best example of the goal that I would see getting out there.

The CHAIRMAN. Senator Sununu.

STATEMENT OF HON. JOHN E. SUNUNU,
U.S. SENATOR FROM NEW HAMPSHIRE

Senator SUNUNU. Thank you, Mr. Chairman. Could I ask each of you to give me a specific answer, one specific answer to the following question:

As you look back on current policy, or past policy or decisions made by the FCC or made by Congress dealing with spectrum, what one regulation or policy prescription would you want to avoid,

want to expunge from the record, want to have avoided and, as a result, want us to avoid allowing to happen again, forgetting at least for the moment, for a very brief moment about the political ramifications, and could you be specific? We will go left to right.

Dr. KOLODZY. That is an interesting question, since I was at the FCC, trying to talk about my colleagues there. I am trying to think about that for a moment.

Senator SUNUNU. That is why we brought you here.

[Laughter.]

Dr. KOLODZY. Yes. I guess I do not have a particular case that I think I can mention, but I believe that——

Senator SUNUNU. You cannot think of any bad choices, mistakes? I am not trying to assign blame. I am trying to understand what we need to avoid doing again in the future as we look at spectrum management.

Dr. KOLODZY. I think that instead of a particular case, if I could answer it a little differently, is that taking into consideration that there are a lot of other modalities that we can be regulating upon, and not just in the sense of time and frequencies, understanding that technology is changing so rapidly that we need to basically step back and ask the question, is there a different way of getting access to the spectrum versus just looking at the scarcity issue.

So what I am doing is, I am pushing back, saying, scarcity is not the issue, it is access, so how do we actually change our rules to allow more access into that spectrum and more dynamics into the spectrum.

Senator SUNUNU. Dr. Rosston.

Dr. ROSSTON. I have actually two, sorry. The first—I think I am glad that Chairman McCain is here. The first is the digital television giveaway. This was a nonmarket-oriented approach to technology and the FCC gave spectrum away, as opposed to letting the market decide, and said, here is the technology you have to use, and it was a huge giveaway and has encumbered the prime television spectrum. I think that was a very poor decision.

The other that I will allude to is also the use of installment payments in auctions that got the FCC in the job of bearing a lot of the risk of spectrum policy, and business decisions by spectrum users in the NextWave decision.

So those would be the two that come right to the top of my head.

Senator SUNUNU. Thank you. Dr. Kahn.

Dr. KAHN. It is a tough question. I think I would probably say just the entire philosophical approach of narrow-sliced fixed dedicated use allocations that do not distinguish high- and low-power use modalities of the spectrum.

Now, to be fair, those were correct decisions in their time, because that matched the technology capabilities, but I think it is that set of decisions that said that we have to essentially chop the land up into lots of little plots, that it is very difficult to kind of put Humpty Dumpty together again in some cases, is probably what has caused us difficulty and will actually cause us a lot of difficulty going forward as we try to revamp this stuff, simply because we already have a checkerboard to deal with that that is very complex.

Senator SUNUNU. Mr. Berry.

Mr. BERRY. I assume you are talking just about spectrum issues.

Senator SUNUNU. I am sorry, what is the title of the hearing here?

[Laughter.]

Future of Spectrum Policy.

Mr. BERRY. Yes. Well, there are mandates that the FCC continues to foist upon the industry that have a direct impact on spectrum and spectrum utilization.

Senator SUNUNU. Any particular mandate that you think is unjustified?

Mr. BERRY. Well, those are more nonspectrum issues, I think I would agree with——

Senator SUNUNU. Oh, but putting a mandate on the use of spectrum is a spectrum issue.

Mr. BERRY. No, I am talking about mandates such as local number portability and other mandates on the utilization of the spectrum. I would have to agree with Greg that the broadcasters not vacating the spectrum in the 700 megahertz arena so that you can have long-term, sane, reasonable planning and efficient utilization of resources has been probably one of the most difficult things to plan around.

Senator SUNUNU. Mr. Calabrese.

Mr. CALABRESE. I will mention two quickly, if you do not mind, one which was mentioned, the DTV spectrum giveaway, particularly the fact that there was no——

Senator SUNUNU. I am aware of that, and I have a sneaking suspicion the Chairman is aware of that issue, so you can move to your second suggestion, not that it does not carry merit. I just want to save everyone a little time here.

The CHAIRMAN. I would be glad to hear more.

[Laughter.]

Mr. CALABRESE. I would just point you to my written testimony, where I suggest subsidizing consumers to make that transition very rapidly, rather than subsidizing the broadcasting industry, which has every incentive to hold out for a buyout.

The other one, though, which I think my friend Steve Berry here got caught in the crossfires of just now, was with respect to the way the auctions were designed, as one-off auctions where, with a kind of a wink, and really contrary to the Communications Act, to the literal language, it was suggested to the digital cell phone companies that if they bid billions of dollars at these auctions, that they would have this spectrum forever, despite the fact the Communications Act, as the Chairman said, makes very clear that there is no residual interest by the licensee at the expiration of the license. And so that is why, as I also say in my written testimony, that as we move to leasing, ideally, that we should also change the auction process.

When we assign new spectrum, the auction should explicitly be just for the initial term of 8 or 10 years, with a conversion at the incumbent's option to a fee at the expiration of that first term. That way, there are not these billions of dollars of upfront costs, because that is a real roll of the dice that is burdening the telecommunications industry when, if the auction is simply for one single term, and they know that if they want to keep that spectrum,

that it is going to switch over to a lease fee, then the auction prices will be much lower, but the public's revenue will be ongoing.

Senator SUNUNU. But the issue of fixing or designing a term and clarifying the duration of a term, that is an issue whether you go to a leasing structure or not, correct? I mean, you do not necessarily have to have a leasing structure as you described in your testimony to get the benefit that you describe of having a fixed term.

Mr. CALABRESE. Correct, and we have fixed-term licensing right now.

Senator SUNUNU. They are two different suggestions, each with its own merits.

Mr. CALABRESE. The problem is, the incumbents—in fact, Mr. Berry's members are at a competitive disadvantage because they are the only companies that paid billions of dollars for access to the public airwaves, and other incumbents pay nothing, and so what we need is to internalize the opportunity cost of spectrum for all commercial users and give them far greater flexibility. Then they can just compete.

The CHAIRMAN. Can I just follow up on your question? Mr. Berry and others would say, if you are not going to have a permanent granting of a license, then they will not make the investments that are necessary to maximize the use of that spectrum. What do you say to that?

Mr. CALABRESE. Well, that we can maintain the strong presumption of license renewal. So for example, if we were going to convert from where we are today to spectrum leasing, what we should probably do, I mean, realistically—it is not perhaps, again, ideal—but we would probably give incumbents the option at the expiration of their license to begin paying fees for their new, flexible license.

They would receive these valuable flexibility rights and in return, at their option, they could either start paying the rental fee going forward, or return the spectrum for reauction, and anticipating Mr. Berry's point, I think his members who have already paid billions of dollars—now, that is not true for all cellular spectrum, but for a good part of it—they would have a good case that they should be exempted from those lease fees because they have already, in a sense, paid the present value of expected future rents, but that is less than 5 percent of the prime beachfront frequencies.

I think for everybody else, we ought to switch over, and this will protect sunk investment if you give them the option to renew with the lease fees.

Mr. BERRY. If I might, Mr. Chairman, since several have spoken about what I would say, I think what I believe is that you want to encourage investment and encourage innovation, and changing the rules, it is sort of like the guy who switches horses in the middle of the stream and he falls off. I do not think you want to change those rules after billions of dollars have been invested and millions, 140 million consumers are expecting the utilization of that same asset when they pick up their phone.

I think that if you have a lease structure—and what I tried to say earlier was, there is a place for lease, and there is a way that you can structure a lease so that everyone has the anticipation at the time the spectrum becomes available so they can figure the

cost, and figure the risks, and figure the assumptions. That is not what was done when billions of dollars were paid for current spectrum.

And I think that going forward, that is why I like the Task Force concept, because it did not preclude a mixture of solutions, because we have a whole different mixture and class of citizens that are currently out there with extremely high capital investment.

The CHAIRMAN. Thank you. Senator Sununu, go ahead.

Senator SUNUNU. Thank you. I guess I am not really keeping anyone. I do have just a couple more questions. One, again from each of you, because I think you have probably looked at this certainly in more detail than we would as policymakers, is there anything out there that you would say, here is an issue we have talked about that is in the spectrum report, or that you read about in the papers, an issue that we have talked about that is important, but, the message to us, this is something, a choice and a decision that ultimately should be left to the FCC, rather than prescribed in legislation?

Dr. KOLODZY. Okay, the FCC provides a mechanism to understand at least a lot of the technical issues associated with these very complex spectrum problems, and so, therefore, when you are actually talking about trying to keep up with the pace of technology, and trying to understand exactly, for instance, should opportunistic spectrum be available, should it be allowed, which is, if there is a hole in the spectrum can I jump into it and use it, should that be a legislative thing, or should that be an FCC, maybe giving the FCC the capability to be allowed to do that——

Senator SUNUNU. I am looking for an example where perhaps Congress has stepped in in the past to offer legislative solutions, where you want to right now tell us, this is an area where, if not left completely to the FCC, you ought to be very careful before you move any legislation that prescribes a solution in this area. Do you have an area?

Dr. KOLODZY. One of the recommendations was, in a sense, in the ORBIT Act, and the questions associated with that, and one of our recommendations to the Commission was to take a look at the ORBIT Act and allowing auctions for satellite spectrum. It does not necessarily mean we are going to exercise that option, but the idea was to possibly give the Commission the capability, or the availability of that tool in the toolbox.

Senator SUNUNU. Doctor.

Dr. ROSSTON. This is sort of a little bit hard, not being in Washington and knowing what you are considering, but I would follow up——

Senator SUNUNU. But my point here is, we are considering everything.

Dr. ROSSTON. I would say in terms of thinking about flexibility, that a directive from you to, say, give maximum flexibility would be good, and allowing the FCC to figure out the right way to implement that would be then the right thing to go ahead and do.

Senator SUNUNU. You would be very careful about prescribing specific uses for specific bands?

Dr. ROSSTON. Absolutely.

Senator SUNUNU. Dr. Kahn.

Dr. KAHN. Yes. I think I am pretty much in the same place. This is an extremely technically complex set of issues, and I think the danger always is that it is easy to make oversimplifying assumptions, even for those of us on the technical side. The FCC is far more technical, obviously, than Congress could possibly be, and they may not be technical enough for some of these questions, so I think shaping kind of general policy and requesting them to become more flexible and to examine some of those things is probably very good.

I would be very cautious about anything that prescribed any specific technology or use of a piece of the spectrum, because that is subject to an awful lot of very difficult technical questions I think that are best handled by a set of people who are dedicated to studying those kinds of issues.

Senator SUNUNU. Briefly, Mr. Berry.

Mr. BERRY. Congress does not often legislate with a scalpel. Normally it is a sledgehammer, and you cannot legislate the laws of physics or market forces, so I would concur that there is flexibility authorities granted, and then a lot of oversight.

Senator SUNUNU. As the Chairman will point out, though, we seem to have been awfully sure about that whole HDTV thing.

Mr. BERRY. But flexibility and encouraging new technologies is correct. The wireless industry only has 189 megahertz of spectrum available to it.

Senator SUNUNU. How much?

Mr. BERRY. 189 megahertz of spectrum. 159 of it is in use. The other 30 is still tied up in litigation, and probably now becoming available under the NextWave, so it is incredible what the wireless industry has done in less spectrum than is left on the floor between the broadcasters.

Mr. CALABRESE. One area that would be important coming up is the degree to which unlicensed sharing will be allowed in bands that are licensed for high power uses, because it will be possible, with these smart radio technologies that Dr. Kahn described, to have sharing of bands for broadband networking that does not cause harmful interference, but Congress should not, I think, draw that line.

I think that would have to be a periodic review by the Commission, using its expertise to decide—Dr. Kolodzy mentioned the interference frequency temperature. If we use that concept, that has to be changed probably over time.

Senator SUNUNU. Last question. With all this talk about flexibility, flexibility means multiple variables. You allow greater flexibility, there are greater variables associated with someone's potential return on a given investment in spectrum. It would seem to me that—if you want to take advantage of the Government giving these rights, you want to have a pretty sophisticated auction process.

My question is, to what extent do you all believe that the current state of the auction designs used by the FCC are sufficient to meet sort of the needs, the goals, the ideas that are laid out in the Task Force recommendations? Kind of on a scale of 1 to 10, the sophistication, the design of the auctions, are the most recent auctions by the FCC up to the task completely, being a 10, or do we have an

awful lot of work to do in experimenting and developing more sophisticated techniques? Scale of 1 to 10.

Dr. KOLODZY. Scale of 1 to 10, I would say that you are probably around a 6, or a 5. We learned an awful lot from the most recent auctions that we have gone through, and we started adding flexibility in all the different aspects, and flexibility for people trying to understand what is possible, what is not, and then trying to overlay as to how you actually can make sure you prevent interference with all this flexibility, what you are actually going to be trying to put forth in these auctions, or actually in the rules associated with those bands, that is going to add a new complexity associated with this.

Senator SUNUNU. When you say the most recent experience, you are talking about the combinatorial auctions that were used for the most recent wireless?

Dr. KOLODZY. Yes.

Dr. ROSSTON. This is actually a great question for me, because my institute has——

Senator SUNUNU. I hope they are all great questions for you.

[Laughter.]

Dr. ROSSTON. They are. For me, I said. My institute has co-sponsored two conferences on combinatorial auctions with the FCC, and we have been working with the FCC to try to push the envelope forward, and are tentatively planning another conference to push further forward on the combinatorial auctions in October.

Senator SUNUNU. So you think you are doing a great job.

Dr. ROSSTON. I think we are doing a pretty good job. I think one of the keys that you mentioned is having the rights defined clearly as you go into the auction. Then I think, I am not sure, but I think there may be some legislation needed for the FCC to conduct a two-sided auction, because it is a buyer and a seller. I am not positive about that, because I am not a lawyer, but I think the auction mechanisms that have been going forward will be able to work in this kind of environment. My guess is it is more like a 7 or an 8. There is still, obviously, room to improve, because no one has ever done these kinds of auctions before.

Senator SUNUNU. Dr. Kahn.

Dr. KAHN. I think I am going to have to pass on this one. I am really not an expert on auctions.

Senator SUNUNU. Fine. I appreciate your candor there.

Mr. BERRY. I think they are improving on how they do auctions. I think the definition of the rights that you are auctioning on is very, very key. Authority for auction at the FCC expires at the end of 2006, and one of the recommendations in the report was they have authority to be able to resolve exclusive use issues within the satellite spectrum by a use of some type of competitive bidding in an auction process, so they are thinking more innovatively on it.

Senator SUNUNU. Thank you.

Mr. CALABRESE. I partially answered this before saying that I think these one-off auctions that suggest that the term is indefinite are a bad idea. I also, as I said at the beginning, would oppose the two-sided auctions. The Task Force report asked Congress——

Senator SUNUNU. In all cases? You do not think it is a good idea, it should never be used in dealing with spectrum management?

Mr. CALABRESE. Right. Yes. It is a bad idea because it is a recipe for a giveaway. It basically ensures that the incumbent is the only bidder, and what I am surprised is that the Task Force does not at least discuss an alternative means of auctioning these valuable flexibility rights that they propose handing out, which has been authorized by Congress, and that it is intertract competition, which is an auction mechanism used in auctioning Federal mining leases, which has been authorized by Congress, and it was done specifically to auction tracts that are adjacent to tracts owned by incumbents, because they would be the only logical bidders, and that would mean there would be hardly any money coming back to the public.

And so Congress authorized in the early 1980s the intertract competition model, which was reviewed favorably by the Linowes Commission—it is in my written testimony—and I think that would be a better alternative if we were going to auction flexibility rights.

Senator SUNUNU. Thank you. Thank you very much, Mr. Chairman. You have been very generous.

The CHAIRMAN. Thank you. I want to thank the panel, and you have provided us with a lot of very helpful information, and we will look forward to communicating with you in the future. This hearing is adjourned.

[Whereupon, at 11:30 a.m., the Committee adjourned.]

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