The National Academies

Computer Science and Telecommunications Board

Improving Spectrum Management Through Economic or Other Incentives: A Workshop

February 28, 2006

Lecture Room
National Academy of Sciences
2101 Constitution Avenue, N.W.
Washington, D.C.

Proceedings by:

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P R O C E E D I N G S [8:30 a.m.]

Agenda Item: Welcome - Jon Eisenberg

DR. EISENBERG: Good morning, I'm Jon Eisenberg, I'm acting associate director of the Computer Science and Telecommunications Board here at the National Academies. I'd like to welcome you to this workshop this morning, the rest of today and tomorrow on incentives to improve spectrum management. I'd like to extend my thanks to NTIA for its sponsorship of this workshop and to Eric Stark and his staff for all their help. I hope that these will be two interesting and productive days. I'd also like to thank members of the steering committee that helped organize this workshop, it's chair Dale Hatfield, Bill Lehr and Jon Peha, you'll see these folks later on in the panels and in a wrap-up session tomorrow.

Finally I'd like to point out the CSTB staff who've helped make this event possible, I think they're all of the room right now but Kristin Batch who took the lead in organizing this event, Margaret Wind who's been responsible for all the logistics planning, and Jennifer Bishop who I think is sitting in the back of the room at that computer, you'll want to see her if you haven't yet given her your presentation, we're going to try to get everybody's presentations loaded on this so we don't spend a lot of time connecting computers and so forth and any of

us can help you if you've got any questions.

Before turning things over to Dale who's going to be chairing the workshop I'd like to just note a couple of administrative notes, one is you may have noticed we are transcribing the workshop. This isn't something that will be published but it is something that we'll be providing to NTIA as part of the record for input into the Spectrum Reform Initiative and that will also be available to the public through National Academies Public Access File.

Because we've got a really busy program today, a lot of speakers, with only a few exceptions we're not going to make extended introductions, everybody's bios are in your folders but we'll not take the time to introduce all the panelists individually.

Also a word about lunch, lunch is provided for everybody downstairs in our cafeteria, those of you who are speaking on panels should have gotten lunch vouchers in your badges. As you may know if you're familiar with this area there aren't a lot of other options for lunch, so we've allotted 90 minutes for lunch should you wish to try something other then our very fine canteen downstairs.

Finally I'd like to introduce Dale Hatfield who will be chairing the workshop. He is probably someone who doesn't need much of an introduction for this group so I'll just note a few things. He served as chief of the FCC

Office of Engineering and Technology, before that as chief technologist at the FCC. He served as deputy assistant secretary of commerce for Communications and Information, and chief of the Office of Plans and Policy at the FCC. He's currently an independent consultant and an adjunct professor at the University of Colorado at Boulder. I'll turn things over to you, Dale.

Agenda Item: Welcome - Dale Hatfield

MR. HATFIELD: Thank you very much, Jon, I'd also like to add my welcome to all of our speakers and participants to this workshop, it looks like we've got a good turnout and I'm certainly looking forward to today and tomorrow. I was also pleased to be able to work with NTIA on this event. Although my final years were spent at the FCC my early formative years were spent at NTIA and its predecessor organizations, in fact I was a ham radio operator and when I went to the labs out there in Boulder I thought I had died and gone to heaven, operate the radio equipment.

I'll provide you just a little bit more background on the workshop, the Computer Science and Telecom Board was asked by NTIA to convene this workshop to obtain expert advice regarding incentives for more efficient use of the radio spectrum resource. The information gained from this workshop will be used by NTIA

as it develops recommendations regarding incentives for both private and government sector use of the spectrum. In particular discussions will provide input to support the President's spectrum policy initiative which I'm sure all of you are familiar with. Today we'll have a series of panels exploring a variety of issues including spectrum valuation, rights and secondary markets, sharing, fees and so forth, and tomorrow we will hear from both government and non-government users including experiences from both the national and international level.

Now I've been involved in spectrum management in one way or another for almost all of my 40 year career and over those decades I've attended a lot of panels and workshops like this one. And while I've seen an awful lot of progress over the years, a lot of good progress, I sometimes noticed that these conferences were a little long on generalities and a little on specifics. So one of the things we've done here is to emphasize to the panelists that we'd like to see them come up with specific proposals, specific actionable items that might be considered as part of the initiative.

Some of you may know that this is actually the second workshop on spectrum policy that NTIA has sponsored through the National Academies. Back in early 2004 they sponsored a workshop on a wide variety of topics and I

think that was a very successful experience, as I indicated I'm looking forward to this one today as well.

Practical details, we're going to try to hold closely to the schedule, we've asked speakers to hold their remarks to ten or 12 minutes and then we'll have 20 minutes or at the end of each of the sessions reserved for discussions and questions from you in the audience.

With that background I'd like to turn the podium over now to John Kneuer who is acting assistant secretary of commerce for Communications and Information, who will introduce deputy secretary Sampson.

Agenda Item: Welcome – John M.R. Kneuer

MR. KNEUER: Thank you, Dale, welcome all, this morning it's my pleasure and my privilege to introduce Dr. David Sampson who serves as the deputy secretary of commerce. Dr. Sampson was appointed by the President and confirmed by the Senate in June of last year as the deputy secretary, he began his service in the Administration as the assistant secretary of commerce for economic development. Prior to that he had a long and distinguished career in both public service and the private sector in his home State of Texas.

As the deputy secretary Dr. Sampson is a key member of the President's economic policy team, he also serves as the chief operating officer of the Department of

Commerce overseeing a $6.5 billion dollar budget and approximately 38,000 employees.

Dr. Sampson's reputation in the department is as a peerless management of human resources, capital resources, he very much in that vein understands what we're trying to accomplish here today with regards to bringing real rigor and responsibility to the way we manage this critical resource so I know he will be interested in the outcome and will look forward to the results. And with that I introduce Dr. Sampson.

Agenda Item: Opening Remarks - Dr. Sampson

DR. SAMPSON: Thanks, John, thank you all very much, it's good to be with you this morning. We are very fortunate to have John as the acting assistant secretary at NTIA right now, we all of course miss Mike Gallagher but we are very fortunate to have a deep bench at NTIA and John, thank you for making sure that we don't lose any momentum on issues like this.

I want to welcome all of you to Washington this morning for those who have come into town and especially want to recognize our guests, I understand that we have some conference participants who are here from as far away as New Zealand and Australia and Europe, so a very special greeting to all of you this morning.

All of you are involved in one way or another in

how we use and manage the public airwaves. This is a major responsibility and the fact that you are all here today shows how seriously you take that responsibility. As we all know the radio spectrum has been a key part of our lives and our economy for over a century now, it allows people to communicate and do business vastly better and faster then ever before by phone, television, radio, and most recently over the internet using a variety of wireless connections. And in the knowledge based world of the 21st century the airwaves will be an even more valuable and precious public asset.

But to take full advantage of the power of the spectrum it is imperative that this country remain technologically advanced. We absolutely must be on the cutting edge of radio technology and we must also use the most effective management tools for getting the most out of that technology. We can have the best technology on the planet but what good is it if we fail to tap all of this potential and if it is deployed in an effective or inefficient. And that's what you all will be working on the next couple of days, considering various ways and incentives to encourage more efficient use of the radio spectrum. In turn this will lead to making more parts of the spectrum available for other applications and it will promote development of new technologies.

President Bush's Spectrum Policy Initiative identifies reforming the way we manage our spectrum as a critical contributor to innovation, job creation, and economic growth in our country. There are countless examples of this, today over 200 million Americans subscribe to a commercial wireless service. Many can log onto the internet using unlicensed wi-fi technology or licensed services. There are enumerable applications of RFID technology, NASA scientists communicate with the Mars Rover on radio frequencies, the Commerce Department's National Weather Service uses satellites and other wireless technologies to track storms, farmers and ranchers manage their lands wirelessly. And without a doubt spectrum use is one of it not the most pervasive modern technologies we have and the U.S. is the global leader in radio technology and innovation but to stay the leader we have to stay ahead of the curve.

Now the Bush Administration has a solid track record on getting more out of the radio spectrum in ways that will spur technical innovation and increase competitiveness. We're working to open the government's five gigahertz bandwidth for sharing, facilitating the option of new licenses for advanced wireless service this coming summer, and providing an unprecedented access to the 70, 80, and 90 gigahertz bands is a testament to the

President’s commitment in this area.

The President’s policies have several specific goals, to establish a modern spectrum management system, to create incentives and policies that encourage efficiency and new services while increasing predictability and certainty for users, and to streamline the deployment of new services while preserving national security and public safety and encouraging scientific research. Efficiency is the ultimate aim of good spectrum management, however we’re not as effective as we could be especially given the critical mission needs of some users such as the military and federal agencies.

One way to solve this problem is with economic and other incentives that build new markets and free up spectrum for more users and new innovative technologies. In the private sector market forces are at work in certain industries, broadcasters for example can buy or sell stations with few restrictions from the FCC. In recent the FCC has taken additional steps, it created new market incentives by giving some licensees increased technical or service flexibility by easing rules to allow leasing and secondary markets, and by using auctions to assign licenses.

During this workshop you will be exploring areas where the FCC might need expanded legislative authority to

carry out further market based reforms. How economic incentives might work best for federal users is another topic that you'll be considering. Today federal agencies are not affected by market forces, federal spectrum management is an administrative process in which economic value plays little or no role. An incentives approach recognizes that spectrum has a measurable value and opportunity cost, management reforms based on economic incentives such as fees or greater rights or perhaps something else that we haven't yet identified incorporate that value into the decisions federal agencies make about usage and procurement of new systems.

There are other ideas to explore. Should we consider trading or leasing federal spectrum? Can we make greater use of commercial services? And would more spectrum sharing lead to greater efficiency?

Over the next couple of days you will hear from some of the best economists, engineers, and legal minds as they discuss and debate how economic incentives might improve the way we use the airwaves. Among you are academics, policy makers, and people who are involved in operations out there, from the federal government and the private sector. And we're also very fortunate I believe to have representatives from other nations to hear what they've been doing. Some have been very successful at

creating market incentives, New Zealand and Australia for example were among the first to adopt market incentives with New Zealand taking the plunge over 15 years ago. Guatemala has made some of the most extensive reforms to date. In Europe, the United Kingdom adopted reforms for its commercial users and is now looking at market reforms for government agencies. And the European Union is considering market reforms for its member countries. So there is much about which to learn.

You're in a very dynamic industry at a dynamic moment in economic transition, and I'm certain that you will have some lively and stimulating discussions. In closing let me say that over the next two days we're going to be asking a lot out of you, we want you to put new ideas on the table and kind of following up from Mr. Hatfield, we're counting on you to move past just theory, to come up with a very specific agenda that includes legislative and administrative reforms that President Bush and Congress can consider. And we will use this agenda to try to keep the wireless industry strong and innovative and a leader in a technology that is vital to America's national and economic security, and also to the rest of the world.

So let me say at the very beginning of this conference how much we appreciate you being here, and how much we look forward at the Department of Commerce to the

outcomes from this conference. Thank you very much.

-- [Applause.] --

MR. HATFIELD: Thank you very much, Secretary Sampson, for those very inspiring words. We're going to turn right away now to our first topic which is efficiency, quantification, and valuation of spectrum and our moderator for this session is Adele Morris who holds a Ph.D. in economics from Princeton and is currently a senior economist with the Office of Economic Policy at the U.S. Department of Treasury. Adele?

Agenda Item: Topic 1: Efficiency, Quantification, and Valuation of Spectrum - Adele Morris, Moderator

DR. MORRIS: Thank you, Dale. I've had the privilege of representing the Treasury Department and to a large extent the economic perspective in the President's Spectrum Policy Initiative and I want to start by thanking the National Academy of Sciences, the Commerce Department and the NITA for all their hard work in putting on this conference. This conference is a really important milestone in the President's Spectrum Policy Initiative and personally it's a big deal for me to have this opportunity to talk publicly about all the issues I've been going on about since the President gave us our charge about two and a half years ago. And I really want to thank NTIA and I

see some leadership here, John Kneuer and Eric Stark, who've really been moving the ball forward for us as Deputy Secretary Sampson has said, and so many of the staff from NTIA who've been so committed to this process.

To introduce our panelists is a challenge, there are many impressive accomplishments, you can refer to in the biographies, I'm truly honored to be able to introduce them to you today and give you a sense of the perspective they're going to bring to our conversation. First up we'll have Merri Jo Gamble, now Merri Jo is the spectrum management for the Justice Department and I've had the privilege of working with here as part of the President's Spectrum Policy Initiative, and we need to listen to Merri Jo. She will very well articulate the perspective of federal agencies in our process. She's a veteran of the federal spectrum management system and her agency's mission involves critical protections of life and property. And because her perspective is so representative of many of the federal agencies her words should ring in our ears as we think about ways to induce federal agencies to use spectrum more efficiently.

And then in the other four speakers you're going to hear a theme of property rights and government institutions and the theme will revolve around the ways in which property rights for spectrum, exclusively allocated

spectrum, can allow market forces to achieve an efficient allocation of the spectrum resources. We have Professor Ellen Goodman, she is a distinguished law professor and scholar at Rutgers, she's written extensively on spectrum policy and legal issues and has done some very careful thinking about how government institutions can best enforce more market oriented exclusive spectrum rights. And rightfully she argues that a more efficient allocation of spectrum will in general produce more interference and so we need to think through how do we deal with that in a new policy regime.

Next we'll have Darrin Mylet, Darrin heads up Cantor Fitzgerald's spectrum training enterprise and Darrin really will bring to us the perspective from the secondary market. He sees first hand the transactions cost, delay, and lack of transparency and inefficiencies inherent in the current system, and if we're going to have a system that's more efficient we're going to need to take on board the perspective of someone who's actually trying to make efficiency enhancing transactions.

Next we'll hear from Professor Pablo Spiller, Professor Spiller is the Jeffrey A. Jacobs Distinguished Professor of Business & Technology at Berkeley's Haas School of Business and I can't begin to list his scholarly contributions but I think perhaps most relevant to this

context is his work on practical implementation of property rights for exclusive spectrum access.

And that will bring us to our final speaker, Professor Larry White, who is the Arthur E. Imperatore Professor of Economics and deputy chair of the Economics Department at NYU Stern School of Business. Interestingly Larry is the co-chair with Tom Leonard of a task force at the Progress and Freedom Foundation, they're working on a digital age communications act, and Larry as I understand along with some of you are working already on thinking through some of the issues we're going to be dealing with at this conference and maybe we'll get a preview of coming attractions in their thinking from Larry.

So thank you all for coming, luckily we're a little ahead of time here, we'll have 12 minutes for each speaker except for Merry Jo, and she has special dispensation for 13 minutes, so I'm going to be pretty strict on the timing and I'll have like a little sign when your time gets low, and then when Larry is finished speaking we'll have some discussion. So go ahead, Merri Jo.

Agenda Item: Topic 1: Efficiency, Quantification, and Valuation of Spectrum – Merri Jo Gamble

MS. GAMBLE: Good morning. As the spectrum manager for the Department of Justice I would like to take

this opportunity to talk about incentives in spectrum use from a federal agency's perspective.

The consideration of economic factors in spectrum management has been around a long time. The President's Communications Policy Board submitted its report, Telecommunications, a Program for Progress, which focused on five specific issues. Issue number four stated how shall the United States develop policies and plans to foster the soundness and vigor of its telecommunication industry in the face of new technical developments, changing needs, and economic developments. The report was published March, 1951. As far as how that story ended, the issues evolved into recommendations that evolved into bill S.1378, which failed of enactment. Over time the issue of spectrum management has crept into legislative activities, hearings, executive orders, even the creation or expansion of federal agencies, but here we are 55 years later discussing the same issue.

So what constitutes an incentive? In a real world application incentives are derived through consideration of the combination and interrelationships that exist between an activity's specifically defined purposes, processes, and operating environment. Unless incentive based factors such as these are consistent between the various activities under review the effective

application or relevance of them across all the targeted activities may be moot. To be more specific, incentives that are effective in commercial applications typically have little value or diminished effectiveness when applied to overall federal operations. Effective incentives to federal spectrum use must appropriately characterize and be derived from the unique circumstances of federal operational responsibilities and mission, only then will the incentives be relevant.

Federal operations are typically the result of a mandated service responsibility or mission that is derived in support of the overall public good. Federal agencies are mission driven and created to produce results. They need to be effective in achieving those results. Simply put, effectiveness equals results. This therefore needs to be the focal point of decisions regarding federal use of radio spectrum resources, not efficiency. Efficiency is a question of how well agencies use resources in their efforts to achieve results, not a result unto itself. In this context the responsibility to produce results may not necessarily be based on or follow sound economic principles and processes as understood and applied in the commercial business world.

Federal missions are not profit oriented, nor typically quantified in monetary values, with the exception

of sheer cost. The absence of quantified value in many of the aspects of federal operations complicates any realistic calculation of economic return as applied in the commercial business world. Federal operations, such as with Justice, many times involves safety of life considerations which have the effect of distorting the importance of certain economic pursuits that may be associated with or contrary to operational mission priorities.

In order to examine directive based incentives for spectrum use from a federal government perspective I would like to take a few minutes to outline typical challenges facing the Department of Justice. I won't regress to 1951, however, I will go back to 1993 when the narrowband mandate was taking form.

NTIA was tasked by Congress to develop a plan for federal agencies with existing mobile radio systems to use more spectrum efficient technologies that are at least as spectrum efficient and cost effective as readily available commercial mobile radio systems. The plan submitted was the narrowband plans for the 162-174 MHz and 406.1-420 MHz federal bands. The important point here is directives are many times predicated on a philosophical approach, or generalized capability that may not accurately reflect detailed operational realities and requirements.

During the development of the narrowband plans

there was considerable discussion on when to have these plans take effect. Many agencies, Justice included, had no way of knowing whether narrowband technologies would be available to meet our needs, and if so, when, as well as whether we would be appropriated the funds to acquire these technologies. Remember, the plan was for the federal agencies to use technologies that compare to those readily available in the commercial mobile radio sector. What was currently available at that time was analog narrowband equipment. The federal agencies had requirements for encrypted narrowband digital technologies, which in fact was not readily available.

Considering the ten year life cycle of subscriber units the agencies agreed to a ten year deadline for compliance, with the understanding it would be reviewed periodically to monitor technology development. This would ensure the feasibility of compliance, or if necessary, a recommendation for changing the date. In this case implementation was dependent on further technological development, which made exact timelines, funding and applications unknown for compliance purposes.

Directives also have a tendency to force technology to conform to a dictated standard instead of having technology determine what efficiencies are possible to achieve. As an observation command and control

directives may have an inverse effect to reform incentives. Mandating standards can potentially stifle the infusion of newer technologies, diversified applications and resource sharing.

AS I stated earlier from a federal mission perspective spectrum efficiency does not necessarily translate into mission effectiveness. Federal operations must be primarily concerned with effectiveness in their mandated operational mission responsibilities. However, spectrum efficiency is one piece of the overall operational efficiency calculation. Federal operational efficiency is sometimes gauged in such terms as sharing, broadness of application, interoperability, and even longevity before an additional investment can be made.

Commercial applications typically have the option of being efficient and the degree of that efficiency is a measure of performance capabilities that are based on economics. It is easy for a corporation to realign its structure to meet the demands of the market. They can essentially elect to be efficient where and when they deem necessary as the investment and associated economic return of their processes dictate. Furthermore, commercial entities generally have the ability to exercise more influence and control over the critical factors that lead to creating efficiencies such as resources, budget,

investment and operational processes.

The greatest challenge Justice faces in implementing any new technology is in our budget based funding and acquisition process. In the case of the narrowband mandate each component at Justice historically had the responsibility to design and implement their land mobile communications systems to ensure their individual requirements were met within the limited funding available. After identifying solutions that would meet their individual mission needs each component submitted requests for funds to procure narrowband technologies. The reports of the House and Senate Appropriations Committees on the FY 1999 Justice Appropriations Bill did not concur with the individual appropriation requests and instead directed us to implement a department wide approach to wireless communications as well as develop a strategy for common procurement and shared infrastructure. This was a significant change in not only how systems are designed and implemented but also in how they are acquired.

Equipment modernization is not a good measure to drive efficiency if the organization has little control over capital acquisition and investment. In the specific case of the narrowband mandate federal agencies had to prioritize within their individual agency the cost of replacing their wideband communications suite of equipment.

In the budget formulation process there are many factors that must be considered before the final package is submitted to Congress. If such a request passes the agency scrutiny to become a priority in the overall agency budget request then it is in the hands of the political process. Should the budget authority be granted this only provides funding for one year. There are proposals developed for future years in a complex budget development process but in reality the budget federal agencies operate under are for only one year at a time. So to reinforce what I stated earlier the great challenge Justice has in implement new technologies is acquisition.

In summary the challenges for federal agencies are significantly different then those facing the private sector. However, I believe there are incentives that can be offered that may provide improvements to spectrum use. One is for technologies that use spectrum to have multiple functions, if a single device is able to provide multiple functions that means I only have to acquire a single device. Given that my greatest challenge is acquisition there is an incentive for me to implement a technology that provides some relief in the acquisition process.

From a spectrum use standpoint if the spectrum is allocated to provide multiple functions that to me provides effectiveness and has the potential for efficiency. The

federal government applies spectrum by broad allocations or service classes. In keeping with this allocation approach applying multiple compatible functions such as voice, video and data in technology applications is beneficial. What may require further consideration is wider bandwidth to allow for such multiple functions. In this case narrower bandwidth may be more limiting in technology application then keeping wider bandwidth that allows greater functional flexibility.

I would also like to see a monetary value for spectrum dependent federal mission operations quantified or determined without the preconception associated with commercial factors. This would create a foundation for performing a realistic economic analysis of federal spectrum use that differs from those established for the commercial sector. It is unrealistic to expect or be able to measure and determine a credible analysis of efficiency on federal processes and operations when the primary means of analysis is based on commercial market criteria and values.

Any proposed incentive must take into account the differences between the federal spectrum use and that of the commercial sector. Understanding these fundamental differences will help identify appropriate incentives for each and help move us into the 21st century instead of

revisiting the same unsatisfied goals set in 1951.

In conclusion I'd like to leave you with this thought. Thank you.

[Applause.]

Agenda Item: Topic 1: Efficiency, Quantification, and Valuation of Spectrum - Ellen Goodman

MS. GOODMAN: Well I'm going to get started while the presentation is coming up. I'm a lawyer and I'm going to leave it to the economists to define efficiency, what I wanted to talk about were some of the obstacles to efficiency since markets do operate against a background of rights, entitlements and enforcement of those rights, I wanted to talk about some of those issues.

I wanted to start out by emphasizing how much agreement there is among policy makers and scholars about where spectrum policy reform needs to go, and this is I think largely due to the FCC Spectrum Policy Task Force, I see Peter Tenhula here and I think Paul Kolodzy is here, so the principle authors of that report I think brought us a long way.

Everyone seems to agree that there is inefficient spectrum use in most bands outside of CMRS, there seems to be widespread agreement that CMRS is used efficiently. That one of the sources of this inefficiency is transmitter centric controls rather then a system which allows the most

intensive use of spectrum that receivers will permit. In other words we've relied on worst case modeling to allocate spectrum which was necessary at the time and effective but is not outmoded.

There's widespread agreement that flexible use is a good thing and that market based determinations of uses are a good thing. That said there also seems to be agreement that we need some sort of zoned spectrum use, in other words not everything everywhere, special areas for low powered uses, perhaps for some types of modulation, taking into account that some communication systems are government, some are commercial, that some may be open systems where the service provider has no control over the receivers whereas most others will be closed systems. And finally there's widespread agreement that open access spectrum or commons spectrum is desirable in certain cases, whether it is a private commons, which is owned but open access within that private commons, or whether it's more of a true commons.

So given these areas of agreement we have to recognize that there is still frustration with the pace of spectrum policy reform and also the pace of development of secondary markets in the private sector. So I want to address two institutional legal obstacles to progress.

The first are equity concerns, in many cases when

the FCC seeks to increase efficiency of spectrum use, for example by increasing the flexibility of use or the intensity of use, there are claims that doing so would result in a windfall. Some examples, in the two gigahertz spectrum when satellite providers were given the right to do ancillary terrestrial transmissions there were powerful claims that these entities had been given a windfall.

When Nextel swaps spectrum with public safety to resolve some of their interference concerns Nextel paid a certain amount for their new spectrum but the proceeding took I think over three years and much of that, much of the effort expended there was over this question of was the government getting a fair deal, was Nextel paying enough.

Final example, currently under consideration there's a broadcaster proposal to more intensively use broadcaster spectrum by beginning to move to a network structure of repeaters within the licensed spectrum and there are claims that that would be a windfall to broadcasters.

We also see a little bit and I think we'll see more claims that unlicensed users have received windfall benefits because they operate on free spectrum and of course right now they're not protected from interference so they don't have exclusive rights. But the claim is that they may gain defacto exclusive rights because they can't

be shut down and can't be kicked off when they begin to cause, if they begin to cause interference. And there's a possibility that they may gain actual interference protection which would be du jour interference protection rights.

So typically in the public conversation these kinds of windfalls are called public giveaways of the spectrum resource. Now the theoretical actual value of these claims of public giveaways in many cases is very little, the validity will sometimes depend on what the opportunity costs are of the spectrum. But my point really is that these claims have political valance and they have to be dealt with, so how can we deal with them more effectively.

Well one of the problems here is that the baseline entitlements that users have are not very clear so it's difficult to know whether or not, how much additional value a spectrum user is gaining by additional flexibility or additional transmission rights because their baseline rights are not very clear. In other words their right is to be protected from interference, to cause interference, to fill in their service area are not very clear.

A second element here is that which I think we're going to discuss later in the day are that opportunity costs are either not considered or considered

inconsistently, and obviously opportunity costs are very relevant so let me give you an example. In the broadcaster proceeding that I mentioned the public giveaway claim goes something like this, that if broadcasters use repeaters to fill in their service area it would be like “a cattle rancher licensed to graze cattle on a piece of federal land that is given rights to extract timber, oil and metals from the same federal land because those services are valued by the public,” in other words cattle rancher now gets all these additional rights, we would expect those additional rights either to be auctioned or for the cattle rancher to have to pay something for them.

Well the question is is it really like that? Some cases maybe it would be like that but in other cases it might not be, it might be more like the iron ore miner who’s already licensed, permitted, or already owns particular property rights to dig deeper, to extract more iron ore. Or it might be like the iron ore miner who while they’re digging for iron ore pulls up silver along the way. Another word we need to be careful on both the analogies and also what the opportunity costs are with any expansion of rights. And I think that’s important not only in the administrative regime but as we move towards a property rights regime this question of what the scope of rights is will then come to be very important when claims for

trespass and infringement of rights are raised.

The second obstacle I want to talk about is dispute resolution. Under utilized spectrum, as I think there's widespread agreement that that is what we have now, means that we don't as Adele mentioned, we don't have the sort of optimal level of interference. One way to think about this is that if you have a highways where cars must be separated by a mile you're not going to have a lot of accidents. As we reduce that space of separation we're going to have more accidents and the engineers don't like this but that's actually a good thing to have more interference and so we need to figure out how we're going to deal with that.

I think the lack of a dispute resolution, interference dispute resolution currently presents an obstacle both at the administrative end in terms of spectrum policy reform and at the commercial end, I'd like to hear from Darrin about this, about what he sees in the marketplace, but my sense is that certain deals are chilled because there's a fear about what happens if there's interference and what am I liable for, so deals that we might want to see go through. Currently as we know licensed users are protected from harmful interference but nobody really knows exanti(?) what that means, what constitutes harmful interference.

When there are claims of harmful interference the FCC tries to mediate among the parties, this is cumbersome, often the FCC will tell the parties to go and work it out, there's a great deal of uncertainty about really who has what rights in these disputes particularly when the parties are all operating lawfully, in other words no one has illegally pumped up their power, there just is interference because these are all, the allocations have been based on predictive models.

Given all this uncertainty the system we have now is based on exanti protection, in other words it's keep the cars a mile apart from each other so we don't have crashes. So we all agree I think that we want to change that, we want to shorten that distance, so therefore we want to have more crashes and we need a system to deal with it. And I think unlicensed devices complicate this issue even more because they are largely unaccountable and so it's interesting, you see in the Steven's bill about white spaces, an attempt to address this by putting an onus on manufacturers to keep track and perhaps recall unlicensed devices if they cause interference. So all of these elements of the current dispute resolution procedure, exanti dispute resolution procedure, add up to a lot of uncertainty.

So finally some ideas for reducing these

obstacles. I think better definitions of entitlements, both currently and as we move towards a, if we move towards a property rights system, are important, what is the duty to receive interference, what is the right to cause interference, how much of a right do you have to fill in your service area with additional transmissions. Obviously the interference temperature concept was a step towards defining entitlements more clearly and in a more realistic fashion and I assume that today we'll hear from people about the viability, the present viability of that idea.

Spectrum charges I think we'll hear from later in the day, that would be, could be a useful tool to diffusing the equity concerns. And then finally I think we want to begin to think about implementing a system of administrative law judges at the FCC, so that as we move towards a property rights system these disputes, instead of going to courts which I think a number of people have proposed, nuisance disputes, trespass disputes, we can have them dealt with more efficiently by administrative law judges who would use both, impose both injunctive relief and damages, or damages, as the case might be, so it would not be a pure injunctive relief system of the sort that we have in intellectual property but would rely perhaps more heavily on damages.

Thank you.

[Applause.]

Agenda Item: Topic 1: Efficiency, Quantification, and Valuation of Spectrum - Darrin Mylet

MR. MYLET: Good morning, thank you for allowing me to participate in this session. I'm going to make a bit of an opening statement and then I'm going to get into some of the things that we've been working on and some of the questions and some of the issues that we've seen arise in the marketplace.

Most of the license frequency deals are purchased and sold by specialist intervention, specialists generally broker deals or transact business associated with selective spectrum, e.g., 1900 megahertz 2.5 gig, etc. Specialists generally understand the FCC databases or have engineering contacts, know current or expected service rule changes, comparable valuations, and have legal sources to draft the necessary forms and contracts to transfer spectrum rights. The sell side typically sit and wait for a call over time, or they may not want the call at all. Buyers try to find these specialists and then decide if the cost is worth it, sometimes they decide that the cost is not worth it, or else will decide not to invest in wireless ventures that don't have licensed spectrum in the equation.

In response to these conditions a specialist marketplace has thrived, a marketplace that has a number of

deficiencies and drawbacks. For example, such a marketplace is not efficient as it is difficult to ascertain whether or not a person is paying fair value for a given spectrum. Moreover there's a limited number of participating buys and sellers as can be really appreciated by any individual who understands simple marketplace dynamics, a limited supply of buyers and sellers often produces liquidity constraints, improper pricing of commodities being sold, and misguided expectations about future spectrum market conditions. Such an environment has a propensity to foster speculation, to promote hedging or inhibit overall stability in the marketplace.

As the telecommunications industry begins to rebound from the tech bubble these problems in the current marketplace become more salient. Currently a large number of entities are actively seeking to purchase certain spectrum rights, many associations need access to these frequencies in order to accommodate their business needs and other less potential less popular frequencies individuals are still clamoring to purchase spectrum rights that can be used as a basis for underlying business models in the near future.

If a random poll were taken today that solicited the opinion of local and private governments, municipalities, internet service providers, wireless

providers, content developers, telephone companies, about how to purchase spectrum rights probably no two entities would offer the same answer. The diversity in responses is because there's not a consensus about availability, usage, pricing, marketplace environments, and liquidity parameters associated with the sale, purchase or leasing of spectrum rights. Stated more succinctly there is no central efficient marketplace to execute such transactions.

Now I've had the privilege of coming to work with a firm with a telecommunications, I have a telecommunications and wireless background and my firm is known for creating more efficient marketplaces. But some of the questions that we've seen come up as we've started developing this market is do asset discovery, price discovery, and overall execution costs maintain a limited spectrum marketplace, and I think it has. Is there misassignment of resources today? Possibly and highly likely, both physical and radio service rules, so you talk about assets out there, there's a lot of spectrum out there that may not be utilized today or very under utilized, and I would even go into the PCS and cellular realm and say there's a lot of spectrum outside the core markets that is sitting fallow.

Do operators have a choice in spectrum? I think we're seeing a lot more choices out there today as

technology innovation starts to progress and some of these frequencies you read about in the paper. As primary auctions, are we using the right technology? We have the capability to pull up, and I'll show you some of these tools that we've developed, to actually pull up BTAs that have been auctioned and RSAs, and if you look at what's been auctioned and then where the operators are showing where they have coverage there is a big overlap, so our primary auction tools, efficient and that, they auction off the right amount geography wise and also the amount of spectrum. Do they need 30 megahertz for the entire area? Maybe you could create option technology that says instead of auctioning off a big BTA you create a primary option that allows participants to come in and pick the area more succinctly and the amount of spectrum that they want and the government agency if it's the FCC or if it's another country, they can take a look at those particular bids and decide what's best, both monetarily and for public service.

The other important thing is how do we track ownership and usage on a real time basis, both on a public and a private level, these are I think very important things as we've been going out into the market and making phone calls to owners of spectrum, we find out that they're glad we called, a lot of the spectrum that they own they've owned for a while and they have not been able to find a

business case or capital to move their business plan ahead.

Just real quickly about who we are, I'm not going to spend too much about that, at Cantor we are known for creating more efficient markets, we're known for developing new markets, we've been doing that for many, many years on Wall Street. And spectrum is very similar to financial in that it's a multidimensional asset and being able to describe multidimensional assets can be a bit of a challenge but we figured that out on the spectrum side.

We've been very supportive and we've been behind a lot of the secondary markets rulings, we think it's the right thing to do, we think the FCC has done the right thing here in the United States. And again, where are we as far as launching our exchange? We spent all of last year really testing our ideas and our innovation and we just recently really put it out into the market for active participants, so at this time we're pretty excited about where it's going.

There's no doubt that wireless plays a critical role in the economic development, also in public safety. Some of the ideas that we've seen out there in the market today I want to talk just briefly about are frequencies that could be used to cover larger geographical areas like 700 megahertz. Imagine creating a system that serves a larger area, serves the digital divide, a low throughput

obviously, you're not going to get high data speeds potentially with 700 megahertz. But in the event that there is another hurricane that hits the Gulf Coast these systems could be built that are more likely to not go down due to the way they're built, you don't need as many base stations with 700, so in the event that a hurricane does come these systems are turned off and they're used by local, state and federal agencies, so there's sort of a dual purpose. I think this is a very interesting concept that I've heard people talking about.

The value of these assets in this market, I mean they obviously change due to lots of conditions, and creating a system where people can more readily find out these assets, put them out into an open marketplace, I think the more stimulus we'll get and economic activity. Technological innovation is obviously driving values of spectrum and again we've never seen more activity I think in the past couple months, we see a lot of activity, and where is that activity? Believe it or not it is in the paging frequencies, it is in the EHF(?) channels, the 700 megahertz, PCS and cellulars, some interesting ideas being floated there for excess capacity, 2.3 WCS spectrum, 2.5 gig the BRS and EBS I think is poised to really take off.

So where do you go? Today we find that people are amazed that we've been able to develop the tools that

we've developed and creating more of an online marketplace has really two fundamental challenges. The first is just the technology, developing a technology is one thing, and then developing a market is another, and they're both equally challenging. We're beyond the technology part now so whether you're here in the United States or in the EU or other parts of the world we think we've fundamentally developed the technology that will allow for the trading of spectrum, towers, and tower and rooftop space, now we're going through the part of developing the market.

For the United States market it's very nice in that the sell side or the ownership is public record, so that's a very nice situation for us because we've figured out how to pool these 12 million FCC records and put them into a format that makes it very easy for sellers to come in our tool, find their assets that match their FCC records, and put those out to the market that they are available for sale or lease. The buy side is a different story and that takes a lot of effort, you've got wireless ISPs, municipalities, CLEX(?), RLEX(?), there's a lot of these entities out there in the market that we're actively pursuing now and making them aware that there is spectrum and that they could actually buy or lease this spectrum and build their business case not just on unlicensed spectrum alone.

I'm just going to go through some of these tools, if you want a demo feel free to see me later, I'll take you into the live system, but we've made quite a bit of progress over the past few months and this is the actual system as it sits today. Obviously you need to have trading information, you need to know how to be contacted. There's lots of different trading preferences that it's not just contact me if you want to buy it, there's people that are putting bids and offers into our system now that if something else is bid on and it closes that may make them want to go back in and bid higher on another particular asset, so trading preferences for trading are very critical.

Also deciding which frequencies that you want to trade, you may not be interested in lower, you want higher, or you may be interested in higher and you want lower, so we've got all the FCC records into our system now, we pull those live and in real time and people can trade those based on their set preferences. Here's an example of just a few of the preferences for the actual buyer and seller. This is where you set up your states and your frequencies so that you can actually be notified that if somebody puts an asset out into the market for sale or lease you automatically get an email or a notification within the system that some asset just came out that matches your

particular preference.

This is a real breakthrough for us and I think really for the industry as creating an incentive for sellers and an incentive for buyers to come into our system. What we've been able to do is you put in the entity name, and we're pulling each week the millions of records from the FCC databases. And at the top you put in your entity name and it automatically pulls all the FCC records into an inventory in a matter of seconds, that is critical because we want to make it easy for sellers to come in. In fact we've demonstrated this to quite a few major wireless companies and they've offered to pay us $20,000 or $30,000 dollars just for that capability alone, to keep track of what they have. A lot of these organizations may not have good record keeping or they've lost people due to mergers and acquisitions, so we have that capability.

Further, once they pick out the entity name it goes to the radio service code and then when they click that particular section it brings up the call sign and the actual frequency. When they click on that particular call sign or frequency it plots that automatically up onto a map and describes the asset as it matches the FCC record. And what we found is the FCC records are pretty complete, I mean there are some that we found that there's some

discrepancy in time, maybe if there was a recent transaction it takes a bit of time for that to be updated into the files. But if you're going to create a trading market for trading something you've got to be able to describe it, you cannot trade what you cannot describe both whether you're in the public or the private sector if you want to create a market.

So this shows a snapshot of the particular asset, which is very important, now what if you want to partition or disaggregate, I don't know if you know those words but if you want to partition or disaggregate things which are allowed under certain frequencies you can do that automatically in our system, so you can carve out areas that you want to tell or lease. And whether that's the public or private sector we think that's an important consideration and feature for creating incentive for trading. So we've got the actual asset on a map, this is an actual trade screen so this is where you upload the information about what you're willing to sell it or lease it for, the transaction date, if you're going to create an auction, a mini auction, you have that capability.

Further, we breakdown within BTA so we show the live breakdowns of most frequencies, quite a bit of advanced analysis, trade screens. We pull up the live contours, a lot of people want to use our systems to do

research and analysis, all of that is capable. What is the demographics of the contour, takes a matter of seconds to show that on the screen, and here are all the different trade screens.

Another really interesting on in the BRS/CBS(?) spectrum right now is carving out the footballs where there's overlap in frequencies, we do that live real time so the BRS/CBS bands, which we see a lot of activity going on right now, are in our system. So we do microwave paths, we do lots of cool features, this is marketed coverage so we pull secondary, we pull private data about what PCS and cellular and we go from there.

So again, I appreciate your time, this is something that we're very excited about and I thank you again. Have a good day.

Applause.]

Again, if you want a demonstration on the real system I'll be here throughout the conference or you can give me a call and we'll set up another time.

Agenda Item: Topic 1: Efficiency, Quantification, and Valuation of Spectrum - Pablo Spiller

MR. SPILLER: Good morning, I am following Deputy Secretary Sampson's suggestion that we talk about concrete things, I'm going to talk today about some real world property management and spectrum management product matters

or experiences. Essentially if we try to know whether we are using spectrum efficiently or not, today I think without Darrin's software and market implementation we don't know and I think this is a fascinating thing that will help. And up today it was whether the pudding tastes good and I think there is substantial agreement among participants in this sector that the pudding doesn't taste so good and we're not using spectrum so efficiently.

Now how much of this inefficiency is the result of spectrum policy? What I'm going to talk today is about the experience I had in implementing a real trading, well, potentially trading environment in Guatemala, more then ten year ago I was extremely lucky on being recruited by Freddy Goosman(?) who was at the time the person in charge of telecommunications policy in Guatemala to actually try to implement a regulatory reform that includes also a private ownership of spectrum. And we implemented quite rapidly the --[inaudible]-- property right approach to spectrum then available.

Essentially the property rights approach in Guatemala was based on these title, this is title, it's a thing called the TUF(?), the TUF is the frequency usage title and these are registered titled as real estate, they're registered in the regulatory agency. The title has limitations and has obviously rights. The limitations are

quite standard, obviously the frequency rates, the hours of operation, the maximum affected power, trying to limit interference, geographic extent. The period, the period was 15 years and we knew about the conditions for renewal, it's at some point there was some use during those 15 years, so essentially they are renewable. What it means by use no one has defined it yet, so these are renewable.

The rights are quite real estate rights, you can resell without any problems, you can lease, subdivide, as much as technically feasible. And all that you have to do if you resell or subdivide is you have to endorse the TUF, so behind the TUF there is a line where you have to go a regulatory agency, sign it, get the stamp, now it's a new owner of that part and if you subdivide it you get two TUFs, and then you are free from judicial interference, that we don't know obviously what that means.

The granting of TUFs is extremely straightforward, you go, if you find in the registry, and the registry is online, if you find in the registry there is open spectrum you go and grab it, grab it means I want that, and if no one challenges, there is a period of challenge of 25 days, if no one challenges they give it to you, if someone challenges or even the regulator may challenge for technical reasons, but if no one challenges then there is a process by which the regulator has to

engage in an auction, the auction can be delayed for a few more days at least to try to aggregate more spectrum production. But essentially the regulator has 95 days, not more, to call for an auction, there has been as I will show quite a bit of that.

At the time we have a major problem which was A, how to know who has what, so we implemented a recall so everybody unless you bring up whatever document you have which essentially said I'm the owner of some property here, your license or whatever was recallable. So flying of paper came to the agency, they fill out then who has what, and those who had something were given essentially grandfathering, grandfathering was of two types, politically sensitive spectrum meaning public telephone company was getting a TUF which means all the rights and liabilities, so a TUF was given to them. Broadcasters obviously were also granted TUFs otherwise the broadcast wars would have killed the government so they were given that windfall. And private operators, you and me who had a microwave license or something like that were just given what you have up to today, up to then, and when it expires you have to come and buy it or get it through the TUFs. The spectrum was almost exhaustively given already and indeed there were more then 4,000 TUFs granted and most of the TUFs were granted up to 1999 and there is very little

left as you can see by yourself.

Interestingly there has been no, we put no restrictions on technology, now this tells you for example in the 450 range there is substantial fragmentation and these are obviously very interesting how they manage with so much fragmentation, lot of microwave maybe, we don't know what they use it for because we didn't care. But there are areas with substantial homogeneity of spectrum ownership and here you have Atel(?), Atel Communication, this is fixed wireless, Telecommunication Consumer(?), I don't know what they do there, Communicad(?) Services(?) does all sort things from pagers to microwaves, whatever they want to do.

Now what this means is that they bought, Atel bought via auction, similarly Communications Intelligent, I'm not sure about, in Guatemala broadly they bought and they resell, so there is all sort of varieties to grab spectrum, you can grab it in the resell market.

There has not been a lot of formal complaints, these are the number of formal complaints that reach the agency over the years, as you can see there are minimal amounts but the interesting part is that most of these complaints were not, were in broadcasting, there were major broadcasting wars.

There is a secondary market although not that

well developed, this is endorsements, this is the only thing that the regulator knows, that is who came to the office and signed, we don't know anything about leases, we don't know anything about, well, leases which could be fragmented, could be total, we have no clue, but this is actual TUF endorsements and there are some, not zero, and it's a good market for whoever wants to do.

Now property rights, full property rights with everything, didn't crash the system, wireless developed, indeed, it developed very fast and now it has a penetration of around 25 percent in Guatemala. It grew almost faster then most other Latin American countries, it also came from a slightly lower background, so it doesn't, this by itself is not proof that the system works, it just shows you that it didn't collapse. Now that's not too much of a standard.

There are some problems remaining and as I mentioned the fundamental problem have been the radio wars, the radio and TV wars where most of the, indeed like 90 percent of the complaints were with one radio, which essentially high power dog fights, and there's the big issue about community radios, community radios are unlicensed, illegal broadcasting in most of the countryside, what to do with them is very difficult, how you come down on poor people's radios. Well, that's a policy issue.

Now it's clear that there is a need to enforce a little rigor, enforce the spectrum compliance. Now when we designed this issue we also made spectrum compliance a private market, we created a private, we created how you say, an agent which will be registered with a regulator which means, which will undertake spectrum supervision and there was supposed to be implemented, I understand it has not been implemented, now they are implementing some type of registry. But essentially they proceeded to restore conflict goes too high, one of these companies that undertake spectrum supervision, you find the party that violates your property rights, you take the party to the agency, to the regulatory agency, the regulatory agency reviews and then tries to force the other party to comply. I've done the negotiating, there is substantial amount of mediation taking place in Guatemala as ways to resolve.

Another issue is the decentralization of authority, the regulatory and the radio agency kind of share authority and that has created some problems.

Now the interesting thing in here is about deep technological developments, how do we go about that with property rights over the spectrum. Well, in some technology being implemented telephonic models has already introduced 3G, that's good, doesn't say much. Now what about the two and a half, well what you can see in this if

you have 2.4 spectrum is it's owned, it's owned by various type of corporations and the issue is how do we go forward with this and that we'll have to see.

Now the laws talks about producer interference, as a consequence what is producer interference becomes an issue, obviously if I'm using low ball applications that do not interference with your other activities there is no problem, at least that was what we had in mind when we created this concept. Now if you want to do a large scale open spectrum technology that may not be that easy without contracting first with the parties that I just showed you before. So in a sense we created without much knowing a natural band developed, band spectrum managers and we just have to see how to operate.

Now what implications we have from this experience for the U.S., obviously Guatemala is a very small, very poor country, it doesn't compare in any sense to the problems that exist, that we have here.

Now one of the many issues is the title, we granted real title and that's something that the FCC has been moving slowly into that but at the same time that we granted title we protected incumbents, what Evan talks about granting the Swiss cheese but protecting the holes, that's what we kind of did at the time.

Another issue is spectrum fragmentation, what we

saw in Guatemala is that spectrum can be substantially fragmented and indeed we auctioned, when we did the auction we auctioned in various small pieces and as I showed you before Atel and Telecommunicado(?), they were able to grab a substantial amount of spectrum just by playing the auction line very well.

Implementing speedy conflict resolution process is important, the beauty in Guatemala is that we allow parties to mediate, essentially we promote mediation and arbitration and that's a good thing. And fundamentally the fact is that technology really determines the markets, really determines how spectrum is used rather then heavy handed regulation.

So that's it, thank you.

[Applause.]

Agenda Item: Topic 1: Efficiency, Quantification, and Valuation of Spectrum - Lawrence White

MR. WHITE: Good morning, ladies and gentlemen, in cases you've forgotten I'm Larry White, I'm sort of the clean-up batter here and one of the basic problems in being last on an excellent panel like this is often all the good lines have already been taken, but nevertheless I will try my best.

First, as Adele mentioned, I along with Tom Leonard am the co-chair of a working group at the Progress

and Freedom Foundation to develop a proposed spectrum policy as part of the PFF's larger efforts to draft a proposed Digital Age Communications Act, DACA as its come to be called. Dale and Mike Katz and Tom Hazlett are on our working group, Randy May from PFF who you're going to be hearing from later as well, as well as Mike and Tom, are going to say more about the DACA, but just to say it beforehand the DACA proposals will be aired publicly in nine days on March 9, the PFF website, as any good business school you say it first, then you say it again, and then you say it again.

So as a good business school professor I'm going to tell you what I'm going to say and then I'm going to say it and then I'll tell you what I said. Remind you that the problem in spectrum is interference and then the past response has been command control regulation, auctions have been a very valuable interim step but they're only interim, propertization and markets are really the way, this panel is supposed to be about efficiency, quantification and valuation, you get efficiency and along the way you get quantification and valuable. I'm going to stress the real estate analogy, it is not perfect, I'll be the first one to caveat that and specify it's not perfect but gee, I think it gets you an awfully long way to understand the propertization idea that Pablo just told us about, seems to

be working pretty well in Guatemala. Some ideas of how to get from here to there and again, let me mention on March 9 the working group that I'm co-chairing will be fleshing out the ideas of how to get from here to there much to a greater extent and then conclusion.

All right, the problem, interference, in economist speak that's negative externality, spillover effect, my transmissions interfere with your transmissions, that's been the problem, its been recognized from the early days of the use of the radio magnetic spectrum. And what has been the response? Traditionally in this country, in most other countries, it was to declare in 1927 with the Federal Radio Commission and then in 1934 with the FCC that the spectrum was a national resource, nobody could own it, it was up to the FCC to manage this resource as the nation's steward, what it essentially came down to was command and control regulation where the FCC specified our uses, specified parameters of service, and specified users and up until the 1980s the it way specified users was what came to be called beauty contests, deciding who was going to be the best user of a particular slide of spectrum being used in particular ways with particular parameters of service. Notice this is all essentially input oriented rather then output oriented.

The cost of that command and control regulation

had now come to be recognized, documented, empirical studies, it gets into the tens of billions of dollars, and yes we are a rich country but when you're talking about inefficiencies, foregone opportunities that are in the tens of billions of dollars and when you think that the Congress ties itself up into knots into much smaller amounts of money this is a serious issue. We get inefficiency, inflexibility, delay in developing new products and services and as an economist I have to put quotation marks around shortages because what does shortage means, it means that we're not pricing stuff properly. And obviously when you have something that's pretty valuable and you're pricing it at zero you're going to have excess demand for it and some people will describe that as a shortage.

All right, recent changes just to remind ourselves, it was the cell phone opportunities and early applicants for cell phone licenses that overwhelmed the Federal Communications Commission, made the beauty contest basically unwieldy, infeasible, the FCC went to the Congress and said help us, the Congress said okay, do it by lottery, and they did it by lottery for a while but the windfalls and the flipping of company lotteries turned most people's stomach and so finally in 1993 the Congress authorized auctions. A major motive at the time was not efficiency but just getting revenue for the federal budget,

that’s okay, good actions for the wrong reasons, I’ll take it.

And with auction we’ve gotten greater flexibility, greater efficiency, it does establish valuation originally though in no secondary markets directly, indirectly you could have secondary markets by buying companies that owned spectrum and then getting the FCC to bless the transfer. More recently we’re starting to see partly with the FCC’s encouraging, partly with Cantor Fitzgerald, you just heard Darrin Mylet describe the fledgling opportunities at secondary markets but you won’t confuse what he’s just described with the bond market or even with real estate markets yet.

And so where should we be going? We should be thinking in terms of real propertization, again think real estate and I’ll come back to that in just a minute. As we’ve known since at least 1969 with the Arthur Devaney(?) et al. Stanford Law Review article, if you haven’t read it I urge you to read Arthur Devaney’s article in the Standard Law Review 1969, it is a wonderful, wonderful early statement, the shackles fell from my eyes as I read that article and finally understood what Cose(?) had been talking about.

We need to establish geographic boundaries, spectrum band boundaries, power limits at the boundaries,

we should understand that those can be renegotiated among neighbors, there also need to be in band limits because of the basic physics of transmissions. It all comes down basically, again think real estate, right of exclusion, the ability to enforce the right against trespass, through the courts, through the FCC, through some kind of judicial mechanism.

With propertization you get complete flexibility of use, of sale, of leasing, of aggregation, of subdividing, subject to, you can't trespass on somebody else's property and of course we have antitrust laws to prevent the aggregations that could create market power. The property right ought to be permanent, perpetual, that way you get full confidence and people can invest in equipment, in technologies, in what it takes to make this thing really usable. You want to have robust secondary markets so people can buy, sell, lease, add, subtract, multiply, divide. And you want a registry of ownership and again Pablo showed us that this stuff works in Guatemala.

The advantages, and again, it just sort of echoes what Pablo was telling us, you get efficiency, and the private sectors know how to deal with this, the public sector, well, you got to start understanding that the public sector is going to have to pay for spectrum just the way the police department pays for its police cars, if they

want to build a new police station they have to buy the land or rend the land, this is just another resource that needs to be paid for. You get flexibility and again you get innovation, valuation, quantification.

The new agile radio technology is probably going to help in this process because you won't need necessarily with agile radio to acquire spectrum in adjacent bands, you can skip over bands, that will make it easier for aggregators to aggregate, it eases the holdout problem.

Now that spectrum real estate analogy, think about it. Real estate, finite resource, it's scarce, it's divisible, different geologies have different efficient uses, technological change can improve, expand and/or alter efficient uses. Changing economic demands can alter efficient uses. There are problems of trespass, you can say those things about real estate, you can say exactly the same things about spectrum, and again think about Pablo's description of what's been done in Guatemala and you're talking exactly this kind of stuff.

All right, how to get from here to there, and again at the DACA conference on March 9 there will be more discussion of this. Ellen Goodman was describing some of these issues. We ought to be auctioning unused spectrum, get it out there, get it out there as quickly as possible, we can expand the flexibility of already auctioned

spectrum. Encourage economizing of the government's spectrum, incentivize, sorry, I had to say it, incentivize employees just as they get bonuses and rewards for economizing on other resources, similarly reward them for economizing on spectrum.

And keep in focus, and Merri Jo Gamble is right, that having public safety communications is priceless, that's right, it's terrifically important but you don't need to own spectrum in order to get that result, you may be able to rent spectrum, you may be able to have interruptable spectrum that you can call on. The Defense Department owns some airplanes and it's got a call on passenger airplanes at other times so that it doesn't need to own all of the resources so there are various ways of achieving government spectrum.

We can auction occupied spectrum with either the buyers getting the right to clear incumbence but also an obligation to compensate and then issues of how to determine compensation is an interesting question but that can be an efficient result, there's an excellent article by Peter Cramton and Evan Kwerel and John Williams, you're going to hear from Peter later and from Evan later and John is here as well, that shows that that can be an efficient outcome. Alternatively auction it with no right to clear income then obviously the prices are going to be lower, the

negotiations and bargaining is more difficult but still that's another possibility. Or you can auction as Kwerel and Williams have suggested, auction voluntarily supplied spectrum, provide incentives for people to bring the spectrum to the auction and then you can set of alternative mechanisms, incumbents can either automatically get the right to repurchase their existing rights or they can get equivalent value.

Vouchers, there are pluses and minuses to all of these, again, come to the DACA conference on March 9 and you'll hear a lot more about that. By the way this buyer has no right to clear incumbence is as I understand, as we understand it, close to what the British Office of Communications OFFCOM(?), has proposed, and Martin Cave will probably be able to tell you more about that.

So in conclusion spectrum is simply too valuable to waste, to be used inefficiently. There are large social welfare gains to be had from a better framework, that framework is propertization and markets. Will it work perfectly? No, it will not, I'll again stipulate to that right now. Of course it won't. Does our current real estate system work perfectly? No, it does not, neighbors bicker with each other, they argue, sometimes they even go into court and they sue each other. But will it work a whole lot better then what we have out there right now? Of

course it will, and so in the immortal words of the Nike Corporation let's just do it.

Thank you very much.

[Applause.]

Agenda Item: Q&A

DR. MORRIS: Okay, I want to thank our panelists so very much for their words of wisdom and the perspective they're providing to launch this workshop. And we'll have some give and take with the audience but I want to start with a lightening round and it goes like this. In a few weeks time or whatever timeframe the NTIA and associated folks in the interagency team need to put together a decision memo for their bosses to take critical policy decisions, possibly leading to the legislative or administrative changes that Deputy Secretary alluded to. So the question for the panelists is you get to write two to three paragraphs in that decision memo specifically what you think the administration should support as a legislative change, a regulatory change, or for example a budgetary procedure change in that process. So Merri Jo I'm going to start with you and I'm just going to come down our line here and take advantage of this opportunity to advocate for some policy changes.

MS. GAMBLE: Gosh, I'm not really sure how to answer that --

DR. MORRIS: I think you mentioned that one of your biggest obstacles to achieving more efficient spectrum use was the acquisition process and the budget process, so can you think of anything specific you'd like to see on the agenda to consider to address those challenges.

MS. GAMBLE: Well I guess one of the points that I tried to make in my presentation is the federal agencies are bound by the budget process and that means we have to go through a political process within our organization to prioritize any funding we are looking for. So in order to say what kind of a regulatory change or procedural change or legislative change isn't almost a fair characterization because it would be really nice to say well let Congress give us all the money we want because we need all these new technologies, but if wishes were horses beggars would ride, we don't get the money, we have to prioritize within our organization and there are competing interests within each federal agency. And I think those are fundamentals that are not taken into account in a lot of these presentations, we're bound by this process and maybe OMB might enlighten us on what they would even consider.

One of the things we considered in the Presidential Task Force was legislative changes and one was to take the NTIA and remove the federal agencies telecommunications spectrum management out of the Commerce

Department because we're competing with the commercial interests that they are also the advisor to the President on and that make it very difficult and an unlevel playing field. So there are certain conditions under which we have to live by and so I'm sort of not really sure how to overstep the bounds of the operating constraints we are under in order to provide you off the top of my head with any suggested changes I would propose. We're just bound by this process and it is a political process.

So those are kind of difficulties that we face and I think they have to be recognized in how we move forward.

DR. MORRIS: Okay, thanks Merri Jo. Ellen?

MS. GOODMAN: Okay, I only had two paragraphs to write, one would be for the Congress to require the FCC to develop a dispute resolution procedure and for Congress to fund it. The second would be to allow private ownership of spectrum subject to what Larry talked about, these government calls on spectrum so that the government wouldn't have to exercise eminent domain in order to get that spectrum.

MR. MYLET: I would officially announce my retirement. No, just kidding.

I get to attend a lot of meetings, a lot of conference, a lot of ideas on this. I always go back to

that I think there needs to be a platform where these things are put out, are they the different frequencies, the rules, are they being used, when are they being used, how they're being used, different levels, if it's public or private, different levels of looking into the system to see who's using it when and where. But by quantifying and qualifying those frequencies and having a platform so that whether it's the public sector or the private sector people can go in and find what's available and put it to its best and highest use. I think those are some of the requirements that I think ought to be mandated for the different frequencies.

DR. MORRIS: Okay, so we're hearing about market transparency and a fuller information set to foster the market. Okay, how about Pablo.

MR. SPILLER: I have two articles for that bill, the first one is truth in accounting for government agencies, so government agency's budgets now based on wonderful variance methodology, we have a line which will be annual transfer for use of spectrum which will be essentially how much the spectrum that this agency has in spite of the market barrier and that will be part of their money and they could collect that by renting it out or not but that will be, and from the perspective of the budget it should be fully fungible with real money. So that will

force the agencies to think carefully about their use or lack of use of the spectrum. That's one aspect.

The other part will be to really get out of the mindset of windfalls and windfalls with the income tax and system we have here essentially most of that reverts to the government after all so forget about windfalls and grant current holders of wireless licenses a TUF essentially, transfer that into property.

MR. WHITE: Adele, you've asked a tough question, I'm inclined to fall back on a real estate analogy yet again, recall if you've ever dealt with a real estate agent, he or she has probably told you about the three most important factors in real estate, they are location, location and location. I'm inclined in my three paragraphs to say propertize, propertize, and propertize. That won't quite do it and so as an alternative I've been trying to think, there is a film from I think it's the 1940s that's called Flying Down to Rio, anybody seen it? Fred Astaire, right, Fred Astaire, okay, I was trying to think was it Carmine Morando(?), Fred Astaire. Well, flying down to Guatemala City doesn't quite have the same cache but I would say after having heard Pablo take a vacation, fly down to Guatemala City, look around, I think you could learn a lot. And I'll stop there.

DR. MORRIS: Okay, now we're going to open it up

to questions from the audience. Are they supposed to go to the microphone, okay, yes, you are requested to head to the microphone please.

MR. MAY: Thank you, Randy May with the Progress and Freedom Foundation, this question is for Darrin. Currently licensed terms are limited if I still have this correct, and I know they vary I think, but they're term limited. And my question to you is, and presumably if there were change of the type that Larry is suggested you might, licenses like fee simple might be issued in perpetuity. But my question is in your system that you set up how do you deal, how does that market deal with the limitation, and I understand also that there are renewal expectancies and back when I was at the FCC in the late '70s and early '80s we were in the middle of multi-year, of course it went on for decades, with the broadcasters trying to define what a renewal expectancy means and that was much different then the renewal expectancy of a taxi-cab license which presumably absent the company committing a terrorist act you might expect the license to be renewed. But when you showed your system on the screen, the frequencies and some of the other parameters, I didn't see anything about the license term, I know there was a button for legal and regulatory developments, but if someone goes on the system how much notice do they have concerning the term

limitations, how is a renewal expectancy factored into that, or is it, that's what I'm asking because that seems to me to be possibly fairly inconsequential as a practical matter perhaps but as a legal matter of some consequence.

MR. MYLET: Yeah, that's a good question. I'm not a lawyer and I don't play one on TV, but the issue with the licenses, these licenses have service rules that are physical in nature, they're set in stone, and what we're doing as our system is matching buyers and sellers that's the primary function of the tool, it's fundamentally up to the buyers and sellers to disclose what those service rules are, understand what those service rules are prior to doing a transaction. The EBS licenses I do know are currently limited to 15 year leases and I know there's a lot of work going on right now to extend that out and to change the rules with regard to that. But most of the defacto terms, if I'm the primary owner of the spectrum right I can lease that out as a defacto lease, it's a negotiation, how long do you want it or how long am I willing to lease it out to you for, it's pretty open as far as I know. I think that's about the best, so we don't get into trying to interpret, it's between the buyer and seller to truly figure that one out.

MR. TAYLOR: Thank you, interesting meeting. I'm Robert Taylor, I'm chairman of the ITU's Study Group Seven

which deals with science services. In particular we have many space services, I'm sure you can understand quite naturally that space in itself and the way we use it is international in character. So if we want to continue to operate space services, and I'll just use that term for the moment, if one country decides that a piece of spectrum is worth a certain amount of money then every country that your spacecraft flies over ought to be entitled to their share too, especially if it's property, it's property over every country. That's one thing.

One of the services, actually two of them, the Earth Exploration Satellite Service and the Meteorological Satellite Service, operate among other things passive sensors, passive sensors don't emit anything, they are completely passive. They look down and they sense the temperature being emitted at certain frequencies from whatever is being sensed, it could be the earth or in some cases other planets. It's how we discovered the background radiation for example, although that was done from earth it was looking into space.

The point is if there's any interference at all, any, it is only perceived as noise by the sensor. I'm not talking about sharing, I'm not talking about anything of that type, I'm talking about any interference is RF noise which is noise into the system which translates into a

problem in the products. The problem is is there going to be a hurricane, well, we don't know because there's a lot of noise over here which shows up as potentially a hurricane. If it's systematic over a city repeating every orbit perhaps one can do something about it but over the vast majority of the world you can do nothing.

And lastly there's the point about the particular frequencies used for both passive and active services. The sensors use these frequencies because of the demands of physics, not individual frequencies all the time, sometimes it's groups of frequencies paired together, they're capable and smart enough to be able to bring those frequencies and the results of the observations together to produce predictions, predictions of weather, predictions of critical activities, natural disasters, you may or may not be aware that it's possible to predict earthquakes with some limited accuracy. The United States is investing a lot of money in tsunami prediction, none of that uses satellites but the next generation will if the frequencies are available, you can't operate without these frequencies,

And finally I thank you for the invitation to go to Guatemala City, I'd love to see their space program. The question is how do you handle these issues? Thank you.

DR. MORRIS: Thank you, Robert. Robert brings up an important set of applications for which arguably there's

very little price elasticity demand on the part of the entities who are engaged in those activities, either ones that are highly international, where there has to be very close coordination, or activities where the bands are determined by the laws of physics and the only way to accomplish those missions are to use exactly those bands and no others. So who would like to address the issue of allocating resources efficiently when there's arguably very little price elasticity and demand?

MR. WHITE: I'll step up. Look, first, this is a matter of public record, I'm a big D Democrat, okay, I believe in government, I believe in government services, Adele can attest, I am wearing a tie which is a Democrat's fantasy, all of the states are colored blue, you can inspect this afterward, I want to establish my bonafides here. Notice I talked about propertization, I didn't say privatization because privatization does carry the connotation, gee, government keep out. No, I don't believe that, there is a role for government in owning some spectrum, in leasing others, in having a call on yet others, just as the government owns parkland, owns lots of resources, there are good stories to be told, good public goods arguments for the function of government. You make a case for spectrum for satellite, this and that, fine, good, but just as the police department has to pay for its police

cars and the Defense Department has to play for its airplanes, if you need the spectrum you got to pay for it, it's just another resource, it's got an opportunity cost, government shouldn't be exempt from dealing with opportunity cost any more then anybody else.

MR. SPILLER: That was a difficult thing because engineers are completely against this issue of property rights on satellite spectrum where we do have property rights on satellite spectrum, now you have to buy that. Now what about interference? What about new rights that you want to assign because of international treaties? Well, we said that as well the government has as in any other country eminent domain and since this after all is real estate there is eminent domain here as well but has to pay market price. So if the government is going to retire a particular set of spectrum from private hands it will have to do essentially a reverse valuation and will have to go through a particularly litigious process but it's feasible as much as expropriating land.

I doubt that what to worry about satellite for scientific purposes but that doesn't break the point that Larry mentioned that if you want something you ought to pay for that, and that was what the approach.

MS. GAMBLE: I'd like to address Bob's points and some of the comments made up here. Bob Taylor brought up a

very good point and it talks about the international framework that we have to work within also in the context of spectrum management and that can't be overlooked because there is an extreme amount of effort that goes into harmonization and compatibility so that we can make the best use of these resources.

The other point is when you talk about everyone should pay for spectrum I guess I'd like to throw the comment out does that mean that the recommendation should be that your state taxes, local taxes, federal taxes, should all be raised so that everybody pays for spectrum? Because that's what happens, I know for a fact that there are county and city police departments and sheriff's office that are actually holding bake sales in order to buy upgraded equipment, now you want to charge them for the use of the spectrum and I just have to caution everyone in applying what you're all looking at in a very lucrative market for certain services and just taking a broad brush and applying over everything and I would caution everyone on that. Thank you.

DR. MORRIS: Thanks, Merri Jo. We have time for one more question.

DR. MOORE: I'm Linda Moore with Congressional Research Service, we are non-partisan, I follow spectrum, I also follow public safety, I'd like to reinforce both what

Mr. Taylor said and Ms. Gamble said about the difficulty of imposing a fee, or really it is a tax, on certain types of common access spectrum, public safety, I know about fish fries too, they do that also. I would like to point out in Louisiana there had been a program where the various parishes had been given satellite phones and as long as they were free they had them, when they had to start paying for them for they stopped paying for the service so when Katrina hit none of the parishes had their satellite phones anymore because they didn't have the funds.

As you said, the federal government is not set up in a way that it can compete to buy spectrum, I have done actually extensive research on this for states and counties, there is no way without a total revision of every state law in this country that any public entity can enter into a spectrum auction, there's also an OMB circular about competition between public and private sector, so there are a lot of legal issues that can't just be addressed with a simple policy statement. And I think it's very, very important to recognize the need for free parkland.

I want to just mention also RFID, wi-fi, in addition to the satellite, where are you going to put all of these if you're having a totally property ownership based system? So there has to be a compromise and I think the FCC's management of public safety type spectrum,

critical infrastructure, should be moved to the NTIA and then if they don't put it someplace else they should at least have a memorandum of understanding with Homeland Security so that everybody can be on the same page moving forward in the public safety communications area. And believe me, when you make a call to 911 and 911 can't make the call to the ambulance because they don't have access to spectrum you're going to be sorry, you're going to be really, really sorry, this seemed like such a good idea, it really has to be taken into consideration.

DR. MORRIS: Okay, thank you, I'd like you to join me thanking our panelists --

-- [Applause.] --

DR. MORRIS: And so we have break, let's have hand for our panelists please --

-- [Applause.] --

DR. MORRIS: -- and I think we have a break until 10:45. Thank you.

[Brief break.]

MR. HATFIELD: -- both the opening remarks there and also that first session, and we're turning now for under topic two, the mechanism, tools, and approaches for encouraging efficient use of the spectrum resource, and we'll have three different panels to address this topic, the first coming up with deal with exclusive spectrum

rights and secondary markets, and the moderator for this session is Dr. Michael Katz who holds his Ph.D. in economics from Oxford and is currently a professor at the University of California at Berkeley, he has also held several senior positions at the U.S. Department of Justice and at the FCC. Michael?

Agenda Item: Topic 2: Mechanisms, Tools, and Approaches - 2.1 Exclusive Spectrum Rights and Secondary Markets - Michael Katz, Moderator

DR. KATZ: Thank you, Dale. I'm going to be brief. I'm going to make just a couple of opening remarks for this session and then move on to letting the panelists speak.

Now today and tomorrow is supposed to be on incentives for more efficient use of spectrum and apparently some have interpreted that as being a more efficient use for government and for private uses. And let me say a little bit about each.

On the government side it seems to me in fact there's no serious debate on what the right answer would be if you could make it happen and that is that you would in fact have government pay for the spectrum and you would fund the purchase of those spectrum with adequate revenues given to the appropriate agencies. The notion that that would be taxing I think is exactly backwards, the system we

have today is in fact a tax, and here's what makes it so population, because it's a hidden tax because you pretend that the spectrum that the various agencies get is free when in fact we know it isn't.

Now the fact that it's a hidden tax I think brings up the real issue, the relevant incentives for private use have nothing to do I think with designing a property rights scheme and panelists may tell me I'm wrong and that that's issue, but it seems to me it's not, the real issue is how do you get the right political incentives. And so if we're going to talk about incentives for efficient government use I hope the panelists tell us how do we get the political will or the incentives to move to a system where we adequately fund public safety agencies and then we rely on market forces to guide their decisions once they've been adequately funded. So perhaps we will hear analysis of lobbying dollars because it seems to me that's the kind of incentives that matter in this town.

Turning to the harder part at least intellectually we have the question of how to give incentives to private parties and in this panel and the next two we're going to hear various ways of doing that. It seems to me at some level all three panels are talking about the same thing, they're talking about various forms of licensing scheme, people on the second panel may say

that’s not what they’re doing but it is what they’re doing, they’re talking about particular rules for use that you have to agree to, the licenses may be given out to anybody who agrees to those rules but those are licenses nonetheless.

So in listening to this panel and the next two I think the important thing to do is watch for differences in what the recommendations say about the possibility of trading your rights across different parties, what they have to say about the resulting transactions cost in terms of putting together different combinations of spectrum in order to be offered services, and what they say about price setting, because all three panels are going to have to deal with those issues.

Having offended most of the people in the room let me now move on to introducing the panel, and I’m actually going to do just each one as I come to them for those of you who have short memories like I do and if I introduce them all at once won’t remember when they speak anyway. Our first speaker is Thomas Hazlett who is a professor at George Mason University.

Agenda Item: Topic 2: Mechanisms, Tools, and Approaches - 2.1 Exclusive Spectrum Rights and Secondary Markets - Thomas Hazlett

DR. HAZLETT: Thank you, Michael, and it’s great

to be here today. I just want to say that I agree completely with Michael's statement that it's really a matter of getting the political incentives right. I think spectrum policy in terms of economics is only really complicated if you're doing it wrong, so I think the economic is straightforward. We learned a lot from how these markets are organized and how the property rights work and if you can observe those lessons you can figure out the economics. Getting the political incentives right, that's the trick.

Okay, so here's the topic that I've been assigned, exclusive spectrum rights in secondary markets. Being quite innovative here I decided to divide this topic up into secondary markets and exclusive rights. So I'd say as for exclusive rights yes, additional allocations are needed, the rules are not complex, we have lots of evidence from how these markets can operate, including secondary markets by the way, from cellular and PCS markets so they're in operation in the United States and elsewhere today.

As far as the so-called secondary markets and the secondary markets proceeding, those rule changes are largely superfluous, not completely but largely superfluous, and what is needed actually again is the political decision to create and distribute exclusive

rights that allow markets to be organized and the markets themselves would then reconfigure the spectrum rights and use them and utilize them in ways that are both innovative and efficient.

With respect to secondary markets I just have just a couple minutes so I just want to make a couple of important points. I think left out of the discussion, I mean you read about secondary markets proceedings in the United States, in Europe and elsewhere, and there's sort of a fixation on creating a market and there is almost complete avoidance, not even disdain but seeming ignorance of the fact that there's a lot of activity already taking place in the marketplace, we can observe globally, and particularly in a CMRS market, where you make relatively complex transactions routinely and by that I mean take your average cell phone subscription, that subscription is an extremely complex package of contracts and in the United States for example a subscription to a cell phone carrier routinely yields access to spectrum controlled by over 100 networks and that's just domestically, some U.S. cell phone companies actually give you more then 100 networks of international coverage in addition.

Now all those contracts are freely negotiated, no interconnection mandates, in general no interconnection mandates, but certainly no regulation of access or prices

and these agreements are fairly complicated. But they're seamless to the customers and low cost to the customers to purchase and enjoy. In addition you have in essence third party access to the spectrum control by the CMRS licensees, this has occurred for well over a decade, particularly with data networks that are overlaid on top of the so-called voice networks, PDAs and so forth, and other data networks use these, use spectrum controlled by the CMRS licensees.

Certainly the activity going on now with so-called mobile virtual network operators is quite interesting to observe from the standpoint of interest in secondary markets, there's a very active secondary market already, operators buy and sell billions of minutes and trade these minutes amongst themselves. So there's already a very active wholesale spectrum market taking place, again this is an unregulated market.

And it's quite interesting to observe how that market operates, the one thing I'll just note here in passing is that you don't see spectrum traded nakedly, you see infrastructure and spectrum bundled, generally the services sold rather then spectrum by itself. Now that doesn't have to be the case of course but that's the way that market tends to transact, so it leads me just to this observation that the transactions that we do see are not commoditized on spectrum, that is to say we're not

observing something like the Chicago mercantile market for spectrum even though we have a very active wholesale market.

So the secondary markets proceeding is doing something that's efficient, to relax some of the constraints, the reassignment of spectrum rights, but unfortunately in the United States it's leaving the dominant constraints in place which are the use restrictions and of course that's what U.S. regulators, European regulators as well, others too, need to focus on for more efficiency to come out of that.

When it comes to exclusive rights there's no need to redesign the wheel here. Now we could redesign the wheel, I'm sure we could come up with something better but time is of the essence and it's good to have more spectrum out sooner with exclusive rights and flexibility attached to what the operators can do, we know that CMRS is a good model for doing that, that model should be extended and liberalized even more. But this unfortunately is the rut we're in currently in the United States, this is one of my favorite trade press headlines from the last few years, many people in this room will get this, people outside the room probably would not, it would seem a curious headline. But this is absolutely standard operating procedure for U.S. spectrum policy, in fact it's basically the one policy

you can get with some reasonable assurance in Washington, D.C., and that is a delay.

So it turns out that there has been not only an implicit sort of an inertia or status quo delay for some years on getting more spectrum out into the marketplace in the United States with exclusive rights attached. It's actually been an explicit policy for about the last five years, that is to say that in early 2001 there was a policy developed in the earliest look at this by the Bush Administration to set back additional auctions for what some were then calling 3G spectrum which still has not gone forth in the United States, and this was termed a win-win situation. The delay was turned to win-win and that's a curious expression, it was apparently after checking with revenue authorities that we could get more revenue for the licenses if we waited a few years to auction them, that that was a win for the government. The other side of that of course is that the carriers at that time said look, 2001, it's a bad year, markets are going down, we're not going to pay that much, we don't want to pay that much, it's not really going to help us.

So if you check with the incumbents and you check with the revenue authorities they will often make an argument for delay, so I agree with that. I don't know if that's an appropriate win-win situation unless you want to

leave out, leave 300 million or so consumers out of the equation, the equipment manufacturing section, other wireless applications and so forth, when they're tossed into the mix then you get sort of a mixed outcome and certainly the U.S. economy has suffered from the fact that we've had too little spectrum allocation in the CMRS market and so with available allocation so low here the United States ends up, and this is not relative to perfection or nirvana, Ronald Cose's utopia, this is the United States relative to other countries.

Now I've graphed here just the amount of megahertz available to the wireless carriers in cellular and GDP per capita being on the horizontal, the megahertz on the vertical, and there's a positive relationship though the wealthier countries tend to allocate more spectrum for mobile telephony. The United States here is about 100 megahertz under the line and where we've been here of course over the last ten years is just trying to figure out how to get that last 30 megahertz of the PCSC block assigned to whoever would be the legal owner after the bankruptcy proceedings were figured out. So we went the last ten years figuring out the 1996 auctions and the fact is that we are seriously under allocated, just using the Europeans as a model of dynamic efficiency --

-- [Laughter.] --

-- believe me that gets an even bigger laugh in Europe.

So again, picking up on Mike's comment, and I think this was maybe in the spirit of what he was saying, I hope I'm not distorting it, but the economics here are clear that more spectrum would have very, very high marginal social value. There have been studies on this, additional spectrum allocated with exclusive rights available to carriers for wireless telephony, wireless broadband, other uses with of course flexibility on both services, both or in addition to, flexibility on services, business models, and technology would yield very, very high marginal social gains. The marginal social gains should not be confused as being synonymous with the price of the licenses, the licenses are only capturing the procedure surplus, consumer surplus is some multiple of that and probably at least an order of magnitude higher.

And I'll just end with this, there are some countries that have in fact liberalized spectrum policy and have gone towards much cheaper availability of exclusive rights spectrum and those countries now are getting applications, many are calling 4G applications, that are in fact on the cutting edge but applications that are excluded in essence by a posity of spectrum for the U.S. market. It's also important to understand, and Australia is one of

these countries and Australia has been reported here to have a vibrant and evolving wireless broadband industry not available in the United States even though some of the companies providing these services now for wireless broadband in Australia have tried for years to get licenses in the U.S..

But just looking at the CMRS market you can see that the upgrades to broadband are taking longer and are more difficult because of again the posity of spectrum, the merger wave that did combine firms of about six to nine national carriers, a year and a half or so, have been instrumental in allowing two of the companies to roll out, two national carriers to roll out wireless broadband and it's left another company, T Mobile, without enough spectrum to upgrade to wireless broadband, and in fact there is no 3G application right now for T Mobile in the United States, specifically according to T Mobile, and this is certainly a reasonable conclusion to drive without this inside information, the reason being that there is not enough spectrum available for T Mobile to actually upgrade to 3G. So this certainly I would say is the key issue, more availability of exclusive spectrum rights.

Thank you.

DR. KATZ: Thank you, Tom. Our next speaker is Evan Kwerel who's senior economic advisor at the FCC, Evan

is also as close to a living legend as telecommunications economists get for his work on auctions over the years. Unfortunately he didn't hear me say that --

Agenda Item: Topic 2: Mechanisms, Tools, and Approaches - 2.1 Exclusive Spectrum Rights and Secondary Markets - Evan Kwerel

DR. KWEREL: Well I forgot my walker but I'll just lean on here and I should be okay.

First, as an apologist for the FCC I just wanted to point out that there's another 90 megahertz of spectrum, this advanced wireless services, which is scheduled to be auctioned starting June 29th which will get us, if I had Tom's chart there, we were short of that line by 100 megahertz, that will get us 90 megahertz up, so this one again shows that FCC policies are perfect and they're getting better every day.

[Laughter.]

Having done that let me turn to the topic which is defining spectrum rights and one might ask why am I talking about defining spectrum rights because I think that properly defined spectrums rights are akin to efficient spectrum markets. I mean if the spectrum market is to work well you really need to have exhaustive exclusive transferable and flexibility licenses. Most of the discussion in my presentation today will be about the

notion of exclusivity, it's not such an open and shut issue as to what you mean by an exclusive license but I think you need all four of those characteristics.

A reason why it sort of matters how you define this exclusivity given that you've exhaustively license that is transferable is because using spectrum causes externalities, when one party uses it it affects other parties. And the initial assignment to those rights matters because to negotiate to another position from the initial position can be very costly, so it's not just a matter, sort of arbitrary how you started out and that it's just going to result through market negotiation to an efficient regime, given these transaction costs the way you define exclusivity is of significant importance in terms of the efficiency of the spectrum market.

I have a disclaimer here that people always ignore what I say so this shouldn't be any different. But I will note that I do have a co-author, John Williams, and all the technical stuff that I don't understand you can thank John for.

So now let me talk about defining spectrum rights. Well the first thing, and for people who have carefully read Deveney(?) and all maybe this is redundant but I think this goes a bit beyond that but we'll start with the basics. Which is that there are three dimensions

to spectrum, there's frequency, space/geography, and time. And interference occurs when more then one user operates in the same frequency in the same area at the same time, that's the basic problem. And so all this talk about spectrum management and defining property rights and all, it's about separating users in at least one of these dimensions. And typically in the United States we give licenses for use at any time around the clock so what we do is we separate users in frequency or geography although there are some rare exceptions where they're separated in time but I'm not going to talk about that, they're the exception to the rule.

So now I want to sort of go beyond the hand waving and to get into some of the details. You were talking about defining flexible exclusive licensed. The first part of defining a license is to say you have, as a licensee you have the exclusive right to operate a transmitter on a given frequency in a given geographic area. Nobody else is allowed to do that. And some people, particularly economists, seem to think that's sort of the end of the story, as long as you're operating your transmitter within that geographic area, within that frequency, that's it, what's all this other discussion for. But unfortunately as engineers like to tell us it's more complicated then that, it's so complicated you wouldn't

understand it, you should just leave to them to do it. But with the help of John Williams I've managed to learn something about this and now I'm trying to share what little I know.

So in addition to that basic definition what we have done at the FCC and other spectrum authorities is to establish additional obligations on the licensee to deal with this interference question. And I'm going to show some picture which illustrate this better then the words. But there are three basic things, there's out of band emission limits, and out of band when you're dealing in the frequency dimension and it says how much power is the licensee permitted to emit out of its frequency band, and the right answer is not necessarily zero, that could be a very costly thing to do. So you actually have a right to, even though you're only transmitting, your equivalent is operating within the band, you're actually allowed to emit outside the band, there's the question how much.

Then there's out of area emissions limits, how much power are you allowed to put outside your geographic area on the frequency that you're entitled to use? The first thing has to do with going outside your frequency, this is on your frequency but outside your geographic area.

Those are reasonably well understood, the one that very few people seem to know anything about outside of

engineers are these in band power limits, which is actually a restriction about how much power are you permitted to emit within your band in geographic area, this is on your own property, within your frequency, within your geographic area we put limits. And I'm going to talk about why we do that but that's, it seems to be not well known.

Now I want to do the analogy with land which I think is a good analogy and I don't know where Larry White is now hiding, there he is, all the way in the back, I can hit him with the laser, but I just wanted to put a little more detail on that sort of land skeleton. So if you just think about land, the geographic boundary is the primary dimension of land, you get a license that says where it is, what the boundaries are. But that is not the whole definition of your property right and it's not sufficient to prevent externalities among land owners. And I think you can look at the type of restrictions that are put on land and they are sort of analogous to what we do in spectrum. Like for example like we put limits on noise, that's what you're doing on your property but something that extends over your property, that's sort of like an out of area emissions limit, the noise, you're allowed to make noise but it leaks out of your geographic area.

Limitations on building heights, that's what you're doing on your own land, say you can't build a

building higher then this amount because that has externalities to your neighbors. And just like setback requirements, we don't let you build your apartment or office building right up to the boundary, or your house or anything else often, because they have externalities to your neighbor. So the rule is not here's your boundary do whatever you want within it, the rule is that's the first thing and then there are various kinds of limitations.

An important way in which spectrum is different then land is you can also divide things by frequency, in some ways while it makes it more complicated it also things easier in the sense that you can actually have more fungibility, more competition, it's like being able to have multiple properties in the same exact location, the same geography, because geography matters in terms of providing coverage and since you can divide things by frequency it's possible to have a degree of competition with spectrum that you probably couldn't with land.

And now for a picture, which illustrates these things in the frequency dimension. Over here we've got frequency, so now we're going to talk about what are the limitations of what you can do in the frequency space. Starting with license A is the transmitter and this shows the power, the height is the power, and at each frequency how much power is being emitted. And the license is

defined, this is one boundary and license and there's another boundary of the license over here, your license is defined between those two areas but because these filters are not perfect what happens is when license A is transmitting there's this out of band emissions, A has out of band emissions over here and if you have adjacent license B then this out of band emission is going to interfere with license B. And what these dots are, this shows B's receiver filter, those are the frequencies that are actually admitted into B's receiver, so if there's emissions out of A's band over here B is going to receive interference.

But now I want to get to the point that most people understand this, if it's out of band, out of A's band B has got a problem. But what most people don't understand is the problem when A is just minding its own business, operating within its own frequency, B still can have a problem. This is like A having a building that's really tall because B doesn't have a way of sort of blinding his eyes. If you look at B's receiver filter right over here the problem is that B's receiver filter is not perfect, that it tends to let in frequencies that's outside B's boundary, this is B's out of band emissions, and then interfere with B. So A is operating within its frequency, it's allowed to, and B because its filter

doesn't filter out stuff that's out of B's frequency but are rather in A's frequency, B is going to receive interference from A when A is just minding its own business operating within its own band.

So what do we do? We typically limit the power that A can do, can operate on its own frequency in its own geographic area, so that B will continue, be able to operate with some acceptable level of interference. How you define all these things is not obvious, I mean that's sort of what the rest of this is about.

We have this beautiful slide that John did that shows the same thing for geographic boundaries. In this case this is the transmitter and at the transmitter with the darker colors the power is higher and as you go further and further away from the transmitter the power diminishes. And what we do is we say at B's licensed boundary, this is a geographic boundary over here, we say at the boundary your field strength can't be more powerful then 47 DBUs, it's just a measure of power. And here's A's receiver, well unfortunately this receiver can be interfered with by A if this receiver is very far away from its own transmitters because what makes this receiver work, it has to do with the strength of the desire signal, it's transmitted to the undesired signal, so even though B is doing what it's supposed to be doing, not emitting stronger

then 47 DBUs, licensee A may not be able to operate. And there's nothing you can do to prevent anything from going across these geographic boundaries, I mean I guess you could move way, way back and greatly reduce your signal but that could be very costly.

Okay, I'm going to go quickly through these, but the point of this is to say that there's things that both sides of the transaction are able to do to reduce this interference. And first to talk about the frequency boundary, so the point of this is to say that for receivers given the level of power that they're subject to, that all the costs and benefits are internalized. So if you've got the external environment correct they've got the right incentives to do what they should be doing because if they make their, they move away from the frequency or they increase their desired signal's strength, or they use a better technology, the costs of that and the benefits to that all go to them.

The problem and the reason why we regulate is on the transmitter side, transmitters can reduce their emissions, and they face the costs of that, but all the benefits are external. So not surprisingly you have too little abatement without regulation or some kind of bargaining. Here's the list of various things you could do like improving filtering or lowering your power, and here's

our tipping our hat to poetry, good filters make good neighbors. If you compare this to the previous slide, if A improved its filter now you can see that A's out of band emissions are minimal and so there's less interference with B, but this is costly for A. B could also improve its filters so it will reduce the out of band admissions, in other words it's not accepting stuff that's outside of B's band but that's also costly to improve its filters. What are the optimal levels of these things, this is a policy question, but B has the incentive to put the right filters given whatever environment it faces, A doesn't because A is the transmitter and it's just costing money, it doesn't have any benefit.

So those slides were just talking about optimal level of interference across the geographic boundaries but it's sort of the same deal. So then the question is what is the optimal level of interference? Well, we can talk about it in general, the problem is to do it. But the optimal level of interference, it's just you want to minimize the total cost of interference which is the damage from interference to receivers, whatever remaining damage there is. The cost of interference avoidance by receivers, so it's like putting in a better filter, moving away from boundaries. The cost of interference abatement by transmitters, that's like putting in a better filter. And

then there's the regulatory and bargaining costs which can be very significant and one of the reasons I'm saying this stuff matters is because these transaction costs are not zero, if those costs were zero then I wouldn't worry about how I assigned the stuff originally.

So just one other complication in doing this stuff, there's uncertainty and people care about that. Our standard thing a government bureaucrat will say optimal level is difficult to determine in practice, trust us, we're the expert agency, we'll do it right. And we don't regulate interference directly, what we do is we do it by the way we define these licenses.

And now for my penultimate slide, which is our suggested approach which says we should define license in terms of transmitter outputs, the way I described that, not actual interference. And you could say you can't create actual interference with anybody, we actually do that when dealing with some incumbents but as a general rule it should be the way that I described it where you have your out of band emissions and out of area emissions and soon.

And then we establish parameters to rule out the worst cases of things, very high NBN(?) powers, out of bound emissions, so it leaves the licensee enough flexibility to do something without negotiating with their neighbor. And then leave the rest to licensees to

negotiate within those broad parameters but we don’t make it so tight that you can’t do anything without negotiation. So what it does is it provides licensees significant flexibility to choose services without the need to negotiate and again I think that’s important, a rule that says you can’t do anything without negotiating with your neighbor, can have enormous costs, this allows you do some very useful things to have a certain amount of flexibility without any, and cause a certain amount of interference to your neighbor without any negotiation but it sort of rules out the worst cases.

And the details are left as an exercise for the reader and thank you.

-- [Applause.] --

DR. KATZ: Thank you very much. Our next speaker is Stuart Benjamin, who is a professor at Duke University, and I think is going, I thought maybe he was running away --

Agenda Item: Topic 2: Mechanisms, Tools, and Approaches - 2.1 Exclusive Spectrum Rights and Secondary Markets - Stuart Benjamin

MR. BENJAMIN: So many things to say, the usefulness of going after Tom and Evan is they’ve covered some things that will then let me today speak in less time but I first wanted to pick up on one aspect of the real

estate analogy that I think is important because it highlights the cost of delay. People have been talking about the real estate analogy but there is a big difference between real estate and spectrum in terms of delay. We get some benefit from having an open vista, right, it's nice to be able to look out on a nice plain and you see the trees or whatever, you get no benefit from having unused spectrum. Another way of thinking about that is no matter how bad reruns of Gilligan's Island we put out on the spectrum today it will still be there tomorrow just waiting for us to do something else with it. So it seems to me the costs of delay are particularly great which gives some urgency. I should also note I've actually written an article suggesting that because spectrum is an element of communication there's actually a First Amendment problem with having spectrum that is just left idle by the government but I won't get into that right now.

So now let's talk about exclusive rights for just a second. I do think it's worth highlighting as was already briefly mentioned today that any regime that we have, for better or for worse, is going to have somebody exercising some meaningful level of control. So for those who don't like the idea of private entities exercising that control okay great, we can have command and control, we can have what we call a commons, a commons still has plenty of

government control because the government then has to set out the parameters, I misused the word, I apologize, has to set out what are going to be the limits on what power you can transmit at and all sorts of other ways it's going to restrict these devices to make sure that everybody shares appropriately given those protocols, and the government is going to have to create the protocols. So no matter what we're going to be in the role where some entity is exercising some control that we may or may not feel great about. Again, I've written an article about this, I won't go into it in details, other have defended exclusive use regime as a property model, I just want to highlight there is no, there's always tradeoffs, there is no magic solution here.

So now let me get to what I think is a particularly difficult question for which I have no good answer but I'm keeping in the mind the request made of those of us talking to try to have some, to deal with some practical questions. So a difficult practical question I think is should these rights in fact be exhaustive or not, should we conceive of the rights as, back to the land analogy, as if it went all the way down to the core of the earth and all the way up to the sky or not? My own view is that this is, this does not raise difficulty for the vast majority of uses because for the vast majority of uses if

it's a valuable use there will be bargaining. The difficulty this creates is for uses that entail very, very wide swaths of spectrum at very low power levels, I'm thinking in particular here of ultra wide band.

If ultra wide band is going to be a viable secondary use but we give exhaustive rights for the spectrum all the way down to the core and all the way up to the sky, it's going to be hard for ultra wide then to get off the ground. Because any ultra wide band potential operators are going to have to go negotiate with so many other people the transactions costs are going to be very great. This is a very basic point in economics, it seems to me that ultra wide is probably the only service at least I can think of that raises this problem where the transaction costs will be so great that we're just not sure, we have great reason to doubt that it will be able to be an operational service if we give truly exhaustive rights. So that's one situation where the market can't help us out here because we have to make somebody, some entity has to make a decision before we define, that is in defining what those property rights are, as to whether or not we're going to leave this space for low power operation.

So this is a comparative question, who will be making that decision? For those of you who love markets

and don't like governments that's a decision too, if your decision is exhaustive rights now you've made a decision about ultra wide band, making it a lot harder to do it. On the other hand if we decide to have some, whether we call it interference, temperature, noise floor, whatever, below what you can have interference, then we're obviously making it much easier to do ultra wide band but we may be putting some constraints on future uses of spectrum by entities that would find a way to go below that noise floor and use it usefully.

My own view is this is a comparative question, like many people in the room I'm not a huge fan of the FCC but I don't see any great, I don't see any great Zeus on Olympus who's going to be able to make the decision for us, I don't have any great particular confidence in courts making this decision, I'll come back to that in a minute. Maybe NTIA would be better because it has a single head and I'm not a big fan of multiple headed agencies, I would rather cast my lot with an executive agency then with a multi-headed agency, but there's no good answer here.

I want to come back to that aspect of exclusive rights but I want to now talk for a second about another specific area involving secondary markets and then come back to exclusive rights for a second. So then the question becomes, or another question is if we want to do

something with secondary markets, if we want to go, or even with exclusive rights I guess I should say, for either one, how much further can we go? As you all probably realize Section 301 says the government owns and controls the spectrum and that all you get is a license, you don't get a property right. That's a problem for true propertizing of the spectrum. I'm in favor by the way, for what it's worth I'm in favor of changing Section 301, I'm not holding my breath.

The question is how far can we go given Section 301 and Section 310D? My own view is that actually we can go pretty far, this is beauty of Chevron, if the FCC or the NTIA acts in the context of a notice and comment rulemaking and we hit Chevron deference, and actually you can go fairly far because we've already gone pretty far, which is to say we effectively have a property rights regime. The FCC doesn't use the word property, it uses exclusive use because property is verboten under 301 but the reality is that we now have a system of renewals that is so low, in particular under the '96 Act, that you're going to get the renewals. So I think we can both get to meaningful exclusive use and even have therefore related and more robust secondary markets even in the current legislative scheme. Again, I'm thinking of this in light of the particular questions that we were asked to focus on about

sort of some specifics here.

So one takeaway point I would suggest is you don't have to go to Congress in order to be able to do a lot of what I and other people think is a very good idea. So how do we get there, if I'm right about that how do we get there from here and what seems to make sense? In another paper Evan has advocated what he calls a big bang auction, I won't go through all of the details here, I will simply say that to raise an issue that's already come up that everybody in this room of course recognizes is crucial, there is a political economy issue. It is going to be, it's going to be politically a tougher sell to have a system that appears to give massive windfalls to incumbents, and yet by the same token we all know that incumbents will resist this mightily if they think they're going to get no compensation whatsoever for their spectrum.

One proposal out there is to have transferable auction vouchers to incumbents which would in effect let them gain the value of their current use of the spectrum but it would then be monetized, then we could still kick them off if there's some other bidder that comes in. I'd rather live in a world where that's not relevant, we all know, economists don't care about distributional issues so who cares, we get to the property rights in the end, what does it matter how we get there? But we know the political

realities, incumbents will do everything to block any sort of meaningful change if they think that an auction is going to one day say okay now there's a new owner of your spectrum, you can negotiate with them to continue providing the Olympics that no one is watching or you could just go out of business, we know that's going to be a political non-starter.

But as I say meanwhile we know that if tomorrow we tell a bunch of television broadcasters you can now do anything you want on a whole big, and all of the spectrum that you've been granted, and all of these various new services, people are going to say with some reason gee that's quite a windfall, an inappropriate windfall for the incumbents.

So now I've been talking about the land of political economy, let me pull back a bit and raise two more issues that might be more appropriate for somebody who teaches in a law school. So one issue is how do we want, if we're moving toward exclusive rights, and for that matter more robust secondary markets, how do we want this implemented? Who do we actually want overseeing this? This is a big debate and it's interesting, I was on a conference call as part of this DACA working group where I don't think I'm telling any secrets to say most everybody on the call liked the idea of having courts play a role,

common law play a role of figuring out degrees of trespass or not, and I realized many people on the call said that they were basically hostile to the FCC, they had all worked there. And I pointed out to them gee I'm the only lawyer on this call and let me tell you I'm worried about courts, familiarity breeds contempt for both of us. Let me just tell you the cautionary tale about courts.

So one, we know that judges are generalists, that's a problem right off the bat. Two, something that is maybe less obviously known although known in the intellectual property community, happily for some of the intellectual property community, less happily in others, there can be capture. And I'm sorry to say that I think that the Court of Appeals for the Federal Circuit is a court that has been to a significant degree captured by the patent bar, it's unsurprising in a way, those who have the incumbents here, those with intellectual property rights, are very, very good at pushing for their people to be nominated to this court, those who might potentially be hurt by those rights have a harder time organizing, this is Mancer(?) Olson, right? The logic of collective action, concentrated benefits, dispersed costs.

So I mention this in particular because again we're going to have to have some entity that's going to have a role in policing whatever are the boundaries. This

is a comparative question, there is no, we can dump on the FCC or the NTIA all we want to but the end of the day we've got to choose some entity that's going to play that role. My own view is I would rather it be played by the agency with expertise through its administrative law judges in the first instance then have a court play that role.

So I think with about 30 seconds left, let me finally get to the last sticky point and I'm afraid this goes back to political economy but it is really crucial, and that is the government spectrum. As long as entities, the examiner from Louisiana was really striking, so apparently when they're paying for the spectrum, when they're getting it free, free, there's an opportunity cost but they aren't paying it, they're happy to get it, as soon as it costs something they'll prioritize spending on other things rather then that. Maybe that should be telling us something.

Now maybe they've got the wrong priorities, maybe we should vote them out of office, but apparently they think when they have to choose between spending for spectrum and spending for police cars they're better off spending for police cars. That might actually be the right guess, maybe Katrina is a once in a 100 year environment, it rolled zero on the Roulette table, but maybe that was actually the right, the best guess determination.

But here is the difficulty is as long as there's no incentive to internalize those costs there's no reason to expect it, so the modest proposal that I would put forward has already been prefigured by what some others have said but I think it's absolutely crucial, at a minimum there has got to be as an internal budgeting matter within the federal government there has got to be a line item for the attributed value of the spectrum that all these various agencies have.

By the way that will make the NTIA and the FCC's budget's huge, because that attributed value will then in effect be an asset on their balance sheets and a cost on all these other entity's balance sheets. But just as that is a small step there has got to be a way of sensitizing people to the huge opportunity cost, to the fact that we do have an implicit tax and wild inefficiencies that are going on here.

Well I could go on but I'm over my time so let me stop there.

-- [Applause.] --

DR. KATZ: Thank you very much. I do have to, well not exactly correct one thing but I have to defend economists, it's not that economists don't care about distributional issues because in fact they do quite a bit, in fact a lot of what you hear economists objecting to is

various policies that in the name of fairness confer large benefits on a small group of people to the detriment of society overall. I think the correct statement and probably Stuart actually meant is that economics doesn't prescribe what your distributional preferences should be, it can tell you a lot about how to achieve them but it doesn't prescribe what they are.

Anyway that said, I can keep my Ph.D. and move on, we're privileged to have three expert discussants today and our first one is Mark Crosby who's president of Enterprise Wireless Alliance.

Agenda Item: Topic 2: Mechanisms, Tools, and Approaches - 2.1 Exclusive Spectrum Rights and Secondary Markets - Mark Crosby, Discussant

MR. CROSBY: Thank you. The first thing I want to say is Evan, I agree with everything you said up there, I agree 100 percent.

When I accepted this invitation I looked at the mission of this workshop and I want to repeat it because I think it's going to guide what I'm going to say this morning, identification and implementation of incentives that promote more efficient use of the spectrum while protecting national and homeland security, here's a key one, critical infrastructure in government services. Very noble process and I've listened to a lot of things this

morning and I go so the nirvana is spectrum efficiency, I've heard people this morning said a lot of spectrum is not being used efficiently, or some spectrum is being efficient, it is being used efficiently. Well what is that?

I mean I remember, I'm going to age myself here, Dale, you remember in 1975 the Chicago Task Force, one of the methods to identify spectrum efficiency, a whole bunch of vans went out and monitored the frequencies to see to what extent they were in use. And of course that's how they were assigning spectrum, you get the best frequency because we went out there with a monitoring van and lo and behold we find that these frequencies are only being used five percent of the time, they must be frequencies. And it worked because they might have monitored it at 10:00 a.m. and the people went out on the road at 6:00 to 8:00 and then came back at 4:00 to 6:00. So is that a definition? I mean I look at this, if we want to try to come up with new policies to make sure the spectrum is used efficiently we should define what that is, is it the percentage of time spectrum is in use?

Another one would be is it the number of units and devices that are in play in the spectrum? Is that how we measure that spectrum is being used efficiently? Another one is that all the frequencies have been licensed,

the whole band has been licensed, the band must be used efficiently because everybody has got a license. I would say since I'm in the trenches, let me also say I'm not an economist, I'm not a Ph.D., I'm not a lawyer, I'm not a telecommunication policy theorist, but for 30 years I've been in the trenches and I've lived through lotteries, I've lived through comparative hearings and I know, people go, Mark, I need spectrum, and I'm accused of not using my spectrum efficiently. So I'm in the trenches, so this is sort of my perspectives.

Is another one is that well, spectrum issued efficiently because it's there when I need it, in other words this morning I think someone said the mission can be accomplished because the spectrum, when I need I got it and I got to use it, and I don't know what it is but I've got a sneaking suspicion it depends on what the spectrum is used for and what the applications are.

And then I look over here, well let's figure out does exclusive spectrum rights, what are the methods and how do you get, because this exclusive spectrum rights must help efficiency. Well what are the techniques? Auctions? Auctions, people say they're the best thing since sliced bread, they work every time and in some applications auctions have worked exceptionally well and clearly in the CMRS area, clearly. But in the commission the FCC gets a

little nervous, well if you buy it we've got to make sure you're using it efficiently so you have to do 60 percent of the population within certain timeframes or have transmitters out there to make sure that you're covering your geography because we want to make sure that you're using the spectrum efficiently.

Has that worked? I can tell you right now being in the trenches I know there's a lot of technical people out there that go out once a year with a transmitter that costs them $200 dollars, turn it on for about five minutes, turn it off, and they go did you use this system? Absolutely, positively the system was in play and therefore I've used the spectrum efficiently.

So I look at the competitive bidding process, does it work? Absolutely, I mean how can I say that it doesn't with Evan and Dr. Pepper here and some of my other dear friends, it works great in some applications. Does it work all the time? No, it doesn't work all the time and I can give you examples and examples with auctions.

Now maybe what somebody said this morning I thought was very good, to make it work the purpose, process and operating environment, if all the stars align and those things are in alignment it works perfectly and there are auctions that hasn't worked perfectly. And I'm here to tell you there's been auctions where people have given the

spectrum back in exchange for other things after spending $350 million dollars for it. There have been auctions that have been purely speculative, people buy it, sit on it, go out and turn on a little transmitter and hoping that someone will come and get it. Is that spectrum efficient? No. What I'm saying is that competitive bidding processes are wonderful and I will say this, the commission is very good at a lot of things, they are exception at conducting auctions. I've been in one, they are incredible, if you need a lot of help you call the help desk and boom, you got answers. They do it extremely well, it's almost impossible to make a mistake but it is sort of scary, when you hit that button buy because then you've just created a commitment with the federal government but they do it extremely well.

Some of you might think well what do we got, we got auctions and what else do we have. There are still site specific processes in place, and somebody goes we still do that, yes, we still do that. There are a heck of a lot of bands still in play where people file for a license at the FCC. Now is that efficient? Well, I guess it's the private wireless folks and believe me where are they, well, they're in low band VHF, UVF, 800, 900, they're all over the place, they permeate all the spectrum. Are they commercial carriers? No. Are they critical

infrastructure? Yes.

By the way, we need a definition of critical infrastructure, because that's one of the missions here, we got to help critical infrastructure. I think the definition is petroleum, utilities, railroads, believe it or not I think if you dig a little deeper tow truck operators are in there as critical infrastructure. But you know who's not in there? Airlines, people moving hazardous waste, people after Katrina come in and clean up to help things, they're not in there. So we probably need a definition for critical infrastructure too.

Now the commission tried to force spectrum efficiency in site specific legacy bands. How do they do it? You must go to narrow banding so you've got to go from 25 to 12.5. I think the best way to do is next time let the person keep the 25 and let them use the 12.5 or the 6.25 or the 5s. When the commission first started they said no, to get a new frequency you got to go to 12.5, I think it would've been more efficient had the commission said you get to keep the 25 and add flexibility, which is a great thing, to do new technologies, split your spectrum, and that would drive efficiency.

The other one is of course how do you get exclusive spectrum? The commission gives it to you, they give it to you. Now I don't want to pick on them but this

is the mission critical and public safety people, they're giving exclusive, and their processes are very good at this, they have years of experience adopting plans and more plans and regional plans and local plans and national plans on how that spectrum will be used. Eventually technology catches up I guess but in a lot of times if you would try to, it takes a long time for those people to implement a system that's efficient, years. The sales cycle is long and then by the time you get there the technology has probably turned a couple times. I'm not saying that's good or bad but that's one way they do it. Does it work? Well, I guess it works, public safety is extremely critical to the country of course but I think everybody that has exclusive spectrum has a fiduciary responsibility to put it in play and to use it, and I think that's important.

Last thing I want to cover is secondary markets which is another way to induce efficient use of the spectrum, I think it's one of the best thing the FCC has done is the secondary markets proceeding with the spectrum manager techniques and defacto. I have a lot of people, they said Mark how do I get to that spectrum. The downside I think is right now, I still think it's the best thing, the commission needs to loosen up a little bit because my experience with enterprise, people will want to put the spectrum to good use is they like to control the spectrum,

they like the property right and leasing doesn't always work. Right now I think secondary markets I think as Dr. Hazlett said, there's been a lot of transactions there but it tends to adapt to the same technology that the original licensee holder has, it doesn't necessarily promote at the moment different uses of technology or different uses of that spectrum. I think the commission should perhaps permit the licensee holder to not only just do spectrum or defacto lease agreements but to literally assign geography, spectrum, what did you say, Evan, time, space, geography, pieces of that to other parties so it's not a lease agreement.

I think the other thing that will really help secondary markets as well is the onslaught of technology, agile equipment, cognitive equipment, because I think that will be tremendous. So I think secondary markets at the FCC is outstanding, they're new, a little nervous about it, I think over time they'll modify it so it will become more, promote more spectrum efficiency whatever we decide whatever spectrum efficiency is.

Thank you very much.

-- [Applause.] --

DR. KATZ: Well thank you, Mark. I observed that he and I wore the same suit today but for his sake I have to say the resemblance ends there.

The next discussant is Jennifer Manner who's a vice president for regulatory affairs with Mobile Satellite Ventures. Jennifer?

Agenda Item: Topic 2: Mechanisms, Tools, and Approaches - 2.1 Exclusive Spectrum Rights and Secondary Markets - Jennifer Manner, Discussant

MS. MANNER: Thank you. When I was invited to speak I was spending a lot of time figuring what does flexibility mean and what is the biggest problem that I've seen in getting flexibility for my clients, I'm a lawyer, so whether I was listening to people when they came to see me at the FCC, representing people in private practice or in-house counsel, and what I always found was this concept of spectrum allocations and I think this is especially true in areas when you're dealing with fixed versus mobile versus broadcast and those type of allocations.

And we're seeing this more and more, if you look in the paper almost every day there's discussions of technologies bleeding across different lines so I think there's been a lot of discussion, News Corp for instance, whether they're going to be providing a broadcast service, whether it's a broadband service, whether it's an interactive service, everything is blurring and all of a sudden you're still set with this world, an ITU world, there's the gentlemen from ITU Study Group 7, can tell you

the ITU deals with allocations called, Carl Nebby(?) and Fred Renlin(?) deal with allocations on a daily basis and trying to obtain spectrum for specific uses. Even if you think about CMRS, when you think about CMRS all the folks here are talking about it as a very flexible service but it operates primarily within a mobile service allocation. And if you got to the FCC rules, you go to the ITU radio regulations, there's a very distinct definition of what a mobile service is and that definition does not necessarily encompass a fixed broadband service which is something that might be contemplated in those bands.

So there's an issue here that I see in terms of getting efficient use of the spectrum is that you've got to start to revisit what we do with the spectrum and whether we continue to allocate the spectrum to these archaic frequency allocations that are up in the ITU, at the FCC, that every country has.

This leads to a second question which is really I thought Evan's presentation was great because it answered my second question is how do you realize the highest and best use of spectrum while protecting the rights of licenses, because if you start to blur these allocations, if you start to do, there was an idea a number of years ago, I think it was Tom Titches(?) idea, to create something called the General Satellite Service. You did

away with mobile and fixed but then how do you still ensure that there's the interference protection, so I thought Evan's model was a good start in terms of licking that. How do you protect the operations in those bands if you're not going to have specific frequency allocations because that's always been an important part of having these distinct service allocations. And then how much flexibility is possible.

So this was just a quick overview, so the need for exclusive licenses just to remind everyone really I think involves interference concerns, protection from interference, financial stability, which isn't something I've heard talked about a lot here today which I'm surprised because there's so many economists but investor confidence, they want to know that they have rights to use that spectrum. Regulatory certainty which really goes back to investor confidence and ability to deploy networks, obtain financing, ability to participate in secondary markets. And finally the desire for regulatory flexibility.

So I thought I'd just take a second and walk through where I see the evolution of licenses going and where they're going now. If you think about a license you get a license to do X within a specific allocation and traditionally you receive long term exclusive licenses,

this is what people call command and control, with static technology in many country based on archaic arbitrary frequency allocations. And what happened? You ended up with a lack of innovation, and inefficient use of the spectrum resource, an inability to deploy markets by service and we're going to talk about that in the next slide, a little bit of MMDS but MMDS I'm going to pick on a little bit, not because it hasn't been a successful service but more because it could be more successful and the FCC has tried to encourage that by moving away from a very static licensing regime that restricted use of spectrum.

One of the things that I do want to bring up in the early traditional model, many regulators made technology choices for licensees. And I'll pick on Europe, Europe is always very proud of the fact that they have a great GSM cellular network and I agree, and there's been a lot of criticism over the years that the U.S. should have picked a single technology for the cellular markets and if we had we would have picked wrong and today we would have had a very arcane cellular technology market as opposed to when we allow different operators to choose their technology and ultimately the best one won out.

Then we go to what I call an interim approach and what happened was progressive regulators began to recognize the need for increased flexibility for licensees. And this

also came along with competition, as the PTT model moved away you started to have regulators trying to foster innovation among competitors. So there was a recognition that spectrum was being used inefficiently and that there was a need for increased flexibility. And this is where I'm going to talk about the broadband radio service or what used to be known as MMDS.

A number of years ago the MMDS operators who operate within a fixed service allocation were prohibited from operating any mobile terminals and that was because of a very odd rule about an antennae which is far more technical then I understand. But it was very important they felt that they needed the flexibility to be able to operate both fixed and mobile services, and ultimately in a rulemaking the FCC moved that way and you're starting to see, and there's been some other liberalization and flexibility increase, but what you're starting to see through the broadband radio service, Craig McCall's company Clear Wires is a good indication, is that people are starting to deploy real networks with services that customers are demanding, so in this case fixed wireless broadband, but they also have the option for mobile. So it's not the regulators that are dictating it, it's not because there's an allocation there that's dictating the technology, it's consumer demand which is a very efficient

use of the spectrum.

This was kind of a slow change coming, I think the MMDS and I saw Andy Craig here, he could probably tell me how many years it took but this took a number of years, I'd say five to six years, and at the same point the regulators now are starting to liberalize more standard requirements and technology neutrality is appearing.

What's coming on the market today in terms of regulation is what I'd call a flexibility approach and something that I hope regulators will continue to embrace, and that's the recognition that even more flexibility increases spectrum efficiency and innovation and this is the idea of allowing licensees to offer any type of service. And this is an interference based analysis and this is why I thought Evan's presentations was a nice complement, because you still need to deal with the interference concerns and I wanted to use as an example an ancillary terrestrial component, ATC, to a mobile satellite service, and we'll walk through in a little bit. But I believe this approach is going to allow the highest and best use of spectrum but it's going to require regulators, both internationally and domestically, to rethink the idea of these strict spectrum allocations.

So let me just explain to those of you who don't know what ATC is. This is a pretty basic picture of an

integrated satellite terrestrial network and what the FCC, and Canada is the only other regulator today who has recognized this type of system, has done is they're allowing satellite operators, mobile satellite service operators, to have a terrestrial component to their satellite system, so they simply reuse the same spectrum that they're using for the satellite, they have to have a satellite, to provide a terrestrial component. And the reason this was done was for several reasons, one was spectrum efficiency, there was a recognition that satellites cannot be used in all areas.

If you think about it, and Katrina was a good example, 911, in building penetration is very, very poor for satellites. So in urban areas where there's urban canyons and building blockage you can't get a good line of sight to use your satellite phone, this was a problem with some of the early MSS systems, the hand held systems, was they couldn't get enough scale and scope to produce reasonably priced consumer electronic handsets.

With a terrestrial component if a satellite operator is allowed to build out the terrestrial component in areas where it makes sense such as New York City, Washington, D.C., Chicago, they can combine the scales of economy so that they end up with a single reasonably priced handset that can access both the satellite and the

terrestrial component making a very efficient use of spectrum.

Now the interesting thing that the FCC and Industry Canada both did was that they didn't determine what service the terrestrial component needed to have, whether it was a fixed allocation or a mobile allocation. All they said was it has to be an ancillary terrestrial component so the primary service is still mobile satellite service but the terrestrial component neither has to be mobile nor fixed so this is a movement I would say away from these frequency allocations that we've traditionally seen and I think it's the right movement.

So where do we go from here? I really have questions more then answers but I do think one important question that this group should be thinking about is whether the changes in technology and societal needs means that we have to revisit how we handle spectrum and whether we continue to build on these narrow frequency allocations or we need to look at a new model, and if so how do you address outstanding concerns such as interference.

Thank you.

-- [Applause.] --

DR. KATZ: Thank you very much, Jennifer.

The final discussant is Randy May who's a senior fellow of the Progress and Freedom Foundation.

Agenda Item: Topic 2: Mechanisms, Tools, and Approaches - 2.1 Exclusive Spectrum Rights and Secondary Markets - Randolph May, Discussant

MR. MAY: Thank you, Michael, and thanks to those who invited me here. Larry, what was that line you used about going last after five other speakers? But I do have some points I wanted to make but first I'm going to do that commercial plug that Larry opened the door for that and just briefly I do want to emphasize that next Thursday, March 9th, the Progress and Freedom Foundation is having an all day conference on our Digital Communications Act Proposal, a set of proposals to reform our communications laws and at 2:00 will be the session on spectrum and unveiled there and discussed will be the proposal that the Spectrum Working Group has for reforming spectrum policy and having looked at it and reviewed it I can tell you it's quite detailed in grappling with some of these issues that we're talking about today in a very specific way.

Now the conference is free too and they'll be a good lunch, Senator Dement(?) is going to speak and as many of you know he's actually introduced a bill that embodies the proposals we've put forward so far. So check out our conference agenda at www.pff.org.

Now the second thing that I want to say is Mark Crosby, I mean this is a lot of fun because a lot of people

at this conference go way back like Dr. Pepper but Mark Crosby is an example and I bring up Mark maybe to illustrate a point that Stuart Benjamin raised about the political economy, or that others have raised about the political economy of spectrum policy. I left the FCC in 1981 after serving as associate general counsel for three years and one of the clients that I represented when I left the commission was called the Manufacturer's Radio Frequency Advisory Committee, or MRFAC, or we called Mr. FAC, and what MRFAC did, as many of you know there were many of these frequency advisory committees to coordinate frequency use for the different defined services, the foresters, the taxi cab drivers, the railroads, and this was the manufacturers.

Mark was the head of an organization called SIRSA(?) at that time, Special Industrial Radio Service, that name probably may not mean a lot to many of you in the room, and there was another set of frequencies for what special industrialists or whatever, he can tell you. But the point that I want to make is that under that type of regime and with the allocation of frequencies to define services, and obviously we moved a long way from that regime but in some ways by virtue of law we're still tied to it.

But I got an early great education in how rent

seeking really works when you have a regime where the FCC is basically in a command and control mode because Mark was so terrific at what he did as the head of SIRSA that he built that organization, he was constantly looking out for new frequencies to acquire, new petitions to file at the FCC explaining by SIRSA should manage that frequency or why they should take over MRFAC and manage, they could manage those frequencies more efficiently. So if I turned my back one day I might have a petition filed, the manufacturers are not using those frequencies efficiently. And then of course we would have to explain to the world, or at least to the FCC, why the nation's economy would come to an absolute halt if one of those frequencies was taken away and given to another service. And Mark really has been in the trenches and he knows how that regime works as well as anyone and did a great job at availing himself of that regime in a good way.

Now a lot of that and subsequent experiences led me to believe over the course of my career as a communications lawyer and then a think tanker that we really do need a property rights regime of the type that Larry White spoke about earlier. I mean I think, and I can sum it up quite simply I think by saying that property rights increase efficiency for the same reason that no one ever washes a rented car, I mean it's about that simple.

Or if you want to go back further in 1876 Jeremy Bentham(?) actually put it this way, he said “it is only through the protection of the law that I am enable to enclose a field and give myself up to its cultivation with a sure hope of a distant harvest.” So I think the more that we can move to a regime that has ever more secure property rights protected by law, and I know we’ve, within the limits of the current law we’ve been moving in that direction, I think that that will be a good thing.

I thought it was interesting that I Stuart I think was the first one to actually mention that section, under the current law Section 301 of the Communications Act basically says that the spectrum is the property of the United States and there can be no private ownership of the spectrum. And as long as that is the law it seems to me that there’s only so far you can go without the possibility, even as far as you go, of falling backward, and that ultimately and obviously it’s not an easy thing to do politically. But I think ultimately the goal should be to change Section 301 to recognize the private ownership.

Now that’s a difficult thing to do. In listening to the panelists though, someone mentioned lawyers and economists among others, and it struck me in listening to that that, I’m a lawyer and not a economist and that’s probably why it took me longer to understand a lot of what

we're talking about today. But I think most lawyers come at this issue and issues like this that involve incumbents, or people that have rights, I think there's, by virtue of our training there's a natural tendency to be sympathetic to the issues of fairness and equity to those values as opposed to economic efficiency, it's the nature of the law and what we do and that's obviously an important and valuable thing in many ways.

What I've come to realize over time is that ultimately to move to where we want to move in terms of a property, how do you say that word, property rights, a regime of more secure property rights is what I'll say, to do that we have to increase the understanding. And when I think about it now it seems to me that maybe those of us who are in favor of that regime haven't done it in a way that is as convincing as possibly it might be. We have to show that the value of economic efficiency in terms of overall societal good when balanced against the values of fairness, equity, the level playing field, however you want to put it, tilt in the direction of economic efficiency, maybe there's a way to do that to a greater extent.

In terms of the obviously, that's the problem of the transition, that we haven't, we've alluded to it and talked about it, Stuart addressed it to some extent, but the transition problem with the incumbents is really one

where the political economy challenge is great. The one thing I'll say in the paper that will be released shortly by the Spectrum Working Group, I think Stuart is familiar with this paper and I know Dale is and others, it's the most detailed, it contains the most detailed set of alternative proposals for getting from here to there that I've seen. So I think, I can't go into all of that now but I think all of you hopefully would have a chance to look at those and you'll find those of interest.

Getting back to the law, the legal training, and Stuart said this, I was hoping I would be the one that would be able to first talk about administrative law in terms, because we're both administrative law practitioners and fans, the issue of institutionally assuming you have, as you more to a property rights regime, who's going to do the enforcement and adjudication is an important issue. Economists in general tend to I think almost instinctively say if we're moving to a property rights regime a la land, the courts can handle that like they can handle land. I've ignored Michael but I know you've been part of those DACA discussions as well.

I want to put in a word for the FCC, for the administrative tribunal doing the adjudication, resolving the disputes that inevitably will occur even in a property rights regime. And what I would say is this, as part of

our entire package of DACA proposals that we've introduced there's a notion that the FCC should be more like the FTC for example in carrying out not just the spectrum enforcement role but all of its regulation through adjudication rather then exanti rulemaking. That's a key part of the whole thing and we've done that by virtue of restricting the FCC's rulemaking authority, not eliminating it but burdening it in some ways that will direct the FCC to not use rulemaking as much as it has in the past and use adjudication.

Now the point that I want to make is by virtue of doing that the FCC in an institutional sense under our proposal will be a different type of agency. I mean when I was at the FCC actually there were administrative law judges doing adjudications to a much greater extent then they are now, and there were some problems with those, a lot of those things were comparative broadcast proceedings and there were problems with that. But in a reformed FCC where the nature of the institution has changed it seems to me that the FCC could do these adjudications, that if it's given to the court the courts might just be overwhelmed and the FCC will have the specialized expertise to do it in a way that the district courts or any specialized court won't do.

Okay, I know my time is up so thank you very

much.

[Applause.]

Agenda Item: Q&A

DR. KATZ: Thank you. We started a couple minutes late and even though the questioners will be standing between the audience and lunch, find out if any of you are brave enough to ask questions under those conditions. We do have time for a couple of questions if people would like to ask them of the panel, and again if you could go to the microphone. Thank you.

DR. ROBINE(?): Dorothy Robine with the Bradle(?) Group, a question particularly for Tom and Evan. I was a little surprised that you didn't mention the proposal, several pieces of recent legislation to provide unlicensed access to channels two through 51, the remaining TV bands. What is your view of that and of what seems to me to be an implicit assumption in those proposals that the opportunity cost of that spectrum is effectively zero?

DR. HAZLETT: There are several thousand items I didn't mention in my 12 minutes but the dearth of exclusive rights radio spectrum out there is the central problem, getting more out is the central solution. And there are two big reasons why we haven't been more successful in getting more out recently over the last decade, we certainly know what the right answer is, at least

philosophically or intellectually.

One is this overemphasis on spectrum license auction revenues, which I did mention, and then the other is the continuing command and control of the allocation process that has become further complicated by the idea that marginal allocations for unlicensed spectrum are just as valuable or more valuable as additional exclusive rights and we ought to go slow and be very careful about which way we go. The fact is that the marginal allocations are not valuable, the OFFCOM work on that in the UK I think is compelling work, many valuable applications of unlicensed occur at 2.4 and the five gigahertz regions, 900 and so forth. But there's nothing inconsistent about having open access or whatever you want to call it, commons, whatever name you give it type spectrum, but it should in fact move to an exclusive rights regime where you can actually get tradeoffs and observe the opportunity costs for instituting one regime of use versus another.

And this is something that many of us, Corel Williams 2002 paper mentions this and many of us have talked about actually privatizing the commons in that way which would at least give you some efficiency sense of this. But you can see countries like South Korea that lead the world on hot spots for example have essentially no five gigahertz use for unlicensed, it's all on 2.4, they get

more use out of that then anybody else for that, there's no hold up on technology, quite the reverse, South Korean broadband and wireless and other is doing very well relative to the alternative.

And much more evidence and the fact is for actual investment, the real transactional issues are really never confronted and this did come up here with Jennifer saying she was surprised we didn't mention investment and so forth. Well of course we do, we talk about the transactions taking place, the real transactions that take place in the CMRS market that are complex and interesting all have to do with investors on the one side sinking large amounts of irreversible capital and consumer in future years utilizing the benefits of that infrastructure. Those are fairly complex transactions and to really allow those transactions to proceed exclusivity is absolutely essential, that's why you see all the network applications, the large network applications taking place with those exclusive rights, and so by delaying that we've come to this impasse.

So I would certainly say that further activity in this directly has currently contemplated in Congress and your question is absolutely inefficient, it's more command and control, it's imposing, what the government thinks is going to work versus what market transactors think is going

to work, if Microsoft or Intel or any firm thinks that unlicensed rules are the best and most efficient use of that radio spectrum then I think that that's an excellent idea, they ought to be able to buy that spectrum, get the rights to it, and then turn it into that sort of an application testing their ideas against other market competitors.

DR. KATZ: Are there any other questions? Otherwise if not Tom has provided a perfect segue into the next session and an even better segue into lunch.

[Applause.]

[Whereupon at 12:25 p.m. the meeting was recessed, to reconvene at 1:30 p.m., the same afternoon, February 28, 2006.]

A F T E R N O O N S E S S I O N [1:30 p.m.]

MR. HATFIELD: Before lunch, we were addressing mechanisms, tools and approaches for incentivizing or encouraging the efficient use of spectrum. We talked about the exclusive spectrum rights and secondary markets approach just before the lunch break. Now we are coming back this afternoon to talk about unlicensed, short-term, dynamic and shared uses of spectrum and what it means in providing those incentives.

Our moderator this afternoon is Kevin Werbach, who is a graduate of the Harvard Law School and is currently an assistant professor of legal studies and business ethics at the Wharton School at the University of Pennsylvania. He, of course, is also a writer and consultant, written a lot about issues in this area.

So, with that I will turn it over to Kevin.

Agenda Item: Topic 2: Mechanisms, Tools and Approaches - 2.2 Unlicensed, Short-Term, Dynamic and Shared-Use of Spectrum – Mr. Werbach

MR. WERBACH: Thanks a lot, Dale.

Now that you are all well fed and, hopefully, comatose and light-headed, we are going to do the really exciting, challenging stuff. This is a conference about incentives for efficient use of spectrum, which is the right way to think about it and I think some of the

previous presentations have done a good job of illustrating that. The challenge here is not just how do we prevent interference. The challenge is how do we essentially increase the usable capacity of spectrum so that it can be used for all sorts of good and beneficial things. But doing that exercise, it is critical to have an understanding of just how spectrum can be used. Often, the debates about spectrum policy are, I think, stuck in assumptions about the way the world worked in 1927, when the Federal Radio Act was passed.

Assumptions about what spectrum is, about how it can be utilized, about what sorts of techniques there are for taking advantage of this invisible force, as it were and turning it into usable capacity for wireless communication services. One of the extraordinary things that has happened over the last few decades is that technology has advanced to the point where it is possible to use spectrum in new ways, to use spectrum in ways that don't make sense if you have a fairly traditional simple paradigm and spectrum is just a thing, like some physical asset and we have got to just decide, all right, here is this thing. Who is going to use it? How are we going to sell it to someone else?

Spectrum can be broken up and recombined in new ways, in ways potentially that allow it to be used much

more efficiently. Those changes, those technical opportunities lead to a different policy environment. They don't necessarily, like anything else push one way or another, although they do open up the possibility for new kinds of models of spectrum utilization, like what we have seen with the growth of unlicensed wireless services.

It is hard not to ignore just how powerful it has been, the development of Y-FI and other unlicensed technologies in the last five to ten years in creating new opportunities for new kinds of services and applications to develop. But Y-FI is only the tip of the iceberg.

So, in this panel we are going to look at a variety of different techniques. I think the title is apt because it is not just talking about unlicensed. It is not just talking about commons. We are talking about short term uses, talking about shared, dynamic uses, a whole variety of technical approaches that have the potential to transform the way spectrum gets used and that lead to interesting questions about what the policy regime should be in light of those changes.

So, I am going to ask each panelist to talk a little bit about a piece of this and then, hopefully, they will all leave some time to discuss amongst ourselves and discuss some Q&A. I will follow what Mike Katz said before lunch. It is easy to see this as a debate between a

property approach and a commons approach and really it is not that stark a difference.

Really, the goal, I think, that everyone has is how to get some change going, how to not be stuck in the present or, in fact, stuck in the past and move forward to open up some of these exciting new possibilities for use of spectrum.

So, we will start and go through the panel in order. We have got three presenters and two discussants. Vanu Bose, unfortunately, wasn't able to make it today. The first person speaking is Paul Kolodzy, currently an independent consultant, formerly the head of the FCC Spectrum Policy Task Force.

Paul.

Agenda Item: Topic 2: Mechanisms, Tools and Approaches – 2.2 Unlicensed, Short-Term, Dynamic and Shared-Use of Spectrum – Mr. Kolodzy

MR. KOLODZY: Good afternoon. First of all, I am glad to be here today. I am going to try to be very, very brief.

We are really here because when I looked for incentives for -- incentive mechanisms and best practices to improve spectrum management, but when I was doing some thinking about this the last few days, my big issue that came up was what do you mean by improving spectrum

management and what kind of metrics are you using actually to decide that you actually have improved spectrum management.

So, I have come up -- and at least I am going to assume for the discussion today that I am going to assume that one is to be able to be efficient in the use of the spectrum in a physical sense, but also as with the economists here, efficiency and the transactions associated with the spectrum in the sense of like spectrum trading. So, I will try to address those two issues in a sense today.

There is a variety of questions you can see in your book that we are trying to look at, what opportunities exist, what should the rights be, what kind of technologies should be developed. But since we are here at the National Academy, I am going to probably look at really the questions that are dealing with the economics, the physical and engineering science issues.

I am really glad as we were just talking about that the section is not just unlicensed. It is actually more than that. Dick Lynch at this 2005 inaugural event at DISPAN(?), basically said that there are many technologies that may be technologies that we talk about with shared use and interruptable use, actually are very much applicable to the license spectrum. So, therefore, we need to take a

look at how do we take a look at technologies that have in a sense how to use dynamic shared spectrum or dynamic frequency use.

That is really what we are looking at here, not in the sense of unlicensed or licensed and really the onset of this dynamic frequency assignment is really because we are able to get now with the technology and frequency, agility and AFDR(?) technology. So, this becomes -- and it becomes an issue in the sense of looking at devices that are looking in the local area and trying to do optimization locally versus devices that are system oriented, like the license holders, that provide global optimization and global results.

So, the first thing I did is I looked at the problem of the spectrum management and this is actually a diagram that came off the SPTF(?). What it basically says is it is going to worry about efficiency. Efficiency comes in two ways. These are your throughput limited or access limited, meaning you either have not enough spectrum and you are trying to cram more into the same spectrum or that you have a lot of spectrum and you are just not using it. It is just simply because it is being maybe assigned but not being accessed and used.

So, generally, most of the work that is been going on today has been in the lower left corner here,

improved access and -- Preston may talk a little bit about an allied or -- use ideas. But the other side is also just as important. There are certain areas of the spectrum that actually are really throughput limited and, therefore, you have to take a look at how do you pair users in the spectrum and how do you group like systems together.

So, the question becomes now is where are you operating and what kind of technology pieces are you going to try to use in those areas. We also put out in the SPTF that in a sense if you want to go -- that we looked at a tiered system. Again, we are going away from just as there an unlicensed and there is a licensed, but there is actually a multiplicity of areas here. You can go from unlicensed, which you have no protection in the sense of the interference, but you actually also have not paid anything most likely for your spectrum, to secondary users, which could actually aggregate either unlicensed bands to try to become a band manager or it can actually be a subletter of a license holder, which actually do have some property rights.

Finally, going up to the license holder, which actually has some property rights. So, now you have a tiered system that was being proposed, in a sense the ability to move yourself up through from being not protected but actually having very easy, inexpensive

access, but most of your money is spent in technology, all of that to the license holder, which basically has a lot of protection, but has also had to pay for that right. People could be moving up and down depending upon how well their services are doing and how much -- what kind of spectrum protection they need.

So, what I am going to do here in the last five minutes is actually tell you given this context, I am going to try to give you the answers of what do I think we need for incentives in this unlicensed area and also what are what I consider some of the major issues that need to be addressed, especially being in the National Academy, what should the National Academy be thinking about also in some of these areas.

First of all, incentive for device. Really, device manufacturers want to know how they build more devices. That is the incentive they want. What kind of incentives are you going to give them so they can build more devices, either more per person, put them in sensors or alike?

Well, the first area of getting incentives is somehow find a way to get them more spectrum. We are already doing that in the 5 gigahertz band in the sense of expanding on license uses, but the other area is you can also look for mechanisms that will require more global

optimizations to device interaction. Right now, every device is individual in the sense of an unlicensed device. It does not aggregate its impact of the environment and if devices could actually communicate and be able to actually come up with a more global response, you would reduce your interference. You would give more feasibility to the system, more capacity, which would allow them actually to put more applications on, which means people would actually want to buy more devices.

So, again, the device manufacturer having those kind of etiquettes would be useful. The negative of that, though, is that that is antithetical to what unlicensed is, which is not a coordinated effort between a bunch of different devices. Any device can go up there and be able to use that spectrum, as long as it follows the physical layer rules.

The next area is what is the -- for dynamic and shared use. Well, the first question is for the license holder, what is in it for the license holder. What kind of incentives are you going to give the license holder to be able to put spectrum out there to be shared, to be able to be dynamically accessed? Well, first of all, you need to be able to provide a market. How do you provide that market?

To get a market, you need to have enough participants to make it a market. So, one of the questions that I had -- and we were talking about a little bit here at lunch was that how do you get license holders to want to put spectrum there to be used in an easement and go into this area of secondary users and the like?

Well, one possibility as an incentive is maybe in the auctioning process -- and here I will have the economists go and think about this. This will be for them to think about what if you actually said if you look at an auction as time, as to how long your license is going to last, band width and point of presence tops. If you take a look at that volume cell and you ask the question how many of those volume cells are you going to put up of your bid to a secondary use, that it can actually be traded on an ad hoc basis and you are still getting money for it, but you are putting it up.

Maybe if you put up 20 percent of it, you get a premium on your bid of maybe 3X times the value of those little slots would be added to your bid. So, now the CFOs have to make a decision or the bidders have to make a decision do we want to hold on to all the spectrum or do we want to put some of it to be shared and be able to pay less money, okay, for the spectrum, but we have to then possibly

have this dynamically shared use when we have -- when it is not being used.

Possibilities -- now, I do look at the esteemed economists in here that actually come back and actually say this is possible or what kind of issues would have to be addressed, but I think that you have to find some way for them wanting to put it up on the market. One way is some kind of monetary benefit.

The other one is how do you do real time interference trading with any shared use? Right now, we don't do it in a real time basis. We do it actually in negotiation basis between license holders and the like. How do you do that in real time?

With the shared use, okay, the capacity for trading, either monetary or otherwise for increase or decreasing interference rights. That would also help the ability to actually move forward in some of this area of people to, you know, have access. If you do -- if you are looking at these possible things, areas, for a sense of incentive, there is some issues that have to be addressed in the sense -- in the technology area, as well as in the policy area.

No. 1 is that if you are going to have dynamic access, okay, any way shape or form, one of the characteristics that need to be known is who is causing

interference or if they are causing interference, right? Because that is one of the things we are trying to protect with our licenses and our rules. To do that, I look at two possibilities, either create a standard for exchanging interference information, somehow people will be able to communicate back and saying I am being interfered with, stop it, and these are the conditions that I am being -- how I am being interfered or you have got to create interference standards. It is really up to you, which way you want to go but somehow if you are going to have dynamics, you have to have some way to understand when you are having interference.

The second one is you need to start determining since the technology is coming along to actually, as Kevin was saying, to basically dynamically access the spectrum, again, to determine if that ability, okay, can interact with either static wave forms that are on basically static platforms, on dynamic wave forms or then eventually on dynamic and static wave forms on mobile transmitters. So, you have got to actually walk up this level of complexity.

So, what you really need to do is get the developers out of the testing labs and into the testing environment. I think Dave Donovan actually made a column on that a couple of weeks -- about a couple of months ago, I guess, when we were talking and said, listen, we need to

understand what is really going on and these things can actually work.

Don't make it a go, no go. Don't tell people to go out there and do a test and say if it doesn't work it is dead. Saying that that technology is not ready and it needs to be refined, but you need to be able to go out there and see if you can make some of the technology actually operate in the real environment.

The second area, get the EMC, the electromagnetic compatibility people community to step up with a solid engineering quantifying the issues associated with sharing spectrum. Get them to do it. They are your world's experts. Get them to do it. Not either the legal community, economic community or even the RF community, get the EMC community to do that.

Finally, determine the mechanisms to provide environmental information on those devices. How do you give the information to the devices to say what spectrum is now to be available? How would you take advantage of it and the like. This is an incentive in a sense that the incentivized people saying, listen, you can get paid to actually go out there and give environmental information or you can make money by selling the ability to obtain environmental information.

Should that be a government-funded technology development? Should it be a private sector technology development? I don't really know, but I do think that needs to be done or else you are never going to get there from here.

So, what I have tried to give you now is some incentives to take a look at, some of the technology pieces to take a look at, but one last final note, what if all of our dreams come true. What if we get the ability to dynamically access the spectrum? What if we are able to finally get the usage of the spectrum beyond 1 percent or 5 percent in any area and we get it up to 60 percent? Is that the right answer? The question that I have been looking at and thinking about is that when you start putting that much energy in the spectrum, are there some fundamental issues in the sense of how you do RF design that actually have not been accounted for because most of the time in building our radios, there is not much going on to spectrum.

So, all of our design processes have been built up under a wrong premise for a long time. So, is there a problem if we go to intense usage? That was the final question.

Thank you.

[Applause.]

MR. WERBACH: Bill Lehr from M.I.T.

Agenda Item: Topic 2: Mechanisms, Tools and Approaches – 2.2 Unlicensed, Short-Term, Dynamic and Shared-Use of Spectrum – Mr. Lehr

MR. LEHR: You will notice on this panel, these are all august engineers and if you have been in this area, you know who all these people are, but you probably don't know who I am because I am the one economist they stuck in the session because this is the only session about anything about economics, right, because the economics is all about doing this with licensed spectrum and flexible trading markets because that is how you actually do markets.

So, this is, you know, talking about all these other uses that are enabled by technology. I am going to call this the commons, but let's just be clear. I am not talking about unregulated, unruled, everybody owns it or this would be an alternative model for the whole spectrum. That is a busy man, straw man argument that no one really seriously, except maybe some people at the New America Foundation. I could argue that, but that is really not what this conference is about nor about what I want to talk about today.

Basically, what I mean by commons is that the infrastructure owner, the people that are sharing this spectrum do not have exclusive licenses and they could be a

closed commons, a place of private commons. It could be implemented under licensed spectrum. It is possible. If you have an overarching regime, you want to license everything, but you create public parks -- this can be in the public parks. Okay?

I want to make three points. The first is that in the discussion about how do you price the externality or deal with this problem of interference and the way you -- what does economics tell you about it. What our economists told from the first session is not only limited to doing it with licenses. Common is also a market for doing this and I will talk about that.

The second thing is I want to talk about how the business models for these kinds of commons, I mean, infrastructure sharing of the spectrum are real important and that is a little bit of a pun. They are real in the sense that there are things that really will be happening. They are important because even if they only happen at the margin, they will really influence how this market proceeds. Let's not forget that the very people who would think about building mobile carrier networks today, broadband wireless networks today, have been fundamentally authored by the fact of Y-FI, regardless of whether or not you think that Y-FI and what the activities that happen there has made a big difference or a little difference in

terms of adding up all that value and comparing it to all the value that has come from traditional license spectrum.

It has certainly served its role by having that regulatory diversity opportunity in providing a path for innovation that is important.

Then the last is I am going to talk a little bit about what some of the preliminary lessons are, I think, that are emerging from thinking seriously about how we are going to manage spectrum.

First point. The future is absolutely going to be shared spectrum. What that really means is a decoupling of the spectrum frequencies from the infrastructure investment in the applications. The possibility of doing that in a way that our traditional models of regulatory policy presumed were impossible. This is coming from every part of the business. It is coming from the technology of a lot of the folks that are now on this panel to be talking about those technologies perhaps.

The smart radio systems that create the possibilities of frequency, agility and expanded capabilities of sharing. It is going to come from the revenue, the fact that if you are a service provider offering services that depend on broadband access to data services, you are going to have to work over all these networks and your customers are not going to want to know,

oh, this is wired broadband and this is wireless broadband, this is mobile. It is just going to have to work if you have to do 24/7 availability, you are going to have to work over these platforms. You are going to have to provide that mobility when you offer your services in other countries, when you offer it over new acquisitions, facilities, whatever it is.

That is going to have to be built in there, to be driven by your marketing people. They are not going to want to hear the excuses coming from the engineers. It is going to be driven from the cost. It is going to be driven from the network and provisioning point of view.

As you move to things like broadband services, your traffic is going to be much more bursting. You are going to have more factail(?) usage profiles, so that users are going to have a lot more diversity in terms of what their requirements are for access to the spectrum. To use a single provider to have control of all the spectrum you might need to satisfy adequately your peak users, that is not going to work.

You are going to need to have licensed spectrum and opportunistically use unlicensed spectrum, the dynamic spectrum and fit all that together to offer your services. Then finally policy, and maybe this is the most speculative, the idea is if we actually have efficient

spectrum policy and we do, a lot of what they are saying in this morning, and I think they are mostly right. If you could ignore me completely and just do what they said, we would make a huge amount of progress.

But if you do that, you are going to eliminate a lot of the artificial scarcity that has been due to the legacy regulations. Thinking about optimal models for managing, in that world, if we are so lucky, we need to think a little bit about that in advance so we are not caught completely by surprise.

So, when you think about how you are going to manage access to the shared spectrum, there is general agreement the goal is to move more to these market-based incentives to share efficiently because markets are really good processors of information and they are not as good as rigid, regulatory processes that for lots of reasons are slow and cumbersome.

What you are trying to do is not be efficient with respect to spectrum per se because spectrum per se isn't really what you care about. It is providing incentives for the efficient radio system design, operation and use, but systems of those radios. As was mentioned by someone else, it appears within a phenomena that happens at a receiver. It is not something that just exists out there.

Kevin Werbach made this point very well in a number of his papers. So, there are two different models for how you get market forces in there. One is licenses. One is commons. License is the most obvious way if you really think that the spectrum is scarce, these interference things that are tradeable and a marketing exclusive spectrum licenses is a traditional way that economists would normally think about dealing with this.

The commons are just a different sort of market. It is splitting the baby in a slightly different way. It is a marketplace for technologies and uses. The different market mechanisms have different price allocating costs, but it is wrong to impute that in a common space or in some sort of shared access model, the regulators will say the price of the spectrum is zero. Of course, it is not. The price depends on the shadow price of congestion and whether or not, in fact, that is a weaker or stronger incentive depends on the context of the use in which it is happening.

So, the economic argument that unless you internalize it with licenses and price specifically the life of the spectrum, you are not reflecting and giving incentives for the price of the interference is just wrong.

The second is a question of transaction costs and we have heard a lot in the morning, one of the big concerns about license spectrum is getting the secondary markets to

work and a key element of getting the secondary markets to work is to provide some of the kinds of technology that we are talking about because you need to have someone that is willing to buy that spectrum and can buy that spectrum on a dynamic basis to really make those markets work.

With respect to the commons, the transactions costs or the protocol compliance costs and equipment design, depends on how you do it. The traditional argument is, you know, if spectrum really weren't scarce at all, if spectrum were free, then why would we have any worldwide. We would all be commons, throw away, let them go away. You don't need to regulate it. Okay, fine. That is not a world we live in today nor a world we will ever live in.

Alternatively, if you really need all this strong interference protection and the costs of trading are relatively low, relative to the value of the spectrum you are trading, then we would be licensed. So, these two paradigm rules are -- you know, if you need strong interference protection, like you are a mobile carrier that is spending billions of dollars to build out over a city-wide area and if someone brings up a radio to play, over here, they ruin the ability for you to offer your cellular service and the value of business you are operating is so high that the transaction cost associated with acquiring spectrum are relatively low, so if you have management

mechanism, of course, you want something with licensed spectrum and you should have it. That makes sense. Flexible, tradeable, all of that.

On the other hand, if you have something like Y-FI and, you know, you actually don't have very strong interference requirements and -- but the transaction costs, especially with today's Y-FI, of getting the infrastructure in place so you can actually trade it, is relatively high, you are much happier sort of in an unlicensed space. But the world is changing over time.

The smart radio systems are increasing the interference robustness and also increasing sharing options. With respect to increasing the interference robustness, what they are saying is given any interference problem you thought existed in the past, it is now. So, I don't have this compelling need for interference protection and I also am better able to develop the artificial intelligence I can build into the radio to deal with different kinds of managing and protocol adjustments.

So, in a sense I am using that off diagonal space of where maybe the weaker interference problem, lower transactions costs, the optimal model there is actually unclear, whether it is licensed or unlicensed. Both could work there. Of course, that is only half the story. The other half of the story is, God forbid, we are actually

successful. If we are successful, we are going to see more congestion because more people are going to use the wireless, which means that exactly what you gain with the small radio systems in terms of interference being less of a problem becomes more of a problem because the probability of interference becomes greater.

With respect to the transaction costs, the transaction costs may get relatively higher as you have to operate in a world of heterogeneous spectrum where I don't really want this particular band of spectrum for very long. I am going to bid for it if it is market price. The transactions cost, relative to the value may actually be going up. So, what we are leaning towards possibly are these off diagonal cases, where we might have, you know, weak, low or strong high, where we really don't know what the optimal business model is.

But it seems clear that in both of those cases, the need for more dynamic share of the spectrum options is going to be a key element and we need to approach this from both sides, both from the side of intelligent design of commons and from the design of new licensing regimes for spectrum and that the balance of multiple options is going to be important.

What are some business models that might make sense here? The most obvious one we talked about is sort

of the public commons, Y-FI, the volume of deployment by edge users of wireless devices. These are people -- I bought this box at Home Depot. I put it up. Something cool happens. I start building out. If that person had to go buy a spectrum license, they didn't even know they were trying to build infrastructure. It is going to be a real impediment to them.

Also, for certain kinds of community-based networking, municipal wireless, hot spots with city-wide wireless, these are also models that benefit if they had access to use spectrum. Certainly a lot of the sense of the community -- a lot of other situations where this might happen.

There is also the notion of semi-private commons. I actually sit there and honestly believe when I look at the architecture for base station radio design, that while the Texas Instruments and Motorola and so forth, CISCO, while those guys are designing their radios, is they are thinking that antenna is going to be -- those radios are going to be changing in terms of operations as to how they are doing it and actually the mobile providers, once you actually get rid of spectrum scarcity, so they no longer see spectrum control as being a way to influence industry structure, this is what all the economists hope will happen, but basically the ability to say I have a license,

so I get to say who gets to play and who doesn't, that that aspect is off the table.

Now, the only purpose of them is to control interference. Well, in that case, I don't have to worry about, you know, not every provider wants to have all the broadband spectrum in a town. If I am Sprint, PCS, I only want the PG spectrum. I have to have to serve my customers when I have to serve them.

So, as a major thing, we collectively want to own that spectrum and have a private commons makes a lot of sense. How you get there in the space -- of course, if they own that collectively, there might be antitrust concerns and other stuff, but in terms of the model for efficiently using the spectrum amongst those relatively small number of players, it makes a lot of sense.

Then, finally, there is a whole lot of cool, gee, whiz bang, technology may or may not happen. All the kinds of ad hoc semi-fixed network types of technologies, mesh networking, some of the notions that some of my colleagues at M.I.T. have been pushing in terms of cooperative gain where you basically can get around aspects of Shannon's Laws by sharing access to the spectrum.

You know, one of the things about ad hoc networks is that you don't know where they are going to be. So, unless you have set up dynamic spectrum trading markets

everywhere, which seems like a lot of market overhead, there are going to be places where, you know, gee, these guys just won't use it. Can't they just use it?

So, there are going to be a lot of options for that and I think that all of these models could be explained better. What we need to do to make the commons work effectively is we have to work towards an echo system of foreign-licensed devices and where a lot of the researchers today is thinking about assuming you have a bunch of spectrum and I want these independent infrastructure providers to share -- I don't care if this is created at a public common or if this is created by a licensee -- you know, this could be Intel Boston spectrum and is now figuring out how to let the devices that it sells and anybody else sells actually use the spectrum. What are they going to do?

What is the right kind of etiquette to put in place? Who should set that in place?

There is a lot of game theory going on there. There is a lot of computer science papers in this space and a lot of fundamental information theory and these guys aren't really talking to each other as much as they should. So, one of the things I am interested in is trying to get those folks together.

Cognitive radios, smart adaptive agents at the edges. When you look at sort of cognitive radio at the extreme end of what they will do, perhaps sometime in the future and then all the stuff they already can do today, we already are -- a lot of that is happening.

That is not enough. We also need to have the market mechanisms, which means the business models and thinking about the business models, and now it is sort of the slide before, which is to show you that, indeed, there are these important business models for why folks would want to do this and the difference sorts of sponsors and players in this space.

We really need to think about what the property rights are and just as we need to spend a lot better careful thought, as Evan Kwerel was saying this morning, in specifying the price property rights for license, exclusive license spectrum, we also have to think very carefully about what are the commons right to use spectrum rules we might to think there. In other words if Part 15 in the end data, could we do something slightly better there in terms of what it is we want to specify?

The last thing I think we need is we need to think about the regulatory regime and what I would like to see is a minimalist regulatory regime. But due regulation does not mean no regulation and when you sort of pull

things out, get rid of that, get rid of that, at some point you have to ask yourself, well, what do I want there after I have gotten rid of everything. What do I still want there? How are you going to do that with respect to something like cognitive radio. One of the key issues is certification and one of the key issues there is how are you going to have a meaningful mechanism for liability worlds of enforcement.

One of the real problems here is whatever progress we have made in the United States, unless this progress is exported around the world, it is really not going to be very helpful to the industry as a whole. To really make this matter, we need to have a global model and framework for how you are going to get these technologies so that they can be licensed and can start being deployed by providers who want to do that.

My own thinking on this is that something like the Part 15 rules is the right kind of approach but that we can do somewhat better than that.

That is all I have.

[Applause.]

MR. WERBACH: Next, we have Jon Peha from Carnegie Mellon.

Agenda Item: Topic 2: Mechanisms, Tools and Approaches – 2.2 Unlicensed, Short-Term, Dynamic and Shared-Use of Spectrum – Jon Peha

MR. PEHA: I am Jon Peha. I am going to talk a little about competing models for spectrum sharing. This is a session on unlicensed, short-term, dynamic and shared-use mechanisms. That, to me, is an awful lot of ground. The last couple of talks have been -- you know, addressed some of these and mix some of them together, which makes sense and this is a two day workshop, not a 20 day workshop. We can't separate them all, but I would like for this talk to separate them a little bit.

I think our goal is not simply to create incentives to use any one of these techniques that happens to be handy. It is to give for NTIA and FCC to give spectrum users the ability to match the spectrum sharing model with what it is they want and need to do. I am going to talk about five models very quickly.

First of all, sharing among equals, that is, you may have a bunch of equal devices trying to co-exist, perhaps trying not to step on each other as in today's unlicensed bands. Remembering that this is an NTIA sponsored event, I would point out that there could be a government equivalent of an unlicensed band. I see nothing inherent in that.

Another one that I am not going to talk about today is that instead of having equal devices coexist, you could have them cooperate, carrying each other's traffic, try and increase capacity to cooperative gain. Bill alluded to that. I just want to say if you can do this, this is great. There are lots of challenges. I am going to take it off the table. I mention it only because people sometimes in workshops like these group these things together and to me they are totally different beasts that require very different regulations, as well as technology.

Then I want to talk a little bit about sharing between a licensed primary user and a secondary, such that the secondary cannot cause harmful interference to the primary. Even this to me is not one thing. It is multiple things because secondaries may coordinate with the primary or they may not and that leads down different roads in terms of technologies and economics.

Secondaries in some cases may even be licensed or they may not. Each of these things is good for something different.

Unlicensed bands we have today to look at. We know there are things they are uniquely good for. They are good, for example, if I want to have an entire mobile wireless system, if I want to take a bunch of laptops and a wireless LAN and take it from here to across the street, I

don't really want to have to call the NTIA or FCC for permission to cross the street. I might not want to worry about whether there are incumbents and license holders across the street.

It is also very good for -- whether you have many owners and many low powered devices. It is hard to coordinate them and they don't do that much damage to each other. It is hard to prevent interference in these bands and it is impossible to guarantee quality and service because there is no limit to the number of devices that may come along and share. There is less incentive to conserve shared spectrum here. We have actually analyzed scenarios where this seems to be a problem and I think we have to deal with the problem, either keeping utilization low, perhaps having low powered devices or designing rules that promote some kind of efficiency as -- I do not think it is antithetical that there are some rules in an unlicensed band.

Somewhere we haven't been, at least this community has been not been discussing as actively as long is primary and secondaries that share with each other. First, I will only talk about the primaries and secondaries that coexist without any coordination. In effect, the secondary is invisible to the primary, which is nice in some ways. It means all complexity for spectrum sharing

lies in the secondary devices, which is particularly good if you have legacy systems you can't mess with.

Again, probably no quality of service guarantee is possible. I can do this by having a secondary that transmits at very low power or much more interestingly and along the lines of things Paul has written a lot about and Preston, who will come. They can sense their environment. They can transmit opportunistically.

This is interesting and promising and hard. As you also heard, we are looking at it. Other people are looking at it. Easier in some environments than others, though, particularly if you know a lot about the signal and it is fixed not mobile, like, say, point to point microwave links, the broadcaster's life is a whole lot easier, which again implies that in some cases, this model is more appealing to me than in others.

On the other hand, what if the primary and secondary coordinate. For example, the secondary request permission to use spectrum before transmitting. What I find particularly interesting about this is it is an opportunity to guarantee quality of service for the secondary devices, something that was not possible in the other models we have talked about and in applications where that is important.

It is a commercial use. It is also an opportunity to collect payment. That is, it is a real time, secondary market along the lines of the 2004 FCC ruling, but if it is not commercial, we can still do similar kinds of coordination. There are catches. One of them is that we need a primary that can -- a component of the primary system that can act as a gatekeeper. So, this is not a panacea. Some kind of systems, like cellular, have very obvious gatekeepers. Some like broadcast, it is not so obvious to me where their gatekeeper would be. It is not impossible, but it is not obvious.

Again, we have analyzed scenarios where extensive communications among secondaries is possible with little impact on the primary, which to me makes this a promising approach worthy of looking at.

One other thing I want to raise that does not seem to have been explicitly considered in the session, which is fine, is that secondaries could actually be licensed. They don't have to be unlicensed. There are some tradeoffs here and if a license -- if a secondary is licensed, both for good and for ill, it does not have to contend with other secondary devices.

If and when it can avoid the primary, its quality of service can be guaranteed. So, I can do this or without coordination. Without coordination, I may operate in

unused -- in things the primary doesn't use, like white space and guard bands, very exciting at the moment I think is with coordination. I can operate where the -- except when the license comes in and says stop. If it is an uninterruptable service, which I think is particularly interesting for things like public safety, where they don't need spectrum all that often, but when they do, get out of their way. They need it.

Again, we have analyzed some scenarios where extensive communications among secondaries is possible with little impact on the primary. This little impact actually I think is something that may come up in discussants. One can argue, you know, little impact is still not zero impact and we can have discussions about what is the right level of impact.

Sometimes this works for where primaries access is sporadic, e.g., public safety and sometimes maybe there is maybe a white space to exploit.

So, just so sum up some of the models that we are playing with, if the bottom row here is coordination, the top row is not, the left column is, secondary is unlicensed, the right column is not. We have looked at broadcasters with site license, competing with opportunistic devices, without quality of service guarantees, that is the unlicensed underlay in the top

left. You fill in coordination, maybe cellular makes more sense to me in the primaries and the broadcaster off hand and now we have got quality of service guarantees.

If I license the secondary, maybe that is a microcellular system operating in a broadcaster white space, for example, and if you throw in coordination, you know, public safety might be a good primary user.

To sum up, I think there is no best model. I think we have to explore these primary/secondary relationships. There is probably no more promising way to squeeze more communications through a spectrum than by, you know, license holders aren't going anywhere to do more of a secondary use. It is not immediately obvious which model we want to adopt. Actually, I have a much better sense of the commercial applications for the NTIA folks in the audience, we had -- you know, the academic community that I don't think serves you as well or annoys you as much and both of those are related to the fact that I think we have less of an understanding of what -- at least I do, of what the applications are and, therefore, what the right models are.

I don't think this is the end of the unlicensed either. I think, first of all, it is a proven success. So, why throw it away and, second, secondary devices that

are unlicensed are not an exact substitute for an unlicensed band.

[Applause.]

MR. WERBACH: That is the first I have ever heard academic criticized for focusing too much on the commercial world. Interesting times.

The first discussant is Preston Marshall from DARPA.

Agenda Item: Topic 2: Mechanisms, Tools and Approaches – 2.2 Unlicensed, Short-Term, Dynamic and Shared-Use of Spectrum – Preston Marshall, Discussant

MR. MARSHALL: I interpreted discussant as meaning I didn't have to prepare stuff. But when I listened to the talks before me, there was good coverage on license status back and forth and considerable discussion of ownership. So, I thought I would take the word I didn't hear a lot about was with dynamics and sort of fill the gap in there. I want to leave you with the one line that when you report out to this, I think dynamics is the key to the solution.

Two speakers talked about pooling and I think pooling becomes dynamic. Let's think about this. Let's walk back to the great information technology success we have had in the last decade and it is the Internet. Is the Internet efficient? No, it is grossly inefficient. Voice

over IPA takes 200 kilobytes of band width. Telephone pots took 3 kilohertz. It is grossly inefficient. Efficiency should not be the criteria.

All that talk about spectrum efficiency. Everyone of them has great counter cases. I think it is really a wrong measure. The Internet is grossly inefficient. What it has is an incredible access mechanism that allows us to share really high speed communications and not pay for it when we are not using it. So, the focus should be how do we efficiently access something as well as the Internet does it.

Think about it. The FCC -- and we will talk about FCC because I am a government employee, we can pick on them. The way they get to sell more spectrum is just to sell it to multiple people, like the producers. You know, it is a good model. Sell stock to lots of different guys, M&M Enterprises.

Now, how do we do that inspection? Well, my cable company does it to me. I buy four megabytes per second of cable. So, does my neighbor, my neighbor, my neighbor up the street. It is a lot more than the copper coming in my neighborhood. They sold that band width many, many times. They sold it because they made use of the access method that makes use of how we really use the resource.

When we do frequency management, we walk away from the ability to sell something to multiple people, which is the success model. We have got to sell to -- once I give it a name, 432.156 kilohertz, I can't sell it to anyone else. So, I am going to sort of go with my feed to be -- no one was controversial before me, but there is a real problem with spectrum management as we try to deal frequency management. When we do frequency management, we are assigning something, a named entity, and once we have done that, they know if we sold it to someone else. What we really want to do is to sell lots of overbooked and never have people sell it. That is how the Internet works.

If we all got on our computers and we all tried to do something, we would take down the backbone, but we don't do that. So, that is the model. The model is not engineering or academic concept of efficiency. We can be grossly inefficient. It is not peak the mass because we never have peaked the mass.

It is the access method. I think our investment in it is in a different access method. Really, I am agnostic about whether you apply it to licensed, unlicensed. I am a federal user. I am NTIA, whatever that is. The kind of spectrum you apply to is not important. It is a shift in concept from owning a frequency to owning access to a certain amount of spectrum. So, how can we

create the mechanisms that give us access to a certain amount of spectrum on a highly assured basis out of a pool? Because I think that is the key. I think all these speakers said what we really want is the pool.

We don't have the technology to pool if we have frequency managers. We have to get rid of the frequency managers. That takes care of any NTIA friendship I had. We want to be able to provide people access to -- you have access to 2 megahertz of spectrum when you need it. You have 2 and 2 and 2. I can put 30 or 50 of those together probably in 10 megahertz and never have a collision. At least that is what the cable TV company says.

I have actually sat and tested my line and I get pretty much what I paid for most of the time. The access mechanism, contended access works well. The problem is we don't have a good engineering model for that and that is clearly what we are trying to do in DARPA.

If you take that question then, the issue of property rights becomes kind of interesting because we are not renting a house. We are not buying something 24/7. There are a few cases -- cellular, yes, I think that makes sense.

So, for the bulk of users, particularly federal users, we don't want a house. We want a hotel. We want to have a period of time when we can use it when we are sure

we can call up and get a reservation because we need to be somewhere else and use our access in some other location, some other night, not the same night.

So, when we map it into frequencies and we map into property rights, we have mapped it into a static environment where I am only one place at one time and I have exclusive use. That is really the wrong metaphor. Once we get down that path, we start buying into metaphors that really don't apply.

So, we should keep coming back to the Internet. What has the Internet taught us about successful IT? It is to share resources broadly. So, that is not very anti-property rights. That is really the wrong question. What if my right -- I want to give someone a chit for so many hotel rooms. How he uses that chit is my technical requirement now. So, I want you to think about spectrum not as the way we do it with frequency, how do I give frequency managers better direction, but how do can I make use of adaption?

I think one key is that if we can develop the concept and get people get weaned off of assurance means a frequency assignment and I am not -- I have got piles of frequency assignments in NTIA. So, I am no better. I will carpet them when they don't give me mine.

But the fact is that right now, the only way to have assured access is to have a frequency. We have to move out of that metaphor to make any of this stuff work. Otherwise, we can't double sell. So, to do that, we need our dynamics.

So, one argument I will make is that dynamics is enabling to any of the kind of reforms we want to do here because all of them involve oversubscribing the resource.

The second part and I think Paul started towards it, is that dynamic is essential. Even if we don't change spectrum management, the fact is that as we build more and more aggressive systems and we have more and more occupancy, today we are at 2 to 6 percent. Paul, you guys ran Stevens. What did you find in New York City?

MR. KOLODZY: About 8.

MR. MARSHALL: Eight. Okay. So, 8 percent in New York City. You would say that is pretty much worse case. If we are going to bring those numbers up, we are going to create much denser environments. So, two -- argument to make here. But certainly all research indicates an argument that we will never build wireless systems in 50 to 60 percent occupancy with the issues associated non-linear response, if we have to make any one frequency work.

Whether you felt like frequency management, my philosophy before, we can tell you that as you look ahead,

there will be no way to find frequencies that don't have near/far -- don't have non-linear affects, that don't put you into more and more of the problem of Nextel and public safety. They will become increasingly unavoidable. Therefore, the only way to solve them is to delegate that solution to the devices. So, you have got x amount of spectrum you can choose from.

Check the frequency where there are the least conflicts from you in that locale. They can't come back up to Mother SEC, Mother NTIA and try to swap all this stuff around because these will be increasingly frequent down to the point of occurring thousands of times, perhaps in our dense battlefield.

So, we have got to move away from the concept of frequency, whether to do it because it is good public policy for spectrum or as we would argue, it is a necessity to deal with the dense RF environment. So, the problem with spectrum management is frequency management. We believe our XG technology a couple of people have referred to and there is not enough time to pitch and I am sure everyone has heard it more than enough times, but, you know, we think XG creates a mechanism for allowing dynamic access to spectrum. It is agnostic as to how you apply it. Sometimes people look at XG and think this is the way to make unlicensed or this is the way to make shared. It is

not. It is the way to make it dynamic. It puts back into the spectrum management business the question about where should I be dynamic. Who gets that access? What does it mean to have assured access. Those are all great questions. The technology is agnostic, but we do believe to solve any of these problems, to come up with definitions of efficiency, which represent access probability, because that is the real measure -- the measure isn't bytes per hertz. The measure is access probability.

I want to be able to go up to the public safety work or the federal work or the cell phone user and say you are going to have this confidence of access and be able to create an engineering derivation of that. That is what IT does. You have high confidence when you plug it in. Even if there is someone else using the line at the instant you plug in, you still have high confidence when you plug in you are going to get your packet over.

So, that ought to be our model, high assurance access to spectrum. Dynamics, we think, gets you there. I haven't really seen a fundamentally revolutionary approach that creates the same effect in terms of creating that assurance of access. We think you are going to have to go to that. So, that really ought to be step one in special policies. We have to move out of assignment. We have to allow a large class of applications to become dynamic.

Then you consider about what are the models? How do I pool? What is shared? What is not shared? What is ownership? What is hotel that can plug into those?

Obviously, there are advantages the more you pool the second insurance company, the more you pool the higher assurance. That becomes a policy question, but the first step maybe isn't to go down into what is the titling of the real estate look like in a static environment, but the use of the hotel model, think about it as nice little chits good for a night in a hotel and see where that model leads us in terms of dynamics.

We believe it leads you to a much higher index of what we think is the important measure. What is the confidence that when someone needs it, they get to the spectrum. If I said they have the right, they have it. That ought to be the measure.

Efficiency comes and goes and, again, voice over IP is the best example, 50 times less efficient that the technology than the technology it is displacing, but it has got an access method that really, really works and people have confidence in it.

[Applause.]

MR. WERBACH: And finally, and then we will get to some Q&A, David Donovan from Alliance for Maximum Service TV.

Agenda Item: Topic 2: Mechanisms, Tools and Approaches – 2.2 Unlicensed, Short-Term, Dynamic and Shared-Use of Spectrum – David Donovan, Discussant

MR. DONOVAN: Thank you. It is rather interesting that I am here because being neither an engineer nor an economist. I guess I am just sort of the practical guy. Having worked at the FCC for ten years and looking at spectrum policies, quite frankly, I come at it from a very different and practical perspective. I represent television broadcasters, but I have been involved with spectrum policy for a good long time. More importantly, I am currently guided at least in some of my thoughts, though we do have disagreements from Bruce Francis, who now works for us and was over at the FCC for a number of years and we are happy to have him aboard.

I would like to start off just listening to the presentations with I guess a basic fundamental element, which is what is efficiency. There is an understanding and assumption in all of the models that have talked about is that you need to squeeze more out of the spectrum that we need to get more information out there, more services, and I don't disagree with that one bit. But at least with what the government deals with and certainly what the FCC deals with is that there are other elements besides just pure

spectrum efficiency that are governing spectrum policy in the United States.

Let me just use broadcasting as an example. What you have is a system, which has been devised of a free universal service; in other words, one that is not paid for, one that is not based on subscriptions. In order for that to function, you need wide area coverage in order to get and to aggregate a sufficient number of eyeballs and sell them to advertisers. Now, is that in a pure engineering sense the most efficient way of squeezing information out of the spectrum?

Before you can answer that question either yes or no, you have to look at the underlying policy options that the government is trying to promote here. That is, universal access free and essentially with respect to low cost technology. One of the underlying issues here is that you are seeing a centrally, I think anyway, a paradigm shift and that is one in which we are getting away from licensing and getting away from the silos, but we are going to solve that problem through the receiving devices, through the transmitting devices, through the mechanisms that will be used over and over on the spectrum. That does nothing more than drive up the cost of those receiving devices.

At some point, you have to make a judgment as to how high are the costs with respect to consumer devices that we are going to live with in order to squeeze out the extra bit space in the spectrum. I will tell you why I am very sensitive to that issue right now is that we have made arrangements with some leading television receiving manufacturers to develop a very simple digital to analogue converter box and that seems like the most simple thing in the world and you know something? It is, but one of the key fundamental issues we have to deal with now is that in order to keep the costs within the expectations of Congress, which essentially are $50 a box, and looking out at possible spectrum uses in the future, do I have to provide additional either selectivity with respect to tuning or dynamic range, do I have to provide additional insulating devices to the extent that you have other uses that are going to other entities that are going to be using the television band that directly increases the costs.

So, none of this, I think, is done without certainly some impact on consumers. The other issue here, I think, is usage. Obviously, broadcasting is on 24 hours a day, seven days a week and people do not have to pay for that, for access to that, and at least with respect to providing news, public affairs, your congressman requiring access to that for political statements, that certainly has

been considered a public good and an important policy value to pursue, independent of how tight you want managers to spectrum.

But if you want to get into the whole concept then of dynamic spectrum sharing and I think there was some terrific models that need to be discussed and explored here, the only caution that I would provide is just my examples over at the FCC and I think that there are a couple. First, is that when you start doing sharing, the best intentions of engineering or engineering prognostications sometimes go awry. I think to some extent that is precisely what you saw in the Nextel situation. When that was first proposed, the engineers said there should be no problem between public safety sharing and the anhydron megahertz band and industrial communications and others.

Unfortunately, that proved not to be the case. So, as a result years later you have to sort of try to undo it and unscramble the egg. That became, candidly, a very hot political issue and an ugly process. But the key to the ability to do that was the ability of the government to essentially say I have two license -- I have license entities in there. Let me take one licensee and move that licensee into a different portion of the band.

What that tells me is that if you are going to move down a dynamic sharing issue, what you really need to do is have like sharing and I would argue with respect to secondary licenses or others, that license services should share with license services. I think one of the most problematic issues comes in when you have expectations that come with the license and suddenly you are sharing with unlicensed entities.

That should be no surprise to any of you in the room. The broadcasters have an issue with that. I have an issue with that in particular because broadcasters consistent with the model devised by the government don't control their receiving devices. In fact, we had to sue in order to have the set manufacturers include tuners in DTV sets.

Now, if we begin to move into a system in which we are sharing dynamically with an unlicensed regime, what that means is that we will have no control over those particular licensees. We are not sure on a going forward basis whether the sets would be sufficient and to be removed from the potential interference that is going to enter the band with the license system you have there to control over that.

So, I don't want to focus too much on unlicensed versus license, but I think what it says is that if you

are going to engage in a dynamic sharing situation that you really need to have like things share the band. Broadcasters, for example, already share the band with police in the top 13 markets. We share with Land Mobile. Those types of things, while there have been bumps along the road, they are working at least reasonably well.

I think the other final aspect and then I will sit down and just go into this is that one of the key issues, of course, that underpins all of this is how does one internalize the potential costs of interference. I think to the extent we are going to move towards a shared spectrum, that cost is going to have to be internalized in the equipment, which raises some, I think, profound issues from a regulatory perspective. The FCC, whether you like it or not, is very experienced, I think, in putting an emphasis on regulating licenses and regulating spectrum to that context.

Apart from Part 15, which we can certainly have a debate about, I don't believe that it is truly experienced in the notion of trying to manage spectrum solely through looking at receiving devices, particularly for wide broad area systems. I think if we begin to move down that road, you have to look at the real practical aspects of whether or not there is a policeman out there that can adequately

address that issue. I will leave it at that and we will leave 15 minutes for discussion.

[Applause.]

Agenda Item: Q & A

MR. WERBACH: Let me come over here to referee this process. Why don't we start there? I mean, David sort of pushed back on some of the things that we have heard and, you know, if I could sort of paraphrase it, take a piece of what you said, it was that these dynamics, unlicensed shared kinds of uses of spectrum have a cost as well as a benefit. So, to the other panelists, how do you respond to that argument that this may sound good in the abstract but drives up the cost of the devices, potentially requires new activity by the regulators that they are not good at? Does anyone have a take on that question?

Yes.

MR. MARSHALL: It is kind of hard not to take a little bit of that personal stuff. A couple of things. One, our concern is not just the performance of the poor receivers, but actually the good ones. The good ones tend to be -- because they go closer to the noise flow. But maybe what we can do is we are going to be setting up and testing XG with TV detectors in June. Do you guys want to come down? Bring down what you think -- it is a far distance from D.C. conceptually but it is about 50 miles

south. We are going to set up and really to -- in fact, the offer is really good to most anyone -- to try to set up the cases. We know there are cases where dynamic spectrum won't work against. We don't know which they are, but we know they must exist.

So, we are going to set up for several months and we have offered at the IRAF(?) the same thing. Bring down systems that you think are stressing. This has been debated since Paul started it like four and a half years ago and it has been debated by power point, not both sides. Now we have an opportunity to start looking at some instantiations of these devices. I have never had engineering data behind me to look and see what are the targets and what are the issues, where are the holes, where do the algorithms need work. There are people in the IRAF who are obviously very concerned, even -- as much about broadcasters, about sharing.

Let's try to collect the evidence base and if it is off the plate, let's all learn it quick. If it looks like we have got the wrong test cases, let's find the right ones and come up with some data that can be vetted in a much broader community. We have done some work to make our test open -- you know, normally, DARPA is kind of a closed thing. We come out and tell everyone the results, but in this case, we felt we needed to have a little more

transparency. So, we will have -- the FCC has given us the STA -- you know, coordinate with whoever is incumbent in a couple of those bands and NTIA is going through.

This is now an opportunity to put some science behind it. We have got 200 and 600 megahertz that will be working right now and it is a chance to prove, I think, there is a -- we tell people we expect the -- we expect to find some are not suitable incumbents, but we may find a lot are.

MR. WERBACH: Did you want to respond to that, David, and then Paul.

MR. DONOVAN: I think it is a -- I am glad to see that DARPA is willing to become transparent. I think that is important. Having been at the FCC before, I understand that. But I do like the attitude in this sense. One of the hardest things it is -- and it is not just for broadcasters. It is truly for any incumbent licensee, who has invested, you know, billions of dollars in developing a communications system and what we seem to have gone with over the last sort of several years or so, at least as long as I have been doing this, is sort of policy by power point in which, hey, this is a great new idea. Let's do it.

One of the most frustrating things we had is frankly when the unlicensed sharing proceeding was opened at the FCC was to actually go out and say, okay, please,

show me one of these devises and test it. Do it before you change the regulatory regime. We were never able to get that and what it then does, not just for broadcasters but for any entity that holds a license, you engage in shadow boxing. Well, will this device work? Will this set of parameters or this set of rules work? Will this device cause interference?

I think that is sort of -- I think it sort of flips the presumption and certainly over the long run will actually perhaps undermine investment. The burden really should be on the entities that are seeking to share to demonstrate, not on a power point, not even in a lab, but in the real world that those entities or those devices will not interfere with the incumbents. I say that not only on behalf of broadcasters but other companies, cellular companies as well.

MR. MARSHALL: [Comment off microphone.] But, you know, we are not exactly the rogue kids on the block. Most people here are complaining about DOD having more spectrum and we probably -- I don't think you can imagine a more conservative organization than the people we have to convince --

[Multiple discussions.]

MR. WERBACH: Let's swing back here to the panel. I mean we want to get this out.

Paul had his hand up and then Bill. But please speak into the microphone, too.

MR. KOLODZY: Just briefly I wanted to talk a little bit about the cost associated. We keep pointing to it that when you actually have more complexity in your systems, the costs go up. We also tend to know that when you start getting into mass production in the cell phone business and the like, it is actually the total number of parts that actually is indicative of how much something actually costs when it is in mass production in the 10 million and the above range.

So, the question is that we have to be careful about just automatically assuming that just because there is more complexity, that there is going to be a great additional cost associated with that. One example is you remember when Y-FI came out. It was like $200 a card and when the manufacturing came down, it became a single chip and it became much, much less.

So, yes, complexity does come with a cost initially, but not necessarily after a lot of -- as you go up the learning curve -- or as you go down the learning curve in terms of cost associated with manufacturing will that actually board up in the devices.

So, a little bit of caution I would think a little bit to say that just because it is more complex this

means it is going to be instantaneously much more expensive.

MR. LEHR: I absolutely do believe that the overall system cost is something we do need to consider and certainly an effort to get more data there. I think that, you know, it is a little disingenuous to again hold up the widows and orphans who -- their TV service if they don't get this. That argument against this kind of spectrum will have a lot more credibility if they weren't constantly wrapped in those sorts of silly bits of argument. If that is really what they think is true, then we will have that argument and we will talk about what are the costs of an efficient transition and naming legacy users, these other ones.

There are real costs about developing these systems and one thing we need to do is have places where we can actually experiment so that we can get these real world experiments happening so that, indeed, we can see this. Certainly we don't want to buy sort of the commons model or something like that, you know, without making any -- without understanding how we would want to tweak it. So, the experimental space is also very important in providing space for these kinds of different options.

I really liked what Jon Peha was saying in terms of, you know, there are a lot of different sorts of

initiatives here that we can make progress on in terms of introducing these markets. We certainly shouldn't let the enemy of the perfect be the opposition of sort of making progress on the fronts that we can make progress on.

MR. MARSHALL: I think we have always had a conservatism about regulatory changes. Stuff lives forever. These are software. We can change them. Microsoft does it all the time. So, we aren't stuck with it. We can make mistakes here early and so we don't have to be so cautious. It is not stuff that will live for ten years in people's junk box. We can put six months on it. If you don't update in six months, it doesn't work anymore, we get better policies. We can afford to learn.

MR. PEHA: I never thought there would be so much agreement on this question, but it is clear that there are cases where some television receiver is exactly on the margin and any slight interference is going to put them below. It is clear that there are cases where no damage is going to be done. As researchers, our challenge is I see no meaningful quantifiable data on what the real impact on broadcasters would be, what the real benefit to the secondary users will be and/or what the cost of those secondary devices would be. So, that is all great. And researchers, we have a lot of work to do, but regulators have a slightly different challenge here. If you wait

until we dot all the "i's" and cross all the "t's," you have waited too long. If you move too soon, then you are also in trouble and I think there is going to be a hard decision about when enough is enough.

I think you probably start by making very conservative rules and then seeing if you can relax them later. But we will see.

MR. DONOVAN: Jon, I agree in this respect. I think obviously when you are trying to develop policy, that you can't wait for every "t" to -- you can't deal with every single television receiver out there. However, when you have essentially, as you have in today's world -- and this is not just a broadcaster issue but since I know broadcasting best, I will use that as an example.

Widows and orphans aside, there appear to be at least 73 million television receivers out there that rely exclusively on off air signals to receive them. I think it was even a Consumer Federation of America indicated that may be even one in four sets out there anywhere between 19 to 22 percent of the population in terms of households. So, that is a lot of widows and it is a lot of orphans.

In addition to that, one of the problems that you have is that even on a going forward basis is that one-half -- if you were just going to be the entity, that is going to try to work out arrangements in shared spectrum

dynamically, I have to make sure that the set I am making today will be okay two, three, four, five years from now.

It is not simply a software problem at least from the television reception side unless we want to change the entire nature of the way we deal with that service and that is move broadcasting away from a free service to a paid subscription-based service in which the broadcast industry then gains control over the production of its own receiving devices.

That is a seismic shift in policy from a government standpoint. It may be easy to figure out here in terms of being leaders of technology, what have you, but that is a seismic shift. If I was to go up to the Hill tomorrow and say, look it, in order to be more spectrum efficient, I need to begin to control the quality and cost of my receiving devices. In order to do that, the model which I use, which is a broad-based free over the air model is really, I am sorry, Congressman, it is going to have to change, I am not so sure I may go in the room at 5 foot 10, but I will come out 5 foot 3.

So, while it is very easy to sort of speculate in the environment within this wonderful room, when you get out there, it becomes a little bit more problematic. But I do support the notion -- and if there is one thing I want to come away from here is that you need to at least -- and

I think you said it. Right now, we have nothing on a lot of this stuff. We have no data whatsoever. We have had to try to construct -- when the FCC came out with its unlicensed proceeding, we ask the commission very specific questions. What will the modulations scheme for these devices be? How will all this work?

Not having any answers, one is left to develop, you know, proxies based on the rules as they exist and I submit that in any model of spectrum, in any spectrum management model, I am not so sure that is the way you want to go. I think you want to test first.

MR. WERBACH: Sort of following on this, I mean, I think this is not -- shouldn't just be a debate about broadcast --

MR. DONOVAN: I agree.

MR. WERBACH: -- the same issue in some ways comes up if the incumbent user is the FAA or the Air Force or a public safety user or a cellular operator, you know, which is that to oversimplify perhaps, if you are an incumbent, you have nowhere to go but down and if you are an unlicensed user or someone who wants to be unlicensed user, who wants access to the spectrum, you have nowhere to go but up. So, this is supposed to be about incentives. What kinds of concrete things could be done? And, again not just limited to this broadcast issue, but what kinds of

concrete mechanisms are there that would create an incentive on the one hand for the incumbent to want to find ways to work together to allow some of these shared uses in ways that they are comfortable with and for the potential new entrants and the potential new technologies to provide some of that data that the incumbents feel is necessary?

MR. MARSHALL: One aspect is we have assumed that incentives are economic and I think that they are -- and the rest of the panel will probably talk to that piece. There is the purely technical that pooling has great advantages as signals become dense. If we can open up the concept of pools and dynamics, we will drive people to want to share the risk of unusable frequencies because of co-site, because of the Nextel kind of problems.

So, we believe if you can open up and break the frequency manager concept, you will create strong technical incentives to pool because that creates for each user a higher confidence of usable frequencies because we sort of believe there is going to be increasing number of unusable frequencies, unusable frequency locations because of the increasing density of RF.

So, some of those incentives, if you provide a regulatory structure that is technically enabling of that, you may well find that that is by itself sufficient to create incentives for people to go into a pool, which we

then believe is more efficient in provisioning everyone's spectrum.

MR. LEHR: I would sort of tackle one point that was made this morning, which is, I think the -- if you want to move the incumbents, you need to sort of move beyond this question about windfall profits. I think it is costing us more worrying about that. I would just, you know, give it to them. I would move a lot of that spectrum into flexible licensing because I think that is where you will see a lot of the experimentation happen and then in doing that, we have made some big mistakes in terms of not allowing more national licensing and more broader scope for those spectrums so that real trading can happen. We sort of forced it into another space.

Then I also think we have to be serious in doing this about the parks, the public parks and the multiple kinds of parks for different types of activities are needed. I think that some more dedicated and licensed spectrum into the lower frequency bands ought to be part of the transition and I think if properly -- you know, you give something to get something, that might work. I think that, you know, word problems with underlays is you piss off everybody who you underlay and you keep the government involved in regulating all that spectrum where the underlay is because they have to be the arbiter of that boundary.

If you sort of figure out this bit of spectrum for this and that bit of spectrum for that, you may separate a little and you may get more scope for moving away from frequency.

But this is hard stuff.

MR. PEHA: We have a decision to make with a tradeoff. If we say that, you know, the impact is one customer out of 500,000 and maybe we don't need to -- and we can set very conservative rules and make that decision. If we decide that -- you know, we regulators decide that it is in the public interest to have a bigger impact, I am not sure I see that happening politically, but if you really wanted to do it, you can compensate in a way that fits the application. I don't want to pick on broadcasts, but, obviously, playing with must carry rules or creating -- you know, as was done in clearly in unlicensed bands or even for other types of financial incentives might -- for other types of applications could theoretically make assurance.

MR. KOLODZY: I made a comment before, at least for the service providers, one possibility -- not service providers, but license holders, what mechanism might be able to do to get more spectrum into a pool. As this conversation has gone on, I have been thinking about, well, maybe at the consumer electronics level, maybe what you want to do is find incentives for people to actually -- since interference is caused at the receiver, is to make

sure that you can combine your receivers together in a common box so that some of these things can be addressed.

Now is there an incentive way to actually have the consumer electronic say, hey, that is a good idea. I could sell them a box that does multiple things and I have to pay a little more in my receiver but I can sell for two activities and not simply just one and maybe since the broad band is a big issue for a lot of people today, to have TV and broad band in one box, maybe that would be useful.

MR. DONOVAN: Getting off the broadcasting piece and, frankly, you know, being an old real estate litigator from days gone by, a certain key is important. If you truly want to have significant investment in a telecommunication system, whether it is through a licensing or some type of -- candidly, I lean more towards the property rights model, but certainty is important. To me that means then is that if one wants to go forward and perhaps use that spectrum more flexibly or would have your secondary options of that nature, I think, do make sense.

I think in the long run it may be counter productive however if as a policy I will give you a license to develop a system and in five years from now I start essentially granting easements over what you have. No one buys a house if five years from now the government can say,

oh, by the way everyone can walk through your back yard. That type of certainty, I think, is absolutely central. So, the concept of perhaps a secondary auction and what have you to promote flexibility to create the economic incentives to do that, I think makes a lot of sense.

Having said that, I am not so sure broadcasters would ever be -- whether the government would allow us to participate in that type of situation. I think if that were a model that were used, I am sure Congress would have a pretty hard time with that. So, I think, you know, again -- now putting on my broadcasting hat, I think from an economic sense that is probably a better way than a model that says here you have this in year one but in year five, I am going to force you to either share with someone or someone comes in over you or under you or beside you or however you want to frame it.

MR. DONOVAN: To pick an easier example than broadcast, there are cases where a lot of license holders who do own both their transmitters and their receivers and if you compensate them a little bit for the fact that there is a little bit no one knows about, they might actually be even happier than they were before.

MR. PEHA: Exactly. And to Paul's point, I would love for a universal device to have an off ear tuner in it and other -- whether it is broad band receiving

devices or what have you. All I know is that we had to end up going to court to have the FCC get the detuner(?) rules enforced

So, understanding economics of the consumer electronics market where a penny counts, that is a real tough issue.

MR. WERBACH: Do we have any questions from the audience? If not, I will fire some more questions to these people.

Okay. Well, so what about the argument -- this may take it a slightly different direction, but, again, I want to, you know, get to the different types of uses that, you know, all of these sharing techniques are great for unimportant things like Y-FI, where we are not really worried about the cost of failure in terms of this question about contention-based access. So what if you don't get on the Internet at Starbucks, but it doesn't make sense for things like public safety or government type users where the cost of limiting the access or, you know, you might argue broadcasting is potentially a similar sort of thing. There is different value calculus.

Does that make sense? I tend to think it doesn't, but -- the different sort of application cases and whether they might be better or worse for some of these more dynamic types of actors' mechanisms.

MR. MARSHALL: I have as conservative a user base as anyone can imagine. Military is a very old profession. I think people are facing the fact that they are not going to get assured access to the amount of spectrum they need to do in any case. So, it is a matter of managing the risks better. I think if we shift -- they are willing to accept the framework looking to the future if they have got to shift to access methods other than ownership of frequency, even if we win that battle in the United States. We are operating in 190 different countries overseas.

So, there is a recognition -- everyone is spectrum short. If you can provide higher certainty and control preemption, which is, I think, with the types of requirements and access methods, the idea of dynamic access does not work against those. In fact, pooling preempts -- why do we buy insurance? Because there is a higher certainty of meeting our bills with insurance than we do without it. So, the statistics of insurance for someone who owns 10,000 things is pretty high.

MR. KOLODZY: I was going to say we are already using technology in some sense in the public safety community for trying to actually pool our resources and that is called trunked radios. So, we have already started down that path in the first place. So, this is yet the next generation beyond that and it has to be also looked at

as carefully as trunked radios were in the sense of developed and actually implemented, but we have success stories for this in those kind of sectors.

MR. PEHA: The first dynamic access with coordination with the license holder will give you that guaranteed quality of service. I am not giving up that model, but without coordination, while you may not get it perfectly, the -- and trunked radio is sort of a comparable example. The extent to which your quality is predictable depends in part on how many different bands you can try.

So, the more -- we have a real start up problem here. If we get lots of bands where there is this kind of secondary access and a secondary user can bop from one to the other and there is a pretty good chance they will find one. How you start out that way, I am not certain.

MR. MARSHALL: -- we can have primary -- a thousand user pool into 300 channels and the example at lunch was, you know, I probably am not going to be doing the Super Bowl and Hurricane Katrina simultaneously. I can cross ensure that same pool of frequencies.

[Multiple discussions.]

MR. WERBACH: I guess Tom Hazlett had to go so I can misquote him now and not worry about a rebuttal, but I mean as I understand it Tom's response on the last panel -- and, again, we don't want to turn this into a property

versus commons debate because I think for all the reasons we have described. It is not two polar opposites. But as I understood Tom's response to the question before lunch, he essentially said the issue is we don't have enough property rights. We don't have enough spectrum out there and anything else, including exploring some of these new sharing techniques is just noise that is going to distract us from that -- anything from happening.

MR. LEHR: One of the things that was really clear this morning and is clear, hopefully, now is that you really have to figure have to figure out what these property rights are. There is an appropriate role between what the technology can get you, what the regulatory apparatus can get you and what the industry can get you.

The markets don't create themselves. You have to have an apparatus and framework for those markets to function. I think, Paul, when you were talking about that the standards need to be set by the EMC guys, I think that probably they are important for the technical, but I sure hope they are talking to the market and economist people because I think that absolutely for the more distributed types of technologies, you are trying to create an echo system that is going to look a lot more like an economy and early on in the design process, you need to start bringing those considerations in and you need to understand that

these other older models also have a right to be at the table and they need to have a place, too.

I think that the political economy audience, we have to figure out how to co-opt and trade and we need to have horses we are willing to trade. Give them this to get that and not, you know -- not look for an overarching regime that is going to solve everything because we are not going to get that, I don't believe.

MR. KOLODZY: I couldn't agree with you more. The thing that we do have and, again, what Jon was saying, we do have a start up problem here in the sense that getting the incumbent to deal with the license holders, as well as these new not unlicensed, but these new shared or dynamically accessible from licensed and unlicensed bands to be available and we have to find mechanisms, i.e., the incentives to be able to create these, either through the regulators that do that, through the market bases that are going to do that or through the technologists or actually it has to be really a combination of all three that have to come together to do that.

PARTICIPANT: I have a question for Preston. Your comments were fascinating and I am conditioned to believe that DARPA is always right, but I am having trouble seeing an inconsistency between your producers analogy or the cable TV analogy and the use in a property rights

approach. Cell phone service follows that model no less than cable. Hotels are -- you don't get hotels without property rights anymore than you get houses. So, why can't you get --

MR. MARSHALL: The metaphor and the continuity of the metaphor -- I think I was saying that it is not that we are disagreeing with the idea of property -- I don't do policy, but the technical implementation is not so much fixated on for now or never. It is the idea that the way we have created value and much of the technology that has been successful has been to use the time domain.

When we talk about property rights, we walk out of the time domain. In the case of cell phones, what has really happened is, again, they can't -- if everybody goes on the cell, what happens? It fails. It has made use of a multiplexing access method, multiple people, statistically average. Today we have something like frequencies for a use regardless of whether they are used, but assigning a cell phone to a cell and saying if you are not there, every cell still has the ability to reach your call. That sounds stupid but that is really what we do.

PARTICIPANT: But it is the distinction between -- if Tom Hazlett were here, he would draw the distinction between exclusive assignment versus exclusive use. We assign in the CMRS band, we assign spectrum for -- we

assign it exclusively but it is not for exclusive use. The cell phone system, as he said this morning, that is the epitome of shared use.

MR. MARSHALL: Today our problem is -- CRMS, we have -- for public safety, for mission critical things and who says their mission isn't critical, but for mission critical things the only mechanism we have today to assure that when you press talk there is no one else on your frequency is to give you that frequency exclusively 24/7.

If I say I am not worrying about giving you a frequency, but I will guarantee when you push the button we will find you a frequency because we pooled 200 of them. I can create the same assurance but I don't need a frequency for everybody who has exclusive right because I can use a statistical model, like a telephone. It is not against or for property rights. It is a more subtle delineation. I rent it when I use it. I get it and I can guarantee to a statistical certainty the confidence you will get it.

MR. PEHA: On the spectrum on cellular being the epitome of shared spectrum, if you think that sharing means that both a transmitter and a receiver exists on the same spectrum, then it is sharing, but I don't know how you can -- I mean, transmitters and receivers have to share spectrum. So, cellular system means that they are all part of the same system. To more fundamentally bother Tom

if he were here, if you believe that property rights are a bundle of rights that are well understood, that can be traded during the ten year license, then I see nothing incompatible with what Preston is talking about and property rights. If property rights are something that are defined for all eternity, you know, if we had fixed them when DeVaney(?) wrote his paper in 1968, then this would be illegal and I think there is an incompatibility and that is why I think that kind of property right is ill-advised.

MR. MARSHALL: I think that is going beyond my comments, but I was thinking like deeded time shares, you know, you get a deed for a certain number of weeks. It is a property right. It is recordable but it is something that is shared statistically with 25 other people.

MR. WERBACH: Okay. So, we are going to multiplex this conference in the time domain and stop here. Thank all the panelists very much.

[Applause.]

[Brief recess.]

MR. HATFIELD: The next session, the three dealing with mechanism -- and approaches for encouraging efficient spectrum utilization, having dealt with the exclusive spectrum rights approach, the dynamic shared use approach and we are now turning to fee-based and other mechanisms. Our moderator is Simon Wilkie, who is the

director of the Center for Communications Law and Policy at the University of Southern California. Among other things, he has recently served as chief economist at the FCC.

Simon.

Agenda Item: Topic 2: Mechanisms, Tools and Approaches - 2.3 Fee-Based and Other Mechanisms – Sam Wilkie, Moderator

MR. WILKIE: I just want to start with a brief introduction and I hope with this panel we can push forward in the aims of the conference and actually getting through a couple of concrete policy proposals. This panel actually follows on nicely from the last one, in particular Preston's comments about the new issue is access to spectrum rather than the definition of spectrum. Let's think about access and really the efficiency of access rather than the efficiency of utilization is really the issue. Fee-based mechanisms are one way of trying to get to efficiency of access because, obviously, we can just parse the access.

We can look at efficiency in two dimensions, which I think the talks today are going to illustrate. The first is what we will call efficiency at the intensive margin and the second, efficiency at the extensive margin. So, within the intensive margins, there are the issues of if we define a band plan and we have a particular usage

allocated to a frequency, how can we get efficiency of the users who are doing that frequency. We will call that intensive efficiency. The extensive margin is how should the band plan look like or should we not have any band plan. How do we allocate amongst users in different parts of the frequency and get the efficient assignment of uses to chunks of the spectrum?

These are some of the issues that are being dealt with today and our two speakers who are presenting papers are quite interesting because they are giving us the international perspective. If we follow Tom Hazlett's missive this morning about this is one area that Europeans are ahead of us, Martin Cave from the Warwick is the author of the U.K.'s Spectrum Reform Plans, is going to talk about some of the things that they have been experimenting with in the U.K. and in particular with some of their ideas are extremely progressive with respect to the government use of spectrum.

Then we have a talk from Michael Connolly from Industry Canada and our friends from the Great White North have got some interesting ideas on how to use white space more efficiently and how to use fee-based mechanisms there.

Then Peter Cramton from the University of Maryland and Randy Lyon from the OMB are going to be our

discussants and if there is any time left, I am going to throw in a few missives of my own.

Thank you.

Martin.

Agenda Item: Topic 2: Mechanisms, Tools and Approaches – 2.3 Fee-Based and Other Mechanisms – Martin Cave

MR. CAVE: This is where you have to get used to foreign accents, although mine is probably a great deal more foreign than Michael's and also as far as foreign practices -- administrative incentive pricing, a kind of surrogate for the pricing mechanism, which is designed to have -- to impose some of the incentive effects upon the -- I have a slightly guilty secret because do any of you remember the Soviet Union. Some of you do, but I used to study the Soviet Union. I used to be quite an expert on administered pricing, you know, prices of production, the latest value and that sort of thing.

I have just been trying to figure out how you do a calculation of the price of spectrum, but the Soviet economists were so ingenious that they probably would have been able to do that.

Anyway, just some introductory remarks. There has been until recently a conventional wisdom and by a conventional wisdom, I think I probably mean what I

believed last week, that a conventional wisdom, that you have a marking for commercial uses and then public sector users you would operate on a command and control type system with assignments, target setting, monitoring, all that kind of stuff, but no economic incentive.

I think the interesting thing that has emerged in the U.K. on the co-policy is it is really sort of throwing that out the window. I am trying, as Larry White suggested this morning, to what in essence is a fairly uniform kind of policy based upon markets in which both public sector and private sector organizations participate, but with some exceptions and it is those exceptions which provide the field for administered pricing. Those exceptions are basically what I call legacy private sector licensees. That is people who are gifted spectrum on a command and control regime and they are entitled to it for n years, you know, maybe 2012, 2015, something like that.

That would typically in Europe be a 2GOGSM licensee and then also for what I call irreducible private sector demand and those are public sector uses of spectrum, where for various reasons it is just not practical or appropriate to make tradeable and then apply those kinds of market disciplines with the public sector either trading into the market if it has got too much spectrum through leasing arrangements or sharing arrangements because I am

not really going to talk about sharing. But I think as soon as anybody looks at the public sector assets of the spectrum, in any particular country, you do immediately see the possibility for fairly substantial sharing there.

Of course, the public sector can also -- this is something that is going to be rather harder to sort of organize in both budgeting terms and also in planning terms become a net purchaser of spectrum. If it needs more spectrum to do something under the U.K. regime, which I will talk a little bit more tomorrow, it will be expected actually to go out into the market place and make the purchase.

So, I am really talking here about what I suppose is in the U.K. terms a suitable case for treatment in respect to -- of a relatively small proportion of the spectrum. It is quite large at the moment, but it is actually planned to decline. In other countries where the proposal is to extend the market are less ambitious and clearly the possibility of having some kind of administered pricing of an untradeable spectrum, public or private, might be more durable public.

Now, what I want to describe very briefly is how in the U.K. we have actually tried to establish prices. Now, these aren't spectrum prices or fees designed for cost recovery. The spectrum agency has a certain amount of cost

to raise it in fees so it sets what would normally be some fairly low level of charges in order to make sure it can keep itself in champagne and caviar or whatever spectrum agencies live on. It is not that kind of thing. It is more an attempt actually to proxy efficient market prices.

The method that we chose in the U.K., which I think is probably the correct method, is to proxy the opportunity cost, which we define as the cost saving in the next best use. So, it is really some kind of comparative process and it is focusing upon cost savings which are available in any particular use versus cost savings available in another use. Now I guess the key thing about that is we are trying to capture one of the two major drivers of a price because we are only trying to capture the scarcity rents, you know, the features of the spectrum in question, which makes it particularly valuable, just as fertile land is going to cost more than infertile land. So, a particular sort of sweet spot spectrum is going to be worth a lot more in terms of cost savings than 70 or 80 gigs.

So, in particular what we are trying to do and the procedures I am going to describe is include in the price of spectrum, the other component, which is what I call the monopoly rent. That is to say in the very constrained spectrum management regime that we have got,

somebody who has got spectrum is in a position to exercise market power in a downstream market and that is going to make the spectrum more valuable. So, it is just that one bit of it that the scarcity aspect that we are trying to -- we have tried to replicate so far. Why have we done that?

Well, a number of possibilities, one of which is that we have very few observations of trading for spectrum in the U.K. There was obviously a very famous, indeed, notorious auction in the year 2000 for the 3G spectrum, a few more rather unsuccessful auctions. For the past 40 months we have trading permissible but very few trades. So, we haven't been able to read across market prices as an alternative means of proxying pricing. Hence, the decision to stick with the opportunity costs as I have described it. I guess there is also an argument -- I am not quite sure how valid it is, but in the great scheme of things, the scarcities of land and so on, then the -- events would be eliminated from spectrum and so what you would be left with is relative prices of spectrum, which reflect their relative scarcity or relative efficiency, rather than the monopoly power which they confer.

As a practical problem, people in the public sector or private sector organizations don't like paying administered incentive pricing. So, the policy that has been adopted in the U.K. has been to sort of play them in

gradually by initially charge them amounts on the relatively small proportions of frequencies that they use and then gradually once they have got used to that, then you hit them with a bit more. You raise the prices. It covers a bit more and also, of course, you have the opportunity to improve your calculation of prices by including a slightly more sophisticated mode of calculating the opportunity cost.

Now, I am not sure if this would work anywhere. It is kind of administered pricing by stealth, but, of course, one of the problems is the vendor is actually charging the spectrum users very small amounts. You don't expect to get much of a response. So, there obviously is an alternative view, which is that you should ratchet up the prices to realistic levels, sort of genuine levels of what you think the opportunity cost is rather than mess around to try and get them used to it. But all this depends, of course, upon the budgetary context in which the public or private sector organization is operating.

Now, this process in the U.K. of setting fees started in 1998 when our splendid spectrum agency, then called the Radio Communications Agency, first applied administered prices, which we now call administrative incentive prices, to relatively small number of frequencies and they just did it by very crude valuation method. If a

spectrum is under 2 gigs, you would say, okay, this is mobile spectrum. How much is mobile spectrum worth? We have estimated that by just using the observation that if you have less spectrum, you have got more base stations and, therefore, spectrum is saving you base stations and then you infer the value of the spectrum or the opportunity cost of the base stations.

As far as spectrum above 2 gigs was concerned, the method was simply to take fixed links as the exemplar and so if you weren't using microwave connections we would have to have a cable. How much would the cable cost? The difference between the microwave cost and the cable cost is therefore the value of the spectrum, you know, very crude. Unfortunately, it led to a huge cliff at 2 gigs, where the price suddenly fell by about 99 percent, which obviously is totally unrealistic in terms of actual substitution possibilities. Now, what the U.K. agency has tried to do subsequently is to continue to run with that opportunity cost principle, but to extend it to take account of substitution possibilities amongst frequencies rather than simply substitution possibilities between spectrum and some other physical input.

So, this has made it necessary to revisit the calculations and come up with a bunch of other ones. I think I probably don't time to discuss the new process in

detail, but basically what you have to do is you have to construct a matrix in which you have frequencies on one side and possible uses across the top and then you insert in the sales of the matrix the opportunity costs that you have calculated and then in essence you set the opportunity costs on the basis of the highest opportunity costs that you find for a particular frequency.

Then the idea is that if a frequency has been inefficiently used, then it will be in the interest of the organization concerned to try and switch frequencies or to try and achieve some other substitution and this will have the effect of imposing or incentivizing, if I might use that word myself as well, a more efficient allocation of spectrum across the whole range of frequencies.

So, it is a -- to put it mildly, it is a slightly fragile purpose and the actual prices and payments of administered incentive pricing in the -- here are as follows. You have to multiply that by about 1.75 to convert those into dollars.

Now, what will probably strike you about this is that these prices, these payments are, in fact, pretty low and that reflects the fact that we are still operating under a regime in which prices have deliberately been constructed in a conservative fashion and the coverage has been very small. There has been a certain amount of debate

about how much it takes a U.K. general to get out of bed. If you look at this, you see that at the moment, the Ministry of Defense in total pays 55 million pounds, which is about a hundred million dollars. Now, is that enough to make a general get out of bed and try and figure out a strategy for reducing that expenditure in order to make it possible to redeploy the monetary sum for some other purpose.

Now, I guess my general feeling is that it is not and we have -- very recently in a report, which was prepared under my authorship last year, revisited the question of how the AIP should be set and how to revisit the question of that. We also looked at the question of coverage. So, in the report I proposed that administered incentive pricing should now be applied also to Ministry of Defense radar and -- managed spectrum and to ground based -- and the effect of this if the government accepts it, which I am hoping they will, would be broadly to quadruple the figures that saw above, possibly crossing that crucial threshold, which I have already described and causing the letter to be taken seriously.

There are a whole bunch of other recommendations, which are largely associated with the facts that what we want public sector uses to do is to economize in a whole range of -- by giving spectrum back by sharing it and by

leasing it. Of course, they don't have those competencies. I mean, that is not the thing that an organized -- emergency services or whatever or military has at its disposal. So, we have also introduced into the report's recommendations a whole range of things, which are really designed to create some kind of quasi spectrum trading organization within government departments in order to facilitate this purpose.

In other words, we have in the immortal words of my colleague's business school who deal with -- aspects, we have considered the human factors. Now, how does this fit in with incentives? Because there is no point in doing all this unless it has interaction. There is a real problem here with public sector organizations. It is obvious with commercial organizations if they face higher costs. Then they have got to recover them in the marketplace. With public sector organizations, it is different because of the nature of the budgetary process.

Now, we are greatly helped in trying to achieve improvements in public sector utilization, something which was referred to in the first session this morning, which is I understand generally absent in the United States but we have in the U.K. a fiscal regime under which departments receive -- undergo a comprehensive spending review as a result of which they then receive budgets for a three year

period on a prospective basis. Those are theirs to spend. You know, if, for example, under the U.K. government's so-called wider markets initiative they have some spare land, which they sell off, then they keep it. Equally, if they have some spare spectrum which they sell off, then they can keep that, too. So, there is, therefore, implicit in the regime something equivalent to like a three year price cap. So, we are doing some sort of cost of service regulation. We are doing some kind of price -- incentive regulation. So that the power of the incentive mechanism is a little bit off the floor. Two years isn't very far off the floor, but at least it is a little bit off the floor and then public sector uses, budgets were in -- targets for the amount of spectrum, which the Finance Ministry thinks is appropriate they should have and which they should receive the money to pay for. Then that becomes a target, which they should meet.

Now, there are as has been suggested other ways of introducing incentives, but some of them are really quite tricky. Now, what if doesn't work? Well, first of all, has it worked? We have had seven years of this. What we find is that some public sector bodies have actually handed back spectrum. The Ministry of Defense is a good example. One of those examples in which it has -- illustrates the -- the division between the public sector

and the private sector -- some spectrum, which was then assigned to a tetra opportunity for -- mobile services.

That operation went bust. So, the spectrum was handed back. It is now in -- and allocated at least in part to the emergency services. The emergency services provision of communications has, in fact, been outsourced to a private sector organization. So in fact, the spectrum will end up effectively in private hands and moreover, to make it even more complicated, two months ago, the Spaniards bought that particular organization as well. So, we now have -- we will have Spaniards in charge of our emergency services. So, God knows what is going to happen.

This is intended to be -- United States, rather than anything disparaging towards the Spaniards. As you see, it is really quite a complicated system with no obvious -- nothing of services provided to the public or private sector, which in my opinion is quite a strong argument for achieving some kind of uniform regime.

Now, if it doesn't work and in my review I suggest that after five years the government revisit the issue, if it doesn't work, what you can do, well, one of the things we did as part of the same report, was to quiz public sector spectrum users in an audit. Said what are you using it for? You know, why are you doing that? Are you using it? Do you know what it is being used for?

There are sort of embarrassing answers to lots of those questions. It became apparent that a lot of public sector users had no idea whether the spectrum they are allocated was being used or what it was being used for or whether there were any plans actually to use it in the future. So, I think that kind of challenge is, in fact, quite important as a preliminary way of doing it. Obviously, you can make the challenge proper. Then, of course, if that doesn't work, you go back to setting what are, in effect, quantitative targets for handing spectrum back, which in my view would be a rather gruesome reversal to command and control, subject to the same kind of capture dangers and that would be very disappointing.

So, I am certainly hoping we are not going to get down to that.

Thank you.

[Applause.]

Agenda Item: Topic 2: Mechanisms, Tools and Approaches – 2.3 Fee-Based and Other Mechanisms – Michael Connolly

MR. CONNOLLY: Greetings from the Great White North. Just before we started our session, our moderator gave me very strong incentive to respect the time allotted. So, I am going to try and speak very quickly. Martin has

done me the great service of actually laying out some of the ground work, so we can jump right into it.

First of all, just by way of introduction, Industry Canada unlike I guess the discernible tendency you can see these days to put spectrum management in some sort of an agency outside of the political process is a ministry of the government of Canada. Industry Canada is somewhat analogous to the Department of Commerce.

Under our Rated Communication Act, everything that we do in spectrum management is, in fact, exercising the powers of the minister. So, we are still somewhat in that political model. Also, I would note that Industry Canada has authority over the entire radio frequency spectrum, be it military, government or civil. Because of our very long shared border and the fact that the vast majority of Canadians live within a very short distance of that border, we have allocations that are generally harmonized with those of the United States and we have excellent working relationships and arrangements with our U.S. counterparts.

In fact, we exchange something like 50,000 proposals for frequency coordination every year between us. So, in addition to being a speaker at this conference and being honored, I am a stakeholder as well in what happens in this room and what you decide afterwards.

A few words about revenues and costs. In the early 1990s, Canada was said to have amongst the highest fees for radio licenses in the world and we sort of lost track. We don't know where we stand these days, but as you can see here, our fees exceed our costs by a fair margin. Our fee revenues for non-broadcast spectrum exceed our costs by about $160 million Canadian for a year and on the broadcast side, our costs of spectrum management in Industry Canada are around $13 million; whereas, our broadcast regulator, the CRTC, brings in revenues of $101 million, which are intended to recover our cost of spectrum management, but also to recognize the value associated with the privilege of holding a broadcast license and the spectrum it entails.

There is a reason for that because we are both subject to an overarching government external charging policy, which guides the application of a whole range of user fees, of which spectrum license fees are but a part. I have extracted here a few of the elements that are relevant to our spectrum management practices and which we site readily when engaged in discussions of fees. Note in particular that fees are to act as an incentive to efficient allocation. They are not confined to cost recovery and are, in fact, to be based on market value or a reasonable approximation thereof.

Also note that the government is to earn a fair return for Canadians for the use of their resources. I should quickly add that I will not be claiming that Industry Canada has arrived at a reliable or robust means of determining the market value of spectrum in the absence of a functioning market spectrum. So, if you are expecting that, you may be disappointed.

We decided in 1987 that our license fees would apply equally to federal provincial and municipal government users in the same manner that they do in the private sector and this was greeted by as you might expect strong and focal opposition. This opposition continues to this day and is particularly strong from the public safety community. However in our view, there are compelling reasons why even they should be subject to fees.

We seek to realize the efficiency incentive that fees may provide, to enhance transparency and better revealing the true cost of government services, to avoid hidden cross subsidies and to avoid starting the procurement decisions of government departments and agencies in fulfilling their radio communications requirements.

Unfortunately, at the time of that decision in 1987, to apply fees to federal provincial governments, there was no systematic study or analysis undertaken to

determine the impact of that decision on spectrum utilization. However, for people of my vintage, there are a lot of scars, but also a lot of anecdotal evidence that in the wake of that decision, that the fees did act to change behavior in useful ways and acted as an incentive. Examples include causing government users to release spectrum no longer being used, causing government users to rationalize what spectrum they did have and causing government users to keep better track of the technical data associated with the radio installations.

The problem that we face is that the majority of the radio authorizations currently in force are radio station licenses and I will use synonymous terms that you may be more familiar with. They are apparatus licenses or they are site specific licenses. The fees that apply attach to each individually authorized radio station. Our view is that this is both an administrative burden and may act as a disincentive to efficient use of the spectrum in that constructing more stations is to some extent -- and Martin alluded to this -- a technical substitute for using more spectrum.

In 1996, as part of regulatory changes to introduce spectrum auctions, we introduced spectrum licenses to coexist with those station licenses and we have adopted a spectrum based approach to fees for new bands and

new services implemented since that time. But the legacy station licenses and the associated station-based fees continue to today. We wanted to revamp this legacy fee structure to remove these distortions and to better wield the incentive potential of user fees for spectrum.

We have had one occasion to converge by fees from being station based to being spectrum based and that was in the case of the fees applicable to PCS and cellular systems. To our pleasant surprise, this shift resulted in the voluntary and unsolicited return of certain underutilized PCS licenses.

Facing the prospect of having to pay spectrum based fees, two licenses returned three 10 megahertz PCS licenses, two of which were promptly reissued to new entities who obviously were willing to pay the fees found to be objectionable by the previously licenses. You can well imagine that if Industry Canada had simply proposed the return of these licenses directly through some kind of regulatory action, we would have encountered stiff opposition and intense lobbying efforts.

In 1996, Industry Canada proposed a new fee model to replace the legacy station-based fees. Guiding the consultations that were undertaken were a set of five principles that you see here. The second and third principles, the more spectrum you use, the more you pay and

that fees will be higher where spectrum is scarce constitutes the incentive elements of the proposed regime.

In Canada, we saw it as a priority, the implementation of such an approach in the VHF and UHF land mobile band in our major urban areas, such as Vancouver, Toronto and Montreal where the available assignments -- and I underline assignments -- were at or near exhaustion.

So, every scheme must have a name and we baptized ours Spectrum Efficiency Incentive Pricing. I would like to quickly describe how the proposed model would address those two principle fee determinants, spectrum consumption and spectrum scarcity. First, how can one measure how much spectrum a licensee consumes? Well, here we shamelessly borrowed some ideas passed to us over ten years ago by Mike Goddard of the then U.K. Radio Communications Agency and we have adapted them somewhat.

We were of the view that we could arrive at a useful measure of spectrum consumption and, again for the purposes of determining fees by considering three dimensions of consumption; band width, which probably needs no elaboration, denial area, essentially the geographic area over which the licensees consumption reduces to some extent the availability of that band width to any other user and, finally, exclusivity, to recognize that there is a range of possibilities between some users, who for

technical or operational reasons cannot or will not share their band width to perhaps at the other end, technologies or requirements that are opportunistic and may be accommodated and useful in filling spectrum white space, as it was referred to by the Spectrum Policy Task Force.

If fees could be made to be a function of the volume of this queue, then licensees would have an incentive to take a number of economizing measures, including reducing their band width consumption, reducing their denial area, sharing dynamically, moving to other less saturated bands or subscribing to commercially available services using more spectrally efficient technologies. When I say that, I guess what I have in mind would be our equivalent to your CMRS.

For the purposes of quantifying the denial area, we devised the hexagonal grid covering the entire country, each cell of which represents 25 square kilometers. To quantify the extent of spectrum scarcity in the land mobile bands, we used the technical data for the existing radio station population and calculated every individual land mobile station spectrum consumption and total done in each grid cell.

The amount of spectrum consumed in each grid cell was then divided by the total spectrum available in each grid cell to yield the measure of to what extent each was

saturated. Sometimes our choice of words here is influenced by the fact that we are a bilingual country and we try to use terms that work in both English and French.

Five saturation levels were defined, spanning the range from zero to 100 percent. The results of one such calculation is shown here and they look exactly as you might expect. You can see that the higher consumption associated with urban areas, shown in red, and the lower consumption of rural areas in green and levels in between.

Fees would be expressed on a per kilohertz basis with that per kilohertz price being a function to the saturation level prevailing in the grid cell in which a licensee consumes spectrum. The escalation in the per kilohertz fee across increasing saturation levels would look something like this, rising steeply as saturation approaches 100 percent. At the lowest level of saturation where spectrum is abundant, fees would simply seek to recover a fair share of the cost of spectrum management.

At the highest level of saturation, fees would have to be of a magnitude sufficient to cause low efficiency users to seriously consider economizing alternatives. Our thoughts in this thing again parallel very closely of that which Martin has described.

Finally, due to time constraints, I won't go into the derivation of the exclusivity factor, but suffice it to

say that it will be a multiplier between zero and 1, as determined by the operational and technical requirements of the licensee.

So, an example of a fee calculation, this leads us to this type of presentation. Here we see a very simple denial area, represented by that red circle, overlaying the grid structure. Again, each grid cell's color indicates the per kilohertz fee as determined by each cell's spectrum saturation level. You can see the fee rates made up in this instance in this instance in the little legend there.

So, for the denial area we just saw and assuming full exclusivity and a band width of 30 kilohertz, the fee would be calculated as you see in this slide. Of course, licensees and applicants would never have to actually do these calculations. They would only need to input some fairly basic technical data into a web-based application and instantly be presented with the results.

The expectation is that having been confronted with the results, they might then consider how to avoid or lessen their fees by pursuing one or more of those economizing measures I mentioned earlier. Unfortunately, we will have -- and here is the rub -- unfortunately, we will have to wait some time yet before we have the opportunity to implement any of this. This scheme having reached the proof of concept stage, I will call it, using

readily available geographic information software, but needing to be implemented on a more powerful and capable platform for production purposes, was unfortunate enough to run up against Industry Canada's major spectrum management informatics restructuring project, which is currently underway. As one of our informatics people put it, they did not want to be in the position of trying to change the tires on a moving automobile. So, the implementation is on hold as we await anxiously that new informatics infrastructure and we are not looking at an implementation, 2008 at the earliest.

Changing subjects, just a few words on displacement of incumbent. Industry Canada policy is that incumbents will not be compensated by the government nor will new entrants be required to compensate incumbents. However, Industry Canada certainly does not object to mutually satisfactory arrangements arrived at between the parties. In fact, we have procedures that try to position the parties to pursue such arrangements. Essentially, we try to set up a balance between permitting incumbents to continue for a period over which their infrastructure can live out its remaining useful life and not having new entrants unduly impaired by the presence of incumbent systems. So far this approach seems to have worked and has not been controversial.

I tried to capture the essential elements of the procedures involved in this slide, but I really don't think time permits us going through them.

Just getting out of the way may be the best incentive and we recognize that market forces can be harnessed to bring improvements to the efficiency of both regulations and the utilization of the radio frequency spectrum. We are currently in the process of conducting a public review of Industry Canada spectrum policy framework. I have listed here some of those proposals upon which we have sought comment. These proposals are familiar to this audience and I won't be commenting further on these either.

I wanted to end with this particular quote by Manasian(?), who did some interesting work on how one might go about defining property rights in spectrum and why doing so would be a good idea. He wrote this in the same year that I started my career in spectrum management and although I didn't see his work at the time, this sentiment has proved to be a pretty good prediction of my career's experience in trying to bring new and different approaches to spectrum management in Canada.

Perhaps more than a few of you have encountered these types of problems as well. Thank you very much for your kind attention. Look forward to our remaining discussion.

[Applause.]

Agenda item: Topic 2: Mechanisms, Tools and Approaches – 2.3 Fee-Based and Other Mechanisms, Peter Cramton, Discussant

MR. CRAMTON: I am actually not going to present all 50 slides and, in fact, I am to discuss the very good presentations by the two before me. Unfortunately, I reviewed what was sent extensively, but nothing was sent. Still I can comment very quickly on what I heard, a lot of which made a lot of sense, but I would like to say that overall I am not a fan of administrative pricing. I think it is very much second fiddle to real market-based pricing and that we should move to market-based pricing. We have the technology for market-based pricing and so let's not spend too much time talking about administrative pricing when there are better approaches. Administrative pricing in its worst form is simply entry barrier and that is absolutely the last thing that we want.

So, now let me talk about auctions ant property rights. I am a huge fan of property rights and auctions and auctions is the appropriate market-based mechanism, I believe, for pricing spectrum. I also am a huge fan of unlicensed spectrum and make great use of unlicensed spectrum. So, I am not suggesting that we must use property rights and auctions in all cases. Certainly I get

great satisfaction from opening my garage door and things like that, for which there is no scarcity and the appropriate price is zero.

So, in terms of auction technology, I think that one thing that folks should look at is what has happened in electricity markets. Electricity is traded in many parts of the world, using markets at the wholesale level successfully; at the retail level, less successfully. Electricity, there is very much an analogy between electricity and spectrum. It is a locational product. There is limited capacity. There are benefits to balancing supply and demand at each location. In the case of electricity, it is absolutely essential that supply and demand be balanced at each location and each time. As such, electricity actually is a much more complicated problem than spectrum.

So, I would advocate that if we can do electricity markets, which we can do outside of California, we should be able to do spectrum markets. The reason that we haven't done spectrum markets yet is only -- not because we don't know how to do market-based spectrum pricing, but that the incentive hasn't been strong enough to do it because there has been enough to muddle through and we much prefer muddling through than doing something right at the outset.

That is a little extreme, but -- so, that is the big picture and now let me focus in on a specific technology and that has been proposed for the FCC's next generation of spectrum auctions and let me argue that this kind of approach -- this is still a very simple auction that I am going to describe is -- and in particular, it is one-sided market like what the FCC has done thus far, but the approach is adaptable to two sided markets and exchanges which obviously would need in robust auction marketplace.

I am going to totally ignore the questions which were focused on for most of these two days, which have a lot to do with, well, what is the product that we are offering and need to have a market for. That is a very important question and I will leave it to all of you to discuss that very important question in the next two days.

But I am just going to focus on auctions and presume that we have already defined what the product is. So, this next generation of auction technology that I am proposing with my colleagues, Barry Osborne and Paul Milgram(?), is called the Clock Proxy Auction and it is a combinatorial auction design intended for the sale of many related and most likely divisible goods. You could think of lots of applications, the airports, electricity -- securities emission, but the one that you are perhaps most

interested in is spectrum and here the dimensions of the product are band width, location and time, which I don't mention because I am thinking of a property right, which would be held in perpetuity, although that certainly isn't necessary. In electricity, it is band width, location. They don't call it band width, though. They call it megawatt hours, which is energy, at a particular location and a particular time.

So, that is just another dimension, but that is not a problem.

I should say that this auction format, the Clock Proxy Auction, has already been conducted and conducted successfully by the innovative country of Trinidad and Tobago on the 23rd of June, 2005. The Clock Proxy Auction consists of two phases. The first is the clock phase, which very much analogous to the standard simultaneous -- auction that the FCC uses. It is an ascending auction process in which all the spectrum is on the block. All the related spectrum is on the block at the same time. The bidder can bid on any of the spectrum and prices rise.

The only difference is it is simpler than what the FCC does in that it makes greater use of the substitution possibilities, the cross licenses, by defining to the extent possible substitutable goods, such as megahertz of spectrum in Washington, D.C., in a particular

area of the band. In this particular auction, we had -- so, that is the first phase, this clock phase. One approach is actually just to end the auction after the clock phase, which would be like the standard FCC auctions with enhancements and greater simplicity.

But there is in general an advantage to having a proxy round, which is a final round of bidding in which the bidders get to express valuations for any packages that they like and then the proxy round just like in eBay when you submit a proxy bid, the eBay system then raises that bid as needed, until the auction is over. Nobody is willing to bid any higher. This is the same thing. It is just done in a combinatorial auction fashion, so a bit more complicated. In this Trinidad and Tobago auction, which illustrates the point, the Clock Auction is used to determine who the winners are going to be. That is, there were two licenses. So, this is a combinatorial auction with two licenses. Boy, I think they can do this. Two minus one possibilities, but, in fact, there is a rich number of possibilities, well over 600 because there were many different blocks that could be pieced together in many different ways and so the clock, what it established was the minimum price of band width, dollars per block, and then there was a final last round of bidding. The proxy

then, which determined both the size of the licenses and the specific band plan.

So, this was an instance where the auction determined the band plan and it first determined the minimum price of spectrum. Then it determined through -- effectively in the proxy round, bonuses were offered for different possible band width -- I am sorry -- configurations of these licenses in terms of size and where exactly they sat on the bands. The approach is simply to pick the plan that maximized revenues.

So, in the Clock Auction, that is the first phase, the auctioneer names prices. The bidder names only quantities. So, it is very simple. It is just like walking into the grocery store. The grocer has conveniently posted prices and you get to decide what to put in your shopping cart. Then you go the checkout and you buy everything that is in your shopping cart. It is just that simple. So, it is a standard problem that we face all the time and are accustomed to.

If there is access demand, prices are adjusted and we repeat this process until the market clears. There is no excess demand. The way we conduct the Clock Auction is as a package auction. That is, we completely avoid the exposure problem by not rationing parties' bids unless they say they want to be rationed. So, they get exactly what

they want, just like at the grocery store. When you go to the checkout, you say this is what you want. You get everything in the grocery store. The checkout person doesn't say no, no, you can't have those raspberries, sorry, not unless you buy the apples, too, or, you know, guess what, you can't get those apples. Why I am only interested in the apples if I get the raspberries.

The point I would like to make there is that this Clock Auction, although it is a combinatorial auction, it is really simple. We are not solving any mix and -- problem to figure out what the assignment is. We are just seeing -- we are just actually doing some addition. That is all. So, that is really nice.

You can have a package auction, a true combinatorial auction without any computational complexity. So, we can do this with 15,000 licenses, like in the AWX Auction, as well as Trinidad and Tobago with two licenses. And computational complexity, whether we have 1,500 licenses or two licenses, is identical. There is no difference, effectively no difference.

The proxy round -- well, first, let me say what a proxy auction is. A proxy auction is a particular procedure or -- spinning, in which the bidders simply express preferences and then the project agent actually does the bidding and it does the bidding in a particular

way, what is called straightforward bidding, where it simply looks at, well, what is the most profitable package given the current prices and bids on that. Then it is some other proxy agent is going to jump in and submit a big and bump you and then it is going to keep going until no proxy agent is willing to bid any higher, just like on eBay, just a generalization of proxy bidding on eBay.

So, we combine the Clock and Proxy Auction. We start with a clock and we follow with the final round of proxy bidding. A few points, in this Clock Proxy Auction, all bids are kept live throughout the auction. Bids in the clock phase are also treated as packages, just like in the proxy phase and all bids are treated as mutually exclusive. That is only one of your bids is going to be a winning bid and that is how we avoid the exposure problem. Activity rules are maintained throughout the Clock Auction and between the Clock and the Proxy Auction. You don't have to worry about activity rules in the proxy phase because that is automatically taken care of by the algorithms used by the proxy agents to bid. So, when he concluded with the advantages of the Clock Proxy Auction, basically what it does is it combines the benefits of the Clock Auction, whereas, the Proxy Action. The clock phase in particular is very simple for bidders and provides that standing price discovery. Price discovery, when you have got a bunch of

items that are interrelated is absolutely essential in facilitating the bidder's decision problems. That is, what should be bidding on. Then once the Clock Auction -- and we used this Clock Auction as long as possible. Once the clock bidding is exhausted, there is no further, higher bid. Then we shift to this last and final proxy phase. The proxy phase, what that does is it promotes efficient assignments and competitive revenues for the seller and simultaneously reduces opportunities for collusion. So, it solves all the problems -- not all the problems, but many of the problems that the highly successful, simultaneous most run auction that the FCC uses, it addresses with the proxy phase and then improves upon the current FCC simultaneous -- run auction with the Clock Auction, rather than the more complicated simultaneous multiple round auction.

Well, I have 42 more slides, but I have gotten the big zero. So, I am going to stop here. Thank you very much.

[Applause.]

Agenda Item: Topic 2: Mechanisms, Tools and Approaches – 2.3 Fee-Based and Other Mechanisms, Randolph Lyon, Discussant

MR. LYON: I am Randy Lyon. I guess I am the last person to go today. So, that is somewhat of a

disadvantage because I agree with so much of what has been said today. I would like to think that we are moving toward a consensus, but that is probably a little optimistic because I don't think we quite have a consensus. There are a couple of things I would like to do. One is to point out some areas where I don't think we have a consensus on where we are headed and also to give you a little bit of an idea of what we do at OMB when we think about these things because that may be one of the unique things that I can share with you all.

I think the key insight there is that at OMB we consider ourselves an economic agency and not simply a budget agency. I think we would consider ourselves with Treasury or the Council of Economic Advisors, perhaps the Commerce Department in some context, to be looking at economic policy more generally. Now, clearly, we are interested in budget impact, but when we have been working on spectrum policy both with the Commerce Department and with the FCC, it is not driven by revenues. Revenues are a factor and I think we fortunate and I think it is appropriate that we do consider revenues because the value of the spectrum, maximizing the value of the spectrum to the government can give you some insights into -- can be related to maximizing the value for the economy, but it is not necessarily a one to one relationship there.

I think it was Tom Hazlett, who pointed out when we are looking at spectrum license values, it is the value to the producer and you may be missing the consumer surplus. That is a fair point.

That is one thing in terms of when you are trying to decipher where the administration has been headed on spectrum policy over I would say the -- since I have been doing this and I think even before, I don't think it has just been a revenue-driven policy. I think looking at efficiency is a real big part of that. I thought the presentations about the United Kingdom and Canada actually were quite good and although I understand where Peter is coming from also, that to some extent auctions and creating a property right seems to have some advantages over a pricing mechanism, but I wouldn't give up on the pricing mechanism and the fees. I wouldn't dismiss it as a useful thing.

I think that is also partly reflects where I am coming from, seeing the kinds of things at OMB. One way to approach this is what are our goals when we are thinking of spectrum policy? To me, three or four goals come to mind. One would be efficiency. Another is kind of equity or distributional factors. A third would be certainty of outcome, which you could relate to efficiency if you want, but I think it is -- it may be distinct enough that it is

worth keeping separate and a fourth one might be ease of administration, which I think you could probably also wrap into an efficiency measure if you would like, but I think as Peter has described, you know, how we set up auctions and how we administer things and how we do pricing. It can be a kind of a somewhat distinct issue in itself.

We think efficiency is really important as an economic agency and I think some of the pricing mechanisms that we have heard today are one approach for moving in that direction. They are an attempt to try, as I see them, a very thoughtful attempt to try to equate marginal benefits across users. I think, you know, at least one of those speakers was talking about how this is not intended to be a revenue generating -- a money go round, I think, was the phrase or a money generating machine.

So, the goal here is not to extract monopoly rent, but -- I guess it was the U.K. system where Martin was making that point, but rather to try to balance marginal benefits across users. I think that there are some -- we probably have a wide agreement on that in the audience here. I think a place where we didn't have so much agreement on it is the importance of kind of the equity or the distributional issue here. I think some people in my view hit it right on the head. I thought Professor Katz hit it right on the head.

That is it is not that economists don't care about distribution, but we don't have a ready fix for it. We don't have an obvious answer, but we do care where people are getting huge windfalls or where there are particular individuals that are benefiting greatly at the expense of the whole. I think that frankly is a very important issue when we look at realistically where we stand right now and that if we grandfather everybody's spectrum right and then say, okay, trade, we create a huge windfall.

Now, somebody might argue that the windfalls are not important and that the efficiency gains will soon dwarf the windfalls and that is a really interesting -- in my view that is am empirical question and it is well worth considering. It could well be that by trying to optimize everything and, you know, minimize all the rents, that the government could really muck things up. I just finished The World is Flat and Tom Friedman makes the point about how difficult it is to set up businesses in some countries and in others you can do it in a snap and clearly by trying to protect work, you know, in that case because examples -- by trying to protect workers too much, you end up disadvantaging them because you can't start a business.

And it is to some extent the rough and tumble maybe better. But I think that in the case of spectrum, we

literally have tens if not hundreds of billions of dollars of property rights that are at issue. If we can create a system that at the same time it allocates spectrum efficiently, also pays for interoperable radios for every police station and levees for New Orleans and tsunami prediction and provides all kinds of public goods at the same time.

Personally I would like to look real hard at that system that cares about some of those distributional issues and tries to get at some of those rents, rather than just saying the rents aren't important, just grandfather people. In my view it is kind of an empirical question of which of those is probably the better system. My own gut instinct is we have such tight spending -- such a tight spending environment that if we can collect the rents for the taxpayer, rather than grandfathering them to the people who happen to have spectrum rights, I think that is a preferable outcome.

I think another place where I think there is disagreement and we heard it more in I think the very first session is how do we treat government services. There I think at OMB, we have been very much thinking along the lines that we ought to try to price these things. We ought to try to keep track of how much spectrum is being used. I believe it was Dr. Spiller, who said, you know, could you

keep track of that as a budget item. It should tell you all that we have actually tried to -- we have done exploratory studies along those lines, but I will tell you it is very hard to do that.

One reason it is so hard to do is that so little spectrum has really been auctioned or sold in market transactions. So, our price data over all the frequencies is not real good. Some of the federal systems operate in frequencies where we don't have a lot of very good price information.

The other thing is sometimes federal systems, you know, you might only have systems that operate in White Sands, New Mexico and how are you going to price that. That is a very special kind of regional license and we don't have great data on how much that stuff is worth. But I will saying we are trying to do it and it is the same thing with pricing, you know. We don't want to create line items that are kind of meaningless. So, I would say it is something that we are working towards.

Since I am running low on time, let me leave that at it and if people want to ask questions that would be just fine.

[Applause.]

Agenda Item: Q & A

MR. WILKIE: We have got a few minutes for discussion, but I would like to kick it off myself actually, take my prerogative, and suggest that I think this actually -- maybe I spent too much time in government but there is actually a middle road here. There is room for compromise in the sense that I think both auctions and administrative prices have a role. In particular, if we think of the problems as being the misallocation of spectrum, rather than access, that a lot of it is allocated to government agencies, DOD, Justice, DFAA. And we have a problem with getting into participate in the auction in the sense that at the moment their opportunity costs are -- holding onto the current spectrum is zero. They have no incentives to participate in -- if we were to do the Carl Williams big bang, try and build a two-sided market to get all this stuff out there, the government agencies if they can't retain the money themselves have no incentives to participate in that auction to hand the properties over if they have to then buy them back.

On the other hand if they are facing administrative fees and if they said through a proxy calculation of opportunity costs, then they have an internal budgetary incentives to account for what the value of that spectrum is. That is, they might not go out and say what is the value to us in terms of usage, but in terms

of the line item in my budget, this is an expense that is taking money out of my budget. If I can get rid of that expense by internalizing the use of the spectrum more efficiently, then this might be a way to get there.

So, in particular, I think that administrative fees have a particular role for incenting government agencies to participate in the option mechanism when we get around to actually implementing such a fee.

So, with that said, I would like it open to further comments from the panel, if anybody has got any points for discussion.

MR. CONNOLLY: Thank you, Simon. I have to respond to Peter by saying that I am also a huge fan of auctions and arguably Canada's biggest fan of auctions, also of secondary trading. I think I also buy into the possibility of two-sided auctions, et cetera, but I am also somewhat of a pragmatist and it drove me to put up that last slide about the problems that one encounters. So, yes, we are striving for that middle road that Simon mentioned, which may be a muddle road in Peter's estimation, but, you know, I think there are some in our environment having a minister who carries all this responsibility, who has political considerations, I think it is going to be very difficult to explain to ordinary

Canadians why people who receive licenses pretty much for free, let's say, would now benefit in a two-sided auction.

So, I am sort of sort of looking at that and saying I don't know that I -- you know, I fervently believe that is probably the best thing to do, but it may not be the practical thing to do. So, what is the next best thing to do? I think that is where we are, trying to operate within those constraints which are very real constraints.

MR. CRAMTON: Well, on the two-sided auction point, it really -- I mean, one thing economists to do -- they don't like to talk about distribution. That is true. They like to talk about efficiency, but I actually thinks that that is useful in that the economist likes to separate the discussion of distribution and efficiency and certainly if the consumers of Canada or any other land or taxpayers would like to receive some tax revenue in this process and can politically receive it, then that doesn't stop at all the use of a two-sided auction.

You can have a two-sided auction and distribute the proceeds from the process in any particular way and you can do it in a way that doesn't discourage the holder of spectrum from participating in the auction.

MR. CAVE: -- particularly important because they are like IPOs, sort of once it is done, it is done. The real action must surely in secondary trading, once the

cupboard has been cleared. Then for the next two millennia, the issue will be have we devised appropriate practices and proceedings, which permit spectrum to be traded and shared.

Having said that, though, I do recognize governments are bound to take something of an interest in auction proceeds. One speculates about the decision process that took place in a ministry in Trinidad and Tobago and deciding to have two licenses rather than say three licenses or four licenses.

But just to go back to the question of windfalls, it may be that the British people are remarkably unenvious and so forth or it may be that the mobile operators have already contributed well over $45 billion in license purchases in the year 2000. I am not aware of it as being such a big problem. The government wanting the money is a big problem and that is often dressed up as being a windfall issue and the public will be disgusted at the thought of fat cats getting away with it.

There are various ways of dealing with it. I mean, one obvious one is to auction -- is to make spectrum tradeable subject to AIP, which just sort of careens off the capital gains that will be associated with it suddenly becoming tradeable. A thing that we have used in our privatizations in the U.K. is a requirement that if assets

are sold after a privatization, then there should be a special capital gain effects upon that sale, which obviously inhibits the sale but it sort of quells some of the mutterings about the unfairness of the regime. So, I think there are ways around that, but obviously it depends upon the circumstances of any particular policy.

MR. CRAMTON: I completely agree with your point that the real action must be in the secondary market. At least, you know, going forward -- I mean, today and say maybe the last ten years, the real action has actually been in the primary market, but in the long run, it is going to be in the secondary markets. When I use the word "auction," I use it in a very broad sense. It is simply a market in which prices and allocations determine through submitting of bids and offers.

So, for example, in wholesale electricity, all the auctions are secondary market transactions in that sense. They are all for short duration. The most common auctions are for just a single hour and that is done on a day ahead basis, as well as closer to real time. That is a very important market in electricity. There are longer term markets, but in fact in electricity we see much of the action taking place in these very short term auctions that are actually quite robust despite the locational time and

band width or in this case megawatt features, which makes it highly complicated.

MR. LEHR: This is Bill Lehr.

Question about the Clock Proxy Auction of the model for running efficient wholesale markets and the analogy to electric power. I am dubious that it would apply everywhere but where it would apply, I think it is very, very interesting. Do you see any institutional differences in terms of who should be the market makers. Is it better if the FCC would run that Clock Proxy Auction or if this would be something that whoever buys the spectrum would assume a band manager would do a more efficient job? Does the theory suggest anything about that?

MR. CRAMTON: I would say both. My practical experience, having conducted about 26 Clock Auctions and one Clock Proxy Auction has been that all of the Clock Auctions have been for a band manager if you will, one of the large electricity companies of the world that is auctioning some band width or in this case electricity capacity. The exception to that is the Trinidad and Tobago, which was done by the government and so I think that there is -- I actually think that the FCC has developed tremendous expertise in the auction arena, but I -- and I am sure that they should continue to conduct

auctions, both one sided and two sided auctions, but going forward, I think that the -- ultimately, I don't know whether at five years from now, ten years or 30 years from now, but ultimately it is the secondary market auctions that will be the most important and most of those are likely to be conducted by private band managers. Having said that, the electricity auction, sort of the day ahead market that I alluded to is done by the independent system operator or the RTO in all the markets in the U.S. and in the markets that I am aware of outside the United States.

So, that is an indication that these markets actually are best organized even when it is secondary it could be these -- you know, it is essentially private transactions. An independent efficiency minded organization, such as these independent system operators or the FCC is really important in making the market. Now, that is not to say that all the activity -- that they have an exclusive license in activity. All the successful electricity markets in the world that I am aware of rely heavily on bilateral contracts, private exchange between two willing parties, the buyer and a seller.

That is true everywhere. In fact, when we look at California and the problems that they had in their electricity market, it was because California forbid the -- essentially forbid the large buyers of electricity; namely,

the electricity utilities, from purchasing through bilateral contracts in addition to participation in the spot market. They essentially forced them to purchase everything in the spot market and that made the spot market very vulnerable to exercise of market power. They had lots of other problems as well, but that was the predominant one that led to their disaster when the situation got tight.

MR. METOS: Yes, I am Fred Metos(?) from NTIA. A question for Mr. Connolly. Your example was in land mobile, but I was interested in the fixed service there. Particularly, you said that your model had a Canadian fee model had a -- was related to spectrum. How much spectrum is used? So, in the upper gigahertz range, where naturally the band widths are very large and very few users, spectrum managers were like -- they use pieces of tool to migrate more and more users up to that upper part of spectrum. Does your Canadian formula account for this factor of use of very wide band width up in the upper gigahertz ranges?

MR. CONNOLLY: Yes, in part. The reason why we looked very closely at VHF, UHF, is because that is where Canada experienced its spectrum scarcity. We don't have particular scarcity in many of the fixed bands, particularly point to point, but I think Martin used the word earlier sort of a stealth mode. You know, in my mind, when you think about how allocations are made, who brings

pressures, how lobbying works, it seems to me that, you know, experiencing the opportunity costs in the existing mobile -- land mobile band to the extent that they are inadequate, the actors and the interests will mobilize to acquire new land mobile allocations. So, I look at essentially harnessing both market forces, but also political forces when I think about how this fee model might play out.

PARTICIPANT: I wanted to ask particularly our guests from Canada and the U.K. as we begin to talk about this idea of incentivizing spectrum efficient use in the context of government agencies, where they don't have the ability to make year to year decisions to change their technology in order to increase market share and so on. When we talk in these terms, are we actually talking about incentives for improved efficiency or are we actually talking about disincentives to get the government off the spectrum? What is the goal in the end to meet the economic goals that you are looking for?

MR. CAVE: I have always seen the lack of spectrum, prices and evaluations as being the very severe obstacle not only to -- lack of waste in spectrum in the public sector, but also to the application of sensible investment techniques. In essence you have to decide at an appropriate moment whether to replace an old

communication system with a new one. I am sure the OMB is trying to bring about a situation which those decisions are based upon appropriate MTV decisions and things of that kind. Yet, if you were omitting from the calculation one important element of the cost then it is very hard to see how you can, for example, make sensible what we call in the U.K. spend to save decisions. You know, spend some money now because you are going to save enough over the rest of the period to make it worthwhile.

So, I would have thought that the effect of spectrum interactions fresh from evaluations, even if it was relatively unsuccessfully in promoting -- the handing back of the picture of unwanted spectrum, could at least achieve some kind of benefit in actually rationalizing those decision taking processes. I think that might be quite a big win.

MR. CONNOLLY: I guess I would just want to add in case any of my comments were misinterpreted, you know, I am not saying that Canada's public sector users are any less or any more efficient users of spectrum than are the private sector counterpart. But I think, you know, they are subject to all the same incentivizing, if that is a word, as is the private sector and should experience it. That may mean that they abandon technologies and move to more efficient technologies, that they abandoned sort of

government owned and operated systems and subscribed to commercial services or they may just withdraw from spectrum and make it available for other users. But they are no worse or better than the private sector users.

MR. CRAMTON: I would just like to add that what we do -- I don't mean to be critical, but what we do with respect to government spectrum is really quite odd and I can understand how we got where we are in that we were starting from a point where there really wasn't any scarcity. It was just a question of you operate here and I will operate there and then we won't have interference. So, then having NTIA serve as the organizer made a lot of sense, but as soon as you get into a position where there is scarcity, then it is really quite odd not to price that scarcity and certainly with respect to other government input, we price the scarce resource. Labor, I believe, is priced. Electricity is priced. Gas is priced.

So, you know, all these things and we seem to think that it makes sense for the government to pay a utility bill. You know, I actually think that it does make sense and I think that that is, you know, obviously, where we should be moving and I am sort of -- if we don't have a consensus on that, then, we have a fundamental disagreement about whether markets are good or whether a command and

control of economy is actually preferable economy for society.

MR. WILSON: In that case, I would like to thank you all for hanging in there and I would like to suggest a round of applause for our fantastic provocative panel.

[Applause.]

MR. HATFIELD: I would like to add my thanks to all the participants and to the moderators for their excellent insight in keeping us on time and, of course, the audience, you for your excellent questions.

There were two administrative items. One, just to remind you we will start at 8:30 in the morning with our keynote speech. We will start promptly.

Then, secondly, I understand that there will be a short reception outside in the Great Hall, give you a chance to have some further discussions and one on one basis. So, thank you all for attending. See you tomorrow morning.

[Applause.]

[Whereupon, at 4:47 p.m., the meeting was recessed, to resume at 8:30 a.m., the following morning, Wednesday, March 1, 2006.]