UNITED STATES OF AMERICA
FEDERAL COMMUNICATIONS COMMISSION

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SPECTRUM POLICY TASK FORCE

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UNLICENSED SPECTRUM AND EXPERIMENTAL LICENSES
PUBLIC WORKSHOP

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THURSDAY,
AUGUST 1, 2002

The workshop was held at 9:00 a.m., in the Commission Meeting Room, Federal Communications Commission, 445 12th Street, S.W., Washington, D.C.

PRESENT:

MS. LAUREN VAN WAZER	FCC
COMMISSIONER MICHAEL COPPS	FCC
DR. PAUL KOLODZY	FCC
DR. ROBERT LUCKY	FCC
DR. MICHAEL MARCUS	FCC
MR. MICHAEL CALABRESE	New America Foundation
PROF. LAWRENCE LESSIG	Stanford Law School
MR. DEWAYNE HENDRICKS	Dandin Group
MR. DAVID REED	Reed.com
MR. PETER HADINGER	TRW Space & Electronics Group
MR. WILLIAM CHAMBERLAIN	Cobra Electronics
MR. ROBERT PHANEUF	Harmonix Division of Terabeam
DR. KEVIN NEGUS	Proxim
DR. PIERRE deVRIES	Microsoft Corporation
MR. PATRICK LEARY	Alvarion
MR. DUDLEY FREEMAN	UniiGo Communications
MR. ART REILLY	Cisco Systems
DR. VANU BOSE	Vanu, Inc.
PROF. RAMESH RAO	San Diego Division, California Institute for

Telecommunications

PRESENT: (cont.)

MR. CARL STEVENSON	Radio Regulatory Technical Advisory Group
MR. DAVID HILLIARD Fielding	Wiley, Rein &
MR. LARRY SOLOMON	Shook, Hardy & Bacon
MR. MICHAEL LYNCH	Nortel Networks
MR. GREG BUCHWALD	Motorola
MR. LEO HOARTY	Dotcast
MR. PAUL ROOSA	NTIA
MR. BRUCE FRANCA	FCC

C-O-N-T-E-N-T-S

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

(9:07 a.m.)

MS. VAN WAZER: Good morning, everyone. My name is Lauren Van Wazer, and I'm the Deputy Director of the Spectrum Policy Task Force. Welcome to the first of a series of four workshops addressing issues relating to Spectrum Policy. This public workshop will address Unlicensed Spectrum issues and experimental licenses.

We are fortunate this morning to be joined by Commissioner Copps, who has some introductory remarks. But first I want to say that we are providing sign language interpreting services, and if there's anyone who needs such services, if you could let us know. Thank you.

COMMISSIONER COPPS: Thank you, Lauren, and good morning to everybody. I very much appreciate the opportunity to be here. I want to thank all of the participants in today's session, and all four sessions, for taking the time to assist the Commission in really one of its top priority items. And I'd especially like to thank the people who traveled long distances to be here today. I've recently traveled some long distances myself, and today is the first day back in the

office. We just got back from Alaska and from the NAWICK meetings in Portland, and I had a chance to glance at my desk this morning, and I'm afraid I'm not going to be able to stay here all morning, but I do want to hear a part of the session. And you can be assured that we will be following up on the record of this very, very closely.

I'd like to thank Paul Kolodzy and Lauren Van Wazer, and the whole Commission team for their very hard work on this task force, and on all of these ongoing issues.

This task force will really be successful to the extent of its ability to tap the best and the brightest thinkers from across the land, and it obviously has been successful in doing that, obtaining ideas from academe, from public interest groups, businesses, government, and interested individuals, wherever they may be found. We need all the help we can get on how best the Commission can perform its spectrum management and spectrum allocation responsibilities amidst all the technological changes, and convergences, and demands that are out there. These are new times, and we need new thinking.

I think the problems of the last 12

months demonstrate the cracks in our system, and demonstrate that we need all the help we can get. There are insufficiencies in our auction process, and they have become quite manifest over the course of the past 12 months. They're holding us back.

There are imperfections in the marketplace and it appears that relying solely on the market to yield economically optimal results, and socially optimal results, without attention to the imperfection to the marketplace won't work. Plus, it defies, I think, all economic theory, common sense, and our statute to expect that to happen.

Our auction process is, most would agree, better than what went before it, better than freezing existing users and technologies in place, better than having the Commission choose winners and losers through beauty contests, but there have to be some fixes at a minimum.

There are some new ideas out there on spectrum use, on flexibility, and higher efficiency management. We also have the unlicensed model. I believe in the unlicensed model. It has produced results at a time when there are few bright spots in telecom. It won't work everywhere, but we

should determine how we can expand its use. We should have a better idea of where it can work, and we should be working on finding new Unlicensed Spectrum.

I also believe in the power of new technologies, especially those that address the spectrum crunch, like software-defined radio. We should ensure that our rules encourage such innovation through flexibility, and by allowing competition rather that undermining it by allowing our rules to be used as the tools of stagnation and consolidation.

I also want to point out the particular importance of coming up with a better understood standard of harmful interference. Our current obscurity on what constitutes harmful interference leaves incumbents, and new licensees, and manufacturers without the certainty they need to conduct their business resulting, obviously, in under-investment, protracted and wasteful regulatory proceedings, and time consuming litigation.

We may not be able to come up with the perfect engineering definition of harmful interference, but I think we can come up with a

clearer legal standard. Even if we fail, I think just the intellectual exercise of going through a proceeding on what constitutes harmful interference will help us better understand the issues, and help our stakeholders to better understand the challenges that we face. I've been advocating this for a long time now, as some of you know, and I'm pleased that we're going to be addressing this issue at a later session.

Finally, once this task force has completed its work this fall and published its report publicly, the Commission should rapidly commence a Formal Notice of Inquiry using the insights we gain here to determine what changes to spectrum policy should be made. We must have that kind of Commission follow-through, because otherwise we will be left in muddy waters and the hard work done here would, to a large extent, be wasted.

At the same time, I like the idea of an ongoing Spectrum Task Force to keep the Commission and its bureaus focused on spectrum priorities, and to provide an easily identifiable and user-friendly access point for our stakeholders in private sector, and throughout the country, so you have a

tremendously challenging agenda, but also a tremendously promising opportunity to give us a really badly needed helping hand here at the Commission. There is no higher priority, as I said at the outset, than trying to get a handle on spectrum management, spectrum allocation.

The last year has shown that we have a long, long way to go so I, for one, and I know I speak for all of my colleagues and the chairman in saying that we are delighted that you have taken the time to be with us to share your expertise with us, to give us the benefit of your good judgment. So thank you very much, and I will not delay the proceedings further, and will allow you to get to work, but I thank you for the opportunity to welcome you here.

MS. VAN WAZER: Thank you, Commissioner Copps, for your thoughtful remarks. I'd like to introduce Dr. Paul Kolodzy, who is Director of the Spectrum Policy Task Force.

DR. KOLODZY: Thank you, Lauren, and thank you, Commissioner Copps for your wonderful remarks. Welcome to one of our first -- actually, our first of four workshops that are going to be conducted by the Spectrum Policy Task Force.

First of all, I'd like to thank personally Lauren Van Wazer, and all of the staff who have worked very hard over the past few weeks to organize this event. It wouldn't have happened without their dedication, and so I really do thank them.

Second of all is, I want to thank all the panelists who have taken out of their valuable time to come here and talk about this very, very important topic, and try to get interaction with the community at-large. And third, I'd like to thank all the people who have braved the very hot August weather of Washington, D.C. to come to this meeting, to actually be participants in this process.

The next eight days, and it's going to be one heck of a set of eight days, the Spectrum Policy Task Force is going to hold four workshops on Spectrum Policy. The Task Force encompasses such a large scope that we needed to break the investigation into four separate areas to allow for sufficient time for all the important issues and ideas.

This work shop on Unlicensed and Experimental Licenses will be followed tomorrow by

a workshop on Interference Protection. On Monday, we will hold a workshop on Spectrum Efficiency, and then finally next Friday, on Spectrum Rights and Responsibilities.

The Spectrum Policy Task Force was formally announced by the Chairman in June of this year. The objective is to look for better ideas on Spectrum Policy. This investigation is forward-looking to determine what, if any, changes are needed to bring spectrum regulations to the realities of the 21st Century. The Task Force is looking across all the uses - a partial list is provided here on the slide - in order to understand that there are integrated approaches that can apply to Spectrum Policy.

New technologies that can provide flexibility and agility of our wireless devices are facilitating increasingly dynamic uses of the spectrum, and those uses are actually being operated in a very increasingly dynamic marketplace.

What are the potential building blocks for new policies that will address these new realities? Hopefully, this workshop will shed some light and bring out some ideas for those building

blocks.

The organization of the Spectrum Policy Task Force is shown on this slide. Lauren Van Wazer is my Deputy Director of the Task Force. Special Counsel is Maureen McLaughlin, and Senior Technology Advisor is Mike Marcus. The Task Force Council consists of senior members of each of the bureaus and offices within the Commission, that have a focus on Spectrum Policy, the Wireless Telecommunications Bureau, International Bureau, Media Bureau, The Office of Plans and Policies, and the Office of Engineering and Technology. There are four working groups, each conducting a workshop and headed by one of the members of the Task Force Council.

The Task Force published a public notice in June that consisted of 29 questions relating to each of the primary areas, to provide valuable input to each of the working groups. We received over 140 comments, and over 40 additional reply comments. The interest level is very high, and many ideas and points of view were provided in the comments. I know. I've read all of the comments myself.

It is hoped that the workshop will

provide a forum for a dialogue between the different perspectives and a spirited interaction with the public. I really want to focus on that spirited interaction.

I don't want to delay the start of the workshop any longer, so I'll try to end by saying thank you again, and welcome for coming. I would like to introduce the panel moderators for this morning's sessions. Mike Marcus is the Associate Chief for Technology in OET at the FCC. Mike, could you -- who chairs the Experimental and Unlicensed Working Group. And Bob Lucky, who is the Corporate Vice President of Applied Research at Telecordia Technologies. We are very glad to have Bob as a Co-Moderator today, and I would like to turn over the mike to him. Thank you.

DR. LUCKY: Good morning, everybody. I'm looking forward to this workshop, and to try to get as many opinions and as much wisdom out on the table as we can. Sometimes opinions and wisdom are the same thing, sometimes not, but we'll accept either.

We have a panel up here, and let me just introduce them very briefly, starting with Dave Reed. Dave is a consultant in one of the

Internet pioneers. Bob Phaneuf from Harmonix, Larry Lessig from Stanford. Larry, raise your hand. Dewayne Hendricks from Dandin Group. You can raise your hand too. It's okay. Peter Hadinger from TRW, Bill Chamberlain from New American - no, that's -- sorry, you're Cobra.

MR. CHAMBERLAIN: Correct.

DR. LUCKY: And finally, Michael Calabrese from -- you're New America Foundation. Exactly, what is New America Foundation, if I might ask.

MR. CALABRESE: A non-profit public policy institute here in Washington, D.C.

DR. LUCKY: Thank you.

MR. CALABRESE: Fairly new, three years old.

DR. LUCKY: Okay. Now I'm going to rely primarily on the panel, but we will welcome comments from the floor at all times, and that's what we're here for, to try to get as much information as we can in today's session.

I don't want to spend a lot of time setting up the issue, because I think you wouldn't be here this morning if you didn't know something about Unlicensed Spectrum. It's been a -- you

know, as an engineer it's been a wonderful thing to see what has happened in these bands in recent years. Millions of wi-fi cards are being sold. We see a ground-swell, an uprising of a whole new infrastructure based on this, and it's tremendously exciting at such a bad time in the industry to see such wonderful things happening.

But on the other side of this, you know, I heard just the other day someone said well, you know, you can't really depend on this though, because anybody can use it, and it's unlicensed and, you know, can't use that, so you do hear that kind of thing. And on the FCC's Technological Advisory Council, you know, we've been wrestling with the new technologies that seem to change the dynamics of spectrum allocation.

There are people who say spectrum is really infinite with -- the capacity is really infinite, and there are those who say it's very, very limited. And you can see both views at different times. We've got ultra wideband software-defined radio that can move around and have the agile. We've got multi-input/multi-output processing that has dramatic gains in capacity, adaptive antennas, things that didn't exist some

years ago when spectrum was regarded as very precious.

Bran Ferren, one of the members of our advisory council, said he bought - I don't know if he really did this, but he said it - he bought a DC-to-light receiver and he sat out in the parking lot, and then he tuned it across the whole band, and he says what you hear basically is nothing. And then suddenly you hit like one of the cell phone bands and it's just overwhelming. And then you hear nothing. And the paradox is that, you know, it seems that there's nothing out there except in these narrow, narrow crowded bands, and yet in many cases people own these pieces of spectrum. And the issue that always faces the FCC is, you know, efficient use of that spectrum. And so, that's what we're here to talk about today.

We often worry about the tragedy of the commons. We're here to talk about the commons, and I always have this image in my mind of the sheep eating up all the grass, but there are technologists here who would say that perhaps each sheep can bring its own grass, and that's the way this works. So my Co-Moderator, Mike Marcus, and I will ask some questions, and we'll address them

first to the panel. But again, anybody out there, there are many people in the audience, and I see some out there that I know are very knowledgeable, and I think there are a lot more that I don't know who are very knowledgeable. Please, we're here to gather as much information as we can, so please don't hesitate to raise your hand and speak up.

So we have some generic questions here. The questions themselves are rather innocuous but I hope they lead us onto paths of discussion that bring out the real issue, so I'll start with --

DR. MARCUS: I'll say a little bit about the format. We're going to ask one or two questions to the panelists, and then before we go onto another topic, we're going to ask the audience if they either have questions or statements that they want to make. Please, we don't want long statements, and particularly, we don't want long statements on things that we've already gone over in the record. This is a public meeting that's being taped. There are transcripts, so don't worry about ex parte issues, say whatever you want, but we don't want long statements that are already well-documented in the record.

DR. LUCKY: Say whatever you want, but

bear in mind this is being webcast and recorded, and here are the reporters, and -- but say whatever you want.

DR. MARCUS: But keep it short.

DR. LUCKY: But do keep it short, and we'll try to work on that. So let me start out with the first generic question, you know. What has been good and bad about Unlicensed Spectrum in recent years? And, in fact, I'll address it specifically to Larry Lessig, just to give a start here, Larry. What's good about this? And if you might think of something that's bad, if you don't, somebody else will.

PROF. LESSIG: So there's technical questions that are raised by Unlicensed Spectrum, and I'm not going to address those. I think what's good about Unlicensed Spectrum relates to what I think is the core issue that the FCC has got to think about in this context, and that is, not the technical questions, but the political reality of how the interaction between FCC policy and competition policy affects the innovation in this market.

There's a good history of the FCC, there's a bad history of the FCC. And the bad

history of the FCC is, the FCC being used by private interests to protect themselves against new innovation. And the structural feature of Unlicensed Spectrum, which is so critical against the background of this history, is to the extent there's Unlicensed Spectrum that can be protected for development and innovation outside of the traditional structure. That provides protection for new innovation against interests that might be threatened by that new innovation, so there might -- there's lot of debates about what's possible here, what good Spectrum Policy, what the ideal Spectrum Policy will look like, what the ideal technology for spectrum will look like.

The fundamental thing I think is most striking about this is that technologists say we don't know. We really don't know what the best architecture will look like. In a context where we don't know, the most important thing for the government to do is to set up an environment where competition and technological development can develop without fear of retaliation from those whose ox might be gored by the next great idea for how to use spectrum.

DR. LUCKY: Okay. Let me just follow-

up on that a little bit, we don't know stuff. Dave Reed, I think you might comment about that. You are a technologist.

MR. REED: Right.

DR. LUCKY: What would you put in the category, we don't know about this?

MR. REED: Well, actually, I think I coined that term, "We don't know", in this space, which is, I think, important.

What I've been trying to point out, about 10 years ago I started asking myself the question, as wireless technologies started to really proliferate in the computer industry, is there some limit to what we can deliver using wireless technologies in terms of data communication and so forth? Most of my engineering colleagues said well, I'm pretty sure there is -- there's probably some limit, and we'll run into it, so we better start worrying about that limit, and how we're going to get around it, or how we're going to allocate the Spectrum Resource.

What I discovered, because I'm the naturally curious type is, I went to the theorists and I said, is there a theoretical limit here? And they said well, now that you asked the question,

I'm not sure I know the answer. And I started systematically trying to ask this question, if you have a network of radios in a space like this room that are able to do anything they want to do, or a space like the whole United States - if they're able to do anything that we technologically can imagine doing, is there a limit to the amount of phone calls you could carry over that network, the amount of data communications you could provide, and so forth? And the conventional wisdom is that spectrum limits that.

What actually limits that, it turns out, is the architectures that we use. The spectrum itself - you might imagine there's an ether out there that there's only so much of - the spectrum out there itself does not limit us in any fundamental way. In fact, as Bob pointed out with the grass analogy, as you add systems to a network sharing the same region of spectrum, theoretically the capacity does grow without limit. The question is, so does it grow as far as the number of users? That's the question we don't know. The technical answer is we know, at least, that we have the spectrum grow as the -- the capacity of the spectrum, the number of bits, or phone calls or

whatever, can grow with the number of users in the sense that they bring their own grass with them as they start adding radios to the system.

What we don't know is whether that limit, whether it grows linearly or proportionally to the number of users, or whether it sort of tails-off on a per user basis, so that each new user just brings a little less than the previous user. And that's an active area of research. There's reason to believe that it doesn't tail-off but, in fact, you know, the best theorists are working technologies, protocols, and architectures to try to meet that, and achieve that. We've already demonstrated systems that achieve the basic idea of increasing with the number of users.

DR. LUCKY: But you would say the good thing about unlicensed spectrum is it allows the experimentation to take place.

MR. REED: Exactly. The biggest barrier to exploring the space is that there's essentially no invest, or very little investment in new wireless technologies that don't meet the needs of incumbent users of the spectrum, so there's lot of investment, you know, in say things that will help the cellular operators, or things that help

the television broadcasters and so forth, you know, do a better job. There's no investment in these new things, because the applications they enable are early experimental, and so forth. So what, in fact, the Unlicensed Band, the 802.11 Band has done for us is, it's provided a playground where new applications and new uses, such as new ways to connect to the Internet, and new services in the home, the connect devices, you know, have a place to be developed and experimented with, without the overhead of, you know, the cost of presenting an economic case to the Commission that this is the best use, or even finding the money to buy spectrum at auction, should that be the question.

DR. LUCKY: Let me follow-up on that, and turn to Dewayne Hendricks. You know, I've been in network development and research for a long time, and one of the rules that we sort of always had was that you can't both experiment with the network, at the same time as you're providing service with it, you know. And yet, here in these Unlicensed Bands, people want to provide real service, but at the same time, we want to allow this experimentation to take place. Now is this compatible?

MR. HENDRICKS: I think that it is. I mean, if you look at the use of the unlicensed bands since they were instituted in 1985, you've seen a broad development of broad -- it took three years before the first device was certified under the 1985 rules. And since then things have really taken off, and you've seen a broad breadth of devices that do a lot of different things. In fact, nobody, I think, really knows how many devices are out there, and what they are actually doing.

But to address your question, I think what we've seen is that starting about 1992, you've seen people offering services. I mean, there have been wireless ISPs as early as 1992, I've seen documented, and they continue to operate. I mean, there were never publications or websites on the net that document the experience of these people. They've been around since the mid-90s offering services, and quite successfully, and they're making profits. So I think that the -- Metricom, until its recent demise, is a good example of that, that existed through the 90s until fairly recently. And there are others like Metricom with similar business models, but nonetheless, you can still

experiment and develop these devices. And you know what? It's like common sense would argue against this being able to work at all, but it does. Okay? And that, I've been running an experimental network in the Bay Area since 1996 using all three bands, 900, 2.4, and 5.7 gigahertz, offering services from 100 kilobits up to 30 megabits. And for instance, I operated on 900 in the presence of Metricom with no problems, and it all had to do with the --

DR. LUCKY: You don't have that problem any more.

MR. HENDRICKS: Well, I was able to do that by, you know, the proper engineering. And I think that what people who have been using these bands is that, you know, there is physics, there is science, and if you use them with good sense, then you can get things to work. And so there are a lot of anecdotal experiences about interference and whatever, but the fact remains that there are still people out there delivering services and doing it very well.

DR. LUCKY: Okay. Let's -- I would like to bore into this issue a little bit more, because it's a really big issue here, and that is,

the question of interference in this band. You hear all the time that, you know, you can't depend on this because it's going to melt down, you know. Everybody is going to be jumping in there. You've got cordless phones. You've got microwave ovens. You've got garage door openers, you know. You've got wireless cameras, video cameras, and they're all operating uncoordinated, which is an issue we'll have to get into later. But the issue is, is this going to disintegrate to where it'll be like CB radio and useless, and what are the implications? So let me ask if any of the other panelists who haven't yet had a chance to speak, would like to put in their two bits on this question?

MR. CHAMBERLAIN: Well, first, I would say that expecting uninterrupted service on any one of these bands is improbable. And frankly speaking, I think people have come to expect it, but what it has done, it has spurred on the development of new technologies.

For instance, in the cordless phones, we started out with analog systems. Interferences in the, you know, 50 megahertz band. All of a sudden, there's moves to 900 analog, and now you

have spread spectrum devices, frequency hopping, combinations of the two, but the marketplace has demanded this, because what they said is they want more reliable services. Things got more and more congested, so what really has happened is, the marketplace goes and says we want better service. We, as electronic companies, go out and say okay, let's develop the new mousetrap, the new system, make it more reliable.

Usually, these systems cost a little bit more initially, and then as vines go up, acceptance goes up, they become more proliferate, prices go down, and the next new technology is developed as interference starts increasing in that area. So I think the marketplace has done a great job at producing solutions to these interference issues. And by the way, CB is not dead. I had to say that.

DR. LUCKY: Okay. But the concept is, we'll invent our way out of this, and that we'll be incented to do that.

MR. CHAMBERLAIN: Correct.

DR. LUCKY: So that, in fact, you don't believe that this will melt down.

MR. CHAMBERLAIN: Not at all.

DR. LUCKY: Okay. Other opinions? Okay. David.

MR. REED: I just want to say that my earlier comments really fit into that thing. The question is, you know, when you say "We're going to invent our way out of this", the question is, you know, is there going to come a fundamental limit where we can't? And the point that I was trying to make earlier is, that there's no real fundamental limit where we can't invent our way out of this, so we ought to create the incentives to invent, rather than the incentives to slow invention.

I think the -- what's a really good analogy here is our national highway system where, you know, we constantly run into new problems operating that system. But ultimately, the users are responsible for coordinating their actions, and avoiding crashing into each other, and so forth. We give them new tools occasionally. We might, you know, as in California, create, you know, traffic lights on the on-ramps to the expressway, as we had to in certain cases or whatever, but we don't have to design the system so it doesn't run into problems beforehand.

DR. LUCKY: Have you tried to drive on

the 405 in L.A. lately? It's like --

MR. REED: They need a new innovation. But, you know, I'm just pointing out that --

MR. HADINGER: I wanted to thank David for providing me the segue. I was going to apologize to everybody for being late. I was actually stuck in traffic. When in a cab, one can either worry about being late, or even philosophize. And in this particular case, there was an accident, and it was holding up traffic. And it got me to thinking that, in fact, what's happening is we've got a violation of the expected norms.

In other words, there's a group that is all expecting a certain thing, and working in cooperation, like-systems sharing with like-systems. And actually, a fair amount of flexible interchange among those like-systems, but when somebody violates that set of expectations, it causes ripple effects for everybody else.

In fact, there's a number of different classes of like-systems. If you think about transportation in that roadways, while they are limited in terms of your freedom to choose exactly where you want to go, nonetheless, carry a high

volume of people all intending to go the same direction.

Walking, on the other hand, is completely open, or certainly more open. Although even there you have to, from time to time, step aside to avoid running into somebody in front of you. In the software-defined radio sense, I guess you might consider that to be unlicensed use, where you expect a certain amount of interference, but in fact, what you've done is, you've designed a system which is robust enough that it can tolerate that.

Whereas other systems, which require a certain greater degree of harmonization, can handle less in the way of random events going every which way. It's unlikely that we would have an efficient highway system if we just paved over D.C., and let everybody drive straight from their source to their destination at random.

In fact, there is value in having like-systems brought together and in conformance. And certainly, a lot of software-defined or self-defined rules for sharing, and moving, and optimizing that space but, you know, within systems which are basically similar.

DR. LUCKY: Well, that's an issue that

we do have to get into, is that in the present unlicensed band, people obey their own rules. So you've got some people obeying the 802.11 rules of listening before they talk, and others like video cameras that are just blasting away. So are you saying that there should be rules?

MR. HADINGER: Let's see. For systems operating in an unlicensed band, and where you go into it knowing that there are no rules, one would imagine if you're trying to create a robust system, you will choose a protocol which is, in itself, robust.

Certainly, there's ways of violating even robust protocols. And at some point, I think there may need to be a mechanism by which we allow a commons for the sort of experimental and first use, but eventually find a way of migrating it into spectrum, again where sort of like-systems obeying the same like-rules, follow similar procedures. And certainly, there's no end of opportunity to find stories of services which have come out with lots of great promise, for which spectrum has been allocated in great amounts, and which is not then turned into a valid and viable service.

There needs to be a way of recycling

that spectrum efficiently, Darwinian sort of fashion, but also to take those systems which are successful and which may find, because of their broad use, a need for more protection than they had imagined when it was first out, to find a way of moving those people to spectrum, which is, in turn, more protected.

DR. LUCKY: Other comments about this? The original question, and we're moving around to a lot of issues that I think have to be gone into in more detail as the day goes along, the original question was will these bands melt down? And if we could sort of keep on that theme, but there's a very important sub-theme here about whether there should be rules or not. And the question is incentives that people have, whether they should follow the rules or not.

I mean, I'm not sure that if I'm designing a system for this, I want to follow 802.11, because heck, that constrains me, but let's go ahead with other comments.

MR. CALABRESE: Okay. Thanks. Yeah, I just want to mention, I have a -- you asked about the positives and negatives of unlicensed, and although I have a long list of positives, the one

negative I'm reminded of by this discussion, which is that wi-fi success creates the temptation to impose service rules that tend to protect or lock in wi-fi, which I don't believe should protect or lock in wi-fi, or any other current technology. I think we saw quite a few comments that said, you know, that we may need to have some -- the Commission may need to impose some type of service rules on the 2.4 gigahertz unlicensed band in order to make the most of this wi-fi development that we have. And it may well be that we will decide we need some new dedicated space for unlicensed wireless networking. But ideally, those sort of rules of the road should not be shaped to prefer any particular application, and especially no current technology.

We probably do need protocols and etiquette to facilitate wireless networking, but they should be as open and as neutral as possible. And I'd encourage David Reed to say something about this, because he helped develop those sort of protocols for the Internet. And an Internet-based model in the air is what we need. We must -- essentially, these protocols should certainly not come at the price of limiting sort of free-wheeling

innovation that's possible on the current -- what we once called the junk band of spectrum at 2.4.

DR. LUCKY: Okay. I want to turn it over to Dewayne for a minute, but let me just insert the devil's advocacy here for a minute. The problem with protocols is they change, you know. And if you lock in on particular rules - I mean, look at 802.11 is migrating to a lot of different versions. If you set rules, wouldn't you be taking away some of the freedom to innovate that is the important cornerstone in unlicensed band? Dewayne.

MR. HENDRICKS: Okay. I wanted to address the meltdown question. If you look back on the historical record on Part 15, NCR in 1991 filed comments that effectively said they expected the unlicensed band to meltdown. This is in `91.

Three years ago, Lucent filed comments that basically said the same thing, so what we have is that between `91 and three years ago it didn't meltdown. And we hear a lot of analytical evidence about it has meltdown, but I've got to tell you, where I am in the Bay Area, and having operated since `96 on those three bands, I haven't seen any meltdown, or ways in which you can engineer around any type of interference. So what I would say in

general is that what's missing here, and I would encourage the Commission and, in fact, the TAC, when we reformed four years ago basically said look, you're an agency that doesn't measure what it regulates, which is the radio spectrum. If you look at the EPA, it measures what it regulates. The Commission never has. And what we did is we proposed to the Commission that it needed to embark on a major study of the spectrum and look at noise. Okay?

So we complete -- the TAC has sort of completed the first phase of our noise study, but what needs to happen on an ongoing basis is measurement of the spectrum, particularly say the unlicensed bands across the country, on an ongoing basis to determine whether or not there really is a meltdown. And essentially, what we tried to do is develop some objective measures that would be used to determine when that happened.

DR. LUCKY: You know, I think your experience is particularly valuable, Dewayne, because I look at the Bay Area as being sort of the canary in the coal mine. You know, maybe we don't have to measure the whole country, you know, we just see if San Francisco dies, and then we'd know.

Larry, you wanted to comment.

PROF. LESSIG: Right. I agree with Dewayne, but I think that the perspective should be how do we establish an environment for the widest range of experimentation, protected both against incumbents trying to protect themselves, and against the system melting down? And in this context, I think thinking about different bands differently helps. So I think in Microsoft's comments, for example, they suggested a protocol layer, a MAC layer in the 5g band, a lot of issues about what the protocol would be, and who would set it, of course. How else could there be a proposal by Microsoft without those questions, but still I think it's a good proposal, because in that context, at least we could have a protocol band that would avoid exactly this kind of meltdown problem.

It would be a mistake, though, to take that idea and impose it across the board to all of the bands that are unlicensed. What's got to happen is a wide range of environments that encourage lots of different experimentation here, and develop models that can challenge the owned or licensed bands.

DR. LUCKY: Okay. Bob Phaneuf, what's your experience in this area?

MR. PHANEUF: Well, I've got a different problem than most of you. I probably have more spectrum in one radio than the world has used to date.

DR. LUCKY: Can we have some of it?

MR. PHANEUF: Yeah. It turns out my radios are 60 gigahertz right now, and it's very easy for me to transmit full-duplex 1.25 gigahertz data rate real stuff. It's a wireless link to fiber.

My problem with the licensed band, or the unlicensed band, not a problem really, is that I was really -- I, being my company, was the first guy in. And when you're the first guy in and you're trying to develop new spectrum, this amount of spectrum, everybody thinks they want it, but they really don't know what they want to do with it. And so each customer you go to has a little bit different spin on -- I mean, I have just this wireless link that can do, I think, most anything, but they want to interface it with different kind of switches, different kind of clock rates, different kind of protocols, and so we have to

change.

Every now and then we'll have to change our back end. Very rarely do we have to change the microwave part of it, the millimeter wave part of it, but the back end. And the flexibility of the unlicensed band allows me to go almost any customer, whether it's a campus network or the big carriers are just playing with us now, by the way. That's my problem.

I've got two and four radios on top of a lot of buildings. The only ones that have a decent number, I think I've got oh, maybe 20 in Japan that are linked together. We thought Expedient was going to be our big hope down in Miami, and they kind of caved in and went out of business.

But the problem is, the -- I couldn't have filled any of these to anybody if I didn't have the flexibility that the unlicensed band gives us, and that's, I guess, my big message. I don't think -- I think there's always going to be problems. I've had like five radios on the same frequency on one roof pointing at different directions. Of course, my beam is a needle, and that works pretty well. And what happens when it

doesn't work, you move it a little bit.

I mean, you can solve these problems in a very practical sense. The thing I'll tell you too is, that time I take a look at the design of the radio I can think of improvements, and that's probably the way it's going to happen in terms of correcting our mistakes, or interference mistakes. We really can be clever, but right now the big thing is to get out there and get using this stuff, because if we don't really get using the stuff, then we really don't know where the bodies are buried. We don't know what problems we have to solve, so I do think that the -- and I have a tendency to focus on the fundamental link-to-link. These are point-to-point systems, by the way, because of their frequencies, but they are networked and they network pretty well.

But one of the things that's kind of amusing to me is this panel seems more like a computer data processing panel than it does an RF panel. It turns out that there's still some of us left that think that bandwidth is really information rate, so I guess that's --

DR. LUCKY: Okay. Thanks, Bob. I'd like to turn it over to questions and comments from

the audience now. The two questions on the table are first, what's good and bad about Unlicensed Spectrum? Now I think what we have on the panel is everyone loved it, you know. They want more of it, but perhaps there's somebody out there who could speak for, perhaps an incumbent that feels like they're being undercut by this, or hurt by it, interference or whatever. So the two questions are what's good and bad about unlicensed, and will this melt down? So comments from the audience. Sir?

AUDIENCE MEMBER: Yes. With respect to any kind of hyperbolic statement like spectral meltdown or the converse, that wireless unlicensed is the second coming masqueraded as technology. I think one does well to try to analyze the source of the comment.

Do you think that, you know, the claims that, or as I would contend, the myth of over-spectral congestion say, for example, in 2.4, do you think much of that comes from disingenuous parties who may have a vested interest in making everyone think that it doesn't work?

DR. LUCKY: Some of it does come from that. I think it's also, in my own opinion, that a lot of the technology statements are driven by

fashion. Somebody says, you know, it's going to meltdown, and it becomes very fashionable to say that, and so everybody starts worrying about it. And it turns out that there is no real data behind that statement, that it just becomes common knowledge that this is going to meltdown.

Other comments, questions? Yes.

AUDIENCE MEMBER: I think I heard several of the panelists discuss the problem of interference between intelligent and unintelligent uses of unlicensed, where you have in the way in the commons you have two types of farmers. You have those farmers who are bringing in with them intelligent technology so that their cows can, or their sheep can kind of ease back when they see problems. But in a way, the other farmers who don't choose to use that technology can free ride. And I'm wondering if one of the suggestions that may come out of this is creating or segregating a part of the unlicensed bands for technologies that incorporate some general intelligent or cognitive protocols so that they can have their own place to innovate, as long as no particular technology or solution is endorsed.

DR. LUCKY: Larry.

PROF. LESSIG: I think it's a critically important issue, especially as it relates to incumbent technologies. The unfortunate presumption so far in the regulatory context has been to protect the unintelligent, and to force the intelligent to be really, really super intelligent so that they don't --- and I believe in Darwin. Right?

I think we should have a regulatory Darwin that says if there are unintelligent technologies, we should be tilting against them so that we have a move towards a much higher bits-per-second throughput here in the use of spectrum, so this is a combination both of band, of what we call bandwidth, but also computational power that could really increase the total capacity. I think that's the message, in particular, David was offering here. But the only way we're going to get there is to stop preferring or --- through regulatory structures preferring the unintelligent structures over the intelligent ones.

DR. LUCKY: Interesting. Other comments? Yes.

MR. CHAMBERLAIN: I think the 2.4 gigahertz spectrum is a perfect example of this. I

mean, for instance, you have the unintelligent microwave oven, just spews out energy in that band. And then you have a telephone that needs to operate in the kitchen, so what happens is you devise a way of making that work.

Now if you start segregating that band, depending, you know --- now you're limiting your ability to jump around that information and energy, because I don't think the Commission or anyone can figure out what all devices are going to be created.

You have to give them, you know, give the people within that band the ability to deal with the situation, so you take a look at what spectrum you're in from the marketplace side. You take a look at it, you innovate, and you come out with new products. I mean, I think it's fairly simple.

DR. LUCKY: Sir. You've got one?

AUDIENCE MEMBER: Yes.

DR. LUCKY: Okay. Fine. Go ahead. See, this is the comments, but there are rules.

AUDIENCE MEMBER: Actually, that's sort of what I was going to comment on. I don't see there being a meltdown. I think ultimately we're

going to need more unlicensed spectrum because of increased demands but, you know, there's been some mention about 802.11, and some issue about whether rules, you know, should favor some technology or not.

Actually, I think the industry standards bodies have done a very good job of creating some very innovative products with the cooperation of many, many companies in the process. And my understanding is that there is actually a federal law that requires government agencies, in their procurement policies, to favor industry -- you know, open consensus standards, and also requires regulatory agencies to consider those standards in the regulatory proceedings.

I think the idea of the commons is a good idea, and industry will make it work. As, I believe it's Mr. Reed said, we can pretty much invent ourselves out of, you know, things in the future, as long as we do it in a cooperative way. This may require that the Commission consider some general sorts of requirements for interference avoidance and mitigation techniques in the unlicensed bands in the future, and there are task groups within the standards bodies that are working

on exactly those sorts of things. 802 just recently created a co-existence technical advisory group.

Anyway, I guess what I'm trying to say is no, I don't think there's going to be a meltdown, but I think that there needs to be some thought to protecting all of those people that play by rules that are designed to promote spectral efficiency, from what I would characterize as rogue systems that simply don't care. They just spew, as it was put, without any regard to other occupants that may be trying to use the spectrum cooperatively. Thank you.

DR. LUCKY: Okay. We have a comment over here.

AUDIENCE MEMBER: My question was, we've heard a little bit about whether the unlicensed --- whether we need more spectrum assigned by unlicensed means or not. I guess the question is, do we need more? And if we did, where in the band should it be of the things that are up for grabs now, that it might be in the near future? Where should the FCC be focusing on making decisions to expand the use of Unlicensed Spectrum? And then maybe a second part of the question is,

we've heard about the utility or the disadvantages of having rules for unlicensed. What else could the FCC do that you think would either undermine the use of Unlicensed Spectrum now, or is there anything that they could do beyond more spectrum that would assist?

DR. LUCKY: Okay. That actually is the next set of questions we're going to move on to, so I think you'll be very timely. I'll get one more here, and then we're going to move on. Sir, I'll -- we have --- okay, well two more.

AUDIENCE MEMBER: Good morning. Is this on?

DR. LUCKY: Yes, you're on.

AUDIENCE MEMBER: Okay. One of the things I've been hearing is people have been reaching for analogies to try to understand spectrum, and I've been trying to think about that for a while, and I've not yet found an analogy that's perfect. I just wanted to caution that we not think that spectrum is like either traffic, which one of the panelists mentioned earlier this morning. Cars cannot pass through each other without interference, but radio waves can, in fact, pass through each other without interfering.

It's not really like grass either, but I haven't been able to find the analogy that's as interesting as cars passing through each other to explain why spectrum is not like grass.

I think the most powerful analogy I found is actually due to David Reed, who pointed out that radio waves are ripples on the pond, and they can, in fact, pass through each other. And if you watch rain drop on water, you can actually see the circles expanding, and you can still see the circles from each individual drop, even though there are many drops. And that's a pretty good analogy.

And I don't believe that there's any --- that there's going to be a meltdown. It's like ripples on a pond. There are no wake zones sometimes around docks and stuff, but in the open ocean you don't actually have to have a limit on how big of a wake a ship can make, because there's really no incentive for the ship to make as big of a wake as possible. It just needs to get from where it's coming from to where it's going.

DR. LUCKY: Well, I would say that David's point was that there's --- that interference doesn't --- waves do pass through each

other. But unfortunately, the damage occurs in the receiver design. And that, in fact, you have legacy receivers out there that are not able to disambiguate these ripples in the pond, so that's --- this is a problem that always confronts the FCC, is you have legacy environments that don't --- that play by old rules that may not be technologically advanced.

Okay. We had one more over there, and then we'll move on.

AUDIENCE MEMBER: I'd like to comment on Professor Lessig's comment about having a bias in favor of intelligent systems that tend not to be better behaved. The problem with that is, what is good behavior can be very peculiar to the goals of the system, and so you may well have a system that has a good set of rules internal to itself, but when the next new activity comes around, its definition of what is being a good and cooperative is different. And so, in effect, you can see rules for -- or biases in favor of intelligibility become barriers to entry.

Although I -- the second thing I'd say is that we're not --- not all Part 15 is the same, and that we do not automatically have to have every

band be a classic Part 15 with a power limitation, and no other limitations. Look at the PCS Part 15, and you've got a huge realm of ways of having different Part 15s. Thanks.

DR. LUCKY: Larry, would you like to respond?

PROF. LESSIG: Yes. I was -- this actually picks up on this example of the microwave oven. I think we should distinguish between a bias in the regulatory context, and a bias in the marketplace. I don't think we have to worry about the marketplace. If you've got microwave ovens that are putting off too much --- too high emissions that's interfering with some other use, then you'll have microwave manufacturers who say we have zero-emission microwaves. This is the competitive process, that you have better production of products that people can use within their house.

The particular bias I'm worried about is where somebody doesn't have to rely on the competitive marketplace in order to sell their products, but they can go to the government, and they can say to the government look, this new use of spectrum is making my stupid use of spectrum not

work as well as it used to work. And the presumption, the regulatory presumption has often been well, the stupid use of spectrum prevails because they've been there since time immemorial, like five years. And so all I'm saying is, that attitude from the standpoint of the government is a powerful tool that incumbents can use to protect themselves against what would be better technologies.

It's not that every use of spectrum needs to be as intelligent as David Reed. It's just that some uses of spectrum should, and the government should punish intelligent uses against the unintelligent uses. Maybe this is just a smart kid trying to get revenge from high school life, where the unintelligent seemed to have the bias of the government on their side all the time.

(Laughter.)

PROF. LESSIG: But I think in spectrum policy, it's an important rule. It seems an obvious point which the FCC has not yet universally grabbed onto and run with.

DR. LUCKY: Okay. I've been remiss in asking people to identify themselves when you make a comment or a question from the audience.

Let me --- before I turn it over to my co-moderator for the next set of questions, what we've had here is everybody has said unlicensed is great, and we ought to create more of it. Is there anybody here who would care to give the other side, that would feel that it wouldn't be right to create more Unlicensed Spectrum? This is your chance.

MR. HADINGER: Bob.

DR. LUCKY: Yes.

MR. HADINGER: As possibly the only licensee sitting at the table, I do want to take the chance to say that while I believe that there is great potential in unlicensed communications, that that is not to say that all communications should be unlicensed. And, you know, certainly there are systems and processes of great importance, and which have served us very, very well in a licensed context. And that, in fact, you know, encouraging unlicensed, which I certainly do, is not necessarily to say that that should be the only way.

DR. LUCKY: Okay. Mike, you take over.

DR. MARCUS: Okay. Let me follow on slightly what Peter said and point out, in satellite uplink bands, there are special

considerations for unlicensed things that don't apply in other bands, and UNII, for example, is one place where we address that specifically.

We do actually read the comments people send us. People wonder if we read the comments, but we actually do. And, for example, Nokiapart15.org, Mutual Data Services and IEEE 802 all made the basic point that more spectrum is needed for unlicensed devices, presumably spectrum like the ISM bands where unlicensed devices have a preferred frame of reference.

Section 15.209, which has been on the books since 1989, actually allows unlicensed devices sort of almost everywhere below 40 gigahertz, with the exception of specifically enumerated bands. But I assume what most people were talking about in their comments were bands like the ISM band, or bands like the UNII band, where unlicensed things have fewer restraints and higher power than the Minus 41 DPM per megahertz, which is typical of the other bands. So this set of questions focuses on do we need the additional bands, like the commentors have said? If so, for what type of system is that needed?

Spectrum is not an unlimited resource,

at least beach front property spectrum is not an unlimited resource. If we were to create more unlicensed bands below 10 gigahertz, it's a zero sum gain that we have other users or request for users, and if we allocate any additional bands for preferred use by unlicensed things, basically someone either has to be kicked out, or someone has to be denied entry that they might have. So if you think there's more unlicensed band, could you say something about how do we prioritize it, vis a vis other pending requests for under gigahertz.

And in addition to unlicensed, we have a class of things that -- close cousins, but technically called licensed by rule. For example, citizen band radio service, family radio service, multiple use radio service where you don't apply for a license, but legalistically a license exists somewhere. Family radio service, particularly in the past couple of years has been a growing demand. Is there a need for more expansion in spectrum for that type of services too? So who on the panel wants to speak first?

MR. CHAMBERLAIN: To address the last question you had, Michael, about unlicensed services like FRS. FRS has grown for a couple of

hundred thousand units in 1998, to close to 15 million units this year. It's been a very successful two-way communication device.

Right now it's 14 channels. Last year the Commission allowed a licensed an unlicensed device to be put together, an FRS and GMRS radio, which allowed 22 channels, which gave more spectrum, but now has put the average customer in an unusual position, in that he's very - how do I say it - familiar with the FRS service, and that it's unlicensed, and they've been using it, and they're going out to get more of these products. And now they see 22 channels and they're very excited. I got more than 14, but the problem is that it really requires a license. And unfortunately, most of our customers don't read our instruction manuals. We spend a lot of time on them, but they don't read them, and a lot of these people are not applying for licenses.

So I would say FRS, its success and expansion, the combined service radio into maybe a license-free service would be something that the Commission should consider.

DR. MARCUS: Anyone else on the panel?

MR. REED: Yeah. I think it's an

interesting question, or interesting thing that you phrased it in terms of bands. And really, we've gotten to the point where most technologies really, or there are a lot of new technologies, I shouldn't say most technologies, a lot of new technologies that really are probably best not thought of in terms of bands.

Narrow band radio tends to have a lot of constraints on it. It's useful for voice, maybe, and for low speed data, but wideband systems are what we're going to need for a lot of things. And extremely wideband systems, you know, where the first examples are ultra wideband, but there are lots of other extremely wideband options out there, including the 60 gigahertz stuff here - really provide a very different kind of service, and almost call for sharing with other services in order to get the most out of them. And then there's also the geographic sharing that's possible.

One fascinating thing I pointed out in my filing, it's kind of an -- it exaggerates to make a point, is that if you think about the broadcast stations, regular broadcast television and radio bands that are in the prime area, if you

actually look in most cities, you'll find, if you tune your little spectrum analyzer across the dial, that most of the spectrum is unused.

An agile system, or an overlay system, that ultra wideband can make use of that very effectively without practically interfering with any receiver. However, the way the regulations are written about interference, the regulations refer to interference at the transmitter, or in the transmitted domain, not the receiver domain. So we're in the position of actually having a legal definition of interference that says interference happens even when nobody is there to notice it, like if you're sitting out in some rural area in New York where you could perfectly happily use, you know, the television band, and your radiation wouldn't affect anybody, because nobody actually uses their television antenna to receive signals in your neighborhood.

You're still interfering if somebody could potentially walk in there and, you know, deal with that so -- or, you know, and turn on a T.V. set and, in fact, turn on a T.V. set that was designed in 1930, so it would actually suffer the affects of these problems. So we're really in a

position where we have a lot of beach front spectrum - I hate to use that word - available now. We have a legal system that makes it unavailable, and a set of incumbents who find it very useful to pretend that it's unavailable because it ultimately eliminates competition.

DR. MARCUS: Is there anyone on the panel who does think we need additional band for unlicensed? Maybe this will make our life much easier.

MR. REED: Well, I think we need new approaches to creating unlicensed space, but what we need is unlicensed radio, not unlicensed bands, and we can unlicense a lot of other technological approaches, while still preserving, you know, some of the benefits of some certain licensed services, without them even noticing that you're there.

DR. MARCUS: Dewayne.

MR. HENDRICKS: Three comments. The term "beach front property" has been thrown around a lot. I'd like to define it. Basically, to me, beach front property is from 30 megahertz to 3 gigahertz. Beach front property might go up to 6, that was used once. But anyway, that's my working definition for beach front property.

Next comment. I, personally, am not an advocate for more spectrum for unlicensed according to the current Spectrum Management Paradigm. Okay? I don't think that we've really farmed adequately the Spectrum that we have allocated for unlicensed already. If you look at the historical record again, there's been some more allocations for unlicensed. There was the unlicensed PCS experiment, which I deem failed, and that 20 megahertz was allocated. Apple started that. They wanted 50 megahertz. The Commission allocated 20, and then an additional 10 was allocated, and it was never really used except for the wireless PB access for the isochronous part of that allocation. And then came the UNII band, 300 megahertz. Okay? So the UNII band certainly hasn't been farmed at all to this -- up to this point. And then 2.4 gigahertz, I think there's a lot more that could be done there.

The problem I see for the current unlicensed bands in terms of this meltdown issue, is not a meltdown per se, but the fact that you have incompatible sharing partners in those bands. By that I mean, you have licensed services. For instance, in 2.4 gigahertz you have four licensed

services, and amateur radio is one, but there's three others that most people aren't aware of. And the thing about these incompatible sharing partners, it means that the licensed services can't go to the Commission and claim interference and have the unlicensed services shut down.

Now this is the biggest threat that I see for unlicensed, is the fact that the license holders have bigger rights to those bands than the unlicensed, so it's not a meltdown that I see as the big threat, it's the license holders asserting their rights, so that's a problem under the current Spectrum Management paradigm.

So to sum up my second point, no more unlicensed spectrum under the current paradigm. Let's make better use of what we've got, use Darwinian principles and let's see what happens.

My third and last point is that - and this speaks to what Dave was saying - we don't need no stinking bands - okay - any more with the technologies that are available. I prefer to use the term "wideband technology", which encompasses not only ultra wideband, but spread spectrum. We tend to forget that spread spectrum has been around for a long time, has been pretty darned successful,

and it's a wideband technology, so at the TAC we've been using the term "wideband technology" to handle -- to be the moniker for this class of technologies that use more spectrum than the information bandwidth.

Now the term has been introduced that these things use spectrum overlay so they can essentially transmit over existing services and do no harm. Lately, Bob Pepper two months ago coined the term "Spectrum Underlay", and so I'm starting to use that term now, rather than overlay, because I think it's more politically correct. It also speaks to what's being done there, in that you're basically underlying something under an existing service. Okay? And this is possible with the technologies that we are coming down the pike. And so, now okay, yes, unlicensed but under -- more spectrum for unlicensed but under a new paradigm.

DR. MARCUS: Okay. Peter.

MR. HADINGER: Thank you. A couple of comments on a few of the points that have been made panelists and audience up to this point. First of all, just in response to what is beach front? I think that it depends on who you are. Certainly, in the satellite community, beach front extends

well above 3 gigahertz, and we're quite happy with it.

In terms of the concept of bands, there is, I think, a need to have bands for unlicensed, because again what you're trying to do, at least in my view, is to try to bring things of like characteristics together. And in some sense, unlicensed, it may have a like characteristic in the sense that it's not -- it doesn't conform to rules. And maybe what you want to do is have a place where such things are allowed to operate, all of which realize that they may impose some inefficiency in their design by adding additional protocols, and layers, and so forth, to allow more efficient sharing with people who also don't necessarily have rules. But that making them co-habitate with folks who have adopted similar sharing rules, and have found very efficient ways of using their spectrum is probably not the right answer, so I do think that there should be additional bands set aside for unlicensed. And as in most cases, and probably even more so for unlicensed, what these greenfields should be is everywhere from D.C. to daylight to take advantage of the different characteristics that exist in

different bands.

In other words, there's certainly different characteristics at VHF frequencies, in terms of penetration and propagation distances, than there are at 60 gigahertz which, by the way, I think is a wonderful band for unlicensed, just because the propagation characteristics and the beam widths make it so unlikely that interference would actually happen.

All of these are a way of saying that in order for things to share, there has to exist a barrier between the types of users in one fashion or another. This barrier can take the form of frequency, having people assigned to different frequencies. It can take the form of time, having people in different time slots. It can take the form of having orthogonal codes or amount of attenuation between types of systems, some things for indoor use, some things for outdoor use. A number of different places where we can have sharing, but you have to have a barrier that exists. You know, good fences make good neighbors, and where you do that, I think that you can find an opportunity for the greatest amount of sharing, without creating interference that would otherwise

be harmful.

DR. MARCUS: Okay. Now we want to leave some time for the audience that may have questions or statements, so Larry.

PROF. LESSIG: Well, I -- so between these two comments, one that says that we don't need no bands, and the other says that we do need bands, I think the right answer has go to be we don't know enough about whether we need more bands, or we don't need more bands.

DR. MARCUS: So what question should we ask?

PROF. LESSIG: So then we should be asking, how do we facilitate the experiment to allow both of these to go forward. Now in the context of no bands, I mean, the work that I've been reading suggests that this really is something of the future here, whether we think of this under the general category of wideband. But I would just emphasize that when David says what we need is to facilitate sharing, that opens up a huge political question about what is the "sharing" going to be? Can the unintelligent incumbent say that well, I don't have to put any intelligence into my system at all, and then say that you're not sharing with

me because now we're in some sense conflicting. That would be the wrong answer for the FCC to adopt, so sharing must include at least some reasonable and very cogent idea, cheapest, cost-avoider conception about how to facilitate sharing in this wideband context.

But the second thing that's got to happen is that the FCC has got to begin to clarify the distinction between technical interference and competitive interference. We saw this most clearly in the context of low power FM radio, where the FCC, I thought, did a great job in trying to demonstrate we could actually have much greater, more diverse radio, FM radio. And then this was attacked by Congress under the conception of interference would be created by this low power FM radio. But obviously, there was no technical interference created by low power FM radio, especially as the FCC finally approved it. The interference was competitive interference. It was going to create more competitors.

Now the FCC is obviously not the ultimate policymaker, and if Congress wants to be corrupt, they're allowed to be corrupt in this way. That's fine.

(Laughter.)

PROF. LESSIG: But the FCC could facilitate a discussion about what's the relevant issue -- what's the relevant interest at stake here by distinguishing between which interferences are really technical interference, and then have a competitive impact statement. And this will make it much harder for the following people to continue to do their incumbent way of doing business.

At least we could have a discussion that said okay, you are benefitting the incumbent against this new technology to do whiz-bang whatever, and just bear the political cost for benefitting the old against the new.

DR. MARCUS: David, and then we'll go to the audience.

MR. REED: Okay. I'm not sure I'm going to be quite as controversial as that, but what -- I kind of disagree with this good fences make good neighbors thing. And we could get into, you know, the sheep versus the cattle answer back in the old days, but actually, it turns out there's a really great example in communications of how good fences weren't needed, and that's the Internet.

Twenty-five years ago, or more, we recognized that the applications of the Internet were unknown, and the right technologies were unknown, and we would need to evolve some answers. We didn't anticipate that the system would last 25 years. Our hope was that it would last 5 years, and we'd come up with some very interesting research results.

What we learned, and what the IETF, the Internet Engineering Task Force learned over time, is that there is a way to manage the evolution of rules among a group of not always friendly, and certainly not always compatible users of a system that shares a lot of resources.

That learning, which is based on some architectural principles, one of which I'm partly responsible for, called the "end-to-end argument", basically says that if you find a way to get a minimal standard that allows for cooperation, and a process that allows you to evolve both the rules, and also increase capacity as times goes on, then people can do -- you know, follow a mixed strategy of defining new rules where they can, creating more capacity so the interference doesn't happen. And what we see in wireless, I had thought 10 years ago

when I got interested in wireless that the rulemaking could follow the Internet model, but I wasn't quite sure about whether we could increase capacity over time fast enough to deal with the demand if we opened up an unlicensed or unmoderated space.

This research that I've been looking at recently, which basically says that capacity and all kinds of other benefits can increase with the number of users bringing resources to the system, independent of how much spectrum they're on, leads me to believe that we could follow the Internet model quite safely. We have zillions of engineers involved and, you know, who have figured out how to do that, working for companies ranging from Cisco to, you know, Microsoft, to a lot of other companies, so we know how to live in that world.

It may not be the case that broadcasters or the cell phone operators know how to live in that world, but I think they could learn rather quickly. Thanks.

DR. MARCUS: Bob.

DR. LUCKY: Yeah. Let me comment on that because I think the Internet is a very interesting example, because it is a commons, and

it does mainly work. And one of the interesting things is how TCP shares the space out there by everyone sort of using the same software, different varieties of it that backs-off when it encounters congestion. And it's a lot similar to what 802.11 does, in that listen before you speak kind of thing. But similar to the 2.4 gig band, there are other users of the Internet who don't obey that courtesy protocol, like UDP, which just sort of blasts out there, and you have this mixture of people who are obeying rules, and people who aren't obeying rules. But the bottom line is, it works.

MR. REED: Actually, I could -- Larry hinted at why it works. I've wondered about that for a long time because cooperation or defection from cooperation is an interesting question. And, you know, lots of people -- Bob Metcalfe is the most famous person who prophesized the meltdown of the Internet for precisely this reason.

I started to delve into that question of why no meltdown. Certainly, some company could come out and say I have the world's most efficient protocol, and the way it gets its efficiency is by blasting everybody out of the way and just doing, you know, doing the best for the individual user.

What tends to happen, first of all, that's an observed behavior. It's measured, detected, people point that out to the user. Second, almost always organizations are deploying these systems, not sole isolated individuals. And organizations don't want to blast their other users, so they have an incentive to cooperate, so what ends up happening is that in the competitive marketplace, if you say that, you immediately get noticed as a polluter. And polluters, you know, when you are selling a polluting product, even if it's got benefits to the user, as long as that pollution is, you know, well-known in the marketplace, people don't buy it. People are, you know, for the most part, you know, like the zero-emission microwave ovens, you know, if they could buy an alternative, you know, they'll stay away from the polluting products. And, you know, that doesn't always happen, but that is an aspect of the market self-regulation that's not usually considered in the economic model here, that it happens in the competition rather than the regulatory space.

DR. MARCUS: Okay. I'd like to open the floor now for questions on the need for

additional spectrum for either unlicensed or these other, the cousins that are licensed by rule. And could you please, when you ask a question, identify yourself with your name and affiliation at the beginning. Over here.

MR. SNYDER: Jim Snyder from the New America Foundation. I'm wondering if the FCC is considering any sophisticated variable power and directional schemes in conjunction with unlicensed spectrum. What I have in mind, in particular, is what some have called the Afghan Spectrum Etiquette, which is a conjunction of say GPS and Unlicensed Spectrum to control power levels, so that if you're in rural Wyoming, or in a low-density suburb, you don't have to be restricted on the current, say wi-fi, power limits. Or wherever you are, there are a lot of places where it's an artificial restriction, and if you could coordinate via satellite. You know, in Afghanistan, the military coordinated the air campaign with the ground campaign.

MR. REED: But the current block of question is do we need more spectrum, and we're getting into etiquettes very quickly, but could we keep this particular block of questions on do we

need more spectrum? So keep that thought, the person back here.

MR. KOBB: Well, Michael, you also spoke to licensed by rule, and I'd like to address that, and the comment made by the gentleman from Cobra. I think he put his finger on what is really a terrible dilemma that is to some degree Commission created, and that is the mixing, as he pointed out, of a licensed by rule service with a service that requires a conventional license. So the end-user has this device. It's a single radio unit, but some of the channels in it are exempt from licensing by statute, and other of the channels require an expensive government license, a complex form or web procedure to get a piece of paper from the government, and the radio will work fine without sending the $85 or whatever it is to the FCC.

DR. MARCUS: Do we need another band or don't we then?

MR. KOBB: Well, I want to point out that the issue is licensed by rule. And the clash between users with conventional licenses and users that don't require a license. And this is simply going to increase. These products sell in enormous

volume. And what I think the solution has to be is the introduction of cognitive radio and SDR techniques into these bands. And what the Commission will have to deal with is how to evolve these services, how to introduce this technology into bands that already fill large numbers of analog users.

I'm afraid that the Commission might wait for manufacturers to come up with this initiative. They may be waiting a long time. And the problem is, if you do not address this, you're going to perpetuate this problem of I'm required to send all this money to Washington, and all I get is a postcard with my name and address on it. It makes absolutely no difference, and the continued really increasing interference issues between users who have had licenses, been there for a long time, and expect disciplined operation, and then people who are consumers who really are not concerned with FCC rules. They just want to talk on the radio.

So as to the question of do we need more spectrum for unlicensed, I'm a big booster of unlicensed, but I think it's a myth that if you allocate more spectrum, manufacturers, vendors and users will automatically flow in. That's not the

case.

DR. MARCUS: Okay. Benn, for the few people in the room who don't know who you are, could you please say who you are.

MR. KOBB: I'm a consultant in radio spectrum policy.

DR. MARCUS: Your name?

MR. KOBB: My name is Benn Kobb.

DR. MARCUS: Okay. Great.

MR. KOBB: So it's not just the availability of spectrum. It's the availability of standards, of business opportunity, of technology suitable for that spectrum, and in some cases, the possibility of international markets. All of these are the things that draw manufacturers to a given band, not simply the availability of the spectrum.

DR. MARCUS: Okay. Thank you very much. Has anyone -- now does anyone specifically say (A) we need spectrum for X, or (B), we don't need spectrum for Y? Yes, sir.

MR. COOPER: Well, I'm going to suggest a better -- Mark Cooper, Consumer Federation of America. I'm going to suggest the better question is not whether we need more or less today, but how we'll free it when we do.

Dewayne is suggesting if we really had a chance to develop what we've got, we'd prove that this is a better space, a better way to organize the space, and so that over time the question is, as that space becomes filled, how are we going to get the rest of the beach front liberated from the tyranny of the licenses? And I think that would be a set of -- tat's the better question.

(A) You certainly don't kill the experiments today of which there is a threat. And then (B), if you do conclude, as most people on this panel suggest, this is a better way to organize the space, then you've got the really big question of how you're going to get the incumbents out of their existing spaces.

DR. LUCKY: In the real world, you know, beach front occasionally have a hurricane.

(Laughter.)

DR. MARCUS: Any other questions? Over here.

AUDIENCE MEMBER: Yeah. I'd like to just address this to anybody on the panel --

DR. MARCUS: Could you identify yourself please, sir.

AUDIENCE MEMBER: -- who would like to

address this. We talked about the Internet model, and I think we've got to be a bit careful, and I just wonder how you folks feel about that.

The Internet actually has an underlying architecture, and it does have a minimal protocol, and you could call that a set of rules. How they evolved is another thing, but they do exist. So are we talking implicit in this that we do need an architecture and a set of minimal rules? Is there support for that, or opposition to that position?

MR. CHAMBERLAIN: There is an underlying set of rules, and that is nature, where there's airways, propagation. They are under --

AUDIENCE MEMBER: Networks are not nature. Servers, and bridges, and airports are not nature.

MR. CHAMBERLAIN: No, I understand that, but in today's Unlicensed Spectrum there is nature. Nature has a way of limiting. There's power limits right now. There is -- those things tend to limit the amount, how do I say it, conflict between users.

As in the Internet model, those people that try to go against nature usually are defeated, so I mean, I think there's no need for set of

rules. I think as many of the panelists have pointed out, as people violate nature, they are usually rudely awakened.

PROF. LESSIG: I think -- I mean, this is to emphasize something David was just saying, that it would be ideal if we could get to the position where we had an equivalent to the TCP/IP protocol in the context of the use of wireless. We don't know what that would be right now. I mean, even one of the original architects of the framing of the end-to-end argument says we don't know what that would be right now, so if we don't know what it would be right now, but we agree we ought to be getting there, I think the answer comes back to leaving enough place for the experimentation to discover what that would be. And if we did get to that neck in the hourglass that facilitated the widest range of experimentation on the bottom or the top of the hourglass, then we would have something that we could say that is the Internet, and that does facilitate the same kind of end-to-end innovation the Internet did enable. That's, I think, where we should be going, because the critical feature of David's end-to-end argument that, from my perspective is, it by architecture

eliminates the possibility of the network owner benefitting or entrenching its own incumbent position against the next great idea. It's an architectural solution to the problem that I was suggesting the FCC had to address.

DR. LUCKY: Well, I'd like to comment on that too, because David raised another point in that same discussion about the role of the IETF. And this is more than just an underlying architecture. It's a process for standardization that was different than the telecom industry had previously. The telecom industry had a long drawn out process where, you know, standards would be evolved before the service was done.

In the IETF, you had experimentation, and only when a protocol was observed to behave well was it actually standardized, but the experimentation went on. And the IETF process for standardization was very very interesting.

MR. REED: Yes. And there's a famous phrase which is rough consensus and working code, which points out the essential different; which is that, you know, you build the code and see if it works. And then you get a rough consensus around the standard, which means that there probably are a

lot of people that aren't quite ready to adopt it, but you move forward anyway and address those as you go on. That's very different than any historical communications process in the wired or wireless area, and I'd claim that, you know, is a huge reason why the Internet has eclipsed all the competitors that were trying to build network services, but limiting their aspirations and trying to design the answer before they knew what the problem was.

DR. LUCKY: Contrast that with 3g, with ISDN, you know, with all these things which were, you know, standardized long before they were actually introduced. And then by the time they ere introduced, maybe they weren't wanted any more.

MR. REED: Right. Iridium is actually an exciting example of that, where the most brilliant -- I would claim Iridium was a brilliant technological thing. I, you know, bow down to the people who did Iridium. The one question that they didn't answer at the beginning is what would it be useful for, but yet they designed it, you know, for a particular use.

DR. MARCUS: Can we get Michael at the other end?

MR. CALABRESE: Yeah. You know, on this basic question of do we need more unlicensed? The answer is essentially yes, but I think it's important to distinguish, we need to do two different things. Okay? Because it's important to distinguish between today's wi-fi technologies which are not, you know, are not really ultra -- they're not ultra wideband. It's a type of hub and spoke architecture that can operate. It does operate on a kind of a channelized sort of basis, and for that we may well, and that's what most of the commentors addressed, was that we probably need more space for that kind of wireless networking. But that's very different from what many of us are talking about here, I think as open spectrum. In other words, the potential for ad hoc user controlled networking, cognitive radio, SDR, to dynamically share spectrum and have, you know, the actual user serve as repeaters between nodes, and that's what's based on the sort of Internet-like design principles. And that requires a whole different regulatory trajectory, one that's looking at sharing, and on what we referred to earlier as underlays. So really the Commission, I think, needs to go in two very different directions

simultaneously to create the environment to promote innovation and economic growth, and greater democratic communication unmediated among citizens. And that is both greater space for the sort of wireless networking technology, such as wi-fi, as those develop, but while still maintaining, preserving its authority to periodically refashion license rights so that as cognitive radio and so on develop, and we can use ultra wideband effectively, that we're not "trespassing" on some sort of vested interest of licensees, because I think the interference protections are something that is going to have to evolve over time.

DR. MARCUS: All right. Peter.

MR. HADINGER: Let's see. I guess I had a problem with just assuming that the Internet model basically said that you should just leave it wide open and let it go. I think that certainly there were a lot of rules that were established at the beginning, and over time that have made the Internet a successful model. But it's also important to realize that most communication world does not happen by Internet. In fact, you know, I would guess there's considerably more bandwidth on fixed analog voice lines that are connected to old

telephone switches. And certainly, between scuzzy devices or IDE devices inside my computer, they're not using the Internet protocol, but they are communicating and they have a protocol that's been worked out for their particular type of communication, which is optimum and efficient, perhaps, for what it's doing.

And I would suggest that within kinds of services that are like, similar things develop. It's certainly true in the satellite industry, where through some intelligent forethought, I think, there were certain bands that were set aside for satellite use, and over time very smart individuals have gotten together and spent very, very long periods of time not speaking in analogies, but actually speaking in technical terms, trying to come up with rules. And, in fact, once those rules do get established, there is a certain amount of locking into those rules that forces conformance, and possibly keeps people from doing new and innovative things that they might want to, but nonetheless is good for the whole, in that they share extremely well within that kind of service.

And again, I would really emphasize

that as we look for rules by which to do this, we should find those types of things which are in the same class, and allow the rules to develop among aficionados of that class for the same kind of service.

DR. MARCUS: Okay. Why don't we have one more question from the audience, and who -- over here, and then we'll go to the next topic.

MR. LANGSTON: Tom Langston with Ericksson. I would suggest that for non-communications devices, we do not need more Unlicensed Spectrum, for non-communications devices. We all seem to agree that for communications devices, we do need more bands and more rights.

DR. MARCUS: Where would you get the bands from?

MR. LANGSTON: No. I suggest we do not need for non-communication. I don't have a comment on where we would get new bands for communications devices. That's up for discussions.

MR. REED: I have a quick comment related to that, although it's a side issue. It turns out that one of the difficulties with some of the new technologies, it's hard to separate

communications from non-communications uses. Just like it's hard to separate IP from voice now, and so forth.

We may not need new bands. As I point out, I'm not for new bands, but for example, ultra wideband technologies or various wideband technologies provide location detection services, if you will, that compete very effectively with GPS, or radar, or whatever, and especially in environments like indoor things. And we ought to recognize that the best paradigm for those kinds of technologies is unlicensed. We ought to make sure it's a somewhat different kind of unlicensed, but may also be networked. And we ought to make sure that by focusing on communications, we don't bar experimentation with those kinds of mixed applications over time.

DR. MARCUS: Okay. Bob is going to go on to the next block of questions now.

DR. LUCKY: Yeah. You'll find that the blocks of questions are so similar, that whatever comments you had to questions will still be relevant, so let's not worry about it. I think, you know, there are only a few gut issues here that we're nibbling around that are tricky.

Now the next set of questions, for example, deals with first, will it meltdown? We've already been talking about that a lot. How do we know that a tragedy to the commons has occurred? And I actually would like to talk about that a little. And then the question, should we implement a Spectrum Etiquette that would reduce interference among Part 15 devices? And should the FCC have a larger role in etiquettes for unlicensed band, so let me just take a few of these. Now 11:00 we're going to have a break.

DR. MARCUS: No, 11:15.

DR. LUCKY: 11:15. Okay. Fine.

Okay. Let me just, because this is a question that bothers me a lot. How do you know that we're getting a meltdown? Now somebody made the comment earlier that, you know, the EPA measures pollution, so they're measuring what they regulate. And the FCC is not measuring what it's regulating, so what should we measure? And how do we know if this is melting down? David, you look like you want to say something.

MR. REED: Yeah. I really do. I think Dewayne already pointed out that measuring what's regulated is important. I've been thinking, and a

lot of people have been thinking about how do you do that given the cost. And I actually think the best way to do that is to measure it at the user.

It's perfectly reasonable in a networked world, increasingly networked world to have devices reflect back to the user, and even reflect back into a network in, you know, issues with congestion and interference. It would make sense to me to collect that information at some place like the FCC, or some other neutral ground, some manufacturers, who can then take action collectively on what they learn.

DR. LUCKY: Well, let me --

MR. REED: Well, just let me finis one sentence. This is sort of analogous to the idea that, you know, in most cases of pollution, you can actually see the pollution. In the case of radio, you can't see the congestion, but you can feel the affects of it in the service that you get through the device. And, you know, that's probably the best place to detect it.

Now it's not necessarily the best place to correct it but, in fact, most often the device can also correct it, but it's useful to notice how much -- how often it's correcting it, as well.

DR. LUCKY: Well, you know, I've thought about that, and we could. There are millions of wi-fi cards out there, 802.11 cards, and we could have them report back to some central site on the conditions that they see. But let me imagine for a moment that we actually do that, and that you have all this data, what do you do with it, and how do you know if it's melting down?

MR. REED: That was your other question.

DR. LUCKY: Yeah.

MR. REED: Well, I would claim it's melting down if it's not scaling. You know, basically you can predict what ought to be the case, you know, in terms of what you expect the market place demand to be, and so forth. And if it's really not, you know, getting fixed, and conditions are getting worse for everyone, then either the market place is broken, that is, the people are not solving the problem for themselves, not buying the new stuff, and that would be useful information to know.

But basically, detecting the problem is different from assigning, you know, the fix or the cause, and I'm not sure -- you know, I think the

market can do the fixing, but sometimes it's useful to have the data and just publish.

DR. LUCKY: I'm still not sure when the data tells me I've got a problem. Okay. I want to go there. A lot of people want to talk. Let me start with Larry. I was looking at him.

PROF. LESSIG: All right. So I agree that we need -- it would be great to set a kind of study at home project to see what the actual state of the world is, and it would be a relatively cheap one to fund. And I agree with Dewayne that this is something we ought to push, but I think that the way you frame the question begs the question, because we shouldn't be thinking about meltdowns in any particular part of the communication system. We should be thinking about the communication system as a whole, and so there's a favorite stickman in one of the papers about propertizing spectrum about the Internet, where they say yeah, yeah, the Internet is great, but you wouldn't rely on the Internet -- the Internet would be terrible if what you're trying to do as a surgeon get high quality images beamed to you about the patient across the world, and so therefore, the Internet is a failure because it can't do that. And the

response to that is, why would you ever use the Internet to beam images of some surgery that's going on halfway across the world. There are other communication systems you should be using for that type of communication. And so, if you think about meltdown in a particular area, you could probably identify places where there are congestion going on, given particular types of uses or particular bands. But it would be bizarre to think that the communication system as a whole was melting down because people who can't -- who need higher quality service, who need better reliability in a particular context need to be able to shift, and do shift to other forms of communication that could answer their needs.

So it seems to me the very question makes it sound like we are necessarily facing a tragedy of the commons here when, when you think of the communication system as a whole, I can't conceive of how you would have a tragedy of the commons for the system as a whole.

DR. LUCKY: Okay. Other comments?

MR. CHAMBERLAIN: I think one of the ways the Commission can take a look at whether they feel we're having a meltdown or not is actually

look at the marketplace. As new technologies come out and as they grow, what's going to happen is, these companies will grow right along with the technology. The marketplace will see -- you'll see a huge acceptance of these things. And then these companies will be coming to the Commission and saying, we've got this issue. We've got a problem. Let's work it out. Let's figure out how we can make this system work. And I think the marketplace can react far quicker and analyze this situation far better than say the Commission could by using some kind of technical means.

DR. LUCKY: So you wouldn't -- you don't think we should measure anything.

MR. CHAMBERLAIN: I think you should be good listeners to the marketplace and to the companies out there.

DR. LUCKY: Dewayne.

MR. HENDRICKS: I don't agree that the market can do that, because again, I've looked at the historical record, and you've seen companies cry wolf, you know, for some time, and they really didn't back it up in their filings, because they didn't really know the answer either.

I don't know the answer, so I think

it's just put it down as something that you have to continue to experiment to try to figure out what's going to work. But you know the thing is, is that -- here's a thought I had. We don't have a Jules Verne or an H.G. Wells for this field, you know. I mean, if you look at what they wrote about projecting ahead to where we are now, they didn't talk about wireless per se. Okay? And since that time, no one has really -- you know, the science fiction writers haven't really addressed the kind of problems we're talking about here today. Okay? So we don't have any good things to look at to sort of describe this problem.

I mean, Hollywood hasn't tried to do this either. Think about it. Star Trek, communication devices just work. They just plain work. You know, whoever you want to talk from Point A to Point B, unless the script says there has to be a problem, the communication systems work. It's magic. Okay? So, you know, it could be that simple, you know. It really could, but right now I don't know how to get to Star Trek.

DR. LUCKY: I'd just like to comment myself. I mean, we're -- in my company we've been working with the New York City Transit Authority,

and they want to use 802.11 to talk, you know, to coordinate their trains, and so we've been measuring the interference as the train goes through Brooklyn. You know, as a function of the frequency, time and position, and the answer is just what you'd expect. Some time, some frequencies, some places it doesn't work, but I don't know what wisdom to glean from that. I think it's always just like the Internet, sometimes you don't get through. Sometimes the packets don't get through, and that's the nature of the world. Let me go -- Peter, you have a comment on this?

MR. HADINGER: Yes. You know, ideally we'd be able to measure everything and respond in some sort of adaptive way, but there are limits to knowledge in terms of knowing what the problem is. And most of the issue there is that the definition of interference is often set by the person being interfered with. And the person or the entity causing the interference may often be completely unaware of the fact that interference may exist.

Certainly, in the case of an Ethernet where everybody is looking at collisions on a network, everybody can see when collisions happen. But in the case of radio, you may have a system

which doesn't see any interference to itself in the local domain, but something further away may actually be experiencing interference and not be able to communicate that.

I know we looked at, in one particular sharing example of, you know, whether there needed to be beacons or something like that to allow people to indicate when they've been interfered with but, you know, certainly the problem we have today is that services have no effective way of communicating back when interference does exist, and so there's no effective way of measuring it, even if you confine it to systems like wi-fi or whatever. You aren't measuring all the other things which are non-wi-fi.

DR. LUCKY: Michael.

MR. CALABRESE: Yes. I just wanted to make a kind of a contextual comment, which is when we talk about meltdown, as if that's synonymous with, you know, a tragedy of the commons. It's important to realize that the whole idea of tragedy of the commons is really a misnomer, because what it is, is a tragedy of unregulated access. You know, that's what we mean when we talk about tragedy to commons.

All successful commons from the Interstate Highway system, to the Internet, to New England Fisheries have rules of the road, protocols, and/or etiquettes. And so if there is a so-called meltdown, we shouldn't be thinking of it just as an extrapolation of today's unlicensed world. But rather, I would think that it's most likely to be the result of a failure of policy, and not ultimately of technology. Because, for example, congestion in unlicensed is a sign of huge citizen demand, which means we have to make some tough decisions about reallocation, and about sharing, and about interference standards, and the rules of the road themselves have to be scalable.

DR. LUCKY: Larry.

PROF. LESSIG: But again, I think that the problem with this is that this debate about congestion or meltdown is a kind of specter that haunts this field. And most people's reaction to it is not, as you were suggesting, Michael, to say well, what's the set of rules that we can make sure avoids the meltdown, but the opposite traditional answer to a tragedy of the commons; which is, well, therefore, we ought to sell off all the spectrum quickly, because that's the most effective way to

avoid this type of tragedy.

And here, I think the point that Mark Cooper was making earlier about how do we avoid incumbents who will then fight like hell to make sure they don't have to give up the rights which they have acquired, becomes the relevant policy consideration we have to bring in here. The fear about meltdown is exaggerated, I believe. One way to show it's exaggerated is do lots of measurements, and so that's why I think the measurement thing is an important problem. But let's understand why it's being deployed, why the meltdown thesis is being deployed. It's being deployed often by people who would like to push us towards this solution; which is, let's sell off as much spectrum as we can quickly, so that we can use the market to solve this problem of congestion.

And I think the way to resist that is to re-emphasize Cooper's point, that if you sell off all the spectrum right away in this big band auction-like way, in a context where we don't know what the best answer is going forward, we are quite likely, I think given the information we've been listening to right here, going to be in a position where the cost of buying-off those incumbents will

be extraordinarily high, so high that we won't do it. So we will auction ourselves into a context where we are forced to accept an inferior communication system, when if we just hold off from that, at least right now, we could allow the market and technologies to develop, and demonstrate an alternative to this propertized system, that at least it's possible, I think likely will be superior to their propertized system.

DR. LUCKY: Larry, it's not on our list of questions, but the big band auction kind of hangs over us. And what would happened to unlicensed bands in that kind of a paradigm?

PROF. LESSIG: Well, I think it would create a huge problem for the development of these other types of technologies, in particular, the ones that David was talking about, and for wideband technologies that Dewayne was talking about.

And the biggest reason that it creates this kind of problem is a concept which Michael Heller introduced into the legal discussion, and James Buchanan has picked up in the context of regulatory theory; which is, the problem of the anti-commons, not the commons, but the anti-commons. And the problem with the anti-commons is,

if there are any number of people who have the right to veto your use of a resource, so let's say there are 20 people or 50 people who have the right to say you can't use this resource, then innovators will say it's just not worth it for me to develop new technologies to try to use this resource, because the coordination cost, the transaction cost of using this resource will be too high to make the resource useful. So think about the big band auction now. Right? So we auction off all the spectrum in the world. We have thousands of owners all over the country who own different bits of the spectrum, and then they're going to be in the position of deciding how they're going to make it available. Some will put it into a market, some won't.

The innovator who's trying to use the type of technologies that Dewayne is talking about, thinking about being able to use spectrum across a wideband, that has to enter into the calculation. Well, how am I going to begin to negotiate with each of the spectrum owners in each of the places the spectrum might be owned for this particular context, so I have to develop a technology that's smart enough to know which auction mechanism I'm

going to engage in, depending on whether I'm in Philadelphia, or in San Francisco, or in Wyoming. It just increases the transaction cost so dramatically, that these extremely efficient wideband technologies become priced out of the market, just because of the overhead that you've placed on top of the system.

MR. HADINGER: May I follow-up on that one, just real quickly. This is exactly the reason why in the satellite community for international services, there are no auctions. And it's because there is a huge gain theory problem, if you've got a whole bunch of independent countries coming up with their own auction regimes, and their own spectrum Planning Policies, trying to develop innovative services which can serve a region, yet be subject to the least common denominator of somebody who decided that they want to hold out or whatever, can cause extreme problems. And so, you know, for that reason, we've had a very strong effort to try to make sure that those are determined more on technical grounds, and not on sort of individual country policy grounds.

MR. CALABRESE: I'd just like to add to what Larry said. And I think because of that, it

was extremely significant that in the comments that were filed July 8th, it wasn't just groups. You know, Larry mentioned Consumer Federation of America, we filed for Consumers Union and a number of other groups with us. But also, the major technology companies, particularly equipment makers, software makers and so on, that really were strong in saying that the Commission must preserve its authority to periodically refashion license rights to accommodate changing technology and social priorities.

I mean, the Consumer Electronics Association, for example, is just right on the point we're talking about, stating that:

"To the extent that spectrum is allocated by competitive bidding, the Commission should ensure that such a system does not impinge on the greater deployment of unlicensed devices, the sharing of spectrum among unlicensed and licensed uses, and the allocation of more spectrum exclusively to unlicensed use."

Well, you know, if it was a trend that ran through all the comments from both licensed users and proponents of unlicensed, it was that we must at all costs avoid establishing any permanent

private property rights in the frequencies, because that would just be the death now for innovation, and for any of the things we're talking about here today.

DR. LUCKY: Okay. Other comments on this? Okay, audience. Yeah, lots of comments. Just hand it to an arbitrary person. Sir. Not too arbitrary.

PROF. RAO: Ramesh Rao, UCSD. Bob, I wanted to respond to your question about how would we know that there is meltdown, if everybody with a .11(b) card reported back what they were observing. And I wanted to offer a definition which might resonate, at least for the technical community, and that's the notion of "goodput".

If you measure the number of people that are coming on board this technology, .11(b), then measure the amount of data that they're able to gainfully extract from the network. And if it turns out that you're at a point where, as you add more people you're getting less out of the system that, to me, is meltdown, because if you stay on that trajectory, people are going to abandon this technology, so that was the specific thing that I thought might be worth considering.

DR. LUCKY: Yeah, I think it is, and it goes to David's comment about scaling, is the issue here. And if we can detect that it's not scaling, that's when I think we have the meltdown. If, as we add users, we're getting less goodput, I think that's a very good comment.

PROF. RAO: And the other thing I wanted to say to kind of moderate that, is that there is this issue of self-regulation that takes place. People don't keep persisting with a technology that doesn't seem to be serving their purposes, so it's possible that there will never be a dramatic event that tells us that this thing isn't working. People just sort of shrug their shoulders and walk on, and find another way of getting their work done, so it's possible that we have to be mindful that some of these things might be subtler than a hard measurable thing.

DR. LUCKY: I think sometimes the spectrum hangs over this, as the CB radio thing where we actually did see a complete meltdown and abandonment of it. Anyway, but other comments from the audience. Sir.

MR. LEARY: Yes. To speak to the comments about congestion.

DR. LUCKY: Would you identify yourself.

MR. LEARY: I'm sorry. Patrick Leary with Alvarion. If I walk into a crowded Egyptian bazaar without any shoes and I cut my feet, or I get my toes stepped on, is it the fault -- whose fault is it? It's my fault because I chose the wrong technology.

The same person could back into that same bazaar with a pair of steel-toed boots and be just fine. If that same bazaar, if there's 3,000 people in there, and 2,000 of them don't wear shoes, and 2,000 of them get hurt, yes, there's a problem, but that still is not the problem of the band. It's the problem of the predominant choice, being chosen by most of those people, so I would caution, just as Professor Lessig was saying, you know. The myth of congestion is in large, a comment about the technology itself that's been deployed, not about the band itself so, you know, if you start protecting for this one prevailing standard, of which I also participate in to some degree then, you know, you stifle innovation and you're protecting the wrong things.

Second, there was a comment with

respect to what happened if you did auction off these things. Well, as the largest vendor in any deployed wireless broadband technology from 10 gig under, with roughly about a 60 percent market share, I can tell you what we would do, just like we did in MMDS. We won't spend our millions developing product for MMDS, because you have two choices of having volume sales. And if you don't get one of those two choices, you're out of luck. And if you do get one of those two choices, guess what, you're out of luck, because then they gotcha, or in the case of Worldcom. So that's what happens in the real world from an economic sense. Those are my comments.

DR. LUCKY: Okay. Sir, in the back, and then I'll get to you.

MR. LONG: Wayne Long, a private interested party. It occurs to me that these technologies are so important that at some point perhaps some should be licensed technologies, and they'd be licensed if they're networked as the class license to the manufacturer, with the ability to resolve Peter Hadinger's interference problems by his identification of hotspot, and the many factors building in the capability in their

devices, and developing the spectrum monitoring issue, if you will, to determine when and where corrections are needed, and the manufacturer would be held responsible. So perhaps it has to be a class license held individually, and as a group by manufacturers. Perhaps, even at some point get rid of Part 15 if they're going towards intelligent solutions.

DR. LUCKY: Okay. In front.

MR. EPSTEIN: I'm Bart Epstein from Latham & Watkins, here on behalf of Cognio Incorporated today. One of the topics that we were talking about was etiquette, and the interesting point that Robert made before was that he could have five antennas on the same roof, and that's because he controls them. And if he has a problem with one, he can simply adjust them. And a cordless phone user who turns on her microwave oven, and notices interference can either walk out of the room, or turn off the microwave oven.

And the question of etiquette that I'd like to raise is as follows. What happens if I live in an apartment building, and my next door neighbor has a microwave oven, and it's interfering with my wi-fi? You know, my definition of meltdown

is if I have my wi-fi card, and it's being knocked out by my neighbor's microwave oven, that's meltdown. And the real issue is the property rights, you know. I can certainly buy a better microwave oven for myself, but what about my neighbors? Do I have to buy each of my neighbors a better microwave oven?

Realistically, they're the least cost avoider, but they don't have any incentive to do that unless we somehow create a regulatory environment which says if you're going to have a microwave oven which blasts throughout the spectrum, it's got to be limited to certain areas. I wanted to know the thoughts on that.

DR. LUCKY: Well, we wanted to move on to the question of etiquette, and I think it will be a theme, if not before the break, it'll get up after that.

I would like to say personally though that I think the microwave oven itself is red herring, you know. And it receives a lot more attention than it's really worth. I mean, just don't stand in front of a microwave oven and do this, you know. And it's always given as the prototypical well, you can't do this because there

are microwave ovens, and I don't -- I just think that that's over-emphasized too much.

Let's move on to other comments. We've got one in the back. Sir.

MR. STEVENSON: Yes. Carl Stevenson, Agere Systems.

DR. LUCKY: Do you want to stand up?

MR. STEVENSON: Okay. Thank you.

I'd like to respond to the other gentleman's comment about possibly converting unlicensed uses to licensed uses. I think that's the wrong way to go, and what I would advocate is considering rather than the term "unlicensed", going toward the licensed by rule, or perhaps licensed by compliance sort of model.

In many countries in the world unlicensed equals illegal, and this issue -- you know, the issue of property rights of licensed versus unlicensed services, you have to look at the value propositions, I think, as part of the overall thing in terms of where licensed users may have large amounts of spectrum that is used very little, as was observed before, big holes in the spectrum in the time geography space, if you will. Being able to enforce rights of ownership to preclude the

efficient use of that spectrum by other types of systems that could share effectively is inefficient. Thank you.

DR. LUCKY: Okay. Larry, do you want to respond to that before we go on?

PROF. LESSIG: Yes. I want to respond to the last two comments together. I completely agree with Mr. Epstein's conception that we ought to be thinking about the cheapest cost avoider here, as we think about the problem of deployment, but the FCC could help facilitate a cheapest cost avoider here. For example, you're worried about the wi-fi network problem conflicting with the red herring, or the video camera, something like that. Fine. Again that, I think, is one of the benefits of the suggestion that we have in the 5 gig area a mac layer that the FCC could help facilitate the development of, because if that were true, then the cheapest cost avoider would be the person depending on the wi-fi network, moving into a network space where there's a protocol layer that facilitates interaction among a number of these different technologies. So what has to happen, as you open up the space where you facilitate cheapest cost avoider moves, which in that context then would not

be buying everybody a new red herring. It would be moving into a space where you could rely upon protocols not conflicting.

DR. LUCKY: I think we have a new brand for microwave ovens, you know, see a picture of a red herring on the cover. Okay. Over there.

MR. COOPER: I wanted to get back. Larry made a important point.

DR. LUCKY: You want to identify yourself.

MR. COOPER: Mark Cooper, Consumer Federation. You asked the question, how will we know if there's meltdown? We started with highways. Has the highway system melted down? I mean, rush hour here in Washington, I think the definition given over there is that the throughput has declined per capita, only in rush hour though, so it hasn't melted down. And then you ask yourself the question, what is the solution? And the solution is obviously, may well be mass transit. And we get to Larry's point, that we're really not asking questions about highways, but about transportation systems. And we ought to be asking questions about communication systems, as opposed to this little set of applications in this

little part of a much, much bigger system.

And I think if you think about it that way you escape from the tyranny of the meltdown and the need to find some narrow economic way to solve that problem here, because you've lost sight of the much bigger system.

MR. REED: Actually, I'd like to amplify that. In my filing, which I'd be happy for people to read because it gets into a lot of these issues on a technical point, I pointed out that if I were the FCC, I would focus on basically changing technically certain things. One is, eliminating the idea that repeating is a bad thing, because that's what prevents the development of networks in these unlicensed bands. For example, ultra wideband was created with an explicit bar against repeating in the recent rules. And, you know, that seems to be a knee-jerk phenomenon that, to me, comes from the idea of barring competition, rather than any significant technical reason.

The other is, and referring to this, we really ought to consider wireless in the context of the wired networks and the optical networks and so forth to the world. It's an Internet-worked world now, and we ought to -- if I were to say one thing,

rather than focusing on services, i.e., applications, the FCC ought to have a network bureau which is focused on network infrastructures among all the technologies, rather than services as stovepipes on technologies, and that would eliminate this whole band question, because bands wouldn't be assigned to services. Bands would be assigned to transport beams, just like we don't assign railroads to carrying people versus freight. Well, actually we do the cars, but the tracks are shared among all these applications, and provide a common infrastructure. And that, you know, what Mr. Cooper said really sort of emphasizes a complete 90 degree mindshift about what we're regulating here. We're regulating communications, not regulating, you know -- we're regulating bits, not hertz.

DR. LUCKY: Well, you know, David, this deserves a little more discussion, because in concept I agree with you. But traditionally and for practical reasons, we have regulated hertz. You know, it's like putting up fences in that commons. You know, it's been a useful mechanism, and there are things that break that paradigm, like ultra wideband, that don't naturally, you know,

need or have fences at all. So although I agree in concept that you ought to worry about communication and not hertz, practically it's hard to avoid what they have done in the past; and that is, worry about hertz, because it sort of sets the fences. It makes partitions the problem in a space which makes a problem more easy to regulate.

MR. REED: But actually, if I were to go back to Marconi's time, and say we should do it differently, we could have followed a very different path.

DR. LUCKY: We could have, but we didn't.

MR. REED: So we've got a path dependent evolution up to this point, and I fully understand the reasons for that, but those reasons no longer obtain. And, in fact, they're really hurting us right now. And, in fact, what we're extending is this sort of metaphor, you know, of band boundaries.

You know, every radio signal is infinitely wideband. It interferes with something. You know, it just may not interfere very much. And, you know, technically there is no way to have a narrow band radio signal. The proposals of say

the auction guys that will do microband auctions or whatever they're talking about, you know, both in space and time, make no technical sense whatsoever. It's a lawyer's notion of, you know, boundaries which doesn't make sense. A fence really works but, you know, if we were trying to draw fences around the air that we breathe so that we could allocate it fairly, you know, we'd understand it was absurd, and in this spectrum it is getting to be as absurd as that so, you know, people are talking about protecting the satellites in a different band from 802.11, because there might be enough of that that it dribbles over the boundaries enough, and that's not the place to -- you know, that's not the way to define what we do.

DR. LUCKY: There's a terribly interesting philosophical question about what should be and what is. And what happens is --

MR. REED: Well, I think we can go there -- we can get there if we start now, moving in a direction that's productive, rather than locking in, you know, 70 year old approaches.

DR. LUCKY: I think when we come back, we can pursue some of this. I'll take one question or comment from the audience, and then we're going

to take a break.

MR. GODFREY: I'm John Godfrey with Sony Electronics. I think the right answer is to do both, to proceed on two paths at the same time. Certainly, the very wideband systems offer a revolutionary way forward. The biggest obstacles they encounter are political, and it's not only Darwinian competition, or people resisting Darwinian competition to their businesses. It also includes government users of spectrum who don't want to move, or there isn't the political structure in place that can find a fair way to compensate them for moving.

There's a lot of work that has to be done on the political structure to allow that to move forward, but we should try. We should do some experiments with underlay technologies and see how it works, begin to build interest in that, begin to reduce the fears around that. But at the same time, I think it would be terrible if today's workshop didn't also conclude that we have to, at the same time, look at some discreet ISM-like bands for unlicensed services to operate, where you have cleared out the people who would have the right to shut down those unlicensed services any time they

feel they're being interfered with, which happens all the time in the world today. And that's about it.

DR. LUCKY: Okay. I think this goes to Larry's comment earlier about the difference between technical interference and competitive interference. And perhaps you'd like to end with a comment about that.

PROF. LESSIG: Well, I would. And I think that there's political resistance. I also think, to follow what David was saying, there ideological resistance. And here's where I agree with David, lawyers and economists are doing the most harm, because they're committed to a particular ideology which made sense in a whole bunch of contexts, without looking at the particulars of the technology.

Now what's interesting about this debate is that if you talk to the big band people, they say that their god is Ronald Coase. And if you talk to the spectrum as commons people, they say that their god is Ronald Coase. And let me just make a little plug and an advertisement. Just yesterday, Ronald Coase agreed to participate in a conference at Stanford in the spring, where we will

debate this property or commons idea. And at the end of the day, there will be an oral argument, and he will be the Supreme Court judge, and he will hear both sides, and have the opportunity to ask questions, to finally resolve this question where Ronald Coase is in the formation of this ideology that haunts, and is the specter haunting this debate.

DR. LUCKY: Fascinating. Let's take a 15 minute break. Thank you very much.

(Off the record 11:21 - 11:34 a.m.)

DR. MARCUS: Okay. Here is the list of speakers we have for the second panel. Like for the first panel, we're going to have several groups of questions. This time we're going to have three groups of questions, and we'll give you a sneak preview this time so people don't try to jump the gun. But we're willing to be a little bit flexible as to which batch of questions you ask in. Again, if you ask a question, we ask you to give your name and affiliation.

The first batch of questions deals with general issues of how you might improve Part 15, or improve protection to other types of systems from Part 15 devices. The second class of questions

will deal with specific Part 15 limits, such as the emission limits in Section 15.209, which apply to everything under 50 gigahertz, but then above 40 gigahertz, we have a totally different regime, or the limits of 15.203, which are -- restrict what type of antennas you can use with an unlicensed system, and in requiring in most cases that systems be sold as a turnkey system transmitter antenna and cable in one fell swoop. And the third set of questions deal with both possible needs for new classes of systems, and questions of should we have different power limits for indoor, urban, suburban, rural areas.

So why don't we start off with the first set of basic question for the panel, and then we'll go to the audience, of what changes to Part 15 might be needed to enhance the application of Part 15 devices, or conversely, is there a need for any changes to Part 15 to enhance protection to licensed systems that share the same or nearby bands? So who on the panel would like to go first on that one? Okay, Dudley.

MR. FREEMAN: I think one of the issues is the ability to change out the equipment. Right now equipment manufacturers are having to sell the

entire system, including cables, connectors, antennas, radios and indoor units connecting up, and I think that actually the manufacturers are building radios and indoor units. They really not in the antenna manufacturing business, and there is a 23 dB gain antenna, that is the spec for that specific system as a whole system that the end user should have an opportunity to say hey, I want to buy an antenna from XYZ Company, as long as it meets the criteria and is type-accepted on filing, they should be able to change that out.

DR. MARCUS: Okay. Well, let's go into that in a little more depth in the second batch of questions, but certainly that's a point we've heard a lot in the comments. Are there any other -- anyone else on the panel would like to speak on it?

MR. LEARY: Sure. I think in general, Part 15 has been phenomenaly successful, and I guess some would say visionary when it was created, for allowing vendors like ourselves to do things that were never intended. However, there still is perhaps too static a nature to the rules, and I think the rules can be amended such that, you know, they promote spectral efficiency a little bit more,

maybe within some sort of ratio or log rhythmic ratio that takes into account power, spectral density, and even spatial density in terms of omnisources sectors.

For example, you know, we would contend that perhaps the lowest power device should be, you know, a very low efficient device that's, you know, sitting on omni say maybe 20 dBM, but that same device when applied to perhaps the 45 degree sector should be allowed maybe a bit more power. Or that same device, were it a bit more spectrally efficient could have a corresponding higher power allowed even out of an omni, and then even more so out of a sector, so it would promote the development and innovation of more spectrally efficient systems.

I think the way that the rules are now there is some degree of limits that vendors can do in terms of building in very efficient systems or intelligent systems that are able to avoid other systems out there, et cetera.

DR. MARCUS: Okay. I didn't mention the word "etiquette" per se, but that was a good discussion in the previous session on etiquette, and when we talk about the issue of what changes,

etiquette certainly might be a change that might be considered either one way or the other.

DR. deVRIES: So when I started thinking about this, Paul Kolodzy challenged me, and challenged us to come up with, you know, new ways to categorize the different concepts here. And it struck me, and I'm not a lawyer, and I'll leave it to the lawyers in the room to, you know, turn this into the appropriate terms, but there are a couple of dimensions when we think about allocating spectrum that come into play.

One of them is how you think about the locus of control. Who has control over a particular use? And typically if we think about "licensed", there is one party that is, you know, given the license that controls the spectrum. In "unlicensed", typically, you know, there are many people, so the locus of control is completely generalized. And where we've ended up, I think, is that there is a one-on-one correlation with all sorts of different parameters with these two things, and I don't think it necessarily has to be that way.

And when we've started thinking about the problems that we want to solve which is, you

know, how do we make sure that we get broadband networking to the American people? We've come to the conclusion that it would be good for the FCC to think more broadly about what the choices are, so specifically in terms of locus of control. So right now we have that, you know, you control the spectrum an there's one kind of use. On the other hand, where you have "unlicensed", anything goes.

Those two things, those two correlations aren't built into nature. There can be other variations, so for example, what we're seeing is that there is definitely a trend for services that are licensed to use a particular area band, are allowed to do more generalized things. In the same way, we believe that it would be appropriate for generalized uses to actually be limited in some cases where there is no central locus of control, and that will get us to spectrum etiquettes which we can talk about later.

DR. MARCUS: Anyone else want to say anything?

DR. NEGUS: Yeah.

DR. MARCUS: Okay. Kevin.

DR. NEGUS: I think on the general subject of Spectrum Etiquette, and this goes back

to some of the discussions of interference and meltdown from the previous session, it's really important to understand the dimensionality of spectrum access or using the radio frequency spectrum. And we've tended traditionally to look at it as a frequency domain issue. To a lesser extent, but certainly some exists today, it's a geographic issue; that is, the frequency domain could be used in different geographies, but there's -- as the ultra wideband shows, there's also effectively a coding or an underlay dimension to it that can be exploited, but there's also a tremendous spatial dimension that can exploited, and hasn't been exploited in the regulatory regime very much, at least not as applied in the Unlicensed Spectrum. And I think this is what Patrick just started to allude to.

There's also a time domain dimension, and that's really where we're getting into things like dynamic frequency selection, where spectrum that is unoccupied in a specific geography, at a specific frequency, in a specific spatial orientation, at a specific moment in time can be dynamically allocated. And I think that when we factor all of these into the etiquette rules,

whether within the Part 15, or perhaps another comment from the earlier panel was we want to see more unlicensed radios, as opposed to unlicensed bands. When we factor that into how we would have unlicensed radios, radios that are licensed by compliance. Then that's the breakthrough that I think is going to allow wireless, quite literally, to replace wired networking. Not replace fiber across long haul, but within the local dimension, would completely replace wired networking.

DR. MARCUS: Could you say something a little bit more how you would exploit the spatial dimension in our regulatory world? If you were the FCC, what would you do?

DR. NEGUS: Well, I know Mike, and I know what he wrote on the 2.4 gigahertz and the point-to-point. I think that as one --

DR. MARCUS: This is a three-tenths of a dB --

DR. NEGUS: Right. Right. Right. I think that that is exactly the type of approach that needs to be applied across the board with Part 15, that as you narrow your beam width, your EIRP limitation is moving up. I think that's just a fundamental conversation of energy, or conservation

of interference concept that allows and incentivizes radio manufacturers to be much more efficient.

And here's the thing about -- I believe Bob mentioned in the first panel about multiple input/multiple output technologies, MIMD technologies. We are moving into a realm where Moore's Law allows us to build very sophisticated transceivers such that the affect of high antenna gain is something that is also programmable and steerable on the fly, on a per connection, or even a per packet basis that we can reconfigure dynamically and electrically the antenna characteristics.

And we should have, in the regulatory domain, the flexibility to access power and bandwidth, depending on our ability to do that, because as we narrow the beam, we'd lower our interference footprint.

DR. MARCUS: Okay. Anyone else?

MR. REILLY: Yes. Just on behalf of Cisco, I'd like to indicate that we believe that we should step back from this, as was suggested in some of the panels this morning, and look at this as kind of the complete picture. And we believe

wireless, both licensed and unlicensed, together with wire line infrastructures, have the potential to provide the new broadband access that works in networks that would provide services to all Americans.

We think the experience with wireless local area networks has shown us the capability of that technology to basically aggregate broadband demand. And as we look as to how we can best go forward, we think that the best mechanism is to, as was suggested by several this morning, to have additional spectrum, but have it not only identified for unlicensed purposes, but specifically set aside some for data networking purposes. And there would be some specific rules that would relate to common etiquette techniques that would be helpful with regard to mitigating interference situations.

One point I'd like to emphasize relative to that, as we heard this morning, there's lots of discussion about etiquette. I'd like to reinforce the issue that when we talk about this, I'm not suggesting that the FCC have rules that spell out in great detail what that etiquette would be, but rather leave the issue of having an

etiquette in the rules, and then allow for the marketplace to establish standards with regard to what etiquette, what kinds of techniques that might be available.

There are a whole host of very significant technologies that are currently emerging, but we don't know which ones will emerge tomorrow that will be even better, and so we think that it's best to provide minimum restraints with regard to the etiquette, and that's the point I'd like to reinforce.

DR. MARCUS: Carl.

MR. STEVENSON: I would agree with that. I think that to the degree possible, the Commission's rules should be as technology neutral so that we don't find ourselves blocked from innovation in the future. But again, going back to this idea of sharing and, you know, everybody seemed to agree that we could use more spectrum for systems that are licensed by compliance. I'm going to avoid using the word "unlicensed" from now on.

But part of the problem is, you know, the question was asked, well, where does this spectrum come from? Well, the spectrum can come from technical innovation in the industry standards

by those who develop the standards for these kinds of devices, where as was pointed out, the cost of computational power and the ability to do fairly complicated signal processing, and adapt dynamically to a time frequency geographic location environment, and basically, find all of the holes in the spectrum out there that aren't being used, and use them on a packet-by-packet basis even, perhaps. You know, the period could vary, you know, from small fractions of a second to, you know, hours or days when chunks -- significant amounts of spectrum are lying fallow because they're allocated to specific uses under this property rights sort of allocation model, and they can't be used by other systems.

By going away from this property rights model and allowing this sort of dynamic sharing, that's where the additional bandwidth for the future applications can come from in many cases. You run into the issue of how you deal with the incumbents who are, you know, going to try and assert their property rights and, you know, keep those pesky new-comers out because of concerns of interference, but that's where you get into the etiquette thing, where this -- you know, with a

relatively minimal set of rules that describes perhaps the behavior of an etiquette, or some basic requirements for an etiquette like - okay - you're going to share in a band that is nominally used by these people, and you're going to use little bits and pieces of time and frequency space adaptively. You will listen for the primary user and avoid them, and I think that's a very powerful model for the future.

DR. MARCUS: Okay. Thank you very much. Vanu is a designer of these types of things, and perhaps more hands-on than some of the other people here. Could you say a little bit about when you think these things will be available, and how powerful fancy protocols might be in the next couple of years?

DR. BOSE: All right. I -- so there's two categories of devices in this case, infrastructure and what we'll call client devices, whether they're in your hand, fixed local devices or even in a car. And the technology track varies on the two cases.

On the infrastructure side, the technology is basically ready today. There are less constraints in terms of power and size that

make it feasible to implement these systems in infrastructure devices today.

Now the cost isn't necessarily all that low at the moment, but this is really a chicken and egg problem. For example, to do the kinds of things we're talking about, and maybe not just in one band but across bands. Like maybe you'd want to look at the 900, the 2.4 gig band, and the 5.8 band and be able to grab the chunk you wanted at the time for the application you wanted. Well, that requires a very, very agile front end.

Now technically, there is no real barrier to building those front ends, but business-wise nobody is going to invest the 20 to 30 million dollars required to build one of these chips, because there's no market where you can currently use it, so the technology is ready. There needs to be the incentive for people to see there's a market for this, and that the rules will allow us to use these. Not only allow us, but it will be preferable to do it, in order to push the technology along.

On the hand-held side, things are further out because power dissipation is a number one factor. Inherently, when you build a device

that's more flexible, it's going to take more power than something that's single function. Okay? Anything that's single function you can always optimize for one purpose and make it low power. But I think in three years, you'll start to see some devices and certain applications, and in five years the technology will be viable for things like cell phones.

MR. LEARY: May I make a brief comment?

DR. MARCUS: Yes.

MR. LEARY: To expand, I think it's important as we get started here to kind of establish some definitions as I -- at least as I perceive them. I've read all the comments from everyone, at least on this particular panel, and most of them center around the concept of wireless as broadband.

I think it's very, very important to recognize, as Vanu just commented, that there's infrastructure and then there's client devices, or as what we might say, the last mile versus the last hundred feet. And it's important for people to recognize that those two technologies, as they exist today are -- although they have, share a lineage, they're extremely different at this point.

And it might surprise people to know that in the wireless broadband base where you're doing last mile, creating coverage over a broad geographic area, that there is not one company today that uses wi-fi based technology in scale within their technology to do this sort of thing.

Our's, maybe, is relatively close, but you have Proxim's Multipoint, Tsunami, Mind Breeze Access and many, many others out there in the marketplace, and none of these are wi-fi based. And it's important that we don't get maybe carried away thinking that that is the predominant, you know, technical savior out there for unlicensed that exists in probably its best application in the last hundred feet, whether that's in a public land, or in someone's, you know, private network.

DR. MARCUS: All right.

PROF. RAO: So the comment I want to make is that as services get deployed and the uptake goes up, it'll be important to keep in mind that there'll be competing systems that you'll need to simultaneously collaborate and compete in this space. And I want to sort of make sure that the rules that govern the forms of collaboration that are allowed in the Part 15 keep up with the

increased sophistication of how these things happen. So, for example, right now if I'm not mistaken, 15.247.8 prescribes exactly what kind of frequency hopping you can do, and what kinds of frequency hopping you cannot do, even for the express purpose of avoiding collisions. I think these sorts of things have to revisited if it turns out that there are more higher level notions that allow for open competition between competing space. I think we have to remain open to that.

DR. MARCUS: Let me ask Dudley one question. You mentioned the problem you have with antennas. As the only one on the panel who actually operates these systems commercially, are there any other regulatory problems that the FCC might be able to fix?

MR. FREEMAN: I think one of the fine points that we have to establish either independently or through the FCC, sometimes our database and registration situation so that all the paths that are put up around the country, there's a database you can go to and try to coordinate. It's very, very important that we do it today. And I think it's important to do it today before we open up more bandwidth, because it's even going to be

twice as bad as it is now.

What we're finding is we go out and do frequency coordination. We coordinate with our tower providers. We coordinate the entire path once it's engineered. There are many, we'll say cowboys out there who just point and shoot. And I think it's important to get the manufacturers together with the customers or with some type of coordination protocol, whether it be with the Wireless Communications Association, with someone like Comsearch or one of those organizations, that can pull together or take this information, put it into a database so people aren't stepping on one another. And I think it should be done sooner.

DR. MARCUS: Okay. Pierre, and then we'll go to the audience.

DR. deVRIES: Yes. I mean, to pick up on this point coordination, one of the reasons why we've been very interested in the space is we look at the broadband networking to the home situation, and we feel that we need to find additional ways to provide broadband capacity. So one of the things that I think was pretty commonly mentioned in the previous panel was it was good to say let's do networking, let's do packet networking.

And once we start thinking about that problem the question arises well, you know, what situation are we in, and where are we going? And I think where we are now is that the FCC in large part, I think, assumes that the devices that radiate are dumb, more or less. So essentially you say what are the characteristics of this device, and so we'll set the characteristics of its device, and then when it's out in the field, we're done.

What's changing is the devices are becoming smarter. They have more and more processing power, and they can, in fact, react to the situation they find themselves in. I've actually spoken to some vendors who are inside each of their little access points building databases of the environment that they find themselves in, and what the other radiators are, so that this kind of coordination, there may be centralized coordination, but there also needs to be coordination everywhere.

We have these smart devices. We need to get to a point, or we need to have part of the park open to devices that work well together. And that they actually take into account what else is out there.

The reason why we have to do that is that it's not just, you know, systems where there are administrators. WE're very excited by what's happening in 802.11, and one of the things that we see thee is that it's customers, citizens going out and putting their money on the table, and buying their own devices. They build their own networks, and in some cases, there are administrators, but these people are volunteers. And over time, if we're really going to get adoption of these technologies, you need to be able to go to, you know, the retailer of your choice, buy the device, bring it home and it will just work together with all the other devices that are out there. And in order for that scenario to play out, and we think it's essential that we enable that, we need to have smart behavior. We need to get onto the Moore's Law curve of these devices.

DR. MARCUS: Okay. Thank you very much. We'll now take questions or statements from the audience. WE're willing to be a little flexible in the subject matter. We wish that you, within reason, try to keep it so this general question of what type of rule changes might be needed either to enhance Part 15, or to enhance the

protection of systems from Part 15. And please give your name and affiliation at the beginning of your statement, and we'll start in this corner. We'll try to alternate sides.

MR. SNYDER: If I could ask the question I asked before. What is the FCC doing in relation to coordinating possibly GPS and Unlicensed Spectrum to have variable power levels, directionality, so that if you're in a rural area, you're not stuck with the limitations of the power levels of wi-fi and whatnot? Is that an issue on the table?

DR. MARCUS: Well, fortunately my boss would like to answer that, and I'm sure he has the right answer.

MR. THOMAS: Yeah. I'm Ed Thomas for those of you who don't know me, Chief of the Office of Engineering and Technology. Your question -- the way I read your question is, what are we doing to take advantage of the fact that the spectrum is not heavily used, say in rural areas, and more heavily used in metropolitan areas?

MR. SNYDER: Just to modify that, we're talking about a specific coordination problem using the intelligence of the satellite to coordinate

with your S-Shield system, so it's --

MR. THOMAS: Well, let me tell you what we're considering.

MR. SNYDER: Yeah.

MR. THOMAS: Okay. First of all, the direct answer to your question, are we specifically looking at GPS to do that? The answer is, we haven't thought of that yet, and now we have, because you described it. What we are looking at is the possibility, and please underline the word "possibility", and it says, shall we have different rules in different geographies, albeit, because of the demographics. There's a lot of spectrum available in the middle of a cornfield in Iowa, as compared to downtown Manhattan. And obviously, downtown Manhattan is probably more congested than some places out at the end of Long Island, so we are considering that. How you do the location, we haven't gotten that far yet, so all I could tell you is, it is under active consideration. It's being addressed by the task force that Paul heads up. Okay?

DR. MARCUS: As one who also read th comments, those of you who read the poor guy from Wisconsin who was trying to get data back from his

rural lake. When I get away from underneath this, it turns out Part 5 licenses, which we're going to talk about next session, can be used both experiments in radio technology, but also for experiments in support of other things. And the answer to the poor guy in Wisconsin, can he get more power for it, and his particular way of doing experiments is, we believe he can apply for a Part 5 license. And for that particular narrow case, I think we've found a near-term solution, but that doesn't solve the more general problem. But we've noticed in the comments, a lot of people raised that, and it certainly is getting some attention now.

Okay. A question on this side. One on this side. Okay. A question on that side. Nobody can think of any way to improve Part 15?

MR. LEARY: Have people obey the rules as they exist. That's the first step.

DR. MARCUS: Okay. My colleague, John Reed, who was here earlier, he left. But I guess maybe no need for him to stay because everything he's done was very good. All right. Vanu.

DR. BOSE: Yeah. I have a comment that gets to your initial question, which was, you know,

are there -- do the Part 15 rules sort of preclude the introduction of certain new technologies or services? The answer is absolutely yes, but it's important to know what they are, and know whether we want to deal with them in Part 15.

Fundamentally, there's two kinds of services that Part 15 does not deal well with. If you need service that needs guaranteed availability, so public safety communications, you wouldn't want to do that over Part 15, because in an emergency everyone else is going to turn on and you can't guarantee any minimum bandwidth.

The second that it doesn't do well with is if you have a system that requires guaranteed minimum latency. Okay? There's no latency guarantees. There are certain kind of communication you can't do or control, but for data networking, for a lot of things like cordless phones it works fine.

Now interestingly, there was a lot of discussion about the Internet in the first panel, and those are the same two kinds of communication that the Internet doesn't actually deal all that well with. Anyone who's tried doing Internet telephony knows there's certainly no guaranteed

minimum latency, but it kind of works most of the time, so the same way your cordless phone kind of works most of the time. And, you know, there are certain applications where guaranteed availability is required, not only public safety, but for the people who have large revenue paying customers who want to do that.

And so, the existing Part 15 rules wouldn't incorporate those kind of services very well. You'd have to go to a different set of rules, and I guess I want to throw open the question is, do you think it's possible to get a set of rules or an etiquette that could -- does one size fit all?

DR. MARCUS: Art.

MR. REILLY: Okay. I'd like to comment on an earlier point first, and maybe come back to that. With regard to the discussion about, you know, the rules and the adequacy of them with respect to registration, I just would point out, I think one of the great successes of the wireless land is due to the visionary drive of the FCC in recognizing that by having unlicensed, and putting it in a position where you could innovate, but you've also provided the user with an opportunity

to meet their needs with a minimum of overhead associated with the purchase, the registration, et cetera, of the product is very important. And as we've talked about in the first panel and this panel, I think everyone sees the benefit of moving in a direction towards having, you know, etiquettes of some sort in order to, you know, improve mitigation techniques. So I think the technology is driving us, you know, away from the interference issues, and so issues of registration and other techniques like that that would provide either a barrier, an obstacle that the user would have to consider in making a purchase is one that I would not favor, but rather to build on what we already have and to try to look for new opportunities.

In fact, I think as we look, you know, at additional spectrum that the FCC is considering, we may need to look to see whether we can extend that innovation that the FCC has introduced by perhaps having, you know, licensing rules that provide the same sorts of opportunities, where there is a minimum opportunity or expectation of interference, where you go to processes that are licensed, but have a much more expedited process. So I think we'd be moving in the wrong direction if

we're looking to, in fact, register or license with regard to the spectrum that we're currently talking about. Thank you.

DR. MARCUS: Anyone else on the panel? Dudley.

MR. FREEMAN: I think that registration is important because we're finding as we build out that standard components that are being bought off the shelf are being modified by, shall we call underground amplifier manufacturers. I think Mike and I have a discussion about this many times where people go out and buy a much bigger amplifier and stuff it into a Pringle's can, and bang, they're radiating the entire neighborhood much further than they were supposed to under the rules of Part 15.

By registering them, knowing where they're located and where they're operating makes the system work a lot better, whether it's done outside the FCC, or whether it's done with an outside association like the Wireless Association, and/or it's done between the manufacturers, makes it a lot easier.

MR. LEARY: With respect to registration, you know, it's something that, you know, we tossed around quite a bit. We try to

identify our own operators out there, and even though, you know, we sell to them, the nearest we can come up to is okay, there are somewhere around 600 of these guys. How many each of them have in their own network is hard to say, anywhere from a couple of thousand down to two. But we think there is a case that can be made, not for licensing, but having some sort of requirement that people that are operating for-profit networks declare themselves.

I'm not talking about people, you know, at their home, or schools, or whatever, but people operating for-profit networks should have maybe some requirement. There is no right to use a spectrum in a business, perhaps it's a privilege, that they should have some means of declaring themselves, maybe lat longs of where they have their wireless pops out there, and maybe the nature of their equipment, and that goes into a centralized database. Maybe one that's public friendly, so the public can access it in terms of, perhaps, finding service, so there are different ways that you can structure that. But right now, we're trying to solve a problem which no one is able to quantify or entirely qualify, and that's a

problem.

DR. MARCUS: Would the government add value to this, or could -- industry want to do it? Could the industry just do it itself?

MR. FREEMAN: The question is, is getting everybody in the industry to want to do it. So you have to -- I think the FCC has to set the tone.

MR. LEARY: I think it could be done under -- you know, it could be done under contract, perhaps, with very little --

DR. MARCUS: Okay. We're about to go to the next topic, but does anyone in the audience have comments on this particular -- on these issues? I will go over -- someone --

MR. SNYDER: A general spectrum etiquette issue, it seems to be that the world's great innovator in Unlicensed Spectrum is the U.S. Military right now, and with their software-defined radio, as I understand it, they've got a zero to gigahertz type of device. And, of course, when they go to Iraq and other countries, they don't have a license, so they go in and opportunistically use Unlicensed Spectrum where they need it. And my question to the panel is, are there any lessons

from what the U.S. Military is doing very creatively in using Unlicensed Spectrum? Of course, a very different model than what we're thinking about here for us. And in particular, why not take their software-defined radio and say hey, that will be our unlicensed device. It will go up and down every unused, you know, unlicensed thing, and this is the type of thing we'll use. Are there any lessons from the U.S. Military for us here?

DR. NEGUS: Yeah. There certainly are. In fact, when I met Paul was he gave a presentation on that exact project at DARPA and the research that they're doing. And my comment to Paul, the first time I met him was, you are doing exactly what my customers want to buy. There is no question that that is exactly the device that we at any of the commercial wireless land manufacturers, or outdoor equipment manufacturers, that we can build that. We don't necessarily can build it in every way, shape and form today, but Moore's Law means we build it in two years, four years, six years, have better and better characteristics, cheaper and cheaper. So what is holding us back is we are not the U.S. Military where we can unilaterally say gee, I have found -- I am in rural

Wyoming, and I found 800 megahertz of spectrum here that I can use at this instant in time. I'll just go ahead and do it. Okay?

That's what's really holding us back, and that's really the regulatory breakthrough, because the technology is going to be able to exploit all the dimensionality of the spectrum access issue, the ones that I discussed earlier. So what we need is a change from the FCC from regulating frequencies to regulating spectrum access, and that means regulating across these various dimensions, including time, space, spatial orientation, geography, frequency, and coding.

DR. deVRIES: Not only do I think we need to learn from the U.S. Military, I think, you know, we need to find a way to work with, and live with the U.S. Military. There was a lot of talk this morning about, you know, do you need extra spectrum, and if so, where are you going to find it? And the 5 gigahertz band there are opportunities there in the middle of the band to use the spectrum where there are military uses. And a number of people are trying to understand in detail what the military's requirements are there, what kind of interference they're worried about.

And there are definitely indications that the kinds of things we talk about in terms of spectrum Etiquette, seeing what's there, and if there's something that you will interfere with, backing off will, you know, address those issues. But it becomes more interesting than that too, because the DARPA projects very often talk about mesh ad hoc networks, and these are the kinds of networks where, you know, somebody turns up with a radio. It finds all the other radios, and it places nicely together with them, which sounds a lot like the problem that consumers have when they buy radios, and the problem that consumers have when their neighbors have radios, or microwaves, or other things. Which takes us to the issue of, you know, what is the role of the FCC in these kinds of, you know, unlicensed bands.

I think not only should it be a question of allowing unlicensed bands for experimental uses to find new technologies, but also we should be experimenting with new kinds, new permutations of how people are allowed to use the bands. And specifically for data networks, if we said that there was a kind of what we're calling it, license by compliance where, you know, packet

data networks would operate, that might be able to allow neighbors to play well with each other, not have to worry about rogue cheap microwaves or whatever the red herring of the day is.

DR. MARCUS: All right. It may be that we've driven all the hardcore license people out of the room, and everyone thinks unlicensed is wonderful, so let me raise a variant of this question about the military radio. Military radios are in an uncooperative environment, and have to figure out what's going on. And if they make a mistake and land on say an Iraqi frequency, it's not the end of the world, because if you're shooting at them, who cares if you land on their frequency occasionally.

And on the other hand, if you are a licensed user in an adjacent band, an occasional accident is a lot more annoying, so could the panel say something about the ability of radios to passively figure out what the holes are and the reliability. However, also in the civil environment, you don't have to be purely passive. One could have radios that instead of looking for holes passively, have more interaction with other users to find the holes.

MR. STEVENSON: Yeah. I'd like to sort of amplify what Kevin was saying. I had a briefing at DARPA last Friday, and was very pleased to see the work that they are doing there in this opportunistic flexible use of spectrum. It resonated very, very well with the sorts of things that IEEE 802 suggested in our comments, and I think they were pleased to see that, you know, we were thinking along the same lines.

They're looking, I believe, to avoid conflicts between non-government use and government use of the spectrum by using this sort of technique, as well as doing their opportunistic thing in some foreign battlefield where they have to go in and set up, you know, networks with no setup time, and find the holes where they can live.

Part of the problem again is how do you deal with the incumbent licensed users who feel that they have a property right to keep you out? The Commission ultimately, I think, will have to mandate that these licensed users accept this sort of an underlay and efficient use of unutilized spectrum. And it sort of also plays into a question that you asked about how do you deal with legacy receivers?

I don't think that in the sort of environmental direction that I'm suggesting we need to go in, that you can go permanent, you know, forever protection to all of the existing legacy technologies. And I would not suggest that you pull the rug out from under people that have made an investment in things, but things get replaced with some, you know, useful lifetime replacement cycle. And the Commission could provide some sort of incentives or mandates, perhaps, that would require incumbent users to effectively upgrade their technology, and be more robust, and more cooperative, and more efficient in their use of the spectrum. And this together could promote more sharing.

DR. MARCUS: One more comment from the panel, and then we'll go on to the next step of topics.

DR. BOSE: Yeah. I'd like to follow-up on actually your response to the original question on the military software radio. My company is actually involved in that project and, I mean, what you described is the sort of ultimate vision, which isn't there yet, but is certainly working towards it. But I think Mike's point is right, that the

way you want to use it in a commercial setting versus a military setting is different, but that doesn't affect the underlying technology.

The same basic technology can be used with a different protocol or different etiquette to serve the kind of commercial needs that you were getting at, so I think the military has done us a favor there in advancing some of the technology development. Now we need to figure out the etiquettes and make the rules such that these can be used in the commercial environment.

DR. LUCKY: Okay. If there aren't any more questions, I mean, we ran out of questions. It's just more of the same, and I'll get to you back there in a minute, if I may. But, you know, I'm sitting here kind of confused.

The thing is that we've been talking about how there should be rules, but there should be no rules, everything is changing. The FCC has a problem is that they have to do something, and we've painted a blank canvas here that makes it almost impossible to do anything, so I'd just like to get a lot more specific just for a minute, if I can, to kind of clear up my own confusion.

Let's just suppose, as a thought piece,

that we open up a new band of unlicensed, and that you have to decide the rules this afternoon. And the question is, and I'd like to ask everybody. I'll just take a show of hands here for a minute, because there's a lot of intelligence in this room. What you actually would do if you were able to create a new band this afternoon?

First question, we've all -- we've heard that if people cooperate and adopt a particular protocol or some sharing thing, you could get more efficient use of the band. Now the problem is that technology keeps changing, the protocols keep changing, and what might have seemed like a good idea this year, might not be a good idea next year. So the first question let me ask you all, would you mandate a particular etiquette in your new band? Raise your hands if you would.

MR. STEVENSON: I would encourage the use of industry standards as the basis.

DR. LUCKY: How do you encourage it? Look it, you've got to actually do something. The band is going out there, you know. You can mandate it. I don't know how you can encourage it, but nobody would mandate an etiquette. Is that correct?

DR. deVRIES: Okay. So let me take a crack at it. We haven't had enough disagreement here today.

DR. LUCKY: That's what I'm trying to get here. Okay?

DR. BOSE: I think we got it.

DR. deVRIES: So I think the first thing that would be worth doing is to say yes, we should have some specialization in this band. I would say, since I'm going to make the rules on this band, I think what we need more of is broadband data networking. And so, I'm going to say in this particular band, what we're going to do is, we're going to say, let's say this is reserved for packet data networks, number one. So no more, you know, blasting TVs, you know, no baby monitors, et cetera. So the second thing I'd say is we are going to define some rules in terms of how devices get access to that spectrum.

The things that already are showing up in the industry, both here and overseas, are very simple practices like dynamic frequency selection and transit power control. In fact, the playing nice together issue is not the industry disagreeing with each other. It's the industry not being able

to deal with other people who are not in that process responding to that, so I would say that.

What I would not do, and what I'm very wary of is saying we are going to specify a particular protocol at, let's say the medium access layer that would actually say, you know, I'm making some decisions about what applications, so you could make a decision about the MAC layer that would advance as, let's say, real time streaming, but create other problems with, let's say, latency. So I wouldn't actually be that specific, but I think if you said dynamic frequency selection, transit power control, packet data networks, then you would have something to begin with.

DR. LUCKY: Packet networks. Okay. Other comments on that?

MR. LEARY: Yeah. I don't -- I mean, maybe I don't think it is all that complex. Etiquette comes into play when you have an environment where people don't necessarily play by the rules that even exist. I think if you had -- here's a new band. Let's make it, you know, under one gigahertz somewhere. Obviously, we have to take into account the physical realities of the spectrum.

I think you have a couple of very simple rules like I've already touched on and Kevin has, where you take in the spatial dimension, you take in the time domain, you take in the spectral efficiency, and all --

DR. LUCKY: We're not getting simple any more here.

MR. FREEMAN: But, Paul, I think actually it is simple.

DR. LUCKY: Okay. Fine. Let's --

MR. LEARY: From a manufacturing standpoint, I mean, we already do automatic transit power control, things like that. But the problem is, you know, that listens to all the other noise out there, that other system, so you if you have a packet-based piece of spectrum that's based for, you know, broadband data, perhaps, that eliminates a lot of stuff out of the equation. And then if you make it with these very ratio-based rules, then the vendors are able to develop product where there really virtually is no limit in terms of the kind of efficiencies and the kind of improvements we can see. And then you do that, and then maybe this etiquette is not so necessary because the radios are doing it themselves.

DR. NEGUS: Yeah. I agree. I think that you -- as manufacturers what we want is more of everything. Okay? We want more bandwidth, more power, more flexibility. And you simply need to incentivize us to do the right thing, so again, you get back into power. EIRP, if you give us more EIRP as a function of --

DR. LUCKY: You're it this afternoon.

DR. NEGUS: Yes. Yes.

DR. LUCKY: You're giving me more power. Part 15 is out.

DR. NEGUS: Yes.

DR. LUCKY: You're giving me more power, and what about the rules --

DR. NEGUS: Well, let's take a specific band, 54.70 or 57.25, which is a petition in front of the FCC right now. If we were to say we're going to allocate that band for unlicensed communications, how would we write the rules? I believe --

DR. LUCKY: Well, I'm letting you write them. Okay, so you're going to raise the power limit. And what about the directivity, or are you going --

DR. NEGUS: Yeah. So that's what I --

I would take up on Patrick's point. I would make that the power limit is -- and we can argue over formula, but at the end of the day it's not complex, because as manufacturers, once we know the code, the formula, we know it. So the formula would be reward you for spatial orientation. It would reward you for transmit power controls, that is using only the power you needed. It would reward you for dynamic frequency selection for getting on the band, a channel, only when that's --

DR. LUCKY: You mean reward, you get --

DR. NEGUS: You would get more bandwidth.

DR. LUCKY: -- more power if you use dynamic frequencies.

DR. NEGUS: Correct. If you use transmit power control, if you use spatial orientation, if you use higher efficiency modulation, all of these factors.

DR. LUCKY: So the incentive always would be more power that you're allowed.

DR. NEGUS: That's what we always want.

DR. BOSE: Now, but that -- okay.

Good, we have some disagreement.

DR. LUCKY: Okay. Good.

DR. BOSE: So, okay. Let me -- I'm going to answer your question by putting up a strawman of what I would do with that band.

DR. LUCKY: Okay. You're it.

DR. BOSE: Yeah. So fundamentally, you know, there's a band, and I -- if I'm the Commission now, I'm not omniscient enough to know what the best use is. And I certainly don't know what the best use is going forward in the future, but I know people are going to want to use it. And I know that to some reasonable degree, they shouldn't interfere with other people, so what I propose is you have a band, and you're able to go licensed, for lack of a better term, for ten minutes, ten days, ten hours, for a certain geographic location any piece of that, subject not to an etiquette, but certain rules. And the rules -- the key thing with the rules is the Commission has to set not only emission standards, but minimum receiver standards, because that's the only way you can deal with increased background level which you're going to get from these systems, so I propose the following.

For any chunk of band that you're going to limit in my new band here, you have a limit on the bandwidth, and you pay for that much. You have a limit on the power you can radiate in that bandwidth, and a limit on the absolute out-of-band emissions going out as a function of frequency. That's the emitter limitations.

On the receiver side, you're going to say look, you can work in this, but your receivers have to tolerate a certain amount of background noise, a certain amount of co-channel interference, a certain amount of adjacent channel interference. That's it.

Now by setting that rule, my emissions parameters guarantee that the guy in the next chunk of band over, is his receiver is doing what I've said it needs to do, my emissions won't interfere with him, and vice versa.

Now within that, I have this chunk of spectrum. If I want to do a data network, that's fine. If I want to do voice networks, that's fine. Where does the spectrum --

DR. LUCKY: So you're not going along with this data network stuff.

DR. BOSE: Well, no. I'm generally a

fan of data networks, but there are many types of data networks, and there are certain data networks that have QRS guarantees. There are certain ones that allow lower latency. There are ones that allow wider bandwidth, so there's no one solution.

Fundamentally, everything is data, and it's how you use it, but I would let the market decide, and let the people deploy what they want. Give them the spectrum to use. Let them pay for it, or license it, however you want. Make sure they don't interfere with other people, and let anyone else do whatever they want next to them, subject to those same rules.

DR. LUCKY: Okay. So you're really adding the element of receiver regulation in your --

DR. BOSE: I think it's essential.

DR. LUCKY: Very interesting, yeah.

DR. BOSE: Yeah, because, you know, otherwise you wind up with the UHF TV again. Right? What limits the efficiency of UHF TV is those lousy receivers that --

DR. LUCKY: Now in your band are you going to do what Kevin suggested, have incentives for people with directive antennas and stuff like

that?

DR. BOSE: I would like to see the incentives come in in the market, so I'm going to pay for that spectrum, lease it for -- even if I lease it for ten minutes. And the amount I pay is proportional to what I think the use is. And gee, if I can get more calls and more data through, I'm willing to pay more, so there's -- I would like to see the economic incentive be there for more efficient spectrum, yes.

DR. LUCKY: Who would you pay?

DR. BOSE: So there's two ways to do it. The one is, people license bands, and then we need secondary markets, fluid sub-licenses, a spectrum market, so you pay whoever the current holder is.

Another way, which I'm not as big a fan of is, it's the FCC. And you keep going to some central server and paying them a few nickels every time you want to get a chunk.

DR. LUCKY: I think one of the problems there could be transaction costs, if you get --

DR. BOSE: Yeah, okay. There are always transaction costs, but I think there's two components to that. And the big one today is

really in figuring out your legal liability if you interfere, et cetera. I mean, what I heard in some earlier meetings was that the biggest transaction cost is just getting the lawyers into the rooms for both companies to figure out if we trade the spectrum or let you use it, what's our liability.

DR. LUCKY: It's a real cost.

DR. BOSE: But now, if you limit the receiver and transmitter, as long as you abide by those, you've limited your liability. And I think yeah, transaction costs are high today, but there are plenty of models. I mean, let's go right to the stock market. Well, why shouldn't we think of this as a commodity like stocks, where transactions can become very low? They might not be low on day one, but they should be able to get there, if demand for spectrum is there.

DR. LUCKY: Okay. Let me open it up to the audience. You've got this band this afternoon. Anyone have a proposal what they want to do? In the back.

MR. REED: Yeah, David Reed, Reed.com. I think the crucial thing that I would do, and I'm very much a fan of letting the market decide what it's going to do with it, but the crucial thing

that enables a market to decide is the ability to change its mind. And so, the single primary thing I would do is require that the radios in that band be cognitive. And the definition for me of cognitive is an extension of the idea of a software-defined radio, so that they can, over time, adopt new etiquettes that work better than the old ones that didn't work very well. Certainly, the first draft will be wrong.

And second, they have the ability to sense a much wider part of their environment than just the signals they're trying to receive, so in order to enable all of this stuff we're talking about, you've got to have receivers that can, you know, bond to what's going on, that enable the kind of etiquettes to work. So the key thing here -- and then the other thing I would require, which is sort of number two that this enables, is network cooperation; that is, that it should be legitimate and required that you minimize your emission by what we call cooperation gain, which is the notion that through repeaters, or coding, or whatever, you jointly use the minimum energy possible to get all the signals of all the participants, rather than having competition on a point-by-point basis.

You know, one of the flaws with some of the traditional etiquette things are they're centered on one node doing what's good for it, and that's an unstable economy, even when you put a market framework underneath it, because it doesn't incent cooperation. So what you've basically got to do is say that the etiquettes which might be deployed by consortia or groups of users, you know, need to be changeable over time. That's the software-defined radio part, and auditable by outside parties to see if they're doing the best they can, or are --

DR. LUCKY: Okay. So you've got a new band called the cognitive radio band.

MR. REED: Right.

DR. LUCKY: And it's the certain basic policies that people must adopt to use this band, and one is cooperation.

MR. REED: Right. And the way to enforce cooperation is a market means of cooperation, which is basically that if you don't cooperate, you don't get to join these large beneficial networks, and you're left out in the cold.

DR. LUCKY: So the FCC decides if

you're playing by the right rules with your cognitive radio?

MR. REED: No, the other -- the networks are allowed to, for example, refuse service to you. So if some network is, for example, providing --

DR. LUCKY: Who is the network here?

MR. REED: A network is a collection of nodes that decide to cooperate, operate on cooperative protocols. We know that good networks tend to have increasing returns to scale, and so there's a strong incentive to cooperation built into the network. And if those networks have access to such things as the public internet. In fact, if they have a say, you know, a collection of T3s distributed around the city, by merely refusing to provide Internet access, they create a huge disincentive for non-cooperation, so I think we can use the networking level to incent cooperation without very much FCC involvement.

DR. LUCKY: Yeah. TCP is such a great example of that kind of thing. Anyway, comments?

MR. LEARY: Whatever happens, cooperation, etiquette, predominantly it needs to be something that's done electronically, because

there's -- and here's a point I'm always big on that very few people, especially in the -- I don't have the burden of a Ph.D.

Sociologically, things are done very, very different in unlicensed as they are in the licensed community. You've got to account for the way people use technology. And in the unlicensed space, you are always going to have a large degree of cowboys out there, whatever extent. So cooperation, etiquette, all these things and, you know, playing nice, if they require people to do these things, it's not going to happen very well. Predominantly, it has to exist within the technology itself.

DR. BOSE: Are you talking about cowboys within the rules, or cowboys that break the rules?

MR. LEARY: Cowboys that break the rules.

DR. BOSE: So people who use 5 watts in the --

MR. LEARY: In the unlicensed community, it's chronic. And it's just the way it's always going to be, because it's human behavior.

DR. BOSE: Is it a problem? Who's getting hurt?

DR. LUCKY: I've got to say something on the other side myself. I mean, I think you can concentrate too hard on the idea that people could break the rules, because I think the predominant manufacturers of equipment will play by the rules. And that occasionally, you get somebody who doesn't, and make an example of them. And I just wouldn't personally --

MR. LEARY: It's not the manufacturer. It's the implementer.

MR. FREEMAN: How do you catch them?

MR. LEARY: The manufacturers I'm not worried out. It's the implementers.

MR. FREEMAN: How do you catch them if they're not registered, and you don't know where they are?

DR. LUCKY: Well, I mean, I just think you can over-emphasize that as a problem. Let me go on, just personal opinion.

MR. CRAIG: Andrew Craig, Wireless Communications Association. Picking up on this last dialogue, but also the original question of the imaginary rules for the new band, a quick

comment and a question.

I think it's very significant in listening to the discussion that the two, or two representatives of the outdoor last mile community, a leading manufacturer and an operator, are both trying to focus the attention on a distinction between unlicensed and registration. And for one thing, I think that brings out the value of this kind of wide ranging discussion, but the question is, how do those who are primarily in the software arena, or indoor arena, think that that would play out? Again, that distinction between some kind of idea of registration, so that people can coordinate in what will always be unlicensed bands?

DR. NEGUS: Well, I can tell you for starters, there is no coordination for mobile devices. If what we're suggesting from the fixed wireless side is that you're going to have a national registry of coordination on fixed devices, I think that's one solution to the problem. I think that self-organization and self-registration, if you like, by cognitive radios that can do this, is probably a better long term solution. I think that's a short term view.

But for mobile devices in the indoor

environment in the last 100 feet, this is nonsense. I mean, you're not going to coordinate them. They have to self-coordinate. They have to be able to sense the environment, and the technology exists. That's not the same thing as saying that the devices today, based on the standards that we have today, they don't do that, but the technology completely exists. And I think what the FCC should be doing is incentivizing us, as manufacturers, to use that technology.

DR. deVRIES: I'd just like to pick up on a point you made, Bob, in terms of, you know, if we create any rules, what happens to them as technology changes? And I think that's a very interesting point, because there's always a tension between a desire for stability, and a desire for innovation. It's like, you know, do you want to pay less taxes and get more services? Yes. It's the same kind of thing, and so one of the things I speculate that may be interesting to do is when one actually creates, you know, new experimental unlicensed regimes, or licensed in different ways regimes, that one actually puts a time limit on them, or a sunset on them.

One of the things that's really common,

you know, in the PC world is that, you know, the technology rolls over every few years. And, you know, nobody really goes out and buys software for a 286 IBM PC any more. You know, what we do know is that capacity and the ability to use capacity will grow. It's interesting to compare with the spectrum because there's actually somebody at Microsoft who once said, you know, who would want to use more than 256 kilobyte of RAM? You know, we're now up to machine shipping with a thousand times as much, so the rules that are created, and it would appear as if in the short term in the transition, there should be rules.

It should definitely be done in such a way that there is some assurance for people who are deploying devices to comply with those rules. But then at a later date, there may be new ways of, you know, operating the same spectrum. Which, in fact, takes you to a question of backwards compatibility. Anything that's new needs to not break what went before, but can do new things in new ways.

DR. LUCKY: Okay. Let me just summarize for a minute now. The proposition was that we have th is new band, and we were talking about rules. And some of the things I heard was

first, you make it for data networks. That was one proposition. Another -- packet. Yeah.

Then we heard a proposition that you could incentivize behavior by giving more power for certain things that you could do here, like agile frequencies and things like that. Then we heard the idea of regulating receivers in this band. Then we heard the idea of a cognitive band where people bring -- you have to have a cognitive radio, and we heard the idea of sunset clauses on this new band.

Now does anybody have any other suggestions about our new band? Okay. Over there.

MR. LAHJOUJI: Ahmed Lahjouji, FCC. Just on the issue of spectral efficiency, we should be very specific as to what kind of performance we need these technologies that are going to be competing in this new chunk of the bandwidth. After all, the idea here is a better use of the spectrum, so we're going to say okay, if you want to compete here, this is the kind of performance that you must have.

DR. LUCKY: So you would require a certain level of performance efficiency. But suppose that interferes with other people when

you're doing it?

MR. LAHJOUJI: Well, when somebody talks about receiver design and all of those issues, that pretty much takes care of interference. You know, that can be done at multiple fronts. I'm focusing primarily on the spectral efficiency, better use of the spectrum.

DR. MARCUS: Would you have that efficiency varied between rural areas, and urban areas, and indoor areas, or would you have the same for everybody?

MR. LAHJOUJI: I'm thinking along the line of --

DR. MARCUS: I think that's the crux of the issue.

DR. LUCKY: Well, that was actually my next question. And let me go to Kevin, of course. In your thing, would you give special allowance, because you're allocating power in your band.

DR. NEGUS: Yeah.

DR. LUCKY: Would you give people out in the rural Nebraska more power than people in New York City?

DR. NEGUS: Yeah, absolutely. I think you have to take geographic location into effect,

but speaking as someone -- I live at a ranch in rural Wyoming. As someone who lives in a rural community, I think it's -- that concept should go far beyond just this new band. I think that if you look at where we are, the spectrum is completely, overwhelmingly, unbelievably under-utilized, yet it is illegal for us to do the logical thing.

DR. LUCKY: How would you define "rural" in your new band? I mean, how do I know when you're qualified for this power?

DR. NEGUS: I think that this gets back to the issue of the GPS, and doesn't necessarily --

DR. LUCKY: No GPS.

DR. NEGUS: I know. I was going to say, it doesn't need to be GPS, but I mean the point is, if you generally -- certainly with a fixed system, with a fixed wireless system you know where you are. We use GPS in our fixed wireless system --

DR. BOSE: Is the issue --

DR. LUCKY: How do you --

DR. BOSE: The issue isn't rural or urban, the issue is crowded spectrum or not crowded spectrum.

DR. NEGUS: Exactly. And again, it's self-organizing.

MR. FREEMAN: You've got NTAs, you've got BTAs. I mean --

PARTICIPANT: I'm not convinced it changes over time.

DR. BOSE: I think you determine it by -- the comment on the first panel was great, which is the FCC should be measuring what they're regulating. And, you know, not too many receivers or people who are willing to cooperate and send back information from their local area will get you a good picture of what's being done in the spectrum in different places.

DR. LUCKY: Okay. So your receiver measures the power around it, and decides whether it's in a rural area or not.

DR. deVRIES: Yeah. Because, I mean, otherwise, you know, areas where ten, fifteen years ago was forest. There was nothing there.

DR. LUCKY: So in this band the receiver looks at some integrated whatever across the spectrum, and decides whether it can use more power or not. And that's type-certified or something.

DR. deVRIES: The way to think about that is if you get from certifying by a set of characteristics, to certifying on the kind of behavior. So the way in which you would certify this device is you would put it, you know, you would put it through a bunch of tests and say, you know, under these circumstances how does this device behave? And if it behaves in the way that it's supposed to behave, then it's okay.

DR. LUCKY: Certify behavior, okay. Yes?

MR. REILLY: I'd like to just go back to again to -- I think what was fundamental to the Part 15 was to establish some rules that allowed for a lot of innovation, and didn't overly specify what was being provided. There are lots of good ideas that have been suggested, and I'm sure at one point in time all of them will have some place. But to think that you would establish rules that specify all of this in detail at one point in time, and then have a technology be able to evolve, the simplicity of it with regard to unlicensed not requiring the user to do anything but purchase, install, operate and maintain, they have rules that were very simple and fundamental, that provide an

environment in which manufacturers commit resources to develop products, knowing what that situation was, recognizing what the interference would be from other situations initially.

Now we've talked about various mitigation techniques. Those will be incorporated. I think the panel has suggested manufacturers cooperate. It's to our advantage to come up with techniques that will, in fact, allow these things to operate, so we'll make those decisions consistent with economics, market, et cetera, and technology evolution. So I think if we minimize the amount that the FCC specifically specifies but create an environment that will be a launching pad for this. That's the best that the FCC could --

DR. LUCKY: Well, let me translate this into specifics. Would you buy his power?

MR. REILLY: The total power control, TPC, that's --

DR. LUCKY: Well, he's going to give you allowances, incentivize the power. Would you buy that?

MR. REILLY: I would think that would be an option that the user might have with regard to, perhaps, capabilities that might be available

to --

DR. LUCKY: We're talking about the rules for the band, though.

MR. REILLY: No, I would not put that --

DR. LUCKY: You wouldn't. Okay. Would you buy the receiver regulation?

MR. REILLY: No.

DR. LUCKY: Okay. And wouldn't buy the geography stuff?

MR. REILLY: When you say, I'm buying it with regard to inputting into the rules, as opposed to having standards bodies, having the industry collectively discuss the issues, identify what, in fact, makes sense with regard to ways going forward. And then the market will adjust with regard to implementing or not implementing.

MR. LEARY: With respect to power in the rural environment, maybe I'd have some disagreement here. I'm not entirely convinced. Give me the lower band, I'll take that over the power because, you know, I can already do 300 square miles from a single location with existing power in those areas where you can see your dog running away for two days. However, in most of the

world, you know, the problem is --

DR. LUCKY: That's a good criterion, by the way.

MR. LEARY: It's a problem of --

DR. LUCKY: That's a good definition of rural.

MR. LEARY: But seriously, it's a problem of foliage, not necessarily of power. And also, in a data environment you have to take into account the reality of latency, so we could get lots of power. Okay. Fantastic, out at 60 mile link, but then I've got, you know, a certain amount of latency that's unavoidable because of that distance, so give me the lower band. I'll take that any time over the power.

DR. LUCKY: Okay. Over there.

MR. SNYDER: Two related questions. Earlier when we talked about beach front spectrum, and you could take Sahara Spectrum, you know, high frequencies as a contrast point. Does spectrum Etiquette systematically vary based on frequency? We've assumed here that I think etiquette is sort of homogenous, regardless of the band, but are there systematic differences?

I, for example, think the UNII Band is

too high for a lot of valuable unlicensed applications. Your comment would bolster that, so that's -- are there any systematic differences based on frequency? And the second question is, let's take spectrum below 3 gigahertz and above, could you give me a specific number as to what percentage of that spectrum should be allocated for unlicensed? Would it be 10 percent under 3 gigahertz, and 5 percent between 3 gigahertz and 30 gigahertz, or would it be the same spread equally? You know, with land, 90 percent of the federal lands is, you know, on the other side of the Mississippi, on the western side of the Mississippi.

Are there systematic differences as to where this unlicensed spectrum should be allocated because of, you know, etiquette related issues around frequencies?

DR. LUCKY: Okay. Well, the answer to your first question is yes, and the answer to the second is 27 percent.

DR. NEGUS: Yeah. I'd like to re-emphasize. Bob is correct, it is 27 percent.

DR. LUCKY: I think 27.5.

DR. NEGUS: Presumably, when you say

unlicensed, do you mean something like the ISM Band or the UNII Band, where unlicensed has a preferred home? Let me remind you, under 15.209 you can put unlicensed in most places under 40 gigahertz as long as you avoid the places that are drilled out, and as long as you stay at a very low level of -40 dBM per megahertz. But I think what you're talking about is higher powers.

DR. deVRIES: Yeah, I just want to -- yes. And I think, you know, to answer your first question, or to address your first question, you know, if I think here about, you know, a place where "unlicensed" has a special home, or essentially where, you know, there is no single owner of the use of that band, I think the lower you go, the more important spectrum Etiquettes or sharing rules become, because it propagates further. And so if you're up, you know, at a part of the band where it doesn't go through walls, gee, you know, do you really need it?

Well, actually in some cases if you've got thin walls, you live in an apartment, yeah, you probably do. But if you're, you know, down where it goes for miles, you absolutely need those things.

DR. LUCKY: Okay. I think it's time to change gears. I appreciate the specificity that we got to, even though everyone had a different proposition about what should be done, so I'll turn it back over to Mike.

DR. MARCUS: Okay. Well, let's be a little bit more explicit. Dudley talked a little bit about the antenna problems that the wireless ISP community is having, and their desire to mix and match antennas. We -- the current restriction on antennas and cabling comes with the more general Part 15 devices, which include cordless phones, remote control cars, and things like that where it really doesn't make any sense to allow people to put any antenna on it. So one question is, if we were to -- if the wireless ISP industry is having major problems with that, can they come up with any better ways of allowing other antennas, but that keeps the intent of our rule, you know, the narrow rule.

But the second question, which is a close cousin of that is, in 15.209, which I keep mentioning, which allows unlicensed virtually anywhere under 40 gigahertz, the current level of 500 microvolts per meter and -40dBM for megahertz,

depending which units you want, currently applies everywhere from 960 to 40 gigahertz. Is that the right number? If it isn't the right number, how in the world would we go around determining what the right number is?

So those are two possible changes to our rules that may or may not be helpful, or may or may not change the balance of power. And does anyone on the panel want to talk about either of those?

MR. FREEMAN: The first part, I think we should consider having the antenna manufacturers just submit through a testing lab the specs of the specific antenna that would have the same characteristics of the antenna that comes from the specific manufacturer. Remember, the specific manufacturer is not in the antenna business anyhow, unless it's an integrated product.

DR. MARCUS: Okay. So you would have the manufacturer say, or submit for approval to the FCC or the -- whoever does the approval --

MR. FREEMAN: Right.

DR. LUCKY: So I can't use a Pringle's can?

MR. FREEMAN: No, I don't think so.

DR. LUCKY: I want to use the Pringle's can.

DR. NEGUS: Pringle's can certify their antenna then.

DR. LUCKY: Pringle's could certify their can.

DR. MARCUS: So the specs that you, the manufacturer of the transmitter, say you would issue some spec, and if Pringle's met that spec --

DR. LUCKY: And right on the can it would have a Good Housekeeping seal of approval, you know, approved for use after you've eaten the potato chips.

DR. MARCUS: Yeah. Dual use technology.

MR. FREEMAN: The other thing is the clear understanding that professional installation is required for the systems in the fixed broadband.

DR. LUCKY: Oh, no.

MR. FREEMAN: Installation.

DR. LUCKY: We've got all these volunteer hot spots out there.

MR. LEARY: A different network.

MR. FREEMAN: Different network.

MR. LEARY: Different network. We're

talking infrastructure from basically predominantly tower --

DR. MARCUS: Now if it was a turnkey system that you bought in Radio Shack as a turnkey system, do you think professional installation would still be required, or only if you buy your own antenna?

MR. FREEMAN: Well, I think professional installation for the -- what we do as a last mile provider, or a big pipe between two buildings requires a professional installation. And the reason I think it requires professional installation is because again, we go back to the cowboy mentality where they buy this equipment, and they juice up the amplifier and so forth, and so on. You have someone who is certified by each manufacturer of using, how to install and understand the equipment.

DR. MARCUS: So Kevin certifies the manufacturer. Kevin certifies the installer.

MR. FREEMAN: Kevin certifies the installer. He takes a course, or his distributors teach a course all about the product and how to install it.

DR. MARCUS: Okay. Vanu was shaking

his head about --

MR. FREEMAN: By the way, that's in the rules.

DR. LUCKY: Are you a professional installer? I mean, do you do that stuff?

MR. FREEMAN: Not often.

DR. MARCUS: Okay. Vanu was shaking his head about that, but also shaking his head about the power -- on the power limits.

DR. BOSE: Yeah, I've got a bunch of things. Yes, on the power numbers, your question was was that the right level adequate? And the simple answer is no, because you don't see any commercial products out there doing anything with that. It's simply not enough.

Now I hate to keep harping on the same point, but this goes back to receiver standards. If there were standards so that receiver standards in all the bands have to tolerate a certain amount of background interference, now you could bring in devices, like ultra wideband to start, but other things that sort of operated under the radar, and make that more useful. And we've actually done stuff in the lab at those levels and, you know, you can transmit a few feet, and there are just not

that many applications.

DR. MARCUS: Well, most systems above 10 to 40 gigahertz, tend to have highly directional antennas.

DR. BOSE: Yeah, up above 10, that's a different issue.

DR. MARCUS: Well, I mean, but part of the question is, is the number between 10 and 40, should it be 500 microvolts per meter, or should it be lower, should it be higher?

DR. BOSE: Well, I think it's a different issue --

DR. MARCUS: How would you figure it out?

DR. BOSE: Well, when you get to 10 and 40, when you have such directional transmission, I think that becomes less an issue, because there's less chance of interference.

DR. MARCUS: So what number would you write? If you wrote the rules, what number would you write?

DR. BOSE: You know, 27 percent.

DR. MARCUS: How would we determine what the 27 number is?

MR. STEVENSON: In the 24 gigahertz

band, the Commission adopted a report and order increasing the field strength from 250 millivolts per meter at 3 meters, to 2,500 millivolts per meter. There was -- but with a requirement for directional antennas of at least 33 dBi. So the argument there was that the total area encompassed would be smaller, you know, or certainly no more than the lower power with an omni antenna.

DR. MARCUS: Well, should we extend that up to 40 gigahertz, or should we keep that only in the 24 gigahertz band?

MR. STEVENSON: I think you have to look at what you have to live with there.

DR. NEGUS: Well, I would answer yeah, you should. But I think you should across virtually -- I hate to speak and not think through the consequences on every band, but that concept, I think, applies across every band from DC to daylight.

DR. BOSE: Well, not only that. I want to make the point that I think that's something in the spectrum that the Commission should encourage because, you know, if you look at David Reed's argument that going into the future, once we've sort of taken care of all the legacy

inefficiencies, and spectrum is pretty fixed and usage increases, we've got to go to more dense lower power transmitters, and this is a way to start encouraging that use, is letting people do more things at lower power under the radar.

MR. STEVENSON: Another point, if I could is, is not just a question of transmitter power. It's a question of EIRP. For example, in 99.231, the comments that my company filed, we advocated actually a lower power than the Commission ended up adopting but, you know, we advocated the use of higher directional antenna gain before you had to start backing off on the transmit power. Because you take advantage of antenna gain at both ends of the link on point-to-point links, and you can end up getting the same margin to a given bit air rate at the same distance with less EIRP. You're discriminating against interfering with systems off to the sides and overshoot beyond the intended end-point, so there's more bang for the buck in higher antenna gains, more directive antennas than omni antennas, or low gain antennas and brute force power.

PROF. RAO: I wanted to add a few comments here. I think the antenna issue is

actually related to the architectural issue. I think .11(b) technologies have been extremely successful at the access level, where you're trying to reach a large number of people. But if you want to build the one level up from there, the back haul so that you can afford to go wireless a longer distance, that is where you start to need more directional antennas.

And to the extent that we feel that there is a need to stimulate and incentivize the development of technologies that will not just work in a single hop, but work multi-hop, I think paying attention to the directionality of the antenna and the kinds of power levels that you're allowed to use, I think will become critical.

MR. LEARY: I really need to defend the professional installer clause for -- with respect to the infrastructure. Two reasons why. Last year, I think the number was 116 people died from tower accidents, the highest number ever. That's one.

Two, I give you an example of a school in the northeast who one day they came back from the weekend, all the water fountain motors were dead. Well, over the weekend they had a lightning

storm, but the installer who didn't know any better, grounded to a water pipe. Went down, blew the motors in these waters fountains. Had a child been using that while this occurred, the child would have been likely killed, so in terms of infrastructure, not on wireless lands, not on public hot spots, but on legitimate infrastructure - this is broadband after all, folks. This isn't some little hobbyist thing. These are providing critical services to schools, police, fire even in those occasions, hospitals, and for businesses as primary connections. You know, it's not some silly little, cute little niche activity here in the free-net community. This is real, live, legitimate infrastructure, and in those environments there needs to be a stronger professional installer clause.

DR. BOSE: Well, I'd like a maybe tighter definition of infrastructure there. Let me give you an example. You know, I've got an 802.11 hub in my apartment, and the last time I checked there's seven other people using it for access to the Internet. Am I an infrastructure provider?

MR. LEARY: No, you are not. The last hundred feet is distinctly different from last

mile.

DR. deVRIES: So let's assume that Vanu, you know, that a few years from now there's "unlicensed" spectrum lower in the band, where he can, in fact, reach more people, and he's one of a group of people that build out a mesh that cover square miles, is he an infrastructure provider?

MR. LEARY: Not in the mesh architecture if it's deployed like that. I'm talking about things specifically deployed on towers, tops of buildings, different --

DR. BOSE: So it seems like you're keyed to power and height.

MR. LEARY: I am. It's location-based.

DR. BOSE: Okay.

MR. LEARY: For example, if it's in your home, single story building, no. But if you're the installer and you're climbing on the third floor, and you're mounting something on the outside, so yes, it is location-based in that sense. And I think there's even OSHA elements in that that certainly cross over.

DR. BOSE: Well, I guess one sort of example on the boundary is Direct TV dishes. I climbed out the side of my house and bolted it up

there. And, you know, it might not be that lightning proof.

DR. MARCUS: Let's ask David Reed. He's been trying to say something here.

MR. REED: This is totally outside the technical field, but I would just point out that we're emphasizing the reason that local electrical codes exist, not the reason the FCC exists. And if we really want to regulate people falling off towers, or not getting lightning storms, that's an electrical code issue, not an FCC issue.

MR. LEARY: It's the behavior of people as operators in unlicensed spectrum.

MR. REED: Oh, sure. But what I'm saying is the --

MR. LEARY: So, I mean, there is an FCC overlap, and certainly NEC, and OSHA, as well.

MR. REED: But NEC is the place to do that, and surely we don't need to have installers worrying about the EIRP in the NEC so, you know, I really think those are totally separable.

DR. NEGUS: I think this is analogous to the FCC regulating cell phones while driving. I mean, right? I mean, it's a communications device. People are distracted while driving, and I don't

know. I have no idea what the statistics are, but I'm sure it's more than 116 people year in the United States are killed by driving while being distracted on their cell phone. But I don't think that's an appropriate issue for the FCC.

MR. REED: Yeah. The DOT is worrying about that. It's a fine place for it to be worried about.

DR. MARCUS: Okay. We only have two or three more minutes to go. Get away from the professional installer issue for a minute, are there any other issues that people have that they think are important? Yes.

MR. REILLY: Just one I'd like to make is, you know, throughout the discussion today, this morning and both panels, we talked a lot about unlicensed. We've had some discussion of licensed. And I made the point earlier that I think there's a lot to be learned from the experience with licensing by rules that took place with regard to Part 15. And we ought to look at opportunities to, in effect, have streamlined licensing processes.

And I think that brings up another point, which is that there may be a tendency to think about unlicensed as related to either

enterprises or residential users, and to think of licensed as perhaps related to carriers or service providers. I think with the kinds of technologies and the capabilities that we're talking about now, it's appropriate, you know, to disassociate technology from who is utilizing it.

I think there will be opportunities with the higher frequencies, with regard to more directional antennas, to have distances where a service provider may want to operate in an unlicensed mode between -- to kind of extend a fiber optic system in an environment that might not otherwise be appropriate for bearing fiber. Or there may be, you know, private sector users that are looking to have a licensed operation because they want to put it in, and they want to have the benefits that derive from the rights associated with licenses, but that process should be streamlined so they don't have to wait six months or more in order to get in operation, so that's just a point I'd like to make.

DR. MARCUS: Okay. Let me point out that people who want to give us inputs on certain philosophies of licensed versus unlicensed, in June we issued a Notice of Proposed Rulemaking on 70-80-

90 gigahertz bands, in which we proposed three options for the bands on an equal -- at least in the NPRM they're equally treated. We'll obviously probably only adopt one, but one is licensed, one is unlicensed, and one is a band manager, which is sort of in-between. So if people have thoughts and would like to try their thoughts in a specific context, please feel free to send in comments to the NPRM, and it's a much higher frequency, but some of the philosophical issues apply here.

Does this side of the panel have anything to say in the last minute or two?

DR. deVRIES: Just one last comment. We seem to be making the distinction between licensed and unlicensed very clearly. Just to say that to me, the distinction is not that clear, and I expect that as the devices that we build become more intelligent, and some of the futures that are being talked about become real, the distinction will become even more blurred. And as the FCC thinks about these issues, it needs to take a more broad view about the range of possible ways of regulating use of spectrum.

DR. MARCUS: Thank you very much. I'd like to thank the panelists here. I don't want to

rush you, but at 2:00 we're going to have the experimental license panels in the same room with a new cast of people. If you would like to stay here for lunch, let me explain what the arrangements are. You have to take the elevator up one floor to the floor which is oddly labeled CY for courtyard. You can go out the back of the building through security. You have to give them your red badge. They give you a card. Then you have to come in the same door. There are two doors in the courtyard. You have to come in the same one you went out of. There are two restaurants there. If you want to go down 12th Street to the seafood restaurants on the waterfront, they take a little bit longer. There is another cafeteria on the outside, there are actually two on the outside of the building, or there are two in the courtyard, and feel free to stay here. And thank you all very much, and thank the panelists for their excellent remarks.

(Off the record 1:03 - 2:07 p.m.)

DR. KOLODZY: Welcome back. Thank you for coming back here. We're ready to get kicked-off the third panel for the day and the final panel on experimental licenses. I'd like to introduce Lauren Van Wazer, who is the special counsel within

the Office of Engineering and Technology, and also the Deputy Director of the Spectrum Policy Task Force. And I don't think I need to introduce again, but I'll say Bob Lucky, who actually has been co-moderating all three panels today, so I'd like to turn it over to Bob and Lauren.

MS. VAN WAZER: Thank you, Paul.

I'd like to just start down this end, and we'll do some introductions. Maybe you could just say -- introduce yourself and say a word or two.

MR. SOLOMON: I am Larry Solomon with the law firm of Shook, Hardy & Bacon. I've been practicing private communications law for longer than I wish to disclose, and have worked on and filed, and processed many experimental applications.

MR. ROOSA: My name is Paul Roosa. I'm with NTIA. I, too, have been doing this longer than I care to admit but I might anyhow, 1966 I started doing structure management stuff, so I have worked from time to time on our processes of reviewing experimental systems that we call major systems. And that's why I'm here.

MR. LYNCH: Hi. I'm Mike Lynch, Nortel

Networks. I do spectrum regulatory issues, including experimental licensing, and spectrum allocation issues. And probably one of the reasons I'm here is some of the difficulties there.

MS. VAN WAZER: Well, that sounds enticing. Why don't we skip over.

MR. HOARTY: I'm Leo Hoarty. I'm the Chief Technical Officer of Dotcast, Incorporated, a technology in Silicon Valley, developing a novel wireless technology. I spent a good part of the last year in these hallowed halls begging before the Commission for experimental licenses, and finally our authorization.

MR. HILLIARD: I'm David Hilliard with Wiley, Rein & Fielding, and for more than 25 years I've had the pleasure of working with some of the folks in this room to secure experimental licenses and other forms of approval from the FCC.

MR. FRANCA: Hi. I'm Bruce Franca. I'm the Deputy Chief of the Office of Engineering and Technology. I just want to point out that we're in alphabetical order, and this is -- the separation between me and Paul has nothing to do with our close work together in ultra wideband.

(Laughter.)

MR. HILLIARD: I guess I'm glad to hear that.

MR. BUCHWALD: Hi. I'm Greg Buchwald with Motorola Labs in Schoenberg, Illinois, and I, of late, have been responsible for obtaining experimental licenses for our beyond 3g activities.

MS. VAN WAZER: Thank you. The Commission's experimental license program is supposed to provide manufacturers, inventors, and entrepreneurs with the opportunity to test new radio technologies and new equipment designs, among other things.

In 1998, the Commission performed a significant review of our experimental license rules and made lots of changes, including allowing longer license terms. They can be up to five years now, allowing for blanket licensing, allows for STAs without the prior issuance of an experimental license. And also, adding some streamlining rules.

I'd like to find out, and particularly since you made a comment that was intriguing. How did we do?

MR. LYNCH: Well, essentially when it comes to STAs and things that conform to DOS allocation table, you do very well. But when

you're working on products that are foreign market products, at least our experience has been that it doesn't work so well. I mean, especially when if it happens to fall into the DOD arena. And I'll summarize it, it goes to the IRAC and that's it.

DR. LUCKY: That's it?

MR. LYNCH: That's it.

DR. LUCKY: You don't get a reply back? I mean --

MR. LYNCH: You may get a reply, but there's no conversation about the reply. If it's negative, it's negative and that's the end of conversation. And I guess my --

DR. LUCKY: And how often does that happen?

MR. LYNCH: Well, it's not how often. It's just that it does happen, and it's frustrating. We had a wireless open loop product that we were trying to refine here in the U.S., and it absolutely was not going to be possible to get experimental licensing for it. There was another product similar - we understood the controversy on that one. We ended up doing it in a closed loop fashion, which is still not the best way to test our product. But the other one, in particular, was

in a band that we told them in the beginning it won't happen, and --

DR. LUCKY: And it didn't.

MR. LYNCH: No, it didn't. Yeah. And it hurt our ability to fine tune and to sell that product as a competitive product for a local loop, for total quality in our local loop.

DR. LUCKY: Let me understand. Was that in a military band?

MR. LYNCH: 450.

DR. LUCKY: What were you doing there?

MR. ROOSA: When did it occur?

MR. LYNCH: This was probably 1998.

MR. ROOSA: 1998. No wonder I couldn't find any records about it this morning.

MR. LYNCH: It was a while ago, but it isn't -- that's sort of well gone, and use it as an example of what can happen. On the other hand, after 9/11, we came in and asked for some stuff in the 1710-1850 proportion for people nodes at Ground Zero, and I think it took about five hours doing OET and NTIA to get the permits out, and get the -- that worked quite well, but there was an impetus --

MS. VAN WAZER: It's good to get kudos

for our coordination process.

MR. LYNCH: But there was an impetus for doing that. Right? Okay. But in the other case, there was no impetus. In fact, there was in various international organizations at the time the U.S. government was opposing the use of that band for that purpose too.

MR. FRANCA: I think, Lauren, if I might just comment on that, because I think that happens. And I think these are issues that while the equipment is being developed for a foreign market, there also was petitions to use that spectrum, or transfer some of the spectrum domestically. And I think you -- you know, in those cases, I think we can understand what the government side might be concerned about, where an experiment might lead, and be more cautious about approving that.

I will say that in general, you know, I mean we have very good relationships with NTIA. They understand the experimental program doesn't promise anything, and generally, I think we're able in most instances, unless there are some real interference concerns or other issues to work things out. Although, it does in some instances

take a little bit of time.

DR. LUCKY: Bruce, could I ask you or Lauren, you know, I don't know very much about experimental licenses. I've gotten them at Bell Labs in the past, and used them and so forth, but who actually has authority in these cases? I mean, does it really -- who really makes the decision? You say you coordinate with NTIA, but sometimes it goes to IRAC and, you know.

MR. FRANCA: Right. I mean, we issue the license, and the application comes to us, but we -- if it's an exclusive government band, we coordinate that, just like we would if, for example, somebody wanted to use the broadcast band and there was an interference issue. We may make a determination that that experiment doesn't make sense in that particular geography, and we rely on the government's eye to kind of make those same determinations.

DR. LUCKY: I'm not sure I understand the word "coordinate." I mean, if NTIA says no, I mean, the answer is no?

MR. FRANCA: Generally, the answer is no in their spectrum, or we might ask them why. You know, and offer some advice to the licensee

about going another place.

MR. HILLIARD: You know, that exchange that we just heard prompts the thought that in this process, particularly for the non-routine applications, we really need to build in dialogue, because in many cases, I think things can be worked out. But so often times, experimental licensing has sort of been in the background, and sometimes deemed not to be very important by management, when in fact, it's the seed bed from which a lot of things flow. And resources haven't been put upon it to get people into Washington to have the discussions with the right folks at NTIA, and if necessary, even in other government agencies. So the model, if you wanted to construct one, currently is pretty good. It works very well for routine things. They've done an excellent job there, but for things that are not routine, and you can expect non-routine sort of situations right here. There needs to be a lot of dialogue, and it may mean that Bruce ends up spending more time than he wishes talking to Washington folks and others about experimental licenses.

MS. VAN WAZER: I just want to remind the speakers to speak into the mike. I guess some

folks at the back of the room are having trouble hearing us. David, you mentioned something about wanting to build on the dialogue. What specific ideas do you have with regard to that?

MR. HILLIARD: Well, I think that one of the first things you need to think about before you apply for an experimental license is what interest might this affect? And if it's something that could be controversial, that calls for some discussions first at the FCC, to find out, you know, where the stakeholders might be. And then once you learn who those players are, go to them and talk with them. Especially when we're having a situation involving operation in spectrum that requires coordination with the government. And, you know, if you hit a brick wall right there, well that says something about the process and its need for reform. But my experience has been that if you keep going at it, you can usually find somebody who will talk with you about those sorts of problems.

The difficulty is that sometimes these authorizations are actually needed fairly quickly. And when you get into that situation, then things become a little big rugged.

MR. LYNCH: And just, you know, going

back to comments about, I think I heard a veiled reference to some discussions on three and a half gigahertz we have over the last several years. I, from a purely experimental point of view, if it's sensitive because somebody thinks it's going to go towards a possible allocation, I could see an agreement in the very beginning, I mean, if we had some sort of process check sheet, if you would, that this is not an application for an experimental -- for export technology and not for the purposes of doing a reallocation, and having it clearly understood at the time that the request is even made, it may help reduce the tension for some people.

MS. VAN WAZER: Well, many of the comments have been about the process. I guess I want to step back a bit and say if our goal is to promote innovation through the use of experimental licenses, how could we do better substantively?

MR. SOLOMON: I think one way the Commission really needs to get out to the public and talk about experimental programs, and encourage people to do that. You have almost two groups of people. You have one that are sort of a vested industry interest that have a lot of money to

spend. Well, these days they don't have a lot of money to spend, but let me just say that they understand the process. They know how to work, at least a little bit through the FCC. They understand the process.

On the other hand, you have some very, I think, brilliant people out there who just don't understand the FCC, don't know about the FCC, are frightened to death about the FCC's processes, and just don't know what to do. And while I don't have any great ideas today, I think the FCC really does have to make an effort to get out there to the public, to call for innovation, to try to get people excited about doing experimentation in radio. And I think these days it's particularly important because a lot of the venture capital money has certainly dried up. The telecommunications market isn't doing exceedingly well, and there has to be some incentive to do experimentation.

DR. LUCKY: You know, I -- this morning we focused on how to get new technology and, you know, there are a lot of things, cognitive radio, software-defined radio and so forth, and how we can fit them into the mainstream, how we can slide them

into it. And to the degree that experimental licenses can be used for that, I would be very interested. And I know, Paul, you had some experience with ultra wideband. Now that's a specific example of a dramatic new technology that interferes with current technologies. How do you ever get going with something like that? What was your experience?

MR. ROOSA: The hardest part we had with that is understanding what the technology could do in the way of wave forms and technical characteristics, and what affect the signals would have on existing operators. We went into a measurement program and measured a number of different ultra wideband devices.

DR. LUCKY: Now the "we" here is the NTIA. Right?

MR. ROOSA: Indeed. I'm sorry. NTIA, and with -- our facilities out in Boulder did that, the measurement effort. Still felt pretty comfortable we understood what the spectrums looked like, and how the energy that came out of the ultra wideband device would affect conventional receivers.

At that point, one has to make some

kinds of assumptions about what the transmitters and the receivers may do, and where they may be located relative to each other, and how to control that. And I'd hesitate to say we're any further than about halfway through the processes figuring out what to do about ultra wideband devices.

DR. LUCKY: So it's neither here nor there.

MR. ROOSA: I'm sorry. I don't understand.

DR. LUCKY: Well, I mean, the problem is how you get going on these things. I think the FCC actually has acted fairly wisely in permitting some experimental use of this, and liberalizing what can be done, without going the full step forward, and just freeing it out. But right now it's sort of in a halfway house. Certain uses are allowed, certain others are not.

MR. ROOSA: Yes, that's true. The difficulties are, of course, that you don't know where across the spectrum from about 100 megahertz to many -- three or four gigahertz these systems might be used. And it's very difficult to determine how to operate compatibly with the folks and the environment. It's certainly a technology

that the government is excited about, and is probably is as big a user as anybody else, if not bigger, of different forms of ultra wideband technology. So it's not that we're opposed to it, it's that we want to be sure we know how we're dealing with it.

I think that brings up some of the issues that you've been talking about, perhaps this morning, about the rights that come along with an assignment. How do you ensure that a person who has an assignment can exercise his rights, if that's the proper word. And whether they are, indeed, rights. Maybe they're just a temporary use of the spectrum that should be subject to withdrawal under many circumstances. I'm not prepared to decide how the circumstances could be organized though.

MS. VAN WAZER: Does anyone else have comments on how we can better promote innovation through possible changes in the rules, or provide incentives for innovation?

MR. HOARTY: The Dotcast technology is, of course, different from the problems with military but it's a similar situation. We've developed a high speed data sub-carrier that we add

to television broadcasts, and this has been around before. As many know in the 1990s, the software-defined radio, been able to do it at very high speeds. But because the television band, apparently a lot of people watch television and the broadcasters care about that, and it makes it tricky to define what is interference. And, of course, that's the topic of, I believe, Monday's panel, and I certainly don't want to segue into that, but that goes hand-in-hand with the experimental license, is experimental license issues. And that is what is important to -- it's important to define what is host impairment, what is impairment to the adjacent. And although there are rules that very clearly articulate that, many of them are crafted during the period of the 6th report and order back in the 50s. And it's just a little bit difficult when you're testing in an area so crowded and near and dear to the broadcast community.

Many of the problems, we've sought and received two experimental licenses. One in Scottsdale, Arizona, and we had that for a little over a year, and with a kind extension -- at the Commission at the time, one year was the period,

and that was tough. Then we moved -- we opened a research facility in Seattle and needed an experimental there, which we still have, on channel 61. And again, you addressed many, as you opened in, Lauren, the issue of moving to five years blanket license. That helps a lot in just being able to get through the research and development. And it is -- timing is critical in the time span, so I think those issues that we originally had are gone as far as the duration and where.

I believe there's the ability to have more than one license now, or more than one frequency is part of the blanket license, so I'd go back to saying that perhaps this should be reserved for Monday's panel, but what defines interference? It's so crowded out there, you can almost do nothing, as they were just mentioning with the ultra wideband, as to what can you do, and how do you operate in this incredibly crowded RF spectrum?

DR. LUCKY: Well, some of us aren't going to be here Monday, so if you could -- you know, I think you could say something about the issue of interference. It's pretty critical here. I mean, that's what's really being used to decide this.

MR. HOARTY: Exactly. I think that's exactly --

DR. LUCKY: You know, is are you going to interfere with somebody? And so the question is how does one make that determination?

MR. HOARTY: And this is -- again, just looking at the notes for Monday's meeting, the issue is, if you lower the link budget of somebody else by a decibel, but the receiver doesn't notice it yet, is that important? How do you tell? It's a hard problem.

With television, it's somewhat more straightforward. If the consumer gets a lousy picture, obviously, you can't be messing around anywhere around that frequency. But then there's the issue with DTV where we're seeing analog, NTSC channels by putting up a fair amount of energy in the upper adjacent and causing threshold effects that weren't anticipated. Adding our data carrier to NTSC has been a question. Matter of fact, I'm here regularly meeting on that issue of exactly what does that cause, by adding yet a different configuration to NTSC while we're trying to bring up the DTV stations. So I don't know how to answer the question, but it certainly needs to be clearly

examined.

DR. LUCKY: David.

MR. REED: Since the big elephant in the room maybe hasn't been fully addressed because nobody who is involved in the UWB stuff seems to be able to talk about it other than obliquely, let me ask the following question, which I think I understand.

In the UWB proceeding, it was alluded out at the conference in Boulder where some of the technical results were presented, that in fact, the biggest problem in that proceeding, which among other things put at least one start-up out of business, the one that I was involved in the early days before it was founded. What apparently happened was that the -- certain individuals on the IRAC took positions that they were unwilling to disclose the basis for in public.

It seems to me that without transparency, and whether the government owning so much of the spectrum, we're going to continue to have that problem, and it's going to hurt -- you know, it's going to basically mean that anybody who either competes with the government, or might have a better use for the spectrum than the government,

or might even be developing technology that would ultimately benefit the government, has an extremely high burden to bear of many years of delay, if nothing else, while they try to work through a non-transparent system.

So I guess I'm curious why, you know, nobody's referring to this as, you know, publicly and, you know, anybody who's not, you know -- does not work for NTIA or the FCC might want to comment on that, if no one else is willing to.

MS. VAN WAZER: I had a comment on that.

DR. LUCKY: Well, let me ask, though, the people who do work for the FCC and NTIA, do all the applications go to the IRAC?

MR. ROOSA: For what variety of devices? I mean --

MR. FRANCA: If I might. I mean, it's only those devices, or only those experiments that would basically be operated in government spectrum or shared spectrum.

DR. LUCKY: So for example, in ultra wideband, since it cuts across everything, it automatically goes there.

MR. FRANCA: It automatically goes

there.

DR. LUCKY: And they have veto power? You keep dodging this issue. I mean, do they or do they not? You keep talking about coordination, and stuff like that.

MR. FRANCA: Well, we theoretically -- you know, I think that's somewhat of an open debate. I think, you know, it's --

DR. LUCKY: I'm glad to hear you say that.

MR. FRANCA: It's an application that comes to the FCC. The FCC can basically grant it, and the Commission could have, for example, adopted rules. I know, I've been here a fairly long time, and I can certainly cite instances where the Commission basically said thank you very much for your advice to NTIA, and did just the opposite of what NTIA recommended.

DR. LUCKY: But we're talking about the IRAC. I mean, do they do the same thing that David Reed was alluding to? Do they tell the FCC no, don't do this, but we're not going to tell you why?

MR. ROOSA: The IRAC is our advisors, not the advisor to the Commission, so the IRAC provides whatever their wisdom tells us is the

appropriate advice to us, and we either, at NTIA, accept it and relay it to the Commission, or change it.

It has occurred, from time to time, and ultra wideband is one of the times where the federal agencies were concerned enough about the issues that they made some direct discussions with the folks at the Commission. And I have a little problem with the business about the untransparency of the IRAC positions. I believe they were very transparently stated in the record, so I'm not really sure what you're talking about.

MS. VAN WAZER: Since we've got lots of engineers in the room, and I think everybody is familiar with statistics, I'm going to throw a few statistics out, which actually might provide some insight on really --

MR. REED: Actually, I was holding onto the mike only for the reason of asking one more question which related to your thing, which is that it's my understanding that the IRAC also played a very significant role in effecting the original Part 15 change that enabled spread spectrum. And that clearly was not an interference with a military use or government use. I'm curious why

that was.

MR. FRANCA: Actually, there was -- they do operate in some shared bands.

MR. HILLIARD: 902 to 928 is a shared band.

MR. FRANCA: It's a shared band.

MS. VAN WAZER: Since we've had some reference to the IRAC process, and the NTIA coordination process with FCC, I'd like to throw out these statistics so you get a sense of really the issue.

Last year, there were approximately 90,000 authorizations, and there were 50 Commission-level items that were coordinated. And we've only heard about a handful, so it really isn't -- if you look at those statistics, it's not as much of an issue. I mean, basically, the issues are tough, and the ones you hear about are the ones that are the nature of the beast. They're difficult, but we have a lot of items that sail through and have a good process.

MR. BUCHWALD: I could add to that, that I've gone through four experimental licenses in the last 24 months, and one of them involved development of a product with our semiconductor

group, that needed to be tested in a 1452 to 1492 band. And as compared to two other development projects we had at 790 to 806 and 3.65 to 3.7 gigs, which sailed through the Commission quickly, one of them required us to simply state that we would be developing this for external sales, offshore sales, and the other required that we coordinate with the Society of Broadcast Engineers. They sailed through very quickly.

The 1452 to 1492, though, we did hit some pretty good stumbling blocks, even though 300 miles from our location, the Canadians were transmitting away in that band for URICO 147. We ultimately did get through that, but I think a lot of times you don't hear about the problems, because we don't want to, you know, sort of bring those issues up, you know, for future licensing. We don't want to ruffle the feathers, I guess, as it may.

DR. LUCKY: We had three people in the back that wanted to talk. Is there a microphone?

MR. KOBB: Thanks. Ben Kobb, a consultant. I have a couple of recommendations for the experimental licensing process, having spent quite a bit of days recently writing a how-to use

the experimental licensing system for mere mortals, so when my clients start to use the system will see how well I did.

I was surprised to find out in discussions with the experimental licensing staff that, apparently, there is a policy, or there is said to be a policy, that they cannot make recommendations on amendments to the application. For example, if the applicant proposed a frequency or a set of frequencies, and these frequencies could not be granted, for whatever reason, and yet, perhaps some adjacent frequency or some other minor amendment might be possible to enable the grant, the staff could not recommend that. They couldn't specify an alternative frequency that would accomplish the objective because, I was told, that would be competing with the private sector, and that the private sector has consultants who makes these kinds of recommendations.

Well, I'm in the private sector. My client is in the private sector, and I don't see any reason why, if there was some relatively minor switch of a frequency or some kind of minor amendment, why it couldn't be recommended.

The other thing is, I'd be curious if,

over the years in the experimental radio service, if allocations to that service had ever come up? I think it would be a marvelous idea. I have to explain to my clients that of all the radio services, the experimental service has no frequency allocations. You have to pick the frequency, and you better be right, because the staff won't correct you if you're wrong. They'll just decline it. But even one megahertz somewhere in the spectrum could be useful. Nothing else has to change the temporary nature of the license, but this could ease a lot of the process.

The clients I've been working with might well be able to use an allocation somewhere that isn't being used right now, wherever it might be in the spectrum, so it's something to consider.

DR. LUCKY: Okay. Dewayne, you wanted to say something too. Pass the mike over there.

MR. HENDRICKS: Dewayne Hendricks, Dandin Group. A few comments. First, I want to -- Part 5 is great. I mean, it's great that this country has it. It's done a lot of good, so I wanted to state that first, and that there's a lot of countries that don't have it. Like Japan, for instance, and they suffer for not having it, in my

opinion.

Next comment. I was involved in STA involving spread spectrum back in 1993. This was for the amateur radio service, Part 97. And we wanted the authorization to do anything we wanted with spread spectrum from 50 megahertz up to light in terms of all the existing amateur allocations, so we weren't asking for any new allocations. We were just saying we wanted to use spread spectrum in creative ways within the existing amateur allocations.

The application went to the Commission and they took it to the IRAC. Okay? It took a year to go through the IRAC and come back approved. Now we got a one year STA, and so we went through this process three times. It goes to IRAC, one year, comes back. It was very frustrating, and again, so there's been a number of comments about the IRAC. And I would just add from my experience, is that there is this black hole. Okay? And once it goes in there, you don't know what's going to happen or what. And that really hurts this process, the uncertainty.

And I would urge the Commission to work out some way to deal with this. And I understand

it's only a few exceptional applications but look, we're -- from the panel this morning, we're moving into the area where we're getting a lot of new technologies coming down the pike. Okay? And the experimental process, Part 5 is the first step on the road to getting a product to market, so you've got to do whatever you can to make the process faster, and a lot less uncertain. Okay?

My final comment has to do with, the one thing you can't do with an experimental license is sell your stuff, sell your product. And that you can't test the product in a real market. Okay? I think this is a deficiency which has caused my company to go to other countries to -- where there's an ability to do what you can do under experimental licenses, use a lot of the spectrum, but also have a market to test the product in, and sell it, and see whether or not the thing is going to work or not, you know, or survive. So that's one thing that's missing. And, in fact, I'm working with the Japanese Ministry of Economy, Trade & Industry, to look at this notion for, you know -- because they don't have an experimental license, but they're thinking about taking the island of Okinawa and turning it into what they're

calling "Otokua", a radio haven, where they would have an experimental license capability, but with the addition of having a market so you could sell anything into that market and see whether or not it flew or not. Those are my comments.

DR. LUCKY: The license still limited in time though? I mean, you sell a product that would expire after a year?

MR. HENDRICKS: Or maybe three years, but some fixed period of time.

DR. LUCKY: I just picture this radio that's got a label that says expires after a year. I mean, does this really test the market?

MR. HENDRICKS: Well, where I come from product lives are like 18 months these days, so that's not --

DR. LUCKY: Yeah, but there's no label that says that. We just sort of know it.

MR. HENDRICKS: That's right.

MR. HOARTY: I think an example of where that would apply, I was thinking about that very issue, that you can't sell something that expires per se, but in our case, we're testing on an experimental frequency in a television band. Our product is designed to grab any frequency that has

our data carrier embedded in it, so we actually could test on our own experimental station in a market condition, because the device would continue to function.

Now you get down to timing and the issue of how impatient the investors are, and which is -- it goes hand-in-hand with that ability to test in a commercial manner. In other words, you have to be pretty sure of your timing, that you're going to have a product or you're going to have authorization, or with extending the experimental. But there are instances where I could see where you could test, and it would be really beneficial to know how, if the -- you know, the dogs ate the dog meat, as they say, before you take the thing to market.

MS. VAN WAZER: Bruce, would you like to --

MR. FRANCA: Yeah, let me -- I'd like to just respond to at least -- actually, to both Ben, and to Dewayne. One, on certainly -- well, we don't do engineering work for folks. We certainly, when people come in here, will talk to them, and certainly offer advice, you know, when it's appropriate. And certainly, we're more than

willing to do that. We've done that on a number of occasions where, you know -- and there are coordination problems that go beyond just the government. I know we've certainly solved some of those.

With regard to the market test, the rules do allow, under Part 5 do allow limited market test. We do care very much about protecting the consumer at the end of the day, and so there's generally restrictions on ensuring that whoever has the license retain ownership of all the equipment, you know. But you charge and we've had, you know, market tests going on for several years, you know, so that people can decide whether a service, what data rates are appropriate, what pricing should be done, so we do allow that under the rules right now.

MR. HILLIARD: The rules actually have the flexibility to allow the Commission to permit the sale. I haven't seen that happen, and I can understand that there would be some significant concerns about allowing that to happen. But I could also imagine that it's possible to posit circumstances where those concerns could be answered.

MS. VAN WAZER: I think there are some countervailing considerations in terms of possibly introducing consumer confusion, and issues of possibly competing unfairly with regularly licensed services, so I think there's sort of countervailing policies, some of which were addressed in our 1998 order about this.

Someone in the back of the room I noticed has a comment.

DR. BOSE: Yeah. Actually, I had two comments. One, I wanted to respond to the discussion that was just going on, which is, what happens if it expires in three years, or more to the point, how do you enforce it? And that's actually something which is contemplated and considered during the software-defined radio rulemaking process. And you probably all have bought software that's expired after a certain amount of time. You could absolutely do that in the radio, and it would stop working after three years, or you get an upgrade or a key if they've got a license to continue selling. But what I wanted to comment --

DR. LUCKY: We don't like it though.

MS. VAN WAZER: I know. I don't like it.

DR. BOSE: I understand, but if it's not selling it at all, or selling it for three years, I'll take the three years.

MR. HILLIARD: Now you're talking about price.

DR. BOSE: Right. Yeah. That's a much better discussion. What I wanted to comment on was your question about experimental licenses and new technologies, like software-defined radio, and I have a specific comment, and a general comment.

Specifically, as you know, there was a rulemaking last year on software-defined radios where you can now go through an approval process. The experimental license process, to my knowledge, has not been similarly adapted or adopted to incorporate that. And specifically, when you apply for an experimental license it is an emission designator, three letter code which is frequency, modulation and access-type basically.

Well, the whole point of a software radio is I can change all those things at any time to do different things, so I just wonder, the way we've done it so far is I basically make a list of all possible combinations of three letter designators and submit that, but it seems that there needs to

be a corresponding change to the experimental license process to, you know, the box you check off, software radio, or you have it designated as XXX if it's software radio, or something like that.

But more generally, I think this is symptomatic of something I'd like to see changed, which is it strikes me as backwards that the Commission actually adopted rules for software radio before there were rules to experiment with software radio. It would have been great if three years ago the experimental licenses had allowed software radios, more flexible radios, because those experiments would have provided data which would have actually informed the rulemaking process more than it was, so I would like to see the experimental license process be -- I think it should be the most forward-looking part of the Commission in terms of what it allows.

DR. LUCKY: Well, let me clarify that. Is this a question of people not knowing that they could have done this with experimental licenses, or is it a question of they're just not allowing it? I mean, is this --

DR. BOSE: It's a little of both. Like I said, we found a way to work around some of it by

just providing huge lists of emission designators, but there were some parts of the application that didn't permit you to do certain things that would limit your flexibility, so there's some of both in there. Especially when you talk about using different frequencies that are covered by the two different agencies represented here, which gets back to the previous point.

MR. HILLIARD: But that's another situation calling for the kind of dialogue I was talking about earlier, because the flexibility exists under the rules, I think, to do what you're suggesting should be done. I don't think it takes a change of the rules. In some cases, it may take some adjustment of policy. In other cases, it just takes a better understanding amongst different folks working at different agencies, but it's possible, at least legally it's possible. Whether it makes good sense technically on a particular frequency with a particular emission, well, that's why these folks are here.

DR. BOSE: Right. And I guess the point is that if I have to -- if I'm looking at even a small number like five different emission designators or something, in a bunch of different

bands that are going to be looked at by different agencies, that just gets unwieldy and is very -- you know, Dewayne's one year doesn't look so bad in that case, so the problem is if I'm relaxing the rules to be allowed to do different things, which is the whole point, and they have to be each evaluated on a case by case band for each band, and each adjacent thing for each emission designator, we have to back off, because like you said, technically you should be able to do that. Practically, it's very hard to get that approved.

MS. VAN WAZER: Does anyone have any comments?

MR. ROOSA: I'd like to make a small comment. I'm not sure how I could make our process applicable to your processes, but in the federal government, we often have two different kinds of approval procedures, one for the system itself, and the other for the frequency assignment. We'll send our new systems, the more what we've chosen to call major systems, will come in as sponsored by the agencies, and we'll review the proposal, and make guidances to different parts of the spectrum they might be better suited for, all sorts of things at four stages during their development. And I think

a process like that might help here, but the issues of proprietary ownership things would seem to be almost insurmountable in this kind of thing. How much can you reveal during your development phase to help spectrum management folks to provide guidances to the spectrum that you might be best suited for? That would be a difficult problem.

I know the Commission now has provisions to allow you to request that the information be held private, and I think that's good. The difficulty is how can you do a very good job of coordinating all these potential issues unless you're allowed to talk about what the spectral characteristics of the new technology are.

MR. BUCHWALD: Yeah, but that would fulfill a requirement within the United States, but when you're developing a product that's going off-shore for export, simple cellular phone, for example, where you're looking at various bands around the world that would be utilized, some of those bands do fall under the requirement that the NTIA would have to approve it. And while approval processes really do put the United States manufacturers at a disadvantage against the foreign competition that could begin testing right away, or

we have a huge cost disadvantage in that we have to go off-shore to test.

MR. ROOSA: It seems to me there's about five or six different sub-processes buried in this discussion. There's the off-shore one that he just mentioned, and that has a different set of problems. And the one where you're developing a new technology in the TV band, and another one where you're developing a new technology that fits into the spectrum. And it's hard for me to address any one of them when they seem to be hopping around so much.

We don't, ourselves, do any oversight of devices the military develops, for instance, for use overseas, other than to ensure that they have proper spectrum assets to use at the test sites. And that's another issue that makes us different.

We have test sites operated by several agencies, many agencies that allow them to do short-term testing on almost any portion of the spectrum for a 30, 60 day time period without any further review from the central authorities. I don't know whether that's practical for the private sector or not, because there are so many different laboratories that you're speaking of, I'm sure.

But it seems to me that there could be some process where you would be able to do short term testing of some of these features without oversight from the Commission.

DR. LUCKY: Now I just -- there's something I want to get out, and I don't know how to get it out. That's how aggressive are we being about the use of experimental licenses? I mean, you know, we've been talking all day about all the new technologies, all the need to pull these things along.

Have we seen -- let me ask you FCC people, have we seen any increase in the use of experimental licenses? Is it something that is really being used to its fullest? Is it something that needs to be more aggressively used?

MS. VAN WAZER: Bruce, did you want to comment on that, or do you have some --

MR. FRANCA: Well, I'll tell you. We generally have about 1,000 experiments going on at any one time. They certainly represent the kinds of things that seem to be at the forefront of the discussion. I mean, certainly software-defined radios, ultra wideband. Certainly, you know, lots and lots of broadband type applications on power

lines so, you know, I can't say whether or not they fully represent, you know, everything that could or couldn't be done, but they certainly are the topics that we seem to see, and they do seem to, in many regards, appear under Part 5 before they get to the FCC so, you know, I think it's a program that's basically being used at least by certainly -- the big radio companies certainly know it's there, and use it. And it seems to me the smaller folks, like some of the people here on the panel, like Dotcast. They certainly have been told about this, and have taken advantage of the experimental radio program.

DR. LUCKY: In the approval process, is the worth of -- the importance of the experiment weighed against the possible harm? Or is it strictly an issue of the Hippocratic oath kind of a thing, "First do no harm"?

MR. FRANCA: It's basically a non-interference -- and that brings up an issue because it seems to me -- I mean, nobody has really talked about this, but even if you're developing a new product, and say I -- that new product needs a new allocation at 10 gigahertz. You might be able to actually develop the equipment and test it at 12 gigahertz or somewhere else in the spectrum that

doesn't raise government issues, or doesn't raise some of these other things. And then pursue the political course to actually get the allocation, so there's the experiment and the development, and how frequency dependent, certainly for ultra wideband and software-defined radios, you know, those are issues that are much more frequency dependent. But there's lots of developments that are going on that probably you can do the experimentation in other places.

DR. BOSE: I would say as a user of the system, my perception is exactly what you said. It seems like the application process is proving that you're going to do no harm, and that's a fundamental issue.

MR. FRANCA: That's the rule.

DR. BOSE: Yeah, I agree. And I'm not saying that's wrong, but I --

DR. LUCKY: Maybe it is wrong.

DR. BOSE: Okay.

DR. LUCKY: Because, I mean, no harm is maybe too tough a criterion. I mean, you know, no harm is really tough. Just a little bit of harm in the social good might be a lot, you know.

DR. BOSE: If it's a little bit of harm

in a defined area for certain period of time, maybe. But I think that when you're talking about harm, the way we go about trying to evaluate harm is unnecessarily complicated at the moment. I mean, fundamentally, it comes down to in the frequencies I want, how much power am I transmitting, and how much power am I spewing outside of that band. And then I can have a pretty reasonable idea of the harm I'm doing to the other people, and we don't have to get into the details of what kind of modulation you're using, and access, and all that. I think we could streamline that process of determining, and that should be it.

MS. VAN WAZER: We had a comment in the front.

PROF. RAO: Yes. It's a process question. Who regulates the user spectrum on a Native American Indian reservation? I have heard anecdotally that it's not the FCC, but I want to hear from you.

MS. VAN WAZER: So this is related to experimental licenses? My understanding was there are some issues in terms of jurisdiction, but we do generally have -- there are agreements, and I think the general view - please correct me if I'm wrong -

is that the FCC has jurisdiction.

MR. FRANCA: I just envision the casinos and radio experiments. I don't know.

MS. VAN WAZER: Yeah, has jurisdiction under the circumstances, but please --

MR. HOARTY: Well, I would think that the fact that the radio waves that you're transmitting within the Indian Reservation wouldn't stop at the border. It would probably mean it would have impact on -- the FCC would certainly have to have a say.

PROF. RAO: But what if it did, if it was sufficiently short distance?

MS. VAN WAZER: I really don't know that we're the panel to speak to that issue. If there's someone else who'd like to comment on it, there's someone in the back of the room had a comment?

MR. FRANCA: Actually, I wanted to add a comment that was sort of a follow-up to what Vanu was talking about, asking for a streamlined process, and determining what causes harm or not. I think there's a real critical question, and I think this is, perhaps, what tomorrow is about. But the critical question I see is, who gets to decide what is considered to be harm? Is it the

incumbent or the existing licensee of the piece of spectrum? If they say it's harm, does that mean it's harm? Or is it the FCC that gets to decide what would be harm? It would be -- you know, is it what would harm a receiver that had been designed, taking all reasonable steps to make that receiver robust against other kinds of things?

There's a very wide range. I actually explained it once. There's, you know, more -- I was able to explain that there's more than a 90 dB range that people could reasonably have in mind as to where the level of harm or interference shows up.

MR. FRANCA: And generally in that case, we'd basically let the experiment go forward. And if we got complaints, or we'd maybe ask you to monitor, you know, or talk to a particular user in the area. And then, you know, if there was a real dispute you'd come back to us between the parties, so I mean, generally we don't say no. We basically say that's your obligation, as to cause no harm. Go out and go do it. It might mean, you know, operating from 2:00 in the morning to 5:00, or kind of just have an agreement. Or it might be basically we're going to operate at this lower

power level. We're going to have some test receivers out there. If we get a complaint, you know, then you have to shut down.

MR. HOARTY: That was certainly the case with us. We were -- I was up many a night in the wee hours of the morning when we first started with our STA, and moving beyond our experimental.

AUDIENCE MEMBER: Thank you. I think that's a good answer in the context of experimental licenses. And I guess there's the whole issue of underlay, which is probably best left for tomorrow.

MS. VAN WAZER: We certainly will address some of those issues tomorrow at the interference protection workshop.

I'd like each of the panelists - we're just about running out of time here. I'd like each of the panelists to give one final remark on what positive experiences and what's positive, in terms of the experimental licensing program, and very briefly, where you seem room for improvement. We have five minutes for the entire panel, so keep that in mind.

MR. SOLOMON: Well, I think the simple answer is that some applications have gone through flawlessly. The staff has been great to work with,

and there haven't been any problems. And on the other hand, as we said here today, sometimes applications just get lost somewhere in the recesses of somewhere, and it's hard to get it out, or hard to understand what the status of the application is. And that's particularly disturbing in the business environment when time is critical, and you must rush to market to beat your competitor, so that can be very disconcerting.

MS. VAN WAZER: Thank you.

MR. ROOSA: One of the things that strikes me is there seems to be a lot of difficulties in the process in an area that I might call frictional time losses between different pieces and steps in the procedure. And I think that's something that NTIA and FCC ought to work together to resolve as much as we can. They give us a document. We look at it for 15 business days and get it back, and somewhere it gets stuck. We need to determine where that somewhere is, and figure out how to solve that problem.

MS. VAN WAZER: Is there anything good about that?

MR. LYNCH: I've got some pretty good experience with it. I've got a nationwide

experimental. We had to coordinate it and all that, but it was an idea that actually came out of somebody in OET when we were trying to roll out a network called Sprint, and it worked quite well for us. And I probably have 800 megahertz to about 30 gigahertz on that license. That's all things that conform to the U.S. allocation table. And again, for non-conforming things, it would be nice to have a method, or be sure that's being done in a timely manner.

And the other thing is, if it's going to -- if somebody's got a problem with it, say DOD. They never have problems, but if DOD has a problem with it, let's convene a small group and sit down and discuss what is the problem as we find our way around this process.

MR. ROOSA: That's certainly an agreeable way to do things for us. I don't know if it's always easy to get the people together, but we certainly are available for that.

MS. VAN WAZER: Well, we've gotten together here. Leo, would you have something?

MR. HOARTY: Thank you. As I mentioned at the opening, I spent a good part of the last year coming to Washington, meeting with the OET and

met with the R&D Labs up in Laurel and, of course, Mass Media, now Media Bureau. And the Commission, in general, was terrifically helpful, and I thought especially for a part of our government, I was pleasantly surprised at how much support I got, and guidance. Especially the tricky issue we've been discussing for the last few minutes, or the last 15 minutes of what is interference, and how do you deal with, when you're in the midst of people operating and making money, and you come along with something new? And I think the Commission has been very good at trying to find a happy medium, even though it meant being up at 2 in the morning experimenting.

The only thing I'd like to close with is venture-funded start-up timing is absolutely everything, especially today. I mean, cash in the bank is our life blood until we get to market, and that's the only comment I would have, is timing is absolutely critical to new technology.

MS. VAN WAZER: Thank you.

MR. HILLIARD: Well, I, too, have had a lot of good experiences, but there's no substitute for trying to share ideas and have that discussion before something unusual comes down the pike and

enters into the formal process.

And speaking of that, I think, as a reform step or an improvement step that would not require a change in the rules, it would be useful to convey more knowledge into industry about the experimental radio service, from both nuts and bolts to the policy side of it, so that you would have greater assurances in some situations where you're dealing with unusual experimental requests, the DC-to- light situation, for example. That those folks that are managing those operations do have an enhanced sensitivity to the problems that they could cause, and they have in place steps to prevent those.

MS. VAN WAZER: Thank you.

MR. FRANCA: I don't think I'm going to answer your question, but I did want to --

MS. VAN WAZER: I hope you say that the staff does a good job, Bruce, because I work for you.

MR. FRANCA: I do want to thank every -- you know, like Dewayne, Benn and Vanu, and David, and Ben for really, I think, some good suggestions that I think we need to take a look at in trying to make this process better.

I do want to reiterate, you know, our goal is really to say yes to every one of these experiments that come on. That's really what we want to do.

MS. VAN WAZER: Thank you.

MR. BUCHWALD: And I'd like to just state that at least over the last three to four years, the experimental process has really been streamlined, and has worked well when it comes to spectrum that's not government spectrum.

When you get into, again, things that you're developing for some markets that are for export, that's where the difficulties come in. And if we could find a place to pour the grease in so that the 15 days it takes to get through the NTIA, if that's what it takes, and then that extra time that seems to add up to a year in-between the approval can get sped up, that would really help a lot.

MS. VAN WAZER: Well, thank you. Thank you, panelists, and thank you, audience. Thank you for your suggestions.

(Whereupon, the proceedings went off the record 3:05 p.m.)