UNITED STATE OF AMERICA

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FEDERAL COMMUNICATIONS COMMISSION

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SPECTRUM POLICY TASK FORCE

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PUBLIC WORKSHOP ON SPECTRUM EFFICIENCY

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MONDAY

AUGUST 5, 2002

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The Workshop was held at 9:09 a.m. in the Commission Room of the Federal Communications Commission, 445 12th Street, Southwest, Washington, D.C., Dr. Paul Kolodzy, Spectrum Policy Task Force Director, presiding.

PRESENT:

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| STEPHEN BLUST | Cingular Wireless |
| GERALD FAULHABER | University of Pennsylvania |
| MICHAEL T.N. FITCH | Boeing Company |
| STEVE GILLIG | Motorola |
| MARC GOLDBURG | ArrayComm, Inc. |
| RON HARASETH | APCO |
| MICHAEL LYNCH | Nortel Networks Corporation |
| PRESTON MARSHALL | Defense Advanced Research Projects Agency |
| PAUL RINALDO | American Radio Relay League |
| ULRICH ROHDE | Snergy Microwave |
| C.K. TOH | TRW |
| CHARLES TRIMBLE | U.S. GPS Industry Council |
| DAVID WEINREICH | Globalstar |
| S. MERRILL WEISS | Merrill Weiss Group |
| BRENT WILKINS | Cantor Fitzgerald Telecom Services |

PRESENT FROM THE FCC:

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|---|---|
| RICHARD ENGELMAN | International Bureau |
| PAUL KOLODZY | Director, SPTF |
| LAUREN VAN WAZER | Deputy Director, SPTF |

A-G-E-N-D-A

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

(9:09 a.m.)

MS. VAN WAZER: Good morning. My name is Lauren Van Wazer, and I am Deputy Director of the Spectrum Policy Task Force. Welcome to the third in a series of four workshops addressing Spectrum Policy. This workshop will address issues related to Spectrum efficiency.

Before we get started, I just wanted to say that we have got sign language interpretative services available, and if you would identify yourself if you need such services, we would appreciate it. Well, thank you.

I would like to introduce Dr. Paul Kolodzy, Director of the Spectrum Policy Task Force.

DR. KOLODZY: Thank you, Lauren, and thank you everybody for coming out today. It is a Monday, and so hopefully we can get things going and get a few people moving quite quickly today. I know that it is a little slow, and everybody tries to get going on a Monday morning.

Welcome to our third meeting, our third workshop, as Lauren has said. Could you go back one slide, please. Thank you. Obviously we have

one more workshop at the end of this week on rights and responsibilities.

This workshop today hopefully will tee up some of the issues on how to become more efficient spectrally; i.e., through technologies, and what kind of policy issues are associated with that. And then on Friday, we will try to go through the rights and responsibility issues associated with the types of models that you want to use for Spectrum policy.

We have had a wild and woolly first two days, and I think we have gotten started very, very well, and has set the bar fairly high with respect to the task force. We are encompassing such a large scope, and therefore, that's why we actually put together four workshops instead of one.

And I think that we have been able to actually focus on particular areas and try to bring those to some sort of head in most of the areas. As you all well probably know, the Chairman announced the formation of the task force in June of this year, and basically the objective is to look for better ideas on Spectrum policy.

The investigation is forward-looking, and so what I am going to ask the panelists today

and for the audience is don't think about what we are trying to do today with the issues associated with Spectrum policy are today.

You really want to take a look at what the situation is going to be in the next 5 or 10 years, or even as early as 2 years from now, and try to help us come up with ideas to be more proactive in our Spectrum policies, versus reactive to what the issues that might come up in 2 years, or 5 years, or 10 years.

And I also ask the panelists and the audience to take a look at not just where you are coming from in your perspectives, but to actually take a look at globally and across the spectrum, because we are actually trying to look at Spectrum policy across all the uses and users, and not just across -- not focusing just on one use or one user.

In new technologies that we see of today, as you see all the different uses that we have up -- that I have shown up on the screen, basically are showing us that technology allows us to have flexibility and agility for wireless devices, or facilitating increasingly dynamic uses of the spectrum for an increasingly dynamic marketplace.

What we are looking at here is the potential building blocks for new policies that will address these new realities. The Spectrum policy -- well, okay. The Spectrum policy task force is run by myself. I'm the director. And, Lauren, as you know, is my deputy director.

Our special counsel is Maureen McLaughlin, and our senior technology advisor is Mike Marcus. The Task Force Council is made up of senior members of the Commission from each of the bureaus and offices that deal with Spectrum issues.

You have the International Bureau, like Rick Engelman, who is chairing today's session, is also the chair of the Spectrum Efficiency Working Group. You have the Media Bureau. You have the Wireless Telecommunications Bureau; Office of Plans and Policies, and Office of Engineering and Technology.

The task force issued a public notice back in June, and we have responses and reply comments that were in July. We ended up asking 29 questions and ended up getting roughly 140 responses, with an additional 40 reply comments. So quite a bit of information to start working on

these workshops.

These workshops are hopefully going to take from those comments and move forward into more of an interactive environment, and able to do the pros and cons of particular points of view.

I don't want to delay any longer with the start of the workshop today. However, first of all, I would like to say before I do, I would like to say thank you to Lauren Van Wazer and all of the staff who have worked very hard in putting together these workshops.

It really could not have happened without her dedication and their dedication to actually pull this all off. I think that putting together four workshops in eight days must be some sort of a record here at the Commission for one task force.

I also want to thank all of you for coming out on this hot day. I think we have had every workshop hit it on a hot August day here, and to brave that weather to come out here, and to hear from our panelists.

Now what I would like to do is to introduce our panel moderators for this workshop. First of all, I would like to introduce David

Weinreich, who is from Global Star. Also, Rick Engelman, who is our chief engineer for the International Bureau, who also as I said chairs the Spectrum Efficiency Working Group.

This afternoon the chair will be one of the co-moderators, will be Preston Marshall from the Defense Advanced Research Projects Agency. Again, we are very glad to have all of our panelists here, and I would like to turn it over to David, for he has some introductory remarks. Thank you.

MR. WEINREICH: Thank you very much, Paul. This morning we are going to talk about Spectrum Efficiency, and one of the questions that comes to mind right away, at least to many of the engineers that are here, is what is spectrum efficiency and how do you define it.

Is it just the amount of information that is transmitted, divided by the amount of spectrum that is used, or are there other less obvious, more subtle, aspects to the definition of spectrum efficiency.

And I think by the end of this session, around noontime, we should have at least a better understanding, if not some kind of definition of

what spectrum efficiency might be. I think that there are a good number of panelists here who will contribute to that.

I work for Global Star. Global Star is a satellite organization that provides mobile satellite service on a nearly global basis, and one of the things that we are concerned about in the mobile satellite service, and also in the satellite service in general is spectrum; and how to acquire spectrum; how to best use the spectrum, and how to maintain the spectrum.

When one talks about maintenance of spectrum, it has many aspects. One is what is the best use for it, and how is it applied most efficiency, and one of the other ones is how do we keep it, for want of a better word, clean.

How do we make sure that we can use the spectrum without being affected by interference or noise that may arise. I think another question that we are going to talk about today is it more efficient to use spectrum to reach, let's say, 90 percent of the people in 50 percent of the country, or is it better to reach 15 percent of the people in 99 percent of the country.

There seems to be a difference between

terrestrial and space applications, or satellite applications in spectrum. It is easy to see that especially in a city like Washington,that there are a lot of terrestrial uses in cellular telephones, and two-way radios, and things like that.

But if one goes outside of the city, and into the more less densely populated areas of the country, you don't see as many cell towers, and you don't see people with cell phones. You don't even see people with too many two-way radios.

They are kind of out there and if they need immediate communication, they have to go to some means to try and achieve that end. And this is one of the places that the definition of spectral efficiency comes into play.

Is it more efficient to just use certain pieces of spectrum for terrestrial, or is it good to have both terrestrial and satellite in the same frequency band.

This is something that has worked in some places in the country, and in sharing between the fixed-satellite service, the geostationary satellites, and the fixed-service radio relay. But the question is, is it a good policy for most of the spectrum.

As I said before one of the other issues that I don't think we are going to deal with directly, but that we have to take into consideration, is interference. More and more each day, we become more dependent, and maybe not dependent, but we become accustomed to the convenience that is provided by devices that emit electromagnetic radiation.

Not all these devices do it on purpose. Sometimes they do it just incidentally. Hence, the name, incidental radiators. There are not very many things that one can see today that don't have embedded processors in them.

Even refrigerators now use computers to keep track of temperature and things like that. Each one of these embedded processors emits radiation, often radiation at different frequencies that has nothing to do with the processing, but it contributes to the general background interference that is on the rise day by day.

So this becomes also a factor that has to be taken into account in spectrum efficiency. So with that, I think that we can go on to the panel. I guess we should let everyone know who the panel is.

We have Merrill Weiss from the Merrill Weiss Group. We have Charles Trimble from Trimble Navigation, and he is representing the United States GPS Industry Council today.

We have C.K. Toh, who is the Director of Research for TRW; and Rick Engelman, on my left here; Ulrich Rohde, from Synergy Microwave Corporation. I was going to say Rhoda and Schwartz.

We have Paul Rinaldo from the American Radio Relay League; Stephen Blust, from Cingular Wireless. I was going to say Bell South. It used to be. But Cingular Wireless. And finally Steve Gillig, who is the Director of Research for Motorola.

So I think we can kick things off with one of the first questions, which is one of the ones that I asked initially in my opening remarks, is how should spectrum efficiency be defined.

Now the next question is who do I want to stick with being the first speaker. I think I will let Mr. Blust open up for us.

MR. BLUST: Well, thank you for the opportunity to address that broad ranging question on spectrum efficiency be defined. I think long

and short, as it can be defined in many different ways, is the question that I think we are wrestling with.

Often I think a definition of spectrum efficiency is almost one that is a form and fit, versus the function. What are you trying to accomplish by defining spectrum efficiency may indeed impact how you define it.

As we pointed out in the opening remarks, it is often a function of whether you are trying to do it in a technical basis, or on a policy basis, or an economic basis. I think part of what we need to consider when we talk about spectrum efficiency is what are we implying it to in terms of the service and capability.

Is spectrum efficiency in a definition the same definition for, for example, commercial wireless, or broadcast, or satellite, or a defense, or some sort of wireless internet application.

You may be able to do it in general terms, but I think that the specifics of the situation very much influences the definition.

MR. WEINREICH: Okay. Thank you, Steve. Are there other comments on the panel who would like to address?

MR. GILLIG: Yes.

MR. WEINREICH: Yes, Mr. Gillig, please.

MR. GILLIG: I would like to comment. One of the things that -- I do agree that the service is very important, and the different unlike services that are hard to measure using the same means and measurement, and the same equation.

One thing though that that we would like to see, we think that some sort of a reference system model is something that we need here. As we are trying to determine how to measure it, one of the things that is helpful is to be able to actually simulate the traffic.

So we think that a reference model that perhaps picks a hot area, such as an urban area of a large city, that sets up a particular landscape of buildings, and users, and streets, and then looks at things like path loss and multi-path between any two locations, and models that.

And then looks at the user traffic versus time, and sets up some sort of a reference model that we can all use to do simulations, and then talk with some sort of a common basis, is very useful.

MR. WEINREICH: Thank you.

DR. ROHDE: Can I add something?

MR. WEINREICH: Sure. Dr. Rohde.

DR. ROHDE: My view is that you start with something which is called information. Let's assume at this meeting here that we have a video monitor, and if you look at the video monitor, you have information, which is the picture.

And you are now trying to transmit this picture to a particular audience. So given the fact that you have information, you have to ask the question how much bandwidth do we need.

And efficiency certainly has to do with bandwidth, and how the signal arrives at the receiving end. So if you can compress the same picture with a certain resolution or quality, the definition of efficiency then lies into things like compression and resolution.

And then, of course, not all transmissions arrive for the first time, which means you have to retransmit certain things. So as a fact of this, you have information, and you have bandwidths, and the time, how often do we have to transmit this.

These are all factors which determine

the efficiency, and needless to say, if you can do it in one rapid transmission and you get all the essential things -- like the human voice has a lot of redundancy.

You can take a lot of things out, like if we say "eh" or some other comments which are totally unrelated, like a delay, because you tried to think in between.

So you can shrink the information to a degree where it is more efficient, and I think I would like to see the efficiency defined, starting with the information. What is the piece of information that I am trying to convey from a to b, and then how to deal with it.

MR. WEINREICH: Thank you, Dr. Rohde, for a little information on the theoretic aspect of spectral efficiency. Charlie Trimble.

MR. TRIMBLE: Thanks, Dave. As the comments were made, and as we look across the various services that you want to use spectrum for, the definition I think we all will agree will differ.

It relatively easy to look in a given service and say is one scheme more efficient than another, and I think people of good will can come

to an agreement on that.

But there is something that goes across the entire range of services. From a tactical theoretical standpoint, the channel capacity according to Shannon is defined by the signal to the noise ratio. And at any given set of power levels, then the signal to noise ratio is determined by the unintended or existing noise floor.

And so as Dave mentioned earlier, worrying about the noise floor, which is to spectrum a lot like smog is to the atmosphere, this is the one thing that cuts across all services, and so monitoring the noise floor and monitoring what the effect of decisions or how various groups control and maintain their noise floor, is going to be very key to spectral efficiency.

MR. WEINREICH: Thank you, Charlie. Mr. Merrill, please; or Merrill. I'm sorry.

MR. WEISS: Picking up on what Charlie was saying, there is another effect that is going on in the world with respect to the noise floor, and that is from all of the incidental radiators which were mentioned earlier.

When you look at different parts of the

spectrum, you see different amounts of noise showing up. An example of that is that when we look -- and I happened to come out of the broadcast world, and so let me use that as a basis.

When we look at low VHF versus high VHF, versus UHF, for instance, we have to apply different models, because at low VHF, there is a substantial amount of man-made noise, and it comes from power lines, and the breakdown of insulators on power lines, and the breakdown of insulators on power lines.

And all those kinds of things that are beyond the control of even the FCC, in terms of controlling radiation by the rules and regulations. So that has to be modeled, and the model of that maintained if you want to know what you can do, for instance, at low VHF, because it is increasing over time.

And if you go back and look at the studies that were done 2 or 3 decades ago, you get a different number than you get today. And not keeping track of that can give you some unintended consequences.

For example, if you look at the studies that were done to decide on broadcast allotments,

you will find that the channel models that were used for low VHF are off by something like 10 to 15 dB. That is work that has just been done in the last few months to try and figure that out.

And it is because the numbers that were used for -- at least it is partially because, some of the numbers that were used for what the noise floor was were wrong. They were old. And by taking data that is old and considering it to be correct and current, you can make some big mistakes.

And so the model has to be one that counts for the changes in the environment. So that is just one addition that I would add to Stephen Blust's uncertainty principle for spectrum policy or spectrum efficiency.

MR. WEINREICH: Thank you. Mr. Gillig again, please.

MR. GILLIG: Yes. One further comment on the actual, in many cases the devices themselves that you carry around you, we need to consider what the energy requirements on that device will be for meeting a certain spectral efficiency, because certainly we are getting used to seeing fairly high data rate transfers for things like wireless LAN.

And the reason that you can do that is because it is short range and the power levels are relatively low. When you start talking about wide area coverage to try to do the same thing at those data rates in a wide area, requires quite a bit more energy. And if you are talking about portable devices, we need to take that into account also.

MR. WEINREICH: Let's see. Mr. Toh, first, and then Mr. Weiss.

DR. TOH: Okay. Let me just make a disclaimer that all my views are not representative of my company, but from an engineer and former professor point of view.

The very fact that you want to strive for spectrum efficiency is because we have limited spectrum, right? So, to what degree of efficiency we want to strive for. Should we look into the aspect of the very nature of how we look at frequencies to operators to services.

I agree with some of the panelists in terms of the fact of servers efficiency, and technical efficiency, and how much bits you can transmit per hertz. Technical innovation. So given a limited range of spectrum, what kind of traffic, and to what capacity we can transport

within that range of spectrum.

So this multi-dimension thing will eventually come into play, and we have seen the evolution of CDMA, for example. So frequency dimension is just one thing that I mention, and nothing is stopping the engineers from looking beyond that dimension.

And the other thing I felt was that in terms of economic efficiency, how much does it cost for an operator to acquire a certain range of the license for the spectrum.

How much for the user to pay to transport a certain amount of bits per hertz. So there is this FCC's point of view, user point of view, and the operator point of view. So I think it is a complex thing, and needs to be looked at in different dimensions before one can come to a conclusion that we have effectively made good use of the spectrum.

MR. WEINREICH: Mr. Weiss, please.

MR. WEISS: I was just going to follow up on what Steve Gillig said a moment ago. He was talking about application in mobile uses, and I would posit that that the very same factor is important for fixed-uses as well.

If you take the absolute extreme opposite of a cellular telephone, and talk about a broadcast transmitter, it is probably the most powerful transmitter, except for maybe some radars and things, or -- well, specialized military applications perhaps, but the most powerful of the -- let's call it civilian applications that is around.

And I would posit that the same factors are at play. That is you put up a big tower and a powerful transmitter, you will cause interference over a larger range than if you put up a number of smaller towers and at lower power, and you will get much better efficiency in terms of coverage from that aggregation of towers than you will from the big one, and you will cause interference over a smaller area.

My question becomes can we build broadcast systems that work that way, and maybe later we can get into some of that. But I would suggest that now that we are moving into the digital realm that we can.

MR. WEINREICH: Thanks, Mr. Weiss. It almost sounded like a commercial for low power FM.

MR. WEISS: Oh, no.

MR. WEINREICH: I was being facetious. Okay. Steve.

MR. BLUST: Just one more comment, which is that what I think you hear also is that no matter how you define efficiency for a service for the moment for the technology, is that there are many, many factors which come into play even after you were to define it.

If you were to use it as a tool to make comparisons, and the model is only as good as the model can be, when you get into the real world deployments, and we see these other factors and other influences come into play, which are often outside of the control of the scope of the model, a lot of times that can significantly change the answers that you get when you run a purely engineering calculation in a lab environment, for example.

MR. WEINREICH: Thank you. Well, I am not sure how well we have done in defining spectrum efficiency. I see that Mr. Rinaldo wants to add a word. Please do, sir.

MR. RINALDO: The classical definition usually amounts to information transmitted, or

desired to be transmitted, or desired to be transmitted over the product of time bandwidth and spacial, or the geography.

And this is pretty good, except that it doesn't take into account everything. There are other dimensions as have been pointed out here. I would say that one view of the bottom line is frequency reused. That's what we are into these days.

If you use a frequency, can somebody use it down the road that may be unrelated to you. So I think the definition really comes down to how much do you need, versus how much you use. Thank you.

MR. WEINREICH: Thanks, Paul.

DR. ROHDE: Can I add something to this?

MR. WEINREICH: Certainly.

DR. ROHDE: Actually, Paul Rinaldo would probably say this. One of the big users of spectrum is the ham radio community, and theoretically when all ham radio folk use, they were on the forefront, and they were the experimentals and did all the things.

And today we are stuck with two

problems, and two real problems. One is that the technology got so complex that most of the radio amateurs who are now appliance operators, and that is kind of a buzz word I guess which is used, are not capable in buying the computers, the microprocessors, and actually doing something with it.

And, second, the FCC is in the way, because by definition you need a license to operate a ham radio station. And, number two, you cannot transmit something which the FCC can't listen to.

So this collides with the fact that you are supposed to be experimental, and some of the questions of efficiency and coverage, and other things which are going to be today's topic here, cannot be experimentally validated by people who have -- this is a hopping on charge weight, they are actually forbidden for doing this.

And I would recommend that the FCC really looks at this whole issue of restrictions, because the cell phone certainly could have been invented by ham radio, and you could have gone to jail, with a kind of frequency hopping, time domain, code division, multiplex, all the things which are involved here, totally violate the laws.

And so this is an issue I think which there may be a side question here, but you have a large resource of people who could do something useful if they get permission to do it.

And I would like to add one more thing which happened to me about 20 years ago. I bought a car, and forgot to add cruise control. So I went to Sears Roebuck and bought a cruise control.

And then I went on one of the national highways and there was a police car next to me. And I set my car at 55 miles an hour and didn't think anything evil. And then the police guy talked into the microphone, at which time my car went faster.

And then he stopped talking and I slowed down. So we did this two or three times, and the police stopped me then and said what are you doing here, playing with my radio; and I said just the opposite, that you are playing with my speed control here.

And this is some kind of interference in noise which was pointed out. You have legitimate operators here, like the police and others which transmit on frequencies, and then you have a poor system which is susceptible to

radiation, and you measure distance, two cars side by side.

And so these are all issues which are kind of buried in my opinion in this question of efficiency, because you are transmitting into my car, and not to the police headquarters. You are transmitting into my car and being a nuisance.

And the two things -- and I have not seen these other panel activities, but when they are conducted and radiated into fields goes both ways. Whether or not you have a cell phone, which you then conveniently place in front of your television set, or in front of your computer screen, at which time the computer goes bananas.

Or likewise you are expecting to get a call here, and then the computer talks into your cell phone, which at that time the cell phone goes bananas.

These are all issues which have to do unfortunately with the wave forms, and the type of transmissions you have.

And that's why there is a subconscious message

that I am going to send out to everybody is not only look at definitions of what efficiency is, but

look at the type of modulations, and type of methods in which you are transmitting in, because some are more noise friendly than others.

And some of them are more advanced than others, and the FCC has a great deal to do and to say about what modulation you do and how you do it. Thank you.

MR. WEINREICH: Thank you, Dr. Rohde. Yes, that certainly is a consideration, a very big consideration as to how we develop future systems, and one of the important things that I think that is going to be an aspect of future systems is how immune to interference they are.

And it is not going to be just one type of interference, but it is going to be a lot of types of interference. So that is one thing that we have to as developers of systems have to keep in mind for the future. Are there any questions that the audience would like to ask?

Okay. Carl, first. If you will please state your name, and some kind of affiliation, and go ahead with your question.

MR. STEVENSON: Thank you. If you will forgive me, I am going to refer to something in my notebook, and so I am not going to stand up. My

name is Carl Stevenson, and I am with Gear Systems, and I also represent IEEE Project 802.

I was very interested with Mr. Weiss' observation, and also I believe Paul's observation that frequency reuse is becoming a more important factor. In fact, in the comments that IEEE 802 filed with the task force, we proposed a wireless efficiency metric which takes into account the capacity of the system in delivering information bits per second after decoding, demodulation, and including the vagaries of the network protocol and duty cycle.

And the number of logical connections or users in the network within the coverage area utilizing the allocated bandwidth B, and where that is of course in hertz; and the area covered in units of square meters. So you come up with something that is sort of bit users per meter squared, per unit bandwidth.

The old measures of modulation efficiency, simply looking at bits per second per hertz just tells you how efficient a particular modulation scheme is in terms of utilizing bandwidth, but it doesn't tell you the whole picture about spectral efficiency.

This sort of plays into the other comments that were made about to the effect that due to incidental radiators and other factors, noise floors tend to be rising.

And at least within the wireless network standards that IEEE 802 produces, we look at our environment as being interference limited rather than at Gaussian white noise-limited, and frequency reuse is a very important part of our approach to how to get increased spectral efficiency and capacity.

We have over the years gone from one megabyte to 11 megabytes, to 54 megabytes. We are looking at 200 megabytes and beyond in essentially the same bandwidth. So we are looking at more efficient modulation and coding techniques.

But we are also pushing the envelope more on frequency reuse, and I think this is a principle in this metric that we have proposed is something that scales very well to all sorts of systems. And I would encourage the commission to think in terms of promoting frequency reuse.

And in cases where it is practical, encouraging people to design systems that are capable of operating in an interference limited

environment, rather than a noise floor limited environment, because the noise floor is only going to continue to rise as we use more and more electronic gizmos of all kinds. Thank you.

MR. WEINREICH: Thank you, Carl. There was another hand over here. Please raise your hand. Okay. There we go.

DR. HARASETH: Thank you. Ron Haraseth with APCO International Public Safety, and I am interested in your comments from Mr. Weiss and Mr. Rinaldo about the frequency reuse, and the interference models that we are looking at.

But that is a model that you are capsulizing, and that is exactly why we have the problem right now in public safety with the interference from that very model. So we have to be very careful that that model isn't incapsulized to the point where it doesn't look at its effect upon other services that are not interference limited on the noise limited systems like public safety has.

If we were all using the same technology and the same given bandwidth, then that one model would probably be correct. But if we are all using -- if we are using any other models at

all that are counter-indicated you might say in this case, then that model can be a problem.

MR. WEINREICH: Okay. Thank you. I can't remember your name.

DR. GOLDBURG: Marc.

MR. WEINREICH: Marc from ArrayComm.

DR. GOLDBURG: Yes. Marc Goldburg from ArrayComm. I have a question for the panelists. We heard some discussion and some comments from the other audience members that it might be possible to develop some sort of spectral efficiency measure that takes into account through put per unit hertz, and takes into account interference.

Maybe it is bits per second, per hertz, per square kilometer. Some value. And then we also hear people mentioning that whatever this quantitative metric is, it would have to be adapted to the particular service.

So one would have different targets potentially for cellular ribose, versus broadband data, versus public safety, because there is other externalities there that have to be considered.

Would the panelists feel that it is possible to develop such a scheme, and develop some performance targets, and possibly expect those

performance targets to improve over time as technology improves?

MR. WEINREICH: Thank you, Marc. Who is going to raise their hand? Mr. Blust again, please.

MR. BLUST: I think it is quite possible within a technology or a service to look at developing a model that describes that service. We have done that, for example, in commercial wireless in the past for WRC and other preparations, where we developed a model that looked at spectrally efficiency or effectiveness on a technical basis.

And a deployed basis in order to be able to predict future spectrum, and certainly that model, and the data that went into that model, for example, looked at a mix of current systems and future system capabilities.

You never change your generations of technology overnight, and so one also has to look at a critical mass in a mixed environmental issue of old, new, and newer technologies.

So I think you can develop models that apply perhaps narrowly for specific purposes. It is much more difficult to take that model and

generalize it beyond its intended bounds and its intended applications.

I think also most services today, at least those driven by the business economics, are always continuing to look at how they use their systems, their resources, their engineering criteria, more and more effectively to get more out of the same infrastructure and devices that are already deployed.

It is just a business principle that drives us more and more into the -- especially in a consumer-oriented realm. Thank you.

MR. WEINREICH: Anybody else? Charlie.

MR. TRIMBLE: I think the issue principally comes when you have overlapping services that frankly don't work together. Clearly the cellular is an example of improving the throughput and handling the issue of capacity problems by adding to the infrastructure, and basically worrying about interchannel interference, and driving specifications internally that frankly are tougher than the ones that the Commission put on the system.

And there inside of an economic

service, you are going to see a migration and an improvement. On the other hand, you look at license-free bands like the 2.4 gigahertz band, and basically it is who is the last man standing as the overlapping services start interfering with each other.

MR. WEINREICH: Thanks, Charlie. Anybody else on the panel want to give us --

MR. ENGELMAN: If I --

MR. WEINREICH: Go ahead, Rick.

MR. ENGELMAN: If I could just ask the question again a little bit. I think what I would be interested in hearing is in answer to the question is if we could develop models within services, which is what I think the question was asked, would people feel that you could also then set goals and targets for people to shoot at over time.

And I would like to hear some more focus on is that practical to do.

MR. WEINREICH: Who wants to -- the first responder here, Steve. What can I say?

MR. BLUST: I think you can develop a model, and you can perhaps apply it over time. You can set those goals and objectives. The question

then becomes what is the goal, and objective, and the metric that you set, and how good is the model as you project it forward in time.

I think that in any industry or service segment that you will probably find great debate over what you should set for an executive. I think, however, as we have seen in the past, if you make the time horizon far enough out where you consider that you are in the next generation of technology to be deployed or to be in place in the systems, as opposed to displacing so to speak, then I think it is possible and practical, and perhaps appropriate, to set some sort of baseline criteria.

I think what goes with that perhaps is a recognition that when you exceed that baseline criteria are much better than that. There perhaps needs to be some credence, or credit, or appropriate weight given to doing that, or else you will always have systems which are just defined for that particular minimum, which is maybe not the desired objective.

MR. WEINREICH: Thanks. That is an interesting thought. We should ask people to meet a certain level or give back their license, or something like that. I know that you didn't say

that, but you could go in that direction. Anybody else? Merrill, please.

MR. WEISS: In listening to the discussion, one thing that came to mind thinking back at the original introductory words that we had about being future oriented, and not being locked to what we have had in the past, suggests to me that as we think about models, we should also be thinking about how those models themselves will improve over time, and must e maintained over time.

We can't just move from one fixed model to another fixed model and say we are done, and that is going to be the measure that we are going to use going forward.

If you look, for instance, at propagation models, something that is going to underlie a lot of what we do, you can take your choice of Longley Rice, or Tirem, or you name your model, and you will get different results.

And different people have spent lots of time going out and developing those models. They have tried to measure what goes on in the environment, and from that derive some kind of numerical analysis process that lets them predict what will happen over a particular path under

certain environmental circumstances.

Yet none of those models is universally applicable. None of those models, depending on the application that you put it to, necessarily does a good job.

Yet, we have had to administratively select models and say that is what we are going to use to predict what we expect to happen between radiators and receivers in a given service and under certain circumstances.

We will probably have to continue doing that, because there is no way to prove that you have got the perfect model. But decisions will have to be made going forward to say, all right, we are going to move from the model that we have now to some new model, and we need to make sure that the process then allows that new model itself to be improved so that we over time arrive at perhaps a better way of evaluating what systems can do, and what the real efficiency is.

DR. ROHDE: Can I add something?

MR. WEINREICH: Certainly, Dr. Rohde.

DR. ROHDE: If I look at the current situation and look forward as Paul Kolodzy has recommended we should do, the systems at the moment

have an analog system, and most of the police still in this country uses analog radios, with all their deficiencies and advantages, whatever you think they are.

And likewise you have a digital system, and I think as was rightly pointed out, the cellular telephone, in spite of all the competition, and all the price wars you car hear, have found a common efficient battleground with minimum interference.

So you have two systems in place at the moment. One is this analog system, and then there is the digital, and if I look at the question of efficient handling, I think one of the issues that has to be really addressed is similar to cars with emission standards.

You have leftover cars which still don't meet the emission standards, and then you have the modern cars. The system is the same, and you have to make the transition from the current analog 25 kilohertz or whatever channel, which have lousy capabilities, which have a lot of interference, to a trunking or digital system which is more efficient, and more reliable, and just better.

Then you have these overlap things here, and even if it doesn't show up on this agenda here, I think it is an important issue to look at how we migrate from A to B, because the sooner that we do this, the better coverage we get, and because of the particular wave forms that I have tried to point out before, you get different emissions.

And I really am not totally convinced that it is really true that we have to accept these increasing noises. I mean, it sounded to me for a moment like that it is god-given that there is a function of time, and the electric emissions overall go up, and we have more noise, and the old noise models are incorrect.

They may have been correct, but I don't understand totally why we just go out and allow everybody to transmit garbage, and then have a higher level of garbage out there.

It doesn't appeal to me, nor does it make sense to me. But maybe somebody else from the panel can educate me on this.

MR. WEINREICH: Thank you, Ulrich. Steve.

MR. GILLIG: Yes. I wanted to make a comment about the upgrading of the models with

time. First off, I agree that that has to be done, and one example of why that might have to be done is if you look at some of the more futuristic things, like ad hoc networks, if you talk about just a transmit and a receive, and you look at the efficiency of that single transmit and receive, you get one number.

On the other hand, if you look at an ad hoc network where you have possibly a hundred different ad hoc units that might be required to send a message from point A to B, you are going to get quite a different number.

So I think the one thing that we can say about the models is that if we are going to look at efficiency, we need to look at an end to end efficiency and delivery of the information, rather than just a unit to unit modulation type of approach.

MR. WEINREICH: Thank you. Well, we are getting on towards I think the second group of questions that we wanted to address. We have pretty much looked at spectrum efficiency, and how it is going to be measured, and how it can be defined, and the effect it has on different types of services.

And one question that was put forward or developed during the preparatory work for this session was should efficient use of the spectrum be a policy goal, and I think that goes without saying.

If we go back to Steve Blust's comments about systems that are going to be designed -- future systems that are going to be designed to meet a certain spectrum of efficiency, and then if possible exceed that, then what do you do with the older systems.

Dr. Rohde has also talked about that, and is there some -- there seems to be a need for some kind of -- I hate to use the word regulated, but some kind of goal for spectrum efficiency that various users would have to reach in a certain amount of time.

Of course, the question becomes how long is that amount of time, and what is the -- where are you going to set the bar for the level of spectrum efficiency. That, of course, assumes that you already know how to measure it.

But I think one question that goes beyond that is how -- what are the policy goals and subjective considerations that affect the analysis

of spectrum efficiency.

Do we have any -- have we already covered that or are there more specific comments about that one? What subjective considerations need to be taken into account to analyze spectrum efficiency? Charlie.

MR. TRIMBLE: Clearly, you have got the problem of grandfathering, and changes with things that belong in the grandfather category have to be measured. You have got a couple of different choices, and you clearly can set goals in the future that demand the movement.

You can go back to the pollution environment, and start trading in pollution credits. So, you can provide an economic incentive, because in those services where there is a monetary toll gate to the transference of information, the companies that have ownership of that portion of the spectrum are highly motivated to increase its efficiency.

So the place that you do not get increases in efficiency from the natural economic environment is where things are given for free, or things are given for public safety reasons, and in those cases you are going to have to mandate

improvements.

MR. WEINREICH: Thanks, Charlie. Well, I guess that begs the question as to how would we mandate them.

MR. TRIMBLE: Well, you have already discussed the modeling of improved goals that over time -- for example, the analog radios are going to have to go to narrower bandwidths or digital technologies. I mean, that would be a set of mandating.

MR. WEINREICH: Thanks. Steve.

MR. BLUST: I wasn't going to answer your second question. I was going to more address your primary question. I think there is three points with regard to this question. The question was where it should affect. I think it is not a should affect. I think it will affect.

I really believe that when you look at it in terms of underlying policy and the subjective aspects that they will determine to some extent the definition and the application of that definition to spectrum with regard to trying to understand efficiency.

It is sort of the other way of looking at it. It goes hand-in-hand, I believe, with the

fact that I think that the desired answer may indeed influence the definition you put in place.

And I think furthermore as we have seen from the discussions that in any of this discussion of efficiency analysis, deployed or technical measures of systems or whatever, that you don't get answers that are what I will call undeniable foundations of truth.

You tend to get answer that you might be seeking, and so I think we need to be cautious about doing that. I think it is a complex task that we are discussing here today by any means.

MR. WEINREICH: Thank you, Steve. Yes, that goes with definitely, almost without saying, that it is a complex task. So, go ahead,

MR. ENGELMAN: Can I ask -- I think what I heard from Mr. Trimble was a thought that in services, and in systems where there are economic incentives to be efficient, that maybe there is less of a need or no need for having these goals defined.

But in the other services where there isn't such an economic incentive, there might be. And I guess I would like to pursue that a little bit further in that regard. And maybe pick on some

of the panelists that are involved in certain services. I will start on my left.

Merrill, what do you think about the broadcasting services? Is there adequate incentive there to be efficient? I will just pick on somebody.

Is AM really ancient modulation?

MR. WEISS: Well, I tend to think in terms of the television side of the world. It has been a long time since I did radio. And you have in some ways a disincentive to efficiency after a certain point, because you have a huge number of consumers spending large amounts of money to buy equipment that they expect to be able to use for 20 years, and to be able to take from market to market and know that it is going to work.

I mean, think about how many television sets you have in your house, and think about how old some of them may be, and you tend to pass them down from your living room, to your family room, to your kitchen, to your bedroom, whatever.

And many people have -- well, I'm in the process actually of measuring some now where I find 7, 8, and 10 sets in a home. So people don't want to have to throw out that assortment of

equipment and start over very often.

Now, we are going through that process right now in the move to digital television. Granted, it has had some fits and starts in getting going. The extent to which it will be success certainly depends a lot on what the Commission does and what the various industry segments do.

I think when you are in an environment like that, you have to have an organized approach for how you are going to make the change, and you have to have some centralized authority driving it.

Now, whether that is the Commission, or whether there is some other -- you know, I am using the term centralized authority in a broad sense, there has to be something that drives it, because you need to get coordination between industry segments.

And when you look, for instance, at the cellular telephone industry, basically they are the masters of their own fates. An operator can decide that I am going to switch from TDMA to CDMA, and I am going to set up a system where I have certain channels that will allocate, and I will gradually switch my customers over to that.

But when you talk about a broadcast kind of environment, where you have consumers spending a lot of money, and -- at least they perceive it as a lot of money, and you have to get perhaps the entertainment industry, as well as the broadcast industry, as well as the consumer electronics, as well as the cable industry, and the satellite television industry, all to agree on what the interface standards are going to be, for instance.

That takes -- and especially when those industry segments have diverging interests. I mean, just look at the must carry issue between broadcasters and cable, and you will see what I mean about diverging interests.

To get all of that coordinated takes a substantial amount of effort and planning, which one might argue hasn't been sufficiently done for the digital television conversion that we are in the process of going through now, and that that may be part of the issue.

So those are the kinds of things that need to be looked at, I believe, in dealing with a transition of that sort. And it is a much more extensive kind of change than you might have. And

under the control of a lot of disparate interests that you may not have in some of the other services.

MR. WEINREICH: What kind of -- in your opinion, what kind of incentives could be offered to, say, the various broadcasters, or even the cable providers, to encourage them to go to more efficient means of utilizing the spectrum?

Is it a carrot or is it a stick? I mean, do you need to beat them over the head and say you have to do this in five years, or is there a way to --

MR. WEISS: Well, we are trying that right now, and it is not exactly working. At least it is not exactly working as planned. You know, there were targets set, and there were goals set, and some might argue that the goals that were set were not achievable in the first place.

And I could make some pretty strong arguments about that, and yet at the time -- well, just for background. I did a lot of the work for the advisory committee on implementation issues, and we pointed out where the delays were going to come from.

And it turned out that we are about 98

percent correct in what the predictions were as to where things would be easy and where they would be difficult in making the transition.

But the thing that I think we failed to look at that is the real hold-up is that inter-industry friction that is going on right now, and where decisions could be made by the Commission, for example, that haven't been made to this point, that might help move things forward.

So I guess it comes down to you give incentives by in this case offering some opportunities that weren't there before, and there are clearly opportunities for broadcasters that were not there before.

But at the same time, you have to make sure that those opportunities don't come with such impediments that they are meaningless or worthless. And we are seeing that, for instance, in the failure to get cable carriage for broadcasters.

We are seeing that in the failure to get the necessary security for the intellectual property that will encourage the entertainment industry to provide content of the quality level that broadcasters seek.

Now there are all kinds of issues of

that sort and until they are sorted out will continue to, if not stymie, at least stifle the transition. So I think it is both sides. I think you have to have the stick if you will, and you have to have the date certain by which people are expected at least to do certain things.

But you also have to make sure that the way is open for them to do what you ask them to do, in a way that doesn't at the same time kill their businesses.

MR. WEINREICH: Steve.

MR. GILLIG: Yes. Responding on the question of whether there should be some subjective considerations, I think that there certainly should be subjective things like what is the public utility of usage of certain spectrum.

And so, for example, in the case of public safety where obviously the public utility is very, very high, and that is even more emphasized by recent occurrences over the last year.

But in that case there I think we have to be careful before we set higher measures for efficiency, because we don't want to in any way degrade the current public utility.

And I am not taking a near term versus

long term view. I just think that is something that we have to consider.

MR. WEINREICH: Thank you.

MR. ENGELMAN: How about other services, Stephen? The CMRS service, the mobile services, tend to be competitive. Is there adequate incentive there you think for spectrum efficiency? Should there be more incentive?

MR. BLUST: I think the fact of maintaining -- an individual service provider and operator maintaining their competitiveness in the marketplace is a pretty big incentive right there.

I think that one of the things that we see at least in the CMRS, cellular PCS, is the fact that there is a measure of flexible use associated with that spectrum, and there is a boundary condition.

Obviously, you always need some sort of boundary conditions, but that has allowed the advancement of the technologies, and the deployment of those technologies in conjunction with the business case, the perceived market need, the demand, what the public and the consumer wants the movement from voice to data messaging and so forth.

And that's I think allowed the investment in the technology development to take place, to provide those services in the most efficient way. When you are spectrally constrained, you tend to develop the best solutions that you can develop.

There is a balance between how much you can economically place, versus what you can do with the technology. You can always perceive of technologies that are so costly that you will never be able to deploy them, and then there is no benefit.

I think that is a balance that we have to look at, and certainly in looking at spectrum as we have pointed out in the CMRS industry, additional spectrum lets us move forward with bringing those services to the marketplace around the technologies that we have defined and designed.

And once we get those services and those technologies in place, we will do improvements and enhancements on those technologies. You may not necessarily fully replace them over a 10 year window, and certainly that is maybe your next horizon.

But during that period of time, we have

learned to apply the advantages and the enhancements to make it more effect and more efficient, and a flexible use policy let's us do that without being dramatically encumbered.

MR. WEISS: Well, I think that would be -- that is probably one of the best ways to be more efficient, is to take the basic platform and then use different applications, or develop things from your basic platform so that you can provide more efficient, or a more beneficial service to your customer.

That is one thing that I think that digital technologies kind of lend themselves to that type of thing, because you can always look around and find a few unused bits or something like that to try and apply to a better purpose.

MR. ENGELMAN: Does anyone in the audience have comments on this? Oh, boy.

MR. WEINREICH: Okay. Let's see. In the third row there.

MR. SPITZER: I am Adam Spitzer from Telecom Filings. I think if we are truly looking forward, I think that we will all agree that the discreet lines between the content and services of the various sectors, be it broadcast or CMRS, or

satellite, that they are providing, those discreet lines are sort of going away.

And we are seeing so much crossover in the services that it is not going to be a regulatory -- you know, carrot or stick. It is not going to be a mandate that invokes the change, but the universal driver that you spoke of is going to be the profitability of special efficiency.

That if we create the market conditions that the license holder can profit from his spectral efficiency with secondary markets, and allowing them to further use the spectrum that they already have.

It is not going to be setting goals and then seeing did they make the goal, or did they not make the goal, and conditioning their license going forward, but saying here is the market condition that you are going to profit from better use of the real estate that you have already taken.

MR. ENGELMAN: And how do you get that profit out of someone who is non-profit?

MR. WEINREICH: Right.

MR. SPITZER: I don't know how that applies to the public safety license holders. Obviously that is a little bit of a different

situation, but maybe in that case it is the Federal regulators who can set the goals and sort of force the change.

But I think in the commercial space it is going to be the conditions of who can make the best use of it. And perhaps as you said before, you know, you have got televisions that are old and that the cost to the consumer is a consideration.

The gentleman before made a comment about the automobile, and the automobile that is older. Obviously an old automobile is using more gasoline than a new automobile, and we are seeing people changing to the hybrids or the more efficient engines.

And it is not probably going to happen because we mandate people have to drive more efficient cars. It is because the gasoline prices get the consumer motivated as well, and perhaps we will see not only the license holder aiming for spectral efficiency, but perhaps the consumer themselves looking for devices and services that they can use, and perhaps they will get on board.

MR. WEINREICH: But in that case the consumer is paying for the gasoline. What does the television viewer pay for?

MR. SPITZER: Maybe he will have more content and more services within the same amount of -- you know, I --

MR. WEISS: Actually, I would agree with that. Just thinking about what you were saying, that the driver there would be if you can get the broadcasters to offer more services that the consumers want, that will encourage consumers then to transition from analog to digital, because it is the digital transmission that allows us more services to be offered.

But you then have to make it possible for the broadcaster t do that.

MR. SPITZER: You asked us to look forward. I could merely look to Japan where people pay for their services by the bit, you know, and if that is not a measure of efficiency, then that is a consumer actively getting into it.

MR. WEINREICH: One over on this side.

MR. EPSTEIN: Good morning. Bart Epstein from Latham and Watkins for Cognio. During last week's unlicensed discussions, we talked about how the Commission might play a role in encouraging efficiency by either giving incentives for or

possibly requiring unlicensed devices to use intelligent, adaptive, cognitive, or otherwise intelligent features, such as listen before you transmit, automatic power regulation, frequency hopping.

And there has been some interesting discussion about possibly setting aside future unlicensed bands for the types of devices which specifically agree to use some form of intelligent abilities.

And I am wondering if this kind of notion also plays a role in the license bands, to the extent that efficiency can be measured not just and within how one type of provider plays nicely with those of a like service, but to the extent that we can encourage competing technologies, which would otherwise cancel each other out when they are on adjacent bands, to somehow use these technologies, which otherwise they might not, because the benefits accrue to users outside of their own band. Thank you.

MR. WEINREICH: Well, I think we have that to a certain extent already. As I mentioned before, satellites routinely share frequencies with fixed-service radio relay licensees, and not only

in the United States, but around the world.

And this is a situation that has been in existence for a long time, and it seems to me to say that you want to have some kind of spectrum planning that would allow this to happen.

I am not quite sure if I understand exactly how you would have one service accrue a benefit at the expense of another. I can see how adjacent services might be -- there might be one that would tend to interfere with another one, but that would be the reason that you would try to group the services so that the like types of modulation or like types of service could share a band rather than be at odds with it. Yes?

MR. EPSTEIN: For example, right now we have -- and just to follow up on that point, for example, right now we have the situation where the public radios for the localities are being interfered with by some cellular use.

It depends on how we define the property right. If the public safety has the property right to force cellular to make a change, then cellular will have to make the change.

But if the property right is undefined, or if it belongs to cellular, cellular doesn't have

an incentive to adapt or adopt a technology which would otherwise not improve cellular, but would reduce interference to public service.

And if down the road the Commission adopted rules which said that users of the bands not only need to be efficient in themselves, but they need to be able to intelligently sense interference in out-of-band emissions.

And that was the situation in which I was discussing how externalities would otherwise accrue to users of other bands, and this is something which might not happen unless the commission puts in place some framework.

MR. WEINREICH: Thank you. Carl.

MR. STEVENSON: Going back to what Dr. Rohde was saying before with respect -- and I would like to point out that I have the utmost respect for the public safety community and all the important services that they provide to us.

But there is the point of how do you make a transition from analog to digital technology, and I would submit that we have the technology today that gates and signal processing cycles are cheap enough that you can economically produce a multi-mode radio that could ease the

transition.

Communications equipment has a finite life, and that practical life is constantly being shortened by the advancement of technology, and you get performance increases and cost reductions from that advancement in technology.

I think I am on my fourth cell phone in five years. Every one is cheaper, and does more things for me, and so on, and so forth. I don't mind changing them. If I perceived a benefit and programming was available, I wouldn't mind replacing a couple of television sets to get those extra benefits.

But there are some services, as has been pointed out, where there is more or less fundamentally no incentive to change. And I really believe that in those situations that incumbents should not be permitted by the Commission to remain frozen in some sort of antiquated time-technology space forever when others require spectral resources as the demand constantly increases.

And as I mentioned before, in the IEEE 802 wireless standards, we have gone from 1 megabyte to 11 megabytes, to 54, and we are looking at 200 and beyond now, and up through 54, we have

stayed within the same spectral mask.

So we have improved spectral efficiency a factor of 54 times, and this is something that the industry's standards bodies have done voluntarily because it is in the interest of the industry to do this. I believe the Commission should require incumbents, if necessary, to keep reasonably abreast, but obviously this can't be something draconian.

It has to be reasonable, in terms of equipment life cycles, and economics, but it is just clearly with the increasing demand for spectrum, we cannot continue to allow these perpetual property rights to accrue to blocks of spectrum and not see improvements being made.

MR. WEINREICH: Well, Marc, first, and then in the back.

DR. GOLDBURG: I would like to ask a question about allocation policies as they relate to spectral efficiency. So, you know, much of the discussion this morning has focused on that we have certain services and certain bands, and how efficient can they be.

But it turns out that some of the bands are just naturally more suited to certain

applications than others. So if you look -- and the spectral efficiency crunch is also sort of band dependent.

So, for example, if you look at the mobility spectrum, which is maybe from a couple of hundred megahertz to about 2-1/2 gigs for propagation reasons, and form factor reasons, which is where the spectral efficiency crunch is highest, and you look at what is in there, there are a lot of applications that are fixed, for example.

And so in a sense the spectral efficiency problem for mobile applications is being heightened artificially. So do any of the panel members see a possibility over time of taking technologies, or really services that could be moved to other bands, through an allocation process, and doing so.

For example, Mr. Weiss gave an example earlier in the day of moving t.v. from sort of the big stick model, where you really did need sort of lower frequencies for good prorogations, and moving to a more cellular architecture, which may be sort of in the distant future, and would allow t.v. services to be relocated out of the mobility spectrum to some higher frequency.

MR. WEINREICH: Does anybody want to comment on that? Paul.

MR. RINALDO: Yes, I will take a chance here. Well, yes, we have propagation as the basis of the problem, and especially in a microcellular environment what you have done is perhaps you have connected these things together with fiber, and then you provide these little cells there where the people are who are going to do the talking.

And, yes, it does amount to a better efficiency. And I think some of the problem has to do with what is left on the air, and what is conducted. I know that there has been a change in the television broadcasting over the years.

We have had just over-the-air broadcasting to begin with, and now much of it is conducted through the cable t.v., and perhaps cellular, or perhaps fiber optics will play a major role in that.

In terms of mobility that you just mentioned, there was a time that the ITU, for example, paid no attention to land mobile because they considered it more or less landlocked. It had to do with your own country, and mobile radios were in cars.

You didn't transport cars from one country to another because that would be stupid and uneconomic, and so why even talk about it. Well, now we have a situation where mobility seems to be it.

If I have an office, and my desk is over here, and I want to move my desk over there and I have a building engineer who rules the day, I have to either wire it myself, in which case I have to clandestinely run the wires so that he doesn't see it, or else I get a radio solution of some kind.

So then there are doctors. They can't go to their telephone any longer. They have to carry their telephone with them. Now they have got to carry their little other device with them. So in other words, what I am saying here is that mobility has just upset this whole apple cart.

We had a nice little system where things that had to be transmitted over radio were done that way, and things that were done on land line were done that way, and the two didn't mix all that much.

But now it seems that we are over-emphasizing the mobility part of it, and if you

simply take a radio solution to the mobility part and don't figure in the conducted carriers, such as fiber, and start to deploy a cellular approach, then it gets more and more congested. Thank you.

MR. WEINREICH: Thank you. In the back.

MR. KRAVITZ: Troy Kravitz, New America Foundation. Building upon the last two comments from the audience, I would like to just make a point. In dealing with incumbents, I understand that is a delicate issue, but the two key things to remember is that spectrum is a public asset, and it was allocated in no uncertain terms a non-permanent basis.

Now, I don't want to decompartmentalize this discussion too much further, but when you deal with broadcasts, we are doing a tremendous disservice to clump them together with the other spectrum uses.

Broadcasting is where the spectrum crunches the highest, and it is also grossly inefficient. You are looking at roughly 402 megahertz of prime real estate, where only 13 to 15 percent of the U.S. derive their broadcast, their

television channels, via this, via broadcasting.

These people could very easily be transferred to cable or satellite at a cost of something like 3 billion, and the estimates are out there. And this real estate could again be reopened, where as I said before, where the crunch is the highest.

Now, in cases like this, there should be no discussion about whether there should be a carrot or a stick. It is quite clear that the stick is the only option when they have no other incentive to transfer over.

MR. WEINREICH: Dr. Toh, please.

DR. TOH: I think there is a general trend that we wanted to achieve spectrum efficiency across a variety of services, including public safety. Eventually, we will come to a point where there is a proliferation of systems, systems of systems, and we need to phase out some of the older systems so that the migration path and the dynamic relocation of the spectrum creates quite a bit of issues.

One of those include logistics. So this redeployment, reprogramming of bay stations, call networks, assess networks, could be pretty

scary to some telcos groups.

But I would think that there should be a general knowledge that we should use scarce resources efficiently.

MR. WEINREICH: Okay. Over here on the left-hand side, my left-hand side.

MR. ACHTNER: Hello. Edward Achtner from Telecom Filings. There was a general view held by many that one of the most efficient ways of allocating spectrum was via an auction.

And I am wondering how this contrasts where you look at part of the -- some of the most dynamic growth in products and services in the wireless industry is in unlicensed bands, where people have not had to necessarily pay a dime for the rights to use that spectrum.

And I am wondering how different enabling technologies as we again look forward, such as offer to find radio or cognitive radio, really will affect the underlying or fundamental understanding that for spectrum public auctions are the most efficient mechanism for allocation.

MR. WEINREICH: Anybody want to comment on hat one. Charlie.

MR. TRIMBLE: Certainly auctions are an

efficient way of allocation spectrum where there is an economic price per bit that can be charged. It clearly works in the cellular environment.

It doesn't work nearly as well where you want to encourage experimentation, because in general the services aren't ubiquitous.

MR. WEINREICH: Thank you, Charlie.

MR. ENGELMAN: Can I ask, by ubiquitous you mean you would propose then making some license free bands more available in different parts of the geographic country, where spectrum is more --

MR. TRIMBLE: No, actually it can either be done by location or by frequency. Trying to correct the problem with overlays -- has an awful lot of unintended consequences.

MR. WEINREICH: Mr. Haraseth, please.

MR. HARASETH: Ye, Ron Haraseth, APCO International, Regarding public safety, in land mobile radio in general, just a couple of case studies on migrating to new technologies and efficiencies. First of all, we went through reforming, and found it to be very, very inefficient, because the FCC mandated financial incentives through type acceptance of the manufacturers.

That had very little to do with the people in that band, and in fact, most conventional land mobile radio, and particularly public safety, that is not their primary function, is to provide service through that medium of RF out there.

It is for commercial services, for commercial mobile radios, and that tower out there is their dollar sign out there. That spectrum is their dollar sign out there. However, public safety is just diametrically opposed.

Their business out there is not the spectrum or the resale of the spectrum. It is putting out fires, saving lives, transporting victims. The radio system becomes a secondary service to what they are doing.

Now, I will digress just a little bit to say that public safety would probably be very, very happy if for some reason or other commercial enterprises could provide every service that they need at the level that they need it.

But they have not been able to do that, and that is why public safety still remains as a primary service out there and probably will for some time. Maybe it won't in the future.

The thing is, is that I know in one

particular case where a gentleman was complaining about that he would never go to narrow band. He didn't have any reason to, and I asked him, well, wait a minute. All your equipment that you bought in the last 5 years is capable of narrow band.

Well, yeah, it is. Well, why. Well, it still costs too much money, and I have to change all my bay stations. Wait a minute. I know that you installed that equipment 15 years ago, and you have installed new equipment in the last 5 years haven't you? Well, yeah.

Is that narrow band cable? Well, yes. Well, yeah, he still wouldn't admit that he wanted to go to narrow band. That's a case of change, and change is hard where you don't have any incentives.

In that particular case, the FCC could have given enough time to mandate a change that would have allowed public safety, and analog land mobile radio, to migrate from their old technology to the new technology under a planned method, and it would have worked, and they still need to go back and readdress that.

The other situation, particularly public safety, is in the 700 megahertz, where the

FCC did mandate digital transition. Absolutely no analog in that 700 band in 63, 64, 68, and 69. The difficult part was determining what technology would be used as a standard, because standards are very important for public safety for interoperability.

They did determine a digital standard, and it will probably work very well in the dispatch format. We don't know yet because now it ties into the other situations with access to, and the removal of, t.v. from those bands.

So it is a complicated picture, but I just wanted to point out a couple of cases there.

MR. WEINREICH: Thank you. In the back on my right.

MR. WARNER: David Warner, from the Commonwealth of Virginia. I just wanted to echo support for the comments from Mr. Haraseth. I wanted to also point out that mandated spectrum efficiency for States and local government does have merit, but unlike our market-based friends who have business plans, and they can make those changes, public safety has to go through a due process.

And so it is just not as easy to make

those changes, and it would probably be a good idea for some incentives, say, from Congress, because that is what it is going to take, because you have got a lot of rural communities out there that really don't have the tax base, or the resources, to make these changes. Thank you.

MR. WEINREICH: Thank you. Well, we have -- yes, Mr. Blust.

MR. BLUST: I would like to make a comment upon technology, and the evolution of technology. There were several comments about we can always adopt technology to solve the problem, and use the advantages of technologies to solve the problem.

And to some extent you can, but I think that the underlying factor that has to be kept in mind is that we are not in greenfield environments. We are generally evolving systems that already exist, the huge embedded base.

And when you adopt new technologies, it takes time for those technologies to propagate. The economics to completely displace is probably prohibitive in a lot of cases.

Just the system aspects of trying to do flash conversions if you wanted to look at a total

displacement if equipment was free is probably prohibitive from disruption of users, no matter what the service tends to be.

I think you always have to keep in mind what the critical mass is, and the relationship between the generations of equipment that are out there in order to assess what the effectiveness is, and the net outcome is of being able to deploy new technologies.

So often we tend to think that new technologies solve the problems instantaneously, and in reality as we all know they do not, but it is worth reminding ourselves of that also, I think.

MR. WEINREICH: Thank you, Steve. Well, we have reached, I think, where we need to take a little break. So we will take a 15 minute break here, and give everybody a chance to stand up and move around, and talk to their neighbors, and come up with some more questions. And we would like to reconvene at five of. Thank you.

(Whereupon, at 10:41 a.m., the Workshop was recessed and resumed at 10:58 a.m.)

MR. WEINREICH: Ladies and gentlemen, we will reconvene, and we still need our colleague

from TRW, Dr. Toh.

We would like to change our focus a little bit, and we are still talking about spectrum efficiency though. We want to look at the technical approaches for improving spectral efficiency.

And we have heard about incidental radiators and interference, and things like that, and things that emit, but the compliment to this are things that receive, and one of the questions that I have always wondered about is what tools could be used for achieving interference protection that are efficient and what are not.

And one of the ones that comes up at least in my mind time and time again is receiver standards. Should there be voluntary receiver standards, or should there be mandatory receiver standards, or should there be receiver standards, period.

So this is one question that I think we could have some fun with here on the panel. So I see Steve Blust over there, but he doesn't have his hand up yet. So I won't ask him. I will ask one of the other members of the panel to kick off this one. Charlie Trimble, please.

MR. TRIMBLE: All right. I will be a lighting rod. Certainly there ought to be receiver standards for services that are in license rebands, because in general those things are going to be inexpensive, and they are going to be consumer.

And the consumer isn't going to have the faintest idea of what the magic is, and clearly there is a lot of room for mischief in terms of Navy radars opening garage door openers; for cheap and dirty implementations.

MR. WEINREICH: Okay. Thanks, Charlie. Anybody else? Merrill.

MR. WEISS: I think we have to recognize that over the years the FCC rules have been built in many ways on what receivers can do. If you look at the causes of spectrum inefficiency -- and again because I come from a broadcast background, I'm thinking about broadcast.

But if you look at th UHF band, for instance, you will find that there are so-called taboos there that essentially only allow 1 out of 6 channels to be used in a market.

And all the other channels, at least when they were originally allotted, would be in adjacent markets, but you couldn't put stations

close together because of the fact that receivers couldn't handle signals on certain channel combinations.

So if you look -- and it is the adjacent channel, and it is the second adjacent, and it is the third adjacent, and then it is plus or minus seven because of local oscillator radiation; and it is plus or minus eight because of intermittent frequency interference. You know, two stations beating and ending up on some other receiver's IF where it is not even tuned.

And it is 14 and 15 channels because of intermod considerations. I'm sorry, because of image considerations. And all of those taboos were generated in the early 1950s based on receivers from the early 1950s.

And so when you want to go and change things, you have to start going out and saying what can receivers do today, and then make the case that, well, receivers are so much better today that we really don't need to be paying attention to that, and this is from a broadcaster point of view wanting to perhaps locate a transmitter where it otherwise would not be permissible.

But we can address this problem in a

couple of ways. We can say, all right, there has got to be some mandatory performance on the part of receivers, and the consumer electronics industry resists that with all their energy.

They don't want to be dictated to, but maybe another way to do it is to allow the taboos to be gradually whittled away so that you can put transmitters where maybe you couldn't have put them before.

And if that happens over time, then maybe receivers will be forced to perform better than they did in the early '50s, and certainly they already do, because they have to work on cable where every channel is in use.

And, for instance, it is the failure to recognize that receivers over the last two decades have gotten so much better because of their use on systems where every channel is occupied, that we still are stuck with those taboos that are a serious loss of efficiency in use of the spectrum.

So some way or another, there is an interplay, I think, between the rules and the capabilities of receivers, and whether it is really necessary to make it mandatory, or you can drive it by what you allow transmitters to do. That is what

I think is the question.

MR. WEINREICH: Thanks, Merrill. Of course, from the engineering standpoint, I think you don't want to allow any more noise into your receiver than you actually or absolutely need.

And you need to cover the band or the channel that you are operating on. So that seems to me to set kind of the narrowest that you want to be, and the question is how much can you relax that and still be efficient when you use the frequency. Dr. Rohde, first.

DR. ROHDE: I believe, number one, we should have some standards, and that is another reason for the protection of the consumer, because you buy 2 or 3 similar or identical devices, you ought to be able to judge them.

But, number two, as was actually pointed out, the technology has vastly improved, and today with multi-layer printed circuit boards, you can now for the same cost, if not for less cost, get higher performance.

And I think that one should really resist the lobby of some of industry's a little bit and do something for the end-user. Of course, I am wearing hats. On one side, I am trying to sell

something in a market with a high profit margin; and on the other hand, I am the user, and like something that works well. So it is kind of schizophrenic.

But the reality is that the bottom technology allow us to do these things, and I think this Commission here and this panel should really put some pressure on the system, and find solutions on how to make not only a transmitter cleaner and to receive a less sensitive to unwanted things.

But also to look from a systems point of view on what is possible and desirable, and to have at least one standard; you are allowed to be better than this, but not worse. And I would highly encourage that something like this comes out of it.

MR. WEINREICH: Steve.

MR. BLUST: I think the other aspect when you look at receiver standards -- voluntary, mandatory, and performance factors -- is what comes down to what is the known environment, or what is the predicted environment of the future.

I think today we are facing an environment as was pointed out is very different than what was perceived to be the known environment

in the past that was set out, because it is only when you have an appreciation of the environment -- I think one of your questions here later, or has already been covered, is should like services be grouped together.

It is a lot of those aspects which come into play when you try to determine what receiver standards or performance criteria might be. In cellular and PCS, for example, within those allocations and those usages, in the standards are generally performance criteria that impact the receivers.

And we as an industry measure those when we do acceptance of product, even to the end level before we pass them on to the consumer. And by and large, we have designed those criteria to work well within our system.

It is when you get interference or perturbations that come from elsewhere, either because it is not a known environment, or the environment has been changed around the known, that you get into a lot of these difficulties and problems.

And even whether they are a voluntary standard, whether you look at a mandatory standard,

you can't determine what that level of standardization, performance, or criteria, is without understanding both what is necessary for that service, what might be impinging on that service from elsewhere, and what might be the future that brings.

So it is a bit of having to have the right crystal ball if you try to develop these standards and extend them for the future.

DR. ROHDE: I think the normal car is a good example. If you buy a new car here and you wonder where the AM and FM antenna is -- I installed an auxiliary shortwave radio because I got bored with all the commercials, and I wanted to hear something else.

And I wasn't able to hear those stations because some much emission came out of the car here. So I don't know what magic -- sometimes the companies do have an AM radio which doesn't get interference, and then you go a little higher in frequency to get those. those.

And the reverse is that if you have a taxi, and you put a radio -- a taxi two-way radio in the car, all of a sudden the microprocessor fails to work. I mean, there is some known areas

what can happen and what cannot happen.

And I am not always sure whether industry takes it that serious to apply a solution. In some of the handbooks and repair manuals, I found a little note saying that if you are in a hostile environment, add those four components.

So the manufacturer in many cases knows what is going on, and he is defensive, and just doesn't want to put those things in for cost reasons, and that is one of those areas which I find it difficult knowingly going into an areas of deficiency.

So I think that some competition is necessary, and I wish the news media, whoever is listening to these panel sessions, would follow up on these, and make a point, saying that the consumer is best served not only by reducing the price of a device by five cents, but also by being able that this appliance can tolerate more levels of interference and other things, and therefore is more likely to be good for you.

I think it is an issue which totally is down-played, and this goes both ways, transmitted and radiated, internally and externally; coming out in the box and going in the box. I wish that the

press were here to cover things like this.

MR. WEINREICH: Thank you, Dr. Rohde. Who else would like -- okay, Paul first, and then Steve.

MR. RINALDO: In the amateur service, most of our stations are in homes; that is, in residential areas. Amateurs are usually interested in technical devices and get the latest technical devices to put in their homes. And then they find out that their amateur radio transmitter interferes with that new gadget.

We have situations where it is not simply an out of allocated band, or a front end overload situation, but it is actually around the same frequencies. For example, Charlie mentioned the unlicensed band at 2.4. Well, actually, it is licensed. It is licensed to the amateur service on a primary basis.

It is also licensed in a way to the ISM -- industrial, scientific, and medical services -- and that they can run all kinds of power. The licensing arrangement is not the same way, of course.

So there we have a mixture of licensed services and unlicensed services in the same band,

and it is a problem, and it is a growing problem. So what is not happening is taking into account the proximity of the transmitter.

In other words, an amateur transmitter is in the home, and there are devices in the home, and nobody is going through this stuff to begin with, and we find out these problems after we get on the air, and maybe interfere with ourselves, or the neighbor carrying a shotgun and is looking through the screen door at us.

And actually a formal interference complaint means that he is carrying a white shotgun. So that is the environment that we live in, and I am not so sure that it is getting worse or better, because there has been a history to this.

There was a time when very early television sets were bothered a great deal by amateur transmissions. That has been fixed for the most part, and the biggest contribution was the cable television.

There have been cases where the cables themselves leak on amateur frequencies. So, okay, we complain, and we work with the cable companies, and they take that channel off the air or start

tightening up all their connectors.

There are a number of cases as Ulrich mentioned with cars. Our laboratory works with the car manufacturers from time to time, and when we find out that things like the steering mechanism won't work if you transmit.

These things are worked out, but they are always worked out after the fact, and that is, that they built their equipment, and they have shipped it all, and they have got hundreds of thousands, or millions of them out there, and then we find out that there are problems.

Now, the problems may not be 50 percent of the time. It may be only 1 percent or 10 percent of the time these things could happen. It is very difficult to retrofit these things at the time, although we are sort of forced to.

In effect, a neighbor's telephone is not supposed to pick up, and is not supposed to intercept radio transmissions, but they do. A simple fix sometimes is to put a capacitor there, or wrap the wires around the toroid, and the interference goes away.

But I guess the question is who should be making those repairs, and especially if the

neighbor is really offended, and figures, look, it is very simple.

When you transmit, I hear the interference. When you stop transmitting, I don't hear the interference.

Therefore, you are wrong and I am right. That's the problem that we have. Thank you.

MR. WEINREICH: Thanks, Paul. Steve.

MR. GILLIG: Yes. I do believe there should be some sort of minimum receiver specifications that are put on the units. I think particularly -- well, as was mentioned before, in a lot of license bans, that comes as part of the normal system design and the architecture as it comes into the system.

But particularly in the unlicensed band, which we have now, and which we are considering further on licensed bands, what can happen there is that you would have people -- if they didn't have minimum receiver requirements, you could easily see where you could come in and come up with a unit that has basically no interference protection at all, and is really cheap, and get that out on the market, and everybody just loves it

because it is so darn cheap until everybody has one.

And then they all interfere with each other and everything else. So that is something that we have to look at, is that if you are going to put services, particularly anything that are disk-like services in the same band, you have got to have some interference minimum requirements.

MR. WEINREICH: Thank you, Steve. What about from the audience? Are there -- okay. Marc first.

DR. GOLDBURG: Listening to the discussions, there are really two types of interference issues being addressed. One was co-channel interference, and the other one was adjacent channel interference, and they got mixed a little bit in the discussion.

And while one really can address the issues of adjacent channel interference through better receiver design, and better front end filters, better selectivity, all that, I think the co-channel interference -- it is much harder for me to imagine a general spectrum would work in the unlicensed band.

How do you filter out interference that

is in your band other than -- I don't know, channel coding or something like that.

MR. WEINREICH: Thank you. I think -- let me just comment on that a little bit. You handle a co-channel interference either of two ways. Either you coordinate it amongst the users of the spectrum, or you try and use some kind of modulation scheme that can mitigate the interference.

Over on this side, we had -- please give us your name, please.

MR. FOX: Paul Fox, an independent consultant. I would like to go back to the case of t.v. receivers that Mr. Weiss raised, because I think it is fairly relevant history, and worth considering in terms of our goals of increased spectrum efficiency.

At least circa 1980, when the FCC measured the t.v. receiver performances, there had not been a significant improvement in taboo rejection over what there was, namely because the marketplace was not imposing any challenge upon them.

It turns out that the cable t.v. experience of having a signal on every channel is

not as relevant because they are all equal, and the sound carriers are down by another 10 dB.

The FCC did, however, contract with Texas Instruments and RF Monolithics for t.v. receivers, which were demonstrated that they could essentially have eliminated the need for the taboo.

The FCC could, and I think should have, back then regulated t.v. receivers, and mandated an improvement in t.v. receivers. The only thing that has in a sense saved the commission has been the migration to digital, which has the lack of a coherent carrier in its carrier; i.e., less interference potential.

And a better resilience to beats from analog t.v. sets. But if the Commission had back in 1980 in mandating improvements in t.v. receivers. I think the current problems with 700 megahertz public safety would be a lot easier to solve. Thanks.

MR. WEINREICH: Thank you. Carl, you wanted to add something.

MR. STEVENSON: Yes. There was a comment before of something to the effect that consumer electronics folks have resisted receiver

standards, and the manufacturers of devices for use in the unlicensed bands, the Part 15 type devices, tend to get lumped in with that.

And I just want to make it clear that in its comments to the task force, IEEE 802 stated that we believed that the development of receiver performance standards or guidelines as part of equipment type acceptance would be beneficial in addressing the issue of harmful interference.

Also, knowing the minimum's performance characteristics of equipment operating in a particular ban can be essential to conducting sharing feasibility studies, and designing devices that can share with existing systems, which will promote new applications and increased spectrum sharing and efficiency.

We are going back to the idea of using unused spectrum in a dynamic way, and if the manufacturers and the developers of the standards know what minimum performance they can expect, because the commission requires it, then it is much easier to design systems that can live together happily in that environment through a combination of modulation and coding techniques, and protocols that allow -- you know, cooperative dynamic sharing

and co-existence.

So of the candidate criteria for receiver performance standards would include selectivity, susceptibility, dynamic range, local oscillator phase noise, and unwanted emissions.

These are all things that we believe the commission should look at developing minimum standards for in the equipment authorization process. Thank you.

MR. WEINREICH: Thank you, Carl. I think the things that you mentioned are things that -- at least the communications users of the spectrum routinely look at as far as trying to make sure that their system is going to provide the performance that they have told their customers that will happen.

I know that it is that way in the satellite industry, and I am sure it is that way also in Sabre mobile radio. Steve first, and then Ulrich.

MR. BLUST: I think from the previous comments that when you look at dynamic usage and utilizations, and a sort of a laissez-faire approach to systems and services, I go back to the fact that you have got to know what you are

designing for.

Most of the situations that we begin to see time and time again are because we are increasingly adding things in, around, or on top of what we already had out there, and we are changing that design problem.

So, again, when you begin to look at how to be totally dynamic, and you look at the number of different combinations of things on the board today, plus the technology advances of the future, I am not sure that you can ever build the right matrix that says these are all the things that I am designing for, and if you could build that matrix, does that product match the economics of the marketplace that those products need to be in.

MR. WEINREICH: Thanks, Steve. Ulrich.

DR. ROHDE: That is a good question, that if they can afford to build everything, you can do it. But I wanted to add one more thing. The FCC has given a great possibility and responsibility to the radio amateurs and their playground.

And I think if the FCC would analog to

what has been used for tech instruments, and to develop a front, and if the FCC would work close together with the American Radio Relay League, as an example, to look at possible things, I think that this would make the league very happy, and would make the consumer very happy, because these things would all be looked at prior to their occurrence.

And that is something that I am not sure why the specifications and tests specifically, when the FCC knows that the league has these capability measurements is not used. Has the FCC ever looked at actually asking to do the league something for their privileges? I think I would look into this.

MR. ENGELMAN: I think we will look into that. I know that we have had a partnership with the league on a number of issues, but whether we have asked them to look at this specific issue in the past, or worked with them, I'm not sure.

DR. ROHDE: They are quite capable of doing it.

MR. ENGELMAN: Paul might know actually.

MR. RINALDO: Well, I don't know about

the general or this specific question, but we certainly have worked with the FCC on a number of issues over the years.

Our laboratory is always available to look at these issues. We have solved problems together, and we have an ongoing dialogue concerning enforcement, and I guess that is another thing that we have not mentioned here.

But sometimes some users of the spectrum get out of hand, and once they start interfering too greatly with others, they have to be found and dealt with in some manner.

And we have identified some of those cases, and the FCC enforcement has improved over the years, and they are still improving. So there is a feedback loop going, and as I said, my moat is always open.

MR. WEINREICH: To go back to something that Steve said about designing for what you -- for the environment that you know, that kind of gets to the question of, well, what about what you don't know, and what about what would come after you finish your design.

And that I think would lead us to something like the software designed radio, or the

software defined radio, where it would be adaptable or readily adaptable to different schemes, and perhaps different interference schemes that might able a user with a specific spectrum allocation to combat or to mitigate some kind of an interference situation that arises.

DR. ROHDE: Can I add one more thing here? Last year, I bought a sailboat, and the sailboat has a refrigeration system on it. And I will tell you that I have never seen a better transmitter than this refrigeration system, and I am absolutely at the end of my wit, because I don't know what to do.

Is the FCC regulating this, because I have a shortwave radio which is for global marine distress purposes, and so it is a legalized radio, and I can't use it. The refrigeration system hates me. The deep freezer hates me. The radar unit sends out clocks every one second.

I am really sitting in the middle of noises in a sailboat somewhere in the Atlantic. The satellite telephone doesn't work, and so I am out of reach. The cell phone doesn't work, and I have no idea what to do.

So that is an interesting question.

Yes, as a consumer, you sit there, and you are in trouble. So this is an environment that you do know, and it is a sailboat, and it has no shielding, and it has a lot of things here.

MR. TRIMBLE: But aren't you the consumer and can't you decide what you want to have interfere with yourself?

DR. ROHDE: Well, at the time you buy this, you have no idea what they are doing.

MR. TRIMBLE: That was a rhetorical question.

DR. ROHDE: I know, but it is a serious question.

MR. TRIMBLE: It is a serious question. It is a problem.

MR. WEINREICH: Right. The problem is that the engineer goes out and designs his system to work a certain way, and then is confronted with this unknown that pops up like in the freezer. And I think it leads us to somehow ask the Commission to provide some guidance at least on how do we make things more electromagnetically compatible.

EMC or electromagnetic compatibility seems to becoming more and more of an issue as far as the devices that we use on a day to day basis.

Steve Gillig first, and then Blust. I'm sorry.

MR. GILLIG: Since we finally brought up the issue of software defined radio, which is a controversial topic, and once you have one, this Holy Grail, why then all the other questions kind of go away.

I would have to say that first off on that, there is two parts to a software defined radio. There is a software in the signal processing, and then there is all these RF hard components which you don't really just change by going in and tweaking the atoms and things like that in software.

So there is some things that you can do in software and software defined radio. You can get rid of certain types of interference, but there is a whole lot of them, and a lot of the types of interference that you are talking about here from out of band interference that you really can't get rid of because you have to protect those in the receiver hardware before it ever gets in to where you are doing the signal processing.

So software defined radio is a great thing, but I think what we have heard in some of the side conversations, too, is that the aspects of

software defined radio are starting to come in.

Radios are becoming more flexible, and they are having adaptable modulation schemes and things like that, and that's true. But to wait for a Holy Grail that just says this software defined radio can overcome whatever interference is out there is something that we shouldn't count on.

And even if we technically could do it, whether it is something that economically would make sense is another thing altogether.

MR. WEINREICH: Mr. Blust, please.

MR. BLUST: To continue on that same thought, when we look at having to -- when we get expansion and additional spectrum for a lot of services, often times just because the nature of spectrum is full, we are looking at it being on different and varied frequency bands.

So when we begin to design receivers or transmitters for that matter that have to operate over 3, 4, or 5 different discreet frequency bands, the trade-off there may be the costs associated with having to put in the front ends to handle four frequency bands, versus being able to put in a very high performance front end and other techniques which may improve on a single frequency band.

I mean, that is not an answer to the question. It's just that it is a fact of life that we are facing. In addition, even if you have all the techniques in the world, and we are looking at in commercial wireless active interference cancellation techniques, and a lot of those criteria using the signal processing.

But to do that, again you have to know what it is that you are trying to go cancel. And the over the transom unknown signals become very difficult to address, and they become even more difficult to address because we are beginning to deploy technologies and techniques which don't lend themselves to readily tracing, or identifying, or characterizing those signals.

In the past when you had interference on a general basis that was a design deficiency, or another deficiency, and you could identify what it was, then you could take remedial steps for future products.

Unfortunately, it is becoming much more difficult to identify these. They are not single events. They are combinatorially events of interferences that are taking place. It is difficult to get inside of the digital front ends

on these radios to look at the signals real time.

You can't -- they are not a laboratory environment. They are out in the real world,and if as was pointed out they are the 3, 4, and 5 percents out of a user base of millions, it directly affects the statistic when it is your device being perturbed.

But on the other hand, it becomes very difficult to find and apply a general solution. So it is an environment that perhaps more research, academic focus, as well as feedback on what we are seeing and finding, where we can all share against the knowledge of what we find, may be a useful way to look towards the future. Thank you.

DR. ROHDE: I hate to disagree with you. In some areas, simply I believe that in (inaudible), and for the same number of components, you can just build better receivers, and I have seen this.

It may not apply to you as an individual, as a company, but if you take the cost to parts count, there is no question around it. And whether you use those parts in an ingenious way or whether you use them in a sloppy way gives you two different results.

And I have seen enough cases where this is an excuse by saying, well, I don't know what is going on. In many cases, you do know what is going on, and in may cases it takes maybe two days longer to design it properly, but do it.

And again this may not be applicable to your particular case or your company, but I have seen from different manufacturers, and which I don't want to identify, where this is clearly the case.

So it is very dangerous to say I don't know what interference level I have, and I don't know what environment I have. There is certain rules of selectivity that are standard, and I think we use those that we are much better off.

MR. WEINREICH: Okay. Thank you, Ulrich.

MR. ENGELMAN: I wanted to ask. Many of your companies are not just U.S. players, but you are also involved internationally, and I would note that Europe has an EMC directive which places in standards which typically place requirements on both the transmitting and receiving side of things.

Are those kinds of standards working differently in Europe? Is this less of a problem

in Europe, or is this a problem everywhere and not just the U.S.?

MR. WEINREICH: Ulrich. Go ahead.

DR. ROHDE: Well, the answer is clearly yes. The market is different. If you look at the symbols which you have on particular equipment to export it into Europe, you can clearly say that you have to meet much more stringent requirements.

And it is a question of economics, and whether you want to sell into the European market. Then you have more stringent things. My company in Germany, with $1 billion in sales, has a huge room in which you can actually drive a tank into.

And you can measure those -- the radiated and emitted energy, as well as susceptibility, gets to the top and you can measure these things. And this has a lot to do with the nations willingness to enforce certain things, and what the regulations are.

There is no question before I came to America and worked at AHE Telephone, which has now, as many other companies, has disappeared, I used to be in charge of handheld radios.

And this was a time when Motorola started to invade my domain by selling two-way

radios, and I actually did it quite well. And this was a time when the standard was lower because of political interference. Motorola put such pressure on the German government.

They wanted to enter this thing here that we had to rethink some of our policies. But at the time I will tell you that the standards were so extraordinarily tough that you couldn't take an off-the-shelf radio from anywhere in the country but Europe, or Germany in this particular case, and sell it. It was just totally different things.

And today I think even the Mercedes or BMWs still hold to a higher standard, and you pay a lot more money for those. And the initial engineering effort and everything is just more. It is less an average income device. It is more of a high income device.

And in radio, where the life depends on what you are doing, I think one should really look into these questions of quality and interference possibilities. That is an essential issue.

And if two policemen tried to talk to each other to save somebody's life, or avoid some bad crime, the ultimate judgment should be can they talk to each other and achieve their common goal,

and not whether they spend five cents less on the radio.

But this is a political issue, and you can see from my emotion, that different countries put different levels of efforts on that. And I just came back from Germany yesterday, where I was on a panel and saw these things.

It is highly political and emotional, and I am not sure that there is a clean answer.

MR. WEINREICH: Charlie.

MR. TRIMBLE: This whole issue of cost and ability to do things in electronics has come up over and over again. The fact of the matter is that the cost of electronic equipment drop at the rate of 30 percent a year.

And so it is really a case of only a year or so to meet any particular price point that you want to meet. Indeed, the NRE may be higher to do the job right, but the ultimate cost is not a major penalty, especially when you are taking a long term view.

MR. WEINREICH: Okay. Thank you, Charlie. Okay. I think we have come to the point now where I think we are going to ask at least my favorite question on the agenda, and that would be

what one rule or policy would you change or eliminate so as to improve spectrum efficiency.

So is there -- I will let Charlie go first.

MR. TRIMBLE: All right. I will be the lighting rod again. I would have the Commission take responsibility for monitoring the noise floor.

MR. WEINREICH: Okay. So we have to have a new FCC bureau that is in charge of the noise floor.

MR. TRIMBLE: No, monitoring. They have got a feedback against their own decisions. They control a fair amount of it, and there is obviously some of it that they don't control.

MR. WEINREICH: Okay. Thank you. All right. Steve Gillig.

MR. GILLIG: Okay. I think we should have just one policy, and this is probably more, but I think the Commission needs to draft and encourage policies that promote cooperation and interworking between different radio access networks, like wireless LAN, and broadcast television, and cellular networks.

And they also need to encourage global

harmonization of the frequencies and the services that are using, because again the same problem that Ulrich brought up, is that without global harmonization, you can build a system and it will be just fine for one country, and then you have got a big problem on how to transition it.

MR. WEINREICH: Steve Blust.

MR. BLUST: I am going to say that I think on a longer term, I totally agree with the global harmonization and the aspect of looking at frequencies on a unified basis, globally, as well as domestically.

That comes from a lot of my background having done this for a number of years. On a nearer term basis spectrum efficiency, and I will speak specifically within the cellular industry, is the fact that even with inflexible use, we still have a criteria to maintain analog cellular.

And I think that we would like to see what it would take to move beyond having to maintain an analog cellular to where we can take the best advantage of deploying the advanced digital technologies on all the radio channels at our disposal. Thank you.

MR. WEINREICH: Thank you, Steve. It

sounds like we need some kind of -- like we said before, sunset rule on some of the older technology. Mr. Toh.

DR. TOH: I think the FCC should have a mechanism -- and I wouldn't say rule, but a mechanism where operators producing com systems to end-users should regularly provide technology and performance statistics, and as a result of trials and study feedback to the FCC.

If the FCC were to look through these various studies, and pinpoint out factors that would create problems, such as interference of one system to the other, and therefore take subsequent steps to rectify the problem.

But I think one issue would be how to you provide incentives to these people to prove you that feedback.

MR. WEINREICH: That's a question of how do you overcome some of the fear of compromising proprietary systems and property rights. Ulrich, please.

DR. ROHDE: I would still like to see that the FCC implement some kind of a working panel on technology, whereby we look at contributions on how to do certain things, whether on radio

receivers, front ends, mixers, oscillators, and how all of these things can be improved and shared on a working panel.

Because it is -- the word economic has popped up a few times today here, and rightly so, but I think if we come up with a common knowledge base about certain things and how to do them, and then there is still enough about how you package these things, and what features you implement, there is another chance around how you can make a better mouse trap.

On the other hand, I think there are certain commonalities, and I think we share certain commonalities, and avoid problems in both the receiving and transmitting.

And I wish that the FCC, as in the past, had gone out and said to ITT to build this better mouse trap. And I remember that ITT did one and then dropped it, and whatever happened there, it lasted for maybe a year or so.

I sent a letter to the people and asked can I have the integrated circuit and Texas Instruments said, well, we kind of dropped the ball. There was not enough interest.

So, yes, it was shown as demonstrated,

and it was built, and it worked, and IEEE wrote about it. So a magazine article came out of it. Texas Instruments got a good name out of it, but no product developed from it.

So what I wish that would happen is that the FCC really invites a bunch of experts on maybe a six months or whatever basis and talks about these issues, and how they solved these things, and everybody would greatly benefit from this.

MR. WEINREICH: Thank you, Ulrich. Mr. Rinaldo.

MR. RINALDO: Yes, thank you. It seems to be something often said these days in the FCC circles that you need technical flexibility, and there are times when that is wonderful, and there are also times when that causes problems.

If, for example, a number of services or a number of systems are put in a band under one set of circumstances, and now someone either new or an incumbent comes along and decides to use technical flexibility and changes the environment.

Now, it is difficult to then figure out how to avoid that, but in some cases standards

should be considered, rather than having complete technical flexibility.

If someone -- if we all know the standards that are set for a new system coming in, and we are all talking to each other and studying that to see how it is going to affect the other systems, I think we are ahead rather than letting it happen, and then wondering what hit us.

So I would suggest that the concept of letting many flowers bloom is fraught with problems because eventually systems are going to collide, and then you have to do something about it.

So technical flexibility may be simply putting off the day when you have to develop standards. Thank you.

MR. WEINREICH: Thank you, Paul. Merrill.

MR. WEISS: I would say it is hard to verbalize this. I guess there is several aspects to technical flexibility that it seems to me ought to be implemented, and I guess this is more in the positive than in the negative. But maybe it is getting rid of some of the rigidity.

One of the things that we did in reconfiguring part of the spectrum some years ago

that would allow for spectrum efficiency was to allow for channelization that was flexible.

There were large blocks of spectrum that were assigned to or that were licensed to particular licensees, and then they could do with them as they saw fit, including combining adjacent channels, and then splitting them down into subchannels and things of that sort.

And so where I think most of the time when I hear people talking about technical flexibility, it is more in terms of modulization and things of that sort. It also needs to be done in the realm of channelization, and that requires that there be some mechanisms put in place as to how you go about calculating interference from unequal channels, unequal band widths, for instance, with overlapping channels.

And we actually developed a regime that allowed for that, and in part of spectrum, and it is in place today. But I think that could see application in other parts of the spectrum than where it is currently in place.

MR. WEINREICH: Thank you. I would like to ask members of the audience now to give us their opinion as to what one rule or policy should

be changed by the FCC. Carl. Down in the second row here.

MR. STEVENSON: Thank you, Dave. I realize that I am making a fairly significant number of comments, but I have a fairly large and vocal constituency that I am representing.

I have to agree with Paul's comment about standards. In fact, there is a Federal law on the books that the commission may or may not be fully aware of.

I believe it is called the "National Technology Transfer Act," and my understanding from reading some papers on the subject that came out of NIST are that regulatory agencies are required to consider open consensus industry standards in their regulatory proceedings.

We had a situation, which I think is what Paul is alluding to, where there are shared bands and there are the bands where you have Part 15 devices, and the Commission has historically taken a very laissez-faire approach, a very technology neutral approach, in the sense of basically saying here is some basic power and emission limits, and here is the edges of the bands. Have a nice day. Thank you very much.

And what that has done in some sense is it has promoted proliferation of a lot of systems that are unlike, and in the standards community, we are going to great lengths to develop standards that will coexist with each other for different things, like wireless local area network, wireless personal area network.

We have listen before transmit, carrier sense multiple access, collision avoidance protocols, and all sorts of things like that, to allow our standards to work together pretty well and share the spectrum effectively with ourselves, and in many cases with unlike systems.

but it only takes one rogue if you will, who doesn't play nice for lack of a better term, to kind of upset the apple cart for everybody. So I would encourage the commission to make more use of industry consensus standards, such as those that IEEE 802 has developed for wireless networking, in defining the types of devices, and the types of requirements for devices for use in those sorts of environments. Thank you.

MR. WEINREICH: Marc.

DR. GOLDBURG: I would actually like to mention a policy that I think the commission

shouldn't change, which is the one of technical flexibility. If you look at other standards, or excuse me, other regulatory agencies throughout the world, you can see a number of cases where industries or economies have in some cases been severely damaged by the government trying to mandate technology.

Having said that though, it is important to come up with allocation rules that foster co-existence, and I think as you mentioned, a policy of sort of like versus like.

For example, putting wide area systems together, versus local area systems, or two way systems, versus broadcast systems, or FDD systems versus TDD systems.

With some basic groupings like that, I think one could develop a set of co-existence rules that do allow different technologies, but are meant to fundamentally provide the same types of services to co-exist.

MR. WEINREICH: Okay. Thanks, Marc. Anybody else? I'm surprised at the lack of comments here. Dr. Toh, please.

DR. TOH: Yes. Just to add on the standardization bodies. My knowledge is that

pretty much it evolved as a working group and eventually endorsed by, for example, IEEE, or TIA, and so on. Very often than not establishing a liaison with another standardization body is not a first criteria.

So the issues of who is going to encourage this formation, should that be the role of the FCC, or should that be the role of that evolving body. The second thing was brought out on the co-existent rule again.

As this community grew with different systems and different people controlling these systems, who should be the major player in terms of the co-existence, because obviously it affects their market, and it affects their control.

MR. WEINREICH: Thank you, Dr. Toh. Steve.

MR. BLUST: Another thing that I would like to mention is the globalization perspective, since that was brought up before. I think one thing that we have to be cognizant of is that perhaps we need to have increased, perhaps cooperative, government-industry research on a lot of these issues of common and core problems.

And that is not just a domestic issue

so to speak. That is an international issue, because while some systems are domestic in nature, and are only in the U.S. border so to speak, and not to mention the issues with neighboring countries at the borders, a lot of the standards that are being defined, and a lot of things being done, are for global bases, meaning your cellular PCS, third generation, and those sort of things.

And that we have to be careful that criteria that may be adopted here doesn't prohibit devices from either entry, or in use, or use and utilization elsewhere, because that is what the consumers are doing today in the mobility world.

And I think we have to ensure that we have that global dialogue in discussion, because it is a global problem. It may be in varying degrees in various jurisdictions, but the interference, the design, the criteria, all these questions that we are asking here, the efficiencies, and so forth, is of global concern, I believe, and that is my ITU hat so to speak on. Thank you.

MR. WEINREICH: I will just mention one other thing about the ITU. The GMPCS, the Global Mobile Personal Communication by Satellite memorandum of understanding was signed a few years

ago in the ITU, and people who do sign the memorandum are allowed to have their terminals passed freely amongst the countries that are the signatories to the memorandum.

And I think that was one thing that goes a long way to try and promote taking one terminal from one country to another. What you say about the mobility is I think compounded a little bit, in that we don't really have any common frequency bands around the world for us by PCS.

We tried it in Work 2000 to come up with something like that, but we weren't quite as successful as the industry wanted to be. But I think that is one thing that has to be taken into account in future spectrum planning, is to try and make a more global approach to the way the bands are assigned to the various services. Okay. Steve Gillig.

MR. GILLIG: Just to add on that comment, and it also gets into what Mr. Weiss was saying, that having large bands is better than giving very small bands that are non-contiguous for the reasons of the technical flexibility, but also because it gives you a much better chance of having some overlapping spectrum with an around the globe

operation.

Whereas, if you have got very small bands, it gets very, very difficult to have any kind of global harmonization.

MR. WEINREICH: Thank you.

MR. ENGELMAN: Let's wrap up then.

MR. WEINREICH: Okay.

MR. ENGELMAN: I guess I would start by saying thank you for coming. I think we have had some good discussions this morning on spectrum efficiency. I want to thank our panel and my co-moderator, Dave Weinreich, for joining us.

I want to thank the audience for participating and would remind you that this afternoon we will have another session starting at one o'clock that will look more at the policies and rules that we currently have, and some of the philosophies associated with where our current rules are, and where they should be going in the future.

And we will also have a short introductory talk from Preston Marshall of DARPA on reconciling technology, flexibility, policies, and rules. I hope you will join us again at one o'clock. Thank you.

(Whereupon, at 11:56 a.m., the workshop was recessed.)

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

(1:05 p.m.)

MR. ENGELMAN: Welcome back. We will try to get started. I hope that you all had a restful lunch and you are ready for some lively post-lunch discussion. We want to keep things lively so that everyone stays awake.

And I don't think we will have a problem with that. We have got a great panel for you this afternoon, and first to kick us off, I would like to introduce our co-moderator, Preston Marshall, of DARPA, and not DARA. There is a "P" in there.

The project word is missing, but Preston, welcome.

MR. MARSHALL: Thank you. The P-word is important to us, because it brings us back to our internet inventor legacy. When Paul asked me to in fact replace him at DARPA to go over to the FCC to work on spectrum management, it was hard to imagine that he could really generate a lot of interest in that, and quite the contrary seems to be true as more and more people have recognized how central spectrum management is to doing IT.

I am sitting here as a representative

of DARPA, but it is important to realize that DARPA is a technology arm of the Department of Defense. It is our job to do the job that no one else would possibly invest in.

Nothing I say is anything other than my personal opinion on the kind of technology inputs. If you want to know policy from DoD, go over and see Steve Price and testimony, and they can work that for you. I am here just as a technologist.

And this is an area where we really think is amenable to technology. I tried to put in a topic sentence for this session, and I had a Blackberry keyboard and so I had to keep it short. Reconciling Technology, Flexibility, Policies, and Rules.

Now, the policies and rules came from Paul, and that was the title of the group, but the issue really seems to be how to reconcile the kind of technology that everyone sees emerging, particularly in the other panels.

And the kind of flexibility we want to see in systems, and how to reconcile those two with something that can be implemented in a policy and rule base. I think as engineers, a lot of us have a strong sense that if we could just go in and do

it, we know how we would have to do it.

But going from that very specific case to a general case of policies and rules, which is to challenge everyone else who enjoys criticizing the FCC for really is a job.

We are one of the last panels, and so a lot of panels have talked about ideas. I would hope that when we are finished that we can come up with some ideas that are implementable, that capture the intellectual content of those, but still in a form that someone can carry forward and actually implement.

To start up the sort of dissention and hope to keep it interesting, I thought I would take the preoperative of being the moderator, and throw a couple of things on the table.

The panel was set up with the framework of policies and rules, and it is hard to argue against policies. We need them. We can't have anarchy in spectrum. I would like people to think about whether though we need rules.

Rules implement policy. We ought to be looking towards a period of time when our radios are smart enough, our interference management is smart enough, so we can give the radios directly

policy, and get the FCC out of the rules business.

We think today about a policy framework which locks in the characteristics of radios. I think we need to be moving towards a framework where we lock in the behavior of radios, and how they respond, and make sure that they behave correctly to interfering conditions. But not to necessarily avoid those conditions.

So, my first sort of charge to the group, both audience and panel members, is that when you think about rule making and policy making, think about it as something that controls action, reaction, response, sensing, rather than something that merely guarantees that nothing can ever interfere at any point in time, and at any point in space, and at any point in the earth. And potentially if NASA was here, the solar system.

The second thing is I listened to Vince Cerf a couple of days ago. Vince Cerf is probably the most famous DARPA program manager and inventor of the internet.

And his comment was that you ought to look at whatever we did as being wrong, because we responded to a very different set of engineering realities, and we could build very different kinds

of systems. It is easy to get into technology and well beyond when it was right.

I think when we look at spectrum, we are all sitting here, and we just finished the blood bath on 3G. If you have been involved in that process, people are still reconciling earlier Congressional actions.

All of those presume a framework that we see as evolving and new, but there is no reason to believe that is the framework of the future. Maybe in fact we should run away from it very rapidly.

And I have heard some of the other panelists, and I have talked and heard a lot about cell phones, and 4G cell phones, and 3G cell phones. But I have not heard people talking about how those same rule frameworks work if the frameworks are ad hoc, peer-to-peer networking.

What if 802.11 is the answer and not a cell phone. What if it is infrastructure less rather than infrastructure based. Certainly from the Department of Defense, we are looking at technology that is infrastructureless, because there is no infrastructure where we want to go.

And so we are going to be pumping

literally billions of dollars over the next tens of years into infrastructureless technologies. So it is not enough to merely prove that we have the right spectrum base to allow us to go to 3G cell phone and 4G cell phone, and even 5G.

We ought to be thinking about what if it is done completely differently. Being friendly to one mode may be really doing technology selection for the other.

So I have done my moderator's preoperative. I would like to go around the panel and introduce them if I can find my right sheet here. We have already introduced myself as the moderator.

Ron Haraseth, Director of APCO, Automated Frequency Coordination. I thought they would be in order.

MR. ENGELMAN: There are not in order.

MR. MARSHALL: Thanks for telling me. Brent Wilkins -- raise your hand please -- managing director of Cantor Fitzgerald. Gerald -- help me out please.

PROF. FAULHABER: Faulhaber.

MR. MARSHALL: Gerald Faulhaber, Professor of Business and Public Policy at Wharton.

Marc Goldberg, from ArrayComm; Michael Fitch, Director of Spectrum Management, at Boeing; and Michael Lynch, Senior Manager of Spectrum Regulation, from Nortel.

We had a number of questions, and what I would like to do is start us out and the question I was given by my FCC co-moderator, and I think it is a good one, is what current or new technologies under development may influence the effective use of spectrum; what may decrease or impede the effective use of spectrum.

And then what is the rule implications of those, and I think we will just start and go down the panel.

DR. GOLDBURG: Thanks, Preston. Let me mention two technologies briefly. One of them is software defined radios, and we have heard a little bit about that earlier in the session today, and the other one is adaptive antennas.

We heard the words or the phrase offer to define radios and offered up as sort of a panacea to a whole wealth of spectrum issues, and I think the class of radio technologies, where the radio is software configurable, to be able to handle different modulation formats, or potentially

work in different bands, is valuable.

I think the thing that gets left out of the current discussion is many of those capabilities are in today's current radios. If you look at CDMA systems, which changed our spreading factor to handle interference, or GSM, which changes its coding rates; or 802.11, which changes its spreading factor.

Most modern communications systems, at least the cellular ones that I mentioned, have elements of software defined radios in it. So I think that as an industry that we are already taking pretty good advantage of that technology to handle interference and provide services under a variety of link conditions.

And it is not clear to me that there is this huge incremental piece of low-hanging fruit that we have not taken advantage of already. That is one comment.

The other one, which is a little bit of a pitch given where I am from, but it is also something that I very much believe in, is the concept of adaptive antenna systems. Spectral efficiency is about -- at least for heavily used systems, is about managing interference.

And adaptive antennas are a technology that are able to do a better job of focusing energy on users, rather than sort of spraying energy throughout the whole cell. And as a result of that, they can have a very dramatic effect on spectral efficiency that has been shown in a variety of commercial deployments.

MR. MARSHALL: Do you want to connect that to rules and regulations? That was the panel that you were put on. You are one of the two panels here, and you are talking to lawyers here.

DR. GOLDBURG: Rules and regulations. Sorry. My bad (sic). I think the connection is this. There are a variety of technologies out there which have individually or in combination been used to increase spectral efficiency of systems over time.

And I think what the Commission should be doing is attempting to look overall throughout the industry and looking at best practices, and potentially coming up with some target performance levels, but not necessarily mandating technology. That is best left to the technology developers, and the people who have to deploy and operate the systems.

MR. LYNCH: Well, actually he stole some of the points that I would have liked to have brought up, but that's okay.

MR. MARSHALL: You get two of your own.

MR. LYNCH: I think one of the things that has got a lot of the manufacturers and operators sort of stirred up today is ultra wideband, and we look at it as a glass half-full, and a glass half-empty.

We don't manufacture it, but we see it as a great potential, but we also say it as a great potential for harm if the rules again aren't correct.

And one of the other little hooks that we would like to throw into that one is the term, spectral efficiency.

If you look strictly at it, it looks very, very efficient, but is it really? Spectral efficiency from a rule point of view isn't I think the way to go, and the way I would preface my remarks is to say to a degree, but an efficient use of the spectrum is maybe a better standard to use.

And just because I get 44 megabits down the pipe doesn't mean that I am using it -- that a technology that doesn't do that is using it

inefficiency. So I think there has to be a balance in there somewhere.

And again the rules, yes, the rules have to help everybody, and again, UWB, we are going to be talking about that for a couple of more years I imagine, and what kind of rules should or should not be in place on that.

But also how do we define a technology that is efficiently using the spectrum, rather than putting out a rule that says you have to push this much down the pipe in order to have your technology accepted.

I think that those are not mutually exclusive, but we prefer the efficient use of spectrum in our model rather than saying how much has to go down the pipe, or how much per kilobyte or per kilohertz, whatever the standard is.

MR. MARSHALL: Okay. Thanks.

MR. HARASETH: From a public safety perspective, I think one of the things that I just wanted to bring up is especially in light of some of the newer technologies in the ultra-wide band, the software-defined radios is security.

Public safety is not one that accepts change really quickly, and it is also one that

doesn't necessarily -- security is a relatively new issue, but we are taking a lot of our lead from the Federal government issues, and that security is obviously a really big item there.

The other thing is that we are talking about efficiency, and the use of these new technologies, and these new technologies are letting us do all kinds of new things. And it just struck me sitting up here listening to this that this is like at home.

You have got an empty closet or an empty garage, and how long is it going to stay that way. So it is not a case of efficiency of technology that you are using.

It is an efficiency of how you are using that technology, and what you are allowing to run down that pipeline. Is it junk sitting in the garage and it won't let you park the car, or is it something worthwhile.

MR. WILKINS: I want to ask the question a little bit differently, and on the fact that on the technological standpoint, I am not going to talk about the technology of the spectrum, but merely the technology of the trading mechanism.

Cantor Fitzgerald is looking at this

market from a standpoint of how can this best be an efficient market, and our company has been involved in trading products for years, from an electronics standpoint, as well as a human brokerage standpoint.

And the technology does exist today to trade it. The question becomes if it is 10 trades, or 50 trades, a thousand trades between the counter-parties, does the technology exist today to actually trade spectrum in a variety of forms.

PROF. FAULHABER: I am actually going to defer my time until we get to policy considerations, because we are largely rearranging deck chairs on the Titanic here when talk about little tweaks, and I would like for us to go for the lifeboats. So if I could hold my time for the next --

MR. LYNCH: That is a hard characterization to follow.

PROF. FAULHABER: Sorry, Mike.

MR. FITCH: No, that's all right. Well, I will speak a little bit to technology in the satellite context, and there what we have is a number of trends, but I would agree with Marc's comments that it is not that there are low-hanging

fruit and some gigantic leap forward overnight in any regard.

But the trends that I think relate to efficient use of spectrum, more power on the satellites generally capable of, and reconfigurable antennas, spot beams, on board processing, on board beam-forming with antennas.

The result of these technology advances is a combination of more throughput overall, and more directed throughput to where the requirements actually are, and in some cases smaller and cheaper earth station terminals, therefore reducing the cost to the consumers.

Regulatorily, these are all pretty compatible with the Commission's rules. The Commission's rules in the satellite services have generally allowed a pretty high degree of flexibility to the operators working amongst themselves, and that has enabled transitions, albeit gradual, as technology advances.

MR. ENGELMAN: Does anyone from the audience what to jump in with some ideas or thoughts? Again, the question was what current or new technologies under development may increase efficient use of the spectrum or may hinder it?

There is no one out there with a good, new idea? In the front row. If you would wait for a microphone, please.

MR. MARSHALL: Thank you. My name is Jim Marshall, and I work with the Mitre Corporation. One of the things that has been brought up from time to time is the potential advantage of spectrum aggregation.

And I was wondering if the panel might comment on that and its advantages and disadvantages.

MR. ENGELMAN: Okay. Anyone have any thoughts? I would ask maybe Cantor -- for Brent to talk about spectrum aggregation, because this is the ability, I think to put bits and pieces of spectrum together into a useable plan.

MR. WILKINS: Well, the issue becomes on any type of traded commodity for a better word, is to somehow have a standardized agreement from which to train or transact. I think the issue becomes how do you put together that type of an agreement between spectrum allocation.

You have to have some kind of standardized format, or some kind of rules and regulations that all the counterparties can agree

to. I think what happened in our experience has been that we looked at the wireline industry quite heavily, and there are some issues there because a lot of counterparties could not agree to what those rules and conditions, terms and conditions, could be in the contract.

There are some issues I think from a standpoint of defining the spectrum, defining that the rules and the terms that the counterparties can address, and I think by doing that that you can actually have something that can be traded and transacted between the parties in such a manner.

MR. ENGELMAN: Gerry.

PROF. FAULHABER: This is a good issue, particularly as I am going to be talking about in a minute or two when you begin to consider property rights in markets models associated with spectrum.

If we think of private goods, and let's say land, for example, it turns out that it is much easier to subdivide it than it is to aggregate it through property markets

And which is why it is sometimes difficult to put together enough property for a shopping mall. It is a lot easier to subdivide it than it is to aggregate it again.

And once we move towards a property rights model, which I am sure that my colleague here would be very excited about, that we have to somehow address that problem of ease of aggregation, because it could be a problem within the context of property rights and markets.

MR. ENGELMAN: Does anybody else want to --

MR. MARSHALL: I would just like to state that I think that as an alternative view that says that I don't need to aggregate spectrum physically. That when we take and leverage the increasing SDR capabilities, and non-contiguous modulations, that another approach is to become better at accepting the reality of a very anarchistic environment of spectrum, and look to modulations that are non-contiguous and no-symmetric energy.

And to exploit holes rather than trying to statically collapse them, and put the subdivision back together again. I think you have got two different paths there. One is a regulatory and the other is to develop technology that accepts we are what we are, and some things are just very hard to put the genie back in the bottle.

MR. ENGELMAN: Okay. I think I saw another question or two in the audience. Over here. Can we have a microphone, please.

MR. GILLIG: Steve Gillig, Motorola. This was something that didn't come out this morning too much, but certainly people are talking about Joe Mattola, about cognitive radio, which is a radio that somehow senses its environment, and senses interference, has the ability to look for open spectrum either by itself or through the system.

And so it sounds like an exciting technology. It certainly is a little ways off before we would be able to implement that, but before we could even implement something like that, there would have to be certain policies enacted that would allow spectrum, be it contiguous or lots of little blocks, to be able to be marketed and be able to be sold.

Otherwise, all this capability isn't going to do you any good if you can't jump to unused spectrum and figure out how you are going to pay for that, and how people are going to offer that for service.

So that is something that has to come

with the policy first before the technology could make use of it.

MR. MARSHALL: I can't comment on that, because that is my position description at DARPA, is building such a radio. So I am the wrong guy to say anything.

MR. WILKINS: I have just got one comment. On the wireline side, one of the reasons, and one of the problems they had on the wireline trading industry was the fact of the interconnectivity.

But if also we are just talking about rights -- you know, trading rights to the spectrum, you don't have interconnectivity problems with the delivery issues that happened with the wireline side.

That is a point to consider when you are looking at the rights of the spectrum; trading as rights, versus actually looking at the physical delivery of the spectrum itself.

MR. MARSHALL: Would you like to talk about that from a policy perspective, because he was basically addressing that tension between policy.

PROF. FAULHABER: Do we have a minute

or two so I can --

MR. MARSHALL: You deferred the time. So this is your little bucket here of your time.

PROF. FAULHABER: I sort of made this provocative comment about rearranging the deck chairs. And let me actually say what that means and how it fits in, I think, to your question, which is -- well, let me make it clear what the current system is, okay?

We all sort of think that we know what it is, but it is basically administration of an important national resource by administrative fiat. Okay. We make rules about things, and that is what we do here at the FCC, or I used to be here.

I tried not to make rules, but that's what we do here, okay? And we have done that for 75 years. We sort of decide where things are going to go, and we hand it out to people.

And we have changed that a little bit in the last 10 years, okay, because we now have a little bit of auctions, but there is less there than meets the eye.

Now the fact is that you might say that here we are in the center of democratic capitalism, and how are we passing, or how are we allocating

this scarce national resource? Well, we are doing it by administrative fiat.

You know, if it were really important, like food, clothing, or shelter, we would let the market do it wouldn't we? Okay. Well, you know, somehow we don't do that.

Well, is there any precedent for this, and of course there is. There used to be this country

-- and some of us might remember -- the Soviet Union, and they had an agency called Gosplan, and that's what Gosplan did. It used to pass out everything.

And what the FCC does is that we are sort of the Gosplan of spectrum, okay? We sort of pass it out and if you are good, we will let you have more. And we know that model doesn't work.

Ronald Couse, the Nobel Laureate, said so in 1959, and he was considered a crank for pointing out that Gosplan is probably not a good thing as a way to allocate resources.

And ever since then, economists have argued, look, this is insane. What you should do is get this out into the market, and get the government out of the business as Preston has said,

but in a different way.

It's like establish property rights, and auction the dam stuff off and get out of the business, and let secondary markets, such as Cantor Fitzgerald, solve this problem for you. That's how we deal with real estate, and you know, it seems to work, okay?

And economists are sort of beating the drum on this for 40 years. We will hear some more of that at the next session, and it is hard to argue that the markets don't do a fairly reasonable job at things as long as we don't interfere with them too much.

And, of course, as an economist, I would have to say that. However, what Preston indicated also is another strain to reform, and just saying, okay, you know, the answer is not necessarily to go to markets, but what we should be doing is deploying these new technologies.

Okay. The brave new world of mesh networks, agile radio, ultra-wide band, generally wide-bank technologies, which guess what, they don't take many spectrum at all.

They kind of sneak in kind of various places, and they really are very efficient, and use

it tremendously. In which case, the whole thing of spectrum scarcity will go away, because all this stuff about managing it, even property rights, is about scarcity.

And what we hear Preston saying is that in this brave new world there ain't going to be any scarcity, okay? So to some extent the technology guys are saying, yes, we think the present system sucks. You know, Gosplan is not the way to go, and we should go to commons.

The commons are saying, yes, Gosplan sucks, and let's go to markets. And in fact what we have been doing -- and I say we, because my co-author, David Ferber, and I have been working on a plan which attempts to accomplish the best of both; to realize the efficiency of the markets through a property rights scheme, and yet has sufficient accommodation for ultra-wide band agile radio through what we call a non-interference easement that we could use markets.

But we could also get the benefits of commons. So if we want to look beyond Gosplan and say where do we want to be, it strikes me that we may be in a future in which the commons rules. That would be wonderful. No scarcity.

I was promised that in 1995 about the internet and it wasn't true, and I hope that it is true this time; or we may be in a world where we are allocating things by markets, and we know that they tend to work a lot better than Gosplan does.

So whatever we do is an in-state, wherever we are looking forward to, okay, we need to come with a future scenario that can accommodate either one. And that is sort of what we are trying to propose, at least in our submission, to the Commission; something which is consistent with property rights, as well as with a commons approach, and that is what I would recommend, and get the FCC out of this business, okay?

MR. MARSHALL: I would hate to be quoted as necessarily believing in markets quite that strongly.

PROF. FAULHABER: Wait a minute. DoD in favor of anarchy? That is a quote.

MR. MARSHALL: We are organized. No one else is allowed to.

PROF. FAULHABER: Organized anarchy. Okay. I love it.

MR. MARSHALL: And I think it would be fair to let the panel comment on your comments,

because they go to the heart of some of the other issues. But I think you also ought to put out that markets -- in a lot of places, we don't allow nuclear power plants to be regulated by market.

If I melt down, I will go out of business and go bankrupt. We in fact enforce standards that are not market driven, and the internet was developed with no market behind it. It created incredible wealth, but no one else probably other than DoD would have been willing in the early '70s to invest in it.

So I will put in a pitch to at least moderate that drive, and recognize that public safety, public interest, as such. and clearly as the Department of Defense, we represent other kinds of interest.

No one has ever modeled them in terms of strictly bidding.

PROF. FAULHABER: You will respond to the moderator's comments or something like that.

MR. MARSHALL: Everyone will respond to yours and mine. And with that -- there are hands up all over the place. So we have got some stuff going.

DR. GOLDBURG: Actually, I have a

question for Gerald, and I am not an economist, and so you will have to bear with me. But it seems to me that one thing that markets don't focus on is the long term.

I mean, they tend to be short-term, mid-term, focused, and if you try to apply that in the context of spectrum -- let's take the example of the television industry today, which is in some sense an industry that is in a certain amount of pain.

We could point to their spectrum and say it is used inefficiently, but the reason that it is used inefficiently in some sense is that television, because of its success, developed a huge amount of content that now other techniques -- cable, and satellite, and so forth -- are delivering.

So in a sense, they are a victim of their own success, and in a pure market-based approach, they may not have had the opportunity to be successful in the first place.

PROF. FAULHABER: Well, television sets a sweet example. A couple of acts here. I think the number is around 85 or 86 percent of U.S. households now get television through a pay

subscription model. Their main source of television is not over-the-air broadcasts.

And that number is growing, okay? To the extent that the television industry identifies itself with over-the-air broadcasts is doomed, and I don't think the television industry does.

The television industry is a content business. I actually challenged Michael Eisner on this once, and he readily admitted that he didn't give a damn how television got into people's houses; whether it was over-the-air broadcasts, or cable, or satellite, and he's right.

Now, the cleanest -- this is like a fun example, okay? You guys remember UHF television? Channels -- what, 52 to 60? It was this huge swath of the spectrum, which we thought was a great idea back in the 1950s, and we actually for a while mandated that tuners have UHF tuners on them.

I doubt -- you would have to look in a junk shop to find a television with a UHF tuner on it anymore, but you know, there are people that are broadcasting in UHF. Nobody is listening, but they are broadcasting.

Why is this you might say? Well, because the FCC has this thing called a must-carry

rule, which says that anybody that is actually broadcasting in a local area has to be carried by cable.

So if you are not broadcasting, you don't get carried by cable. This is an FCC rule. This is what rules do, okay? So now what we have is people actually using the UHF channel. Nobody is listening to it, except on cable.

Now, if we were to sort of free this up and say, okay, you know, UPN, WB, and your affiliates, we will grandfather the must-carry clause. Would you like to, let's say for example, sell your spectrum?

It would be gone in a heartbeat. Okay. And there is more spectrum out there than we would need for wireless for the next 10 years. Boom. Just like that.

Talk about efficiency. That would be a great one, okay? I won't even talk about the digital set-aside. I mean, that is just --

MR. MARSHALL: Anyone else?

MR. FITCH: I will make a comment.

MR. MARSHALL: Okay.

MR. FITCH: From the perspective of the Boeing Company, these great theories aren't frankly

very useful or appealing. I think they probably -- they may or may not apply and be appealing in the broad context of commercial services, commercial wireless versus broadcasting, versus some of the other major categories.

Our uses are driven by other considerations. First and foremost, we build airplanes. We use a lot of spectrum. We don't use a lot of spectrum, but we have a lot of spectrum uses that support that enterprise.

Obviously the safety implications of those uses are extremely high. On the other hand, that does not make a giant market, and it seems to us that the kind of giant market approach to spectrum would be counter-productive, would be destructive, to these kind of specialized uses that actually are on the whole adequately taken care of under the existing system.

Obviously, it could be better, and everybody would like more, and we are all constrained in some way or another. But as we run through a wide range of spectrum interests that we have as an industrial company, none of this fits our needs very well.

It is not clear that any of this would

advantage those uses and requirements ultimately. So while the existing system is certainly imperfect, and no one could possibly argue that it isn't, it does serve a wide variety of needs to a reasonable extent.

And a lot of users I suspect like us are not very favorably inclined to a grand experiment that may improve things and may not, particularly for the specialized users. I think you see that run through a lot of the comments in the docket.

MR. MARSHALL: I would like to move on to some more policy related, and then we will pick up a couple of more of the questions that I see out there. Let's get one more question to the panel, and then we will come back.

Panel opinion: Do policies that make it easier to transfer spectrum to secondary markets improve efficiency; and under what circumstances do you think the Commission should adopt or avoid those kinds of policies? And we will start -- and I hesitate to say, but we will start with Michael.

MR. FITCH: No, actually from a satellite perspective, we use secondary markets, and have for many years thanks to decisions by the

Commission that enabled them.

It works pretty efficiently. I guess the caveat there is that it is -- that it operates to a large extent between like-situated operators serving somewhat consistent requirements of users. So it is a kind of manageable universe in that regard.

But we do take advantage of it, and support its continuation as it stands now for the satellite services.

MR. MARSHALL: Gerry.

PROF. FAULHABER: The FCC has been moving in the direction of secondary markets, less restrictions on use of particular bandwidths, band managers, policies which basically create more flexibility.

And, you know, I am all in favor of this. This is not quite rearranging chairs on the Titanic, but it is the notion of saying taking the present system and let's kind of move it in a more market-oriented way. And obviously I am in favor of that.

Some of my more aggressive economist colleagues would say we are putting lipstick on the pig, but yeah, I sort of think this is okay. Sure.

MR. MARSHALL: Let me guess.

MR. WILKINS: Obviously, we favor a market-based transaction system. However -- I mean, I am just kind of looking and making notes as speakers talk, and I think from a -- and again the research that I guess we have completed in the last few weeks, you know, the current FCC process is a bit cumbersome.

It is an all or nothing situation, I believe, and it requires commission approval, and with bilateral contracts. You know, you purchase for the same use. I think there is some issues there that need to be addressed.

I think if you take into consider the property rights, and the right to use for the individual companies, and examples that I would use is let's say in the broadcast arena that there is a sporting event.

And I was involved in a couple of sporting events in my neck of the woods actually a few years ago, where short-term use of spectrum would have been ideal. It was not available, and a high risk spectrum was needed, and it just was not available in the marketplace, and to negotiate a contract would have taken way, way too long for

this to be applicable.

So again I think there are instances, and I think in the market development that there are shorter term uses for spectrum, and a longer term view that one of the panelists talked about, a long term view of the spectrum.

And let's say we award the auction for spectrum down the road, and all of a sudden the uses or the technology has changed. So the spectrum that you have now been awarded is not as useful as perhaps as you thought.

So now under the secondary market, you can find a counter-party that now has the technology, or the use for that spectrum. So again I think there is instances and examples in a longer playing field where there can be more effective uses of the spectrum.

MR. MARSHALL: I would like to make a couple of comments. This is an area that is totally outside of the DoD's interests, but as an observer, it is hard to argue that we gave someone spectrum 30 years ago, and that that property right is so locked in that they can pursue another piece of business with what essentially is public property.

I think it is one thing to say that you lease out unused public safety channels when you are not using them because you need to have them available to do your mission when you want to reclaim them.

It is quite another to say that when you stop broadcasting Howdy Doody 20 years from now, there is some inherent right to resell that. There was some basis of licensing. The licensing of a public safety channel is valid 20 years ago whether or not it is secondarily licensed or not.

It is presumably a valid public need, and revenues being done, and that's great. That is quite different than saying that I am basically pulling out of the premise for which it was licensed.

So it seems that since we have an interest in deappetizing commercial, and finding other ways for commercial need to be satisfied, and then looking to the public frequencies, Federal frequencies.

Clearly there is a pool of frequencies that exist by legacy, because really a regulatory process hasn't really looked at whether the basis of those still exists and is still valid, and they

merely become a kind of a warrant on the public assets.

And it is sort of hard to see that, and so secondary licensing from the spot market makes sense, and carrying that forward to saying that it necessarily means that a UHF channel is forever until something regenerates hertz seems like quite a different matter in a way until it becomes a regulatory excuse.

And you just not deal with something that clearly that you would never do. And if you say you wouldn't buy stock, and you should sell it if it is in your portfolio. And a similar thing, if you had been licensed to use, why would you retain that license decades later.

MR. HARASETH: I am going to jump back a little bit to Michael back here, and Boeing, and public safety has the same concerns, but it seems like there is a magical number I have heard a couple of times today here, and it is 15 percent. Is it okay that only 15 percent of the people are using the broadcast out there?

Well, the same 15 percent came up two different times under consideration of how much actual air time is public safety using in a given

market, even here in Washington, D.C.

If you took all the land mobile market out there, all the frequencies, and you monitored those on a daily basis, well, 15 percent is still the same figure, and it would probably be the same figure for Boeing down here, too.

Okay. Is there some mechanism within the conventional channelization where that excess time could be given off as a secondary market to some other use that had a greater tolerance for latency if you want? Yeah. You know, okay. So there is a potential for a secondary market even for some of the commercial channel -- the conventional channelizations.

It's what technology would allow that, and what flexibility of the rules would allow that, and what type of mechanisms could broker that. I think these are what we are all talking about here.

Public safety, I think what they are concerned about is not so much having that guaranteed frequency there all the time, but the guaranteed access rights when and where they need it.

And right now the only way to get that

is to have a lock on that channel and that frequency. Now is there a model in the figure that would provide for that in some other mechanism in a more flexible way?

Well, if they could get those guarantees, then that might be a way. So the problem that I see is that transition in moving from the conventional model that we have now into this other model down the road.

MR. ENGELMAN: Would you say that would be true -- I know that you are not military, but would you say that would be true of military, as well as public safety?

MR. HARASETH: As long as they could get the guarantees. Now, convincing them of getting the guarantees is going to be harder than it is for public safety.

MR. MARSHALL: It is not enough -- the policy has to recognize that it is not enough to merely get access to spectrum. I would say that the military has been the most cooperative in not asserting its rights, because frankly the military can have the right to probably open every garage door in the United States if it asserted its full spectrum rights.

It doesn't do that because it is politically unacceptable. So part of access is not merely -- and as much as I would like to think of these as engineering challenges, reclaiming access isn't purely a technical issue.

If someone put a cell system up on to a frequency that is military, and then you come and tell 10,000 people that their cell phones aren't going to come on because you are doing training, the answer is that Congress will tell you not to do any more training.

So you have to take a broad view of what does it mean to regain access, and it is not strictly the technical, depending on time lines. It is the disruption. It is the fact that we have shut down a lot of radar systems because they open garage doors.

They interfere with illegally small C-band dishes that have side-low performance, poor side-low performance. All of these things are incumbent when you share a spectrum, even though they don't appear in an engineering term.

So I think it is not just enough to regain access. Let's regain access without an unacceptable degree of disruption to whoever sort

of moved in and became incumbent. Squatters rights has a lot of effects in spectrum, and it seems to be more than the 17 years that it is in the statute.

MR. LYNCH: With fear of sounding like a me-too person, I think from our point of five that secondary markets for like services -- and let's look strictly a CMRS. Company A has excess spectrum, if that is possible here in D.C., and Company B could use it. I think that should be a peer-to-peer type of transaction, and quite simple, and probably quite quick.

But for the industry, I know that we could probably sell more equipment that way. But the other one that comes out of another part of our company that I am concerned about is the same thing that Ron here is concerned about, and that is the public safety people.

How do you protect their interests, and I think we have made some comments recently without some sort of technology that would allow you instantly to override whoever is in that band commercially.

It is sort of tricky getting these guys what they need when they need it. I know that

there is a lot of debate going on in the public protection-disaster relief arena right now. The same issue of how much is needed, and people who see it blame their fallow, okay? Until something happens, a disaster happens, and then all of a sudden they want to have access to it.

How do you work that, and generally speaking, you are right. The public safety people don't change equipment every week, every month, every time new technology comes out.

And they tend to be somewhat underfunded compared to a CRMS guy. So I think there is sort of a -- yes, it's there, and it would be nice to share it. However, I think their needs -- and I will report back to the DoD that I said this to, that their needs are similar to the DoD's.

You need it and you just have to have absolute access to it. And until somebody develops that magic red button that you push to shut everybody else off, and everybody else understands that, I think we have got a problem here.

DR. GOLDBURG: Just two quick comments. One is that I think that secondary markets may actually help to stimulate the deployment of wireless services in rural areas, especially in the

cases of regional licenses and so forth, because for a regional license for personal communications services, typically the carriers will use go out in the urban areas where there is the largest return, and then use the money from that to subsidize rural deployments.

If you could split that up and sell some of your rural licenses off to companies that are interested in just providing services in a particular market, the services might arrive there more quickly.

The flip side of that though, and I think this is just an echo of something Preston mentioned, is that you don't want to create entitlements for revenues from secondary markets.

And at the risk of being a little controversial, I would point to the ITFS spectrum, which I think on a megahertz top basis is more or less just a revenue producer for the universities and so forth that at least until fairly recently were leasing it back to Sprint, and to WorldCom, and not using it for the educational programming for which it was intended.

MR. MARSHALL: A couple of -- I know we have a couple of questions from the panel. Gerry.

PROF. FAULHABER: I just wanted to make a point, which actually you were its first precedent, which is to say how easy is it to reclaim spectrum. And if I listened closely, and maybe you could correct me here, but I think you argued both sides of this issue, which is to say if people are using this inefficiently, and let's say for UHF, then why doesn't the FCC just claim it back?

But then when you talked about overriding cell phones for military purposes, you said, oh, that is not going to happen. That is politically infeasible. You can't have this both ways. I think most of us recognize that while we all said when we gave people licenses, you don't have a property right, as a de facto issue, just as a de facto issue, they do.

Legally, they don't, but in fact getting spectrum, even if it is not used out of anybody's hands, is a really difficult process, and if you don't think so, look at the next wave case, okay?

So I think we kind of have to understand that we've given away the farm already, okay? And that's where we are, and getting this

stuff back, if we could do it this way, that would be great. Just say, okay, bring it all back. It's ours. It is not going to happen. It just is not going to happen.

MR. MARSHALL: I tried to use your example rather than introducing another upset party. Another good example was brought at the end of the floor, and I think the issue is not that reclaiming is good or bad. It is time scale.

The process for reclaiming a regulatory framework, where you are rejustifying the process, versus a very instantaneous reclaiming, if one thinks about 9-11, the last thing that the Department of Defense would want to do would be to move to New York and set up our comms, and bring down the remaining cell systems, and render civilian comms impractable.

So a framework of reclaiming, which did not have degradation and that was on and off, is an uniplentable framework, a framework for reclaiming that is over periods of time, and justified is the difference.

I think it is a matter of there is no one size fits all across a variety of scales; from the microsecond in a cognitive radio, through to

decades with some of the incumbent licensing.

PROF. FAULHABER: I should add incidentally that the power industry has been -- and I think you are right. This is certainly no one size fits all, but the power industry has had a class of service which they sold to industrial customers for decades, and it is called interruptable service.

And everybody seems okay with that, and from time to time, indeed service gets interrupted. It is part of the contract. So why we can't do that, I don't know. We are just as smart as they are and maybe better.

MR. MARSHALL: And I don't want to comment, but I would say that interruptable service and commercial to commercial is very different than the wireless systems that we are looking at that are sold to consumers.

The first time a hospital bought interruptable service and 10 people died, and the power company waived the interruptable service contract, that would be the end of it.

PROF. FAULHABER: Then you don't buy interruptable service.

MR. MARSHALL: I believe if people

bought cell phones, and said that just int he case of a building being blown up, your cell phone won't work, we would probably buy the cell phone and then be very upset.

PROF. FAULHABER: Then you wouldn't sell for services interruptable.

MR. MARSHALL: Okay. We have some questions I think. Yes?

AUDIENCE MEMBER: My name is Evelyn World (phonetic) with Worldwide Educational Consultants. I want to play with Gerald's question, or his comment about personal property rights. In this particular scenario, Gerald, say for instance that there was an airline that had to go from Point A to Point B, and it had to travel through air space which you owned the spectrum, and you didn't want them to go through that air space, how would the FAA and FCC handle that particular situation since you want to term it as a property rights concept?

PROF. FAULHABER: Okay. When you say the airplane is going through the air space, you don't mean that I would have to give permission for the plane, but for the plane to use spectrum?

AUDIENCE MEMBER: Right.

PROF. FAULHABER: Yes. This actually illustrates an excellent point, which is to say -- and I have to defer to my colleague from Boeing on this, which is to say that when I said that you have to establish property rights, as if that were the easiest thing in the world, it is actually very difficult, because you have to establish a kind of directionality and power.

Just like with your land. Think of a good analogy as your land. Airplanes fly over my land all the time, and you know that they don't ask for my permission, okay? That's because I don't have a property right to that air space. I do have a property right up to about -- I don't know, 50 feet or something, okay?

But they don't have the right to do that, and similarly you would have to define property rights in spectrum to make sure that the airplane guys could use their airplanes without asking everybody's permission. Similarly -- and this is why I use this as an analogy, but Mike has asked me before, well, what about the satellite guys, and what is this guy.

And I say, well, look, if you are going to do terrestrial stuff, you are going to have

property rights to do this. If you are going to have it for spectrum, you are going to have property rights to do this.

It is very different property rights on different pieces of property and the same would be true of airlines as well. Now, that kind of begs the question of how would you define those property rights, and surely they have a lot of clever lawyers here at the FCC to help do that.

I know they do. They have really smart guys, okay? But that is the kind of problem that you would have to deal with, and you would deal with it in a property rights context and defining them carefully.

MR. WILKINS: I would like to make one point on that, and again talking about he property rights. It is much easier to define in a contract what you own, versus what you have to deliver.

So from a standpoint of a contract to use within spectrum -- you know, that is something -- our outside counsel didn't like that because they would much rather see 60 bilateral agreements negotiated out, but if we get one agreement that everyone could use, I think that would be a much better situation.

MR. LONGMAN: Wayne Longman, a private party. I have some experience in spectrum management, and I view it as a technical regulatory discipline, and things such as much carry rules, or government or non-government spectrum, being non-technical, causes all kinds of problems when you try to apply technical solutions to technical regimes, which is radio.

Another point that I would like to make is I would rather liken what the FCC does to spectrum -- and I wish it would -- as the FDA does to the drug industry, and that is the primary purpose is to cause no harm.

So if in fact users of the spectrum want to behave in a way that they want to behave, then the FCC should be protecting them from interference, and it requires a good deal of discipline to do that.

Certainly the drug industry when they produce a drug go through a fairly detailed, lengthy and disciplined technical regime to get that drug approved. Well, let me assure you as having done it several times to get radio spectrum, you go through a very long technical procedural basis, and you have peer reviews, and you have

competition, and there is no free lunch.

MR. ENGELMAN: Thank you. In the peach shirt there. That's the best color that I can tell. It may not be and I apologize if it is not peach.

MR. KRAVITZ: No problem. Troy Kravitz, New America Foundation. We seem to be condemning to a degree secondary markets due to defense and public safety concerns, but there is a large difference between public and private spectrum efficiency.

Fred Wentland of the NTIA recently estimated that about five -- he would guess, he would be shocked if 5 percent of the NTIA spectrum is used at any given time. Although it would be wonderful to boost utilization of this pubic spectrum, security concerns override these desires.

But regarding private spectrum, something like
-- private spectrum is an entirely different issue. Something like broadcast provides no unique contact. It is using the most outdated, inefficient technology, available.

It serves only a fraction of U.S.

households, and it is operating on a license that was issued on a non-permanent basis over a half-a-century ago. And freeing up some of that spectrum is very well possible and entirely desirable.

MR. ENGELMAN: Okay. Thank you. And then behind.

MR. WEINREICH: Thank you. I am David Weinreich from Globalstar. One question I have for Dr. Faulhaber and his colleagues is that if everything goes to a market-based property rights type of situation, how will interference be handled?

PROF. FAULHABER: Thank you. Good question. The point about property rights is that what you need to do, and this gets back to the response that I made to this young lady over here earlier. How do you like that? And that is that the devil is in the details, and the devil is in the property rights, which is to say that you end up having to establish property rights as part of the spectrum that you, quote, own.

And the property rights would be governed by the power flux density within a certain area, times, and directions of broadcast, and these would all be built into as they are now under the

FCC's rules, which are the technical specifications of the license that you get.

That would be built into the property rights. We know how to do that in the case of licensing, and we would do exactly the same thing in the case of property rights. But what we would not put in wold be the use restrictions , which also now go into many FCC licenses.

But that would be that. Now, there are some paintbrushes which we can't go into it, but which have been dealt with in a previous panel, which is to say interference is not just a transmitter issue. It is a receiver issue, and let me just note that without going into explanations as to how to handle that.

But it would haver to be built directly and explicitly into the property rights that you as a spectrum owner would have. You would have certain rights to do stuff, and you would not have rights to do other things.

Much as if you own land. There is certain things that you can do with your land, and there is certain things that you can't, and that is part of the property right that is convened when you purchase land. It would be much the same.

MR. MARSHALL: That was the most gentle way of introducing receiver standards that I have ever heard.

MR. ENGELMAN: Do we have another question from the audience? Could we have a microphone up front, please. Oh, you've got one. Okay. Thanks.

MR. STEVENSON: Carl Stevenson, and I am going to speak as an individual here, and not on behalf of IEEE 802, because I am going a little bit beyond the bounds of established policies and into personal viewpoints.

I personally have a problem with the idea of property rights and spectrum is something to be bought and sold. I view it as a public resource, and I think the commission should establish policies that maximize the use of the spectrum.

When we hear that only 15 percent of the people in the country are actually watching over-the-air broadcasts, and this signal is being spewed all over the place, to the exclusion of other uses, when we hear it -- and again with all due respect to the importance of public safety communications, but when we hear that only 15

percent of their spectrum is actually being used at any given time, I can see tremendous opportunities along the lines of the things that the President has been alluding to with cognitive radios and opportunistic use, where systems such as those that I am interested in, the wireless computer networking and broadband access, things that are growing by leaps and bounds -- you know, we need more spectrum.

We have projected shortfalls of 240 megahertz above the UNII band allocations, and WECA has a petition before the Commission asking for access to 5478 to 5725. And this is a market that -- you know, when the whole telecom industry by and large has been down the tubes, this is a market that grew 40 percent over the last year.

It is the one real success story in the telecom downturn. It is only going to grow. We are going to need more capacity, and one way to have that capacity, in addition to allocations, would be to have unencumbered access under the appropriate policies, where policy is not just a regulatory thing. It is a technical thing that describes the behavior of radio.

And where we could, for example, go in

and transmit packets of data on those unused public safety frequencies, or unused private mobile frequencies, in an opportunistic fashion.

But using protocols that are designed to listen very frequently, and if the public safety user keys up, we would defer. We can stand latency and if we have enough of this in this opportunistic fashion, the law -- you know, the fact that the public safety user comes up and we stop using one channel isn't going to make a real difference in system capacity and throughput.

On the other hand though the idea of property rights, where it would be viewed that public safety or some other group, quote, owns this spectrum, and such uses as I am talking about would be required to pay for the right to access them, seems to me to be contrary to the idea that spectrum is a public resource.

MR. ENGELMAN: Okay. I see three hands that would like to respond to that. So why don't we start with Mike on the end, and then Gerry. We will just go down the row.

MR. FITCH: I have a brief comment with respect to the property rights models and that is two points. On the property rights models, I would

just make a couple of points. I am too long out of law school to remember how many centuries into the development of property law we are, but it is many.

And that is dealing with something that the judicial system can readily understand. They can go out and look at it. If you have a road that's an easement on a piece of property, it is comprehensible.

I don't have a lot of optimism about throwing interference resolution to the judicial system. To a large extent that's why the Commission was created. Again, it may not be a perfect mechanism, but it is a working mechanism, and it is a mechanism with considerable expertise here.

To just say that we will create rights, and we will adjudicate rights, and we will do that in the normal court process and system I think has all sorts of difficult risks and costs involved in it.

MR. ENGELMAN: Okay. Gerry.

PROF. FAULHABER: I disagree with one point that you made and agree with others. The notion of saying that spectrum is a public resource. Well, I mean, everything is a public

resource, okay? If you put it in that term, it sort of turns it into a religious issue, which I just don't think is helpful.

What is more interesting I think is the notion of the opportunistic use, okay? And I gave you sort of the short-mouth version of it, but thanks for your question, because it gives me an opportunity to explain it a little bit more.

The notion that we are proposing is one where people do indeed have property rights to spectrum; what is not held by the government -- and what would be on the private side -- but would be subject to what we refer to as a non-interference easement.

Which is to say that you would have rights to the spectrum and to use it whenever you want it, and to be free of interference. But you would not have the right to exclude others when you were not broadcasting.

So this would work for cognitive radio, or agile radio, provided that if he wants to have his cops call somebody, and you are in the way, you are going to be subject to a very heavy fine if you don't get out of the way.

It also works for ultra wideband, and

of course, let me say that these are not the answers to the Maiden's Prayer. There are little problems with these things about saying can you actually get out of the way quickly enough.

There is some unsettled technical issues on that one but the notion of our proposal of putting in a non-interference easement is precisely to enable these new, very agile, software defined radios, ultra wideband, to operate within the -- in essentially a commons context within a property rights model.

So that's -- specifically, we put that in there for those particular issues so that we could get the benefit of commons. Now, let me sort of respond to this. While everything is okay, and the FCC is just cooking along, and why are we going to go to a property rights model.

I would say the Gosplan model had worked pretty well up until maybe 5 or 10 years ago, when we basically recognized that we had given away all the spectrum, and if anybody is going to get it now, it is going to be a zero sum gain.

Now we find -- well, let me just say that something which would be really simple for not a very major agency to kind of make these

decisions, now all of a sudden is occupying the minutiae of spectrum allocation; the White House -- okay, we are talking about military versus civilian; the Supreme Court, next wave decision; and the U.S. Congress, which is adjudicating the Nextel 800 megahertz public safety stuff.

All of a sudden this is way above the FCC's pay grade, okay? To me that is evidence that this Strauss plan is not working well. It is broken, or else it wouldn't be bumped up as high as it is.

MR. WILKINS: The comment that I would in fact actually make is that the gentleman who commented earlier regarding private industry spectrum. That is where our focus is, and that is where we are really applauding the FCC's efforts to look at secondary markets.

And we think that the private industry is really where the focus should be. Secondly, I think if you have a minimal set of defined rules, and that would be included in the standardized contract. That would discuss and address the co-channel spectrum and the adjacent channel spectrum for interference, and then address specifically that those issues could be addressed.

MR. MARSHALL: I think in a way perhaps the idealogy of the property rights issue overwhelms the reality. The real issue is how much is parklawn, commons, and how much of it is privately held. And what is the expense.

So you could probably find good solutions in any of the models. The gory issue is which part is point revenue producing and which point is distributed revenue unit producing.

I will put in the plug that the internet has probably produced more wealth and lost more in the last several decades than anything that we can conceive of, and yet it has very few point sources
of revenue. And the property model almost implies point source.

It works well for cell phone, and it works well for what we all use today, the Blackberry. There is no reason to believe that that is the model 30 years from now. And I think if we over-rely on it and put more -- and again it is zero sum. What we put into private property rights is gone forever into public use.

And we ought to be holding open at least the rights of the public use to expand,

unless you can take it back, which we have not grappled with, and until we get around, and I think that is a fair question.

The issue unsaid in all of this is how do you rebuild your plan, and the FCC has some questions here, and that is perhaps one I would like to get through one more time. What do you do when you are wrong, but we will go around then hit it.

MR. HARASETH: Just to respond real quickly and then I have some other things, too, the way that you were just saying it, and it is the words, "eminent domain." If there is for some reason or other the public safety for the public good needs access through spectrum somewhere, there is ways of doing that with property right now, and there come be ways of doing that there.

The other thing that I wanted to point out is that there is models right now that do exist where some of what we are talking about does work, or is, or could conventionally be working, even within the framework of the FCC's rules and regulations.

You have scenarios right now that that weren't discussed in the open two years ago. You

have a situation right now where you could have commercial radio providers that are, (a), providing the 911 wireless link to a dispatch center, that over the same exact system could be providing the dispatch service for the delivery of that 911 service.

Now, here is the conundrum in that situation. Do you put the priority on receiving a 911 call from a mother whose child just went in the pool, or do you put it on dispatching the service to that person.

So that is a difficult thing there, but that model does exist right now. It's there. The capability is there, and I don't know if it is actually being used, but it is being talked about.

DR. GOLDBURG: Two things in response to the question. The first one is that we heard some efficiency numbers being thrown around. You know, most systems today only use 15 percent of the spectrum, or 20 percent of the spectrum.

That actually may not be very bad. So no one designs or operates systems ever at a hundred percent capacity. So eithernet, which is what most of have running to our desks, that

actually is sort of a theoretical limit of about 35 percent throughput.

Wireless LANs, and I would guess 802.11 is similar, because it has a similar access scheme. If the phone company designed your phone system so that it ran at a hundred percent capacity all the time, you wouldn't like it, because most of the time you wouldn't get a connection.

So it is just important to keep in mind that 15 or 20 percent may not necessarily be a bad number depending on what the application is.

And then the second comment that I wanted to make has to do with -- and maybe this is directly related to property rights issues. What do you expect in return for the spectrum that you have bought. I mean, sort of one of the principles of licensed spectrum has been that not only are you allowed high powered operation, which means that you can cover large areas, but it means that you have a predictable interference environment.

So you paid -- one of the things that you paid for is predictable interference environments, which means that you can offer a guaranteed grade of service to customers, and that might actually be a very efficient -- you know, in

the economic sense -- use of the spectrum.

With unlicensed, which has other advantages, one of the disadvantages is that you have an unpredictable interference environment. So it is very hard to provide services with any guaranteed grade of service in that sort of spectrum at least if there is other users there.

MR. ENGELMAN: Gerry, and then there was another question in the audience.

PROF. FAULHABER: Let's go to the audience first.

MR. ENGELMAN: All right. Then I saw one off about 10 minutes ago off on the right flank here. Way over on this side if you could, please.

MR. WEISS: Merrill Weiss, Merrill Weiss Group. I actually have a comment and a question. The comment is that I keep hearing the number bandied about during the discussions about only 15 percent of the population getting their television from broadcasts.

And I think that is misinformation. If you take the number of people who get -- who take cable service and satellite service, that will add up to 85 percent. And so, yeah, you think that leaves 15.

But what that doesn't take into account is that there are an awful lot of people who have cable or satellite on one t.v., and they own five, or something along those lines.

And so there are a lot more people than 15 percent who get over-the-air broadcast service, and we learned that lesson the hard way on September 11th in New York, when all of a sudden when the broadcast towers went town, or the broadcast stations went down, and we provided service to the cable head ends, the calls that kept coming from places that were well beyond the 15 percent that were assumed to be out there in -- you know, it was always assumed that it was the poor neighborhoods that couldn't afford cable that were watching broadcasts.

And the calls started coming from the upscale neighborhoods saying, well, we can't get it in our bedroom, or we can't get it in our kitchen, or whatever. So that there were an awful lot more people who were watching broadcast.

And that's in fact what is giving the New York broadcasters the push at this point to try and get their transmitters back on the air, because they are realizing that they are missing a much

larger part of the audience, and a much different part of the audience than they thought they were. So just a comment.

The question is if you go to a property rights approach, how do you handle the kinds of changes in technology that we were talking about this morning, where you want to be able to bring in, for instance, better receiver capabilities, and you want to be able to bring in the capabilities that are allowed by some of the new technologies.

If you have locked in interference rights in an ownership provision, whatever it is -- a contract or some kind of lead to spectrum -- then how do you over time force that to adopt better technology so that it provides better protection to its neighbors.

Under the licensing provisions that we have now, where there are rules, you at least have the ability over time to tell licenses that you must at a certain time upgrade what you are doing.

We have seen that, for instance, in the use of microwave spectrum, where we all of a sudden had certain kinds of dish performance that was required. We are seeing it now in broadcast, and there is a conversion from analog to digital that

is being required, however slowly it is occurring. But it is still a requirement.

How do we manage the spectrum going forward where we want to make sure that those improvements are taken advantage of when you have a property rights environment.

MR. ENGELMAN: Let's go to Gerry, since he is

the largest proponent at the table at least.

PROF. FAULHABER: Let me handle a number of points here, starting with Preston's. Once we put it in the private domain, it is forever lost to the public? I don't think so. I think we have answered that one.

There is also another way in which you can get it back in the public domain, and that is just that the public can buy it. That is kind of how markets work.

If we want to set up a national park, we could do it by buying the land. That works perfectly well. You are not conjoined from owning land because you are the Federal government. The Federal government in fact is the largest landowner in the United States.

And we can do it, and if there is some

kind of a holdup problem, then we have eminent domain. This is all like fairly straightforward.

Okay. The 15 to 20 percent efficiency, and let me take you on on that one, Marc. In a static model, where you buy -- let's take the telephone company, where you buy the switches and the trunks, and they are yours.

And there is time bearing demand, and yeah, you are going to get an average efficiency, which is sort of 15 to 20 percent. Similarly, if you have to glome on to 24 hours, 7 days, 365 spectrum, yeah, you are going to get kind of lousy -- but I think some of the technologies that we have been talking about give rise to dynamic allocational efficiencies.

What you are talking about is that you are getting a low efficiency if you have to do static allocations. You know, this is yours, and you are going to have it forever. But if you can start to do some of this dynamic allocation -- and oh, in the static efficiency, we are really bad on that, too.

But if you have this dynamic efficiency, I think in the long run you could get much higher efficiencies. Fifteen percent of

households. I think I was fairly careful, although somewhat telegraphic to say, that 85 percent of households get their primary delivery through a paid subscription model.

There is a lot of rich guys who have, you know, that broadcast television 13 inch in the workroom. And if they were calling after 9-11, I think the right advice is go to your living room.

Now, the notion of how this property right -- you know, in the property rights model, what do we do about evolving technology. What do we do about new standards. Well, surely these have been extremely difficult to do in the Gosplan model.

And whenever we start talking about putting receiver requirements, which is kind of where you are going with this, everybody sort of gets their undies in a bunch on this, and says, oh, wow, we can't do this.

I would think -- and this is spelled out in a little more detail in the paper that we submitted to this, but basically I think in private markets that receiver standards can be on the table, and they would be on the table within private markets, because there is not that many

people that would actually make the chips that go in the receiver.

And if there is money to be made by changing the chips, then over time as we have in the computer business, you know, shifting bus architectures and so forth, that would get built into the hardware by a common agreement that, yeah, we can all make more money if we build in better filters.

Yeah, I think that will happen. No, I think it will happen in the private market. But there is more to that than I can really explain right now.

MR. WILKINS: Just one more comment. On the agreement of the trading document or master agreement that you would be using as an instrument so to speak. It is a working document, and it is a changeable document, and so its technology changes as things change, and then you can incorporate that into the document.

So over time it would not be -- you know, the document, let's say it was traded for any type of commodity maybe 10 or 15 years ago, is probably not the same document that it is today.

MR. MARSHALL: I would like to get one

more topic in.

DR. GOLDBURG: A quick response to Gerald's comment. The 35 percent number that I quoted for ethernet, for example, was for a heavily loaded ethernet, with lots of users on it. So there is no -- it is not a sense of averaging over days or weeks. It is just intrinsically that's the way that the mechanism works.

And somehow the notion that by allowing other technologies to try to -- throwing other technologies in the mix when you already have a system that is completely loaded is going to drive up -- I mean, 35 percent is completely loaded in our case, and it is going to drive up the throughput.

I think it is a seductive concept, as most sort of self-organizing technologies are, but what people find when they go out and deploy sort of self-organizing technologies is that it always reaches some equilibrium point, but it is almost always a local minimum, as opposed to -- or a local maximum, as opposed to a global one.

So I guess I am a little concerned. We are supposed to be looking at the future here, which is good, but in sort of the near term, the

next 5 to 10 years, I wonder if we are starting to write policy checks that the technology is not going to be able to cash for us.

MR. MARSHALL: It is a shame that Paul didn't invite someone to defend Gosplan. That would make it a really interesting afternoon. One final topic that I would like to hit on very quickly, and then we will go around and summarize, is are there incentives that can be utilized instead of regulations to promote spectrum efficiency. Marc.

DR. GOLDBURG: Sure. I think -- I am going to make a quick comment here, and let maybe some of the more economically-minded folks fill out some of the details.

But certainly through the auction process there is a way to promote spectral efficiency, either indirectly, just in that the people who can provide the most services over the spectrum get potentially the greatest cash return, and so they are incentivized to be spectrally efficient.

Or maybe having some way of -- I think someone mentioned pollution credits earlier this morning, and one could also have spectral

efficiency credits. So the Commission could, for example, and I guess this is a regulation, but have a series of targets. Maybe they are recommended targets.

And to the extent that people get close to them, they may get some benefit in terms of a discount at the auction, or extended lifetime for their lease; and to the extent that they are far away from them, they get penalized somehow.

MR. LYNCH: I will probably repeat myself, at least as far as commercial systems go, that I don't think that spectral efficiency is necessarily the same thing as efficient use. And you have to take into the equation what is the technology, and what is the cost basis, and the entire thing, and not just simply how much are you pushing down the pipe.

And that is for commercial systems. Now let's get into public protection systems and this kind of thing. You really have to get down to what is that system expected to do and at what time of the day, and what standards.

If these guys are using like WPS or PAS, and getting a piggyback on Cingular's network, that is one model. But if they are using a

dedicated system, just because it only answers emergencies once a day, seven days a week, I think that has to be a different model, and effective use rather than spectral efficiency.

MR. HARASETH: I will go back to the auction thing to agree with public safety, and state that as an incentive to get enhanced efficiency and public safety, you are going to have to tie some dollars to that to fund it.

And the auction is one way to do it. Whether it is auctioning spectrum X out here for some vendor to so something else, and some of it is earmarked for public safety is one thing. The other one is okay, even if it is public safety spectrum, and the excess capacity on it was auctionable directly as a secondary market for public safety.

As long as public safety can meet its needs with the returns on that auction. Maybe it wouldn't be money. Maybe it would be access on the system to certain levels that we are talking about.

I am not so sure that that isn't even a possibility right now with the 700 State spectrum that was allocated at 700. So that is not a real far-fetched thing to think about.

MR. MARSHALL: I would just comment that I think efficiency is much easier to measure in someone else's system than in your own, and it is of marginal use with engineers, and probably not a lot to policy makers.

MR. WILKINS: Of course, my comment is going to be that incentives is in the eyes of the beholder, and the value is in the eyes of the beholder of the spectrum, and I will let the market decide what the incentives are.

PROF. FAULHABER: I can't say it better myself. thank you.

MR. FITCH: I agree with Michael Lynch's comment that, first of all, you have to consider the intended use and you are measuring against an actual requirement, as opposed to a kind of theoretical calculation.

I think a lot of incentives can be created by the commission letting groups of users or licensees, licensed or unlicensed, collaborate and figure out how to optimize utilization of spectrum. There are many instances in which this is already done.

Auctions aren't a be all and end all, and as we have seen, they don't necessarily deliver

service in every case at all, let alone the most efficient service in every case.

You can also do user or regulatory fee structures that promote greater efficiency, particularly if you are trying to move from a current environment to a future environment where there is already been a fair amount of user buy-in.

They know that they are going to transition, and they know how they want to transition, and the issue is pace. That can certainly be incentivized.

MR. MARSHALL: You can't resist. Go.

PROF. FAULHABER: In 1988, I was actually visiting the Soviet Union and talking to the Gosplan guy.

MR. MARSHALL: You can represent them here then.

PROF. FAULHABER: Yeah, right. So I will be the Gosplan guy. And some factory owners and what have you. Not owners, obviously. But to a man, there was no factory manager who thought that Gosplan was a bad idea. Everybody that was in the system thought it was a grand scheme, and that we should continue, but that we should try and do Gosplan better.

And I think that we need to kind of resist that temptation, I think, and to say, well, Gosplan is really okay. We just have to be a little focused more on it, and do it a little better.

That doesn't work, okay? Those Gosplan guys were really smart. They really were, okay? Just like the guys at the FCC are really smart. It is the system, and it is not the guys. It just doesn't work.

MR. MARSHALL: Okay. I think what I would like to do is spend a little bit of time going around the panel, and then if we have some time, around the room. The objective of this whole thing was to help Paul make some recommendations, rather than divide them into divergent directions.

So I would like to go around the room and if each one of us could go up and make one recommendation -- policy, rule, whatever -- to improve spectrum efficiency, and what would that be, and what you think the argument for it is. And we will start down with Marc again.

DR. GOLDBURG: I am going to have to start reading the questions in the future before

they make it all the way around this way. I think what I would like to see in the future, and this will actually take some work, is an allocation -- the secrets of flexible allocations that group like services.

So wide area with -- blocks of allocations for wide area systems, and for local area systems, and blocks of allocation for broadcast systems, and two-way systems. Blocks of allocations for TDD systems and FDD systems.

And I think if one categorizes the technologies that way, even though we could have a religious war over the best two-way FDD cellular or interface, we would find at the end of the day that the performance and the requirements of those technologies are actually all pretty similar.

So it would be possible to set aside chunks of spectrum for certain general uses, but then still allow technical innovation and freedom of technology choice within them.

MR. LYNCH: Well, either Marc is a psychic or he has been watching Nortel for the last couple of years.

DR. GOLDBURG: I think you have been watching us.

MR. LYNCH: No, no, no, no. But the idea of blocks identified, blocks of spectrum identified for like services is something that we have been promoting on the international arena, and I am sure that Rick is probably tired of hearing us in Geneva talk about that.

But the whole concept of whether it is fixed service, mobile service, whatever, identify the spectrum, and stay the heck out of the channelization, and let the operators and the vendors figure that out, and you will find out that we have work systems that work pretty well with each other in there.

And it minimizes your pain, and if you say, okay, it is 2 times 20, fine, have a nice life. I don't care if it is 1-1/4 or 25 kilohertz channels or what. Just market it, take it, make it work.

MR. MARSHALL: Okay. Ron.

MR. HARASETH: I don't think there is any one rule or policy, and I really can't restrict myself to one that way. The FCC rules as they exist right now have promulgated over many, many years, many, many years, and it just kind of built on themselves to the point where there are so many

archaic bits and pieces that left hanging over there that really slow us down, even today as we speak.

I have got situations right now in my own environment coordinating frequencies where we are getting requests for a UHF control channel which theoretically should be used for LAN mobile radio use, and it is in an environment where there is hardly any LAN mobile radio spectrum left for mobile operation, but they want to use it to link other frequencies in LAN mobile.

And the reason that they want to do it is because they don't want to pay the premium to get a wireline service to link something together somewhere. And there is absolutely nothing in the rules and regulations that really prevent them from using that frequency in that manner.

And yet morally I am at horror about them using it that way, and it is because of the way the rules are essentially written, and it gets right into the fixed-service, mobile-service, and things like that.

But it goes way beyond just that.

It is just the way that they are, and there are things that they could change right now,

I'm sure, that would make it better, and there are some things that just can't change until we get down the road in some new technology, too.

MR. MARSHALL: Your example points one towards having an arbiter, and that is really stupid, and steps into the rights and enforces a land line solution over the --

MR. HARASETH: Yes, and that would be one possibility, which gets into that, rights and spectrum access.

MR. WILKINS: I would say that my comment would be from a standpoint of one word. I would say make the policies flexible. We are in a situation where there is a limited supply, and there is growing demand. I think a couple of people have pointed this out in the audience today.

And for the market itself, you know, the better and more flexible use of the spectrum -- you know, let the market decide. Supply and Demand. Let the market decide

MR. MARSHALL: Gerry.

PROF. FAULHABER: We have an opportunity here, and I think particularly with Paul's task force, to address some fundamental

reform and to sort of think this issue through and not simply tweak Gosplan, and the notion is that we are in something of a spectrum pickle these days. It seems to be scarce.

And many people view that as an artificial scarcity, and the recommendations of some of us I think have been aimed at decreasing that scarcity by a lot. The economists tend to look to markets to do it, and the technical people tend to look to new technologies to do it, and I am in favor of both.

Now, we know how much people pay for spectrum these days, and I will make a prediction, a personal prediction only, which is to say that if we could deploy both markets, and the new technologies jointly, the price of much spectrum, or as economists say, spectrum at the margin, will be very, very low.

And in that sense the technologist's nirvana of no scarcity may in fact be true. That is not good news to Verizon, of course.

MR. FITCH: I would echo Marc, and Mike Lynch's comments. I think that a broad framework with flexibility to the operators and users is the best way to get to greater and more efficient use

of the spectrum. I also think -- and this is something that hasn't come up, except just very briefly now in the last couple of comments.

The international harmonization issue is a critical one, and the U.S. has to get its international preparation and representation processed to be more effective. We have gone from a long tradition in history of leaving decision making in the ITU to following decision making in the ITU in some cases, and for all of the various interests that care about these issues is problematic.

So there is a kind of harmonization domestically, and also very important harmonization internationally.

MR. MARSHALL: I had thought we would -- that people would be a lot longer frankly. So we will have an opportunity to take some audience responses to that question as well.

MR. ACHTNER: Edward Achtner, from Telecom Fillings. I have heard I guess two separate views, or at least I would characterize them as two separate views, the boxing of like kind -- of spectrum in a like kind manner from a service perspective, but also just supposing that over the

ability for flexible use.

The Commission is now looking at one particular issue with regard to the flexible use of mobile satellite spectrum, and looking at terrestrial repeaters and terrestrial retransmission devices.

And I am curious as to if we look at spectrum eventually has it becomes a commodity, the commodization of everything requires that you have the standardized contracts that have been spoken of.

We know what a barrel of oil is, and we know what a bushel of grain is, but the problem is -- interference was brought up earlier, and when you are dealing with services that are not like-kind, and when you are dealing with MSS, as opposed to terrestrial retransmission, you are dealing with instances whereby I don't think personally the spectrum can be commoditized because you do have different ramifications of that use, both on a local level geographically, and internationally from a frequency allocation perspective.

So this question or statement is addressed to the panel at large. I am wondering if there is a way to reconcile this grouping of

spectrum in a like-kind manner from a service perspective, versus is commodization and truly flexible delivery if the technology, such as cognitive radio and SDR, are able to support that. Thank you.

DR. GOLDBURG: I will give you a technical response to that. There is some sorts of technology

-- I mean, I am just talking from a radio perspective, and one could do this with software defined radios, and the radios of 40 years ago, and you would get the same answer.

Some sorts of systems, for example, can't coexist in the same spectrums, and let me take the case of people actually doing spectrum sharing. If I tried to operate two high powered cellular systems in exactly the same band, I might be able to do it.

But the interference would be so high that I would only be able to dribble a little bit of data through either system. So from a technical standpoint, it is not spectrally efficient in terms of bits per hertz.

On the other hand, you can take two local area systems, or very short range systems,

and actually operate them in the same spectrum. So I could have as many people do my 802.11 access point at one side of the house, and my 2.4 gigahertz cordless phone at the other side of the house, and they work, because it is a lower power scenario, and also because I can sort of avoid precisely co-locating the system, and the whole problem is sort of scaled down to one of tens of meters instead of sort of tens of miles.

So it is those sorts of arguments that lie behind having a small number of allocations for like kinds of systems, because then it is possible to do the frequency coordination and the network planning that make them coexist with one another.

But just to have complete free range and let anyone do what they want I think would result in inefficient uses of the spectrum, both technically and probably economically.

MR. MARSHALL: Mike.

MR. FITCH: Yes, I agree. I think the starting point for grouping is the technical characteristics, and not the service as such, and that is an important part of the service obviously.

The nature of the service is another potential category by which is sort of a ubiquitous

service, a specialized service, geographic, widespread or not. But I think the starting point would be the technical characteristics -- high power, low power, spread, non-spread, et cetera.

MR. MARSHALL: Gerry.

PROF. FAULHABER: Let me address an issue that you raise and Mike raised, too, which certainly would be a problem with a major regime change if we made it here, and that is the international implications, which particularly impact satellite, I think.

We have been here before where we have made major regime changes in government regulation and business, and we have actually done it twice where it has had an implication with our overseas trading partners.

The first was deregulation of airlines, where we deregulate with airlines here, and then the IATA cartel fell apart, and the British, and all kinds of problems occurred. And there are problems when you are dealing with foreign countries in which they maintain the older --

(Brief Interruption.)

MR. MARSHALL: I think you are busy.

PROF. FAULHABER: And yet -- and it has

taken a number of years to work out. But it is not impossible. That was very tough to do that. I think it would be harder actually than spectrum, but we also have gone into deregulation of telecommunications in this country, and there was an issue of how we are handling international calls, and what about the international settlements process, and that has been a mess.

But it is a mess that can be managed, and I would view that if we did this in spectrum, we would have the same problem. And just like when we did it in telecoms, it was the international calls and the international settlements that was the main bone of contention, and I think it would be satellites.

So Mike is quite right from his perspective to be worried about this. This would be a problem. But it is not an insolvable one. It is not like, oh, we have to throw our hands up. We would have to work it.

MR. MARSHALL: I would like to comment just a little bit on the question of harmonization. I think that was a great idea 20 years ago, and I think in satellites obviously it is an inevitable requirement.

But I think we ought to be looking to that, and as one of the issues of technology sort of takes off, we can check off -- you know, the cell phones went from one mode to four modes, and I suspect that they can go to 16, 32, 64, pretty much whatever they need to do.

And if we invest a lot of money in ripping infrastructure out, and just move people to look like we are in Europe. We don't have countries that are 20 miles apart, and we don't have people driving across borders a lot.

It would be nice to think of harmonization, but I think it is something that a dollar spent would be a dollar wasted, compared to all the other somewhat more important issues that are going to get worse with technology rather than better.

MR. WILKINS: The only comment that I would make is that I think that gentleman talked about the oil as a commodity, but in oil, every barrel of oil is not the same. There are differences.

So what you do is spell that out in a standardized agreement, and then address it as such, and then having a moving, working document as

the technology changed.

MR. MARSHALL: I would like to sort of challenge the group. There has been sort of an issue, an undercurrent here, and we have really focused on the right to transmit, and a lot of the questions have kind of broached to who accounts for the right to receive.

In the property model, I can put 5,000 watts right against the edge of the van and I guess that is my right, like I could build a garbage dump in the corner of my property in suburbia. So in the different frameworks, how do you view the ones -- well, every one on this board has pretty much had advocacy for one or other frameworks, and how does it account for the coexistence with adjoining property owners with adjoining systems.

And then, Gerry, I think you have the most extreme case.

PROF. FAULHABER: I beg your pardon?

MR. MARSHALL: I think you are proud of having the most extreme case. I think in your case that is a compliment.

PROF. FAULHABER: No, no, I think I am the representative of democratic capitalism here, okay? I think I am mainstream America. Okay. The

use of the garbage dump --

MR. MARSHALL: Don't accuse the rest of us as being fellow comrades.

PROF. FAULHABER: Yes, okay. The use of the land example is a good one, because economists would refer to this -- the garbage dump, and asphalt plant next door -- as an externality, or as a spillover.

That is to say that I could do stuff with my property that interferes with my neighbor's ability to use their property, okay? And that is inherent in land use, and much of what passes when you buy land are restrictions associated with that property, designed to control those spillovers.

In spectrum, we have exactly the same problem, except that we call it interference, okay? And I responded to the gentleman before is that just as we do with land use, we would have to control those spillovers through the use of property rights.

Now, this may be a requirement about how much out-of-band power you can emit. There could be a number of ways to do that. Just like there is a lot of smart lawyers here, there is a lot of smart technologists here as well who could

help define those things carefully and cleanly.

But that would be -- you know, this is not a new issue. I mean, property rights have dealt with the issue of spill-overs and externalities, and although this is obviously a different field of application, I think the principle is fairly well understood, and there is a lot of existence of law and property law which deals with these sorts of issues. This is not a new problem, and that's how I would handle it.

MR. MARSHALL: That almost recreates the FCC again doesn't it?

PROF. FAULHABER: No, and let me make it clear that Gosplan doesn't enforce the property rights, okay? But this is a good place to put it. One of the things that they came out before as well was that if you have property rights, who enforces them. Well, it is exactly who enforces it if your neighbor builds an asphalt plant next to you, which is to say the courts.

Now, that kind of gets to the issue of -- and an important one here with both property rights and with any of the schemes that we are talking about, which are transactions costs.

How easy is it to enforce your property

rights through the courts, versus how easy is it to enforce your property rights through Gosplan, or the FCC, and that is an empirical issue.

I have a predilection to say that, well, you know, most of commercial America runs through the courts and we seem to think that is okay, although we chouse about how litigious we are.

Nevertheless, I think the Gosplan approach hasn't worked out all that well, and the notion is that these contentions work their way up to the White house, which is not a low transaction cost activity I will tell you. So, yes, but the focus ought to be on transactions costs.

MR. ENGELMAN: There is several questions in the audience, and let me start from this person back here in the back, who I am not sure has spoken before.

MR. EPSTEIN: Bart Epstein, from Latham and Watkins. I have talked, but I moved. Sorry to be tricky. At the end of the day, we have to come up with some specific recommendations, in addition to the interesting academic discussions.

As an individual, I wanted to offer three thoughts to possibly take back. The first is

that we need to redirect more efforts from fighting intersharing. Right now we spend a tremendous amount of time squabbling over who has what rights because they are vaguely worded, and in many instances two people have rights to the same piece of spectrum.

Speaking as an individual, I would suggest that the best person to decide how he can share is the person who has the primary rights, and if you want to have a certain band shared, you should allocate all of the rights to a primary user, and then let that primary user sublease the rights to a third party.

And then to the extent that you want to say that you want the government to capture some benefit, you can allow the government to share those revenues. This way, if I am the user, and I am only using 15 percent of the band, instead of spending all of my time fighting and lobbying to keep exclusive control, it might be more profitable for me to sublease to somebody else, and then share that perhaps directly with the FCC to hire more -- various more people.

The next thing which might be worth considering is telling -- I bet we wish today that

we had told all of the licensees 40 years ago that their licenses would expire in 40 years unless they either met the requirements for a safe harbor, or otherwise demonstrated their continuing need.

Then we wouldn't have a problem with UHF broadcasters, because we could say that they didn't meet the requirements of whatever the general efficiency minimums were, and if we established a system like that today, where we put all licensees on notice that 40, 50, 60 years from now, their licenses will expire unless let's say at the halfway period that they have demonstrated that their technology is starting to develop.

And that is something which would again bring the private incentives in line with the public needs, and to the extent that people needed an incentive to develop efficient technologies, they would know that if they developed them quickly, and they were doing them effectively, they would meet the safe harbor, and perhaps get an automatic extension of their license.

And then they could therefore sell their technology more efficiently, saying to their users that you can go ahead and buy our X, because you can know that it is going to be useable for a

long time.

And my third and final specific suggestion has to do in part with a tremendous number of dumb systems that we have out there. And it is very easy to encourage smart systems. If you want smart systems, to set aside some band for them, and say the only people who can come into this band are people who employ some minimum level of intelligent, cognitive, features.

And the working group, the 802 work, is a perfect example, and as we have discussed the other day, Microsoft has sent in a proposal I believe in the 5 gigahertz band that says set this aside for wireless networking that uses some kind of industry consensus, and I would like to support that. Thank you.

MR. MARSHALL: Did you want to make a comment on this?

DR. GOLDBURG: Yes. So I would rephrase your last point just slightly. Instead of setting aside bands for certain technologies, maybe set aside bands for certain spectral efficiency targets, which might be higher than what have been defined elsewhere.

I mean, if you look through the history

of the Commission's allocations where bands were set aside for specific technologies, or like the isochronous part of unlicensed PCS, where there was this listen before talk protocol, and very much like some of the cognitive radio things that we heard described earlier.

I think if you took all of the panelists hands, you could count the number of devices allocated in that -- you know, 10 megahertz nationwide band today -- you know, 10 years after it was created.

So I think that we definitely want to stay away from mandating technologies, or I believe the Commission should.

MR. ENGELMAN: Up front here. Oh, you have somebody with a mike back there. Go ahead.

MR. GILLIG: Just a comment on the property rights model. Something that we have not talked about too much. We are sort of talking about spectrum as though all spectrum is the same, and we know that land on a swamp in Florida is not the same as bedrock somewhere else.

So if we are going to go to something like that, whoever is doing the selling and the buying have to be very cautious of what they are

selling and what they are buying, because when you buy this piece of spectrum, you had better know what the interference is in there.

And if I am going to use it for public safety, I want that to be interference free essentially, and there is going to have to be a lot of rights and knowledge that goes with this.

MR. ENGELMAN: To Diane, and then to Gene, and then back over here.

MS. CORNELL: Diane Cornell with Cellular Communications and Internet Association. I have got a couple of sort of practical transition questions, and I am going to aim them at the different ends of the table. I, too, perceive sort of different models, and maybe I will put Mike over with the other -- with Mike and Marc over here a bit.

Sorry, Mike, maybe you will accept that. But for Jerry, and Brant, and those folks at that end of the table -- well, actually, this is sort of a general comment. We are dealing with a situation where all the spectrum is given out, and we are dealing with incumbents.

And that is where the sort of transition questions come in. I would ask Gerry,

in particular, I think you were commenting on this earlier, the difficulty I think is defined in terms of property like rights, and I would call them more perhaps license rights. I think it is easier as you were suggesting to define what those rights might be, in terms of output characteristics.

I think the much harder question, particularly as technology evolves, is how do you define those rights, and what interference you must accept. And Northpoint, that whole proceeding is a classic example of that.

I think that is a lot harder to do, and I would ask you to comment on that. And then for the other folks is the comment or the question of trying to group like systems, and in particular spectrum blocks, I think is something that a lot of people have emphasized and I thought would be very useful.

The question, or the very simple question is how do we get from where we are today, where that is certainly not the case, to that kind of scenario.

MR. MARSHALL: Gerry, we all have got different questions here, and so you get to do yours first.

PROF. FAULHABER: Let me answer both questions. You are absolutely right about not only saying what are your output characteristics, but what must you accept in the way of potential interference.

This is very similar to what you do now when you go into Part 15, which is to say that you are supposed to generate no interference and accept all interference.

Well, that is pretty extreme, but clearly that has to be part of the property right system. Let me briefly mention the transition issue, because so far I have been talking about property rights as an end state as it were.

This is not a transition plan of which I am the author. It is actually being authored by two fellows here in the Office of Plans and Policy, which they have somewhat salubriously called the big bang auction, okay?

And it gets to my earlier point of you are not going to take auction back from people. It just is not going to happen, and their proposal is in the more extreme form would be to take existing spectrum and the people who currently have the rights to it -- let's assume there is only one

primary, and to have a huge auction.

People can put their spectrum in the auction if they wish. I am saying there loosely. The auction is held all at once, and people can bid on spectrum. If you happen to be a public safety person -- you are a police chief, okay, or a fire department chief, and you have auction, and you have some spectrum, and you can put all or part of it at auction.

If you get bids that you like, or maybe the mayor likes, for some of it or all of it, you may take the bid. You may say, okay, we will give you half of it, and we will use a new digital technology to use the rest of it more efficiently and meet all of our needs.

So you basically can monetize it, and two things happen. Number one is that you get the money. The mayor gets the money, and the FCC and OMB don't get the money in this spectrum auction. And that may not be fair., but they have the spectrum right now, and they get to use it.

If you put the spectrum at auction, then from then on, even if you decide not to accept the bid, it then becomes yours. It is really yours. Fee simple. You know, subject to the

easement that we mentioned before.

This would be a way to get that spectrum into the market, and it would be a way to monetize it, and in essence, nobody loses. The public safety people don't lose, and in fact they get to monetize part of their asset if they want to, okay?

They also get to put conditions on it. They can say, oh, this is mine, and now I can lease it to people under certain conditions. So they get a great deal more flexibility.

And if they want in the future, they can buy more. But, in essence, in one big bang, it gets us out of the spectrum management business, and puts it into the market.

Do I think that the t.v. guys that own scads of spectrum in the digital range, or the UHF guys, deserve this? No. But it is too late and we have given it away. So the notion is let's provide incentives for people to put it in the market. So that would be my transition plan.

MR. MARSHALL: Now you had a different question down here as I understand it.

MS. CORNELL: Maybe they can comment on Gerry's comments and --

MR. MARSHALL: Well, let's comment on him first, and then we can go to the much less interesting second question.

DR. GOLDBURG: I will take a crack at the transition plan. I think it actually has to be an evolutionary process and it will occur over many years. As frequency is reformed, and now the Commissions is now starting to reform UHF, and there may be opportunities for other spectrum that just has not been commercially used the way people thought it was when it was originally allocated.

So I think over time one can slowly move towards this type of very idealized scheme that I described. I mean, I think another thing that that would help would probably be if this weren't left to the Commission on its own, in the sense that there are other government agencies involved, like NTIA, which could maybe be involved in the process, and maybe there could be a sequence of spectrum swaps that over time, rather than the sort of higgledy-pickledy arrangement of spectrum that we have today.

There would be these larger groups of spectrum organized in a way that made coexistence easier.

MR. LYNCH: And building on Marc again. As we do that transition, as a person who dearly loves being in Geneva so much of the year -- and I see Mike shaking his head, and he probably knows where I am going on this, but I am going to use the H-word that someone didn't like on the table.

But the more that we can get in line with Article V of the Radio regs, and harmonize with it, and as a manufacturer, I am going to tell you that it will be an economy of scale on there.

And like it or not, I have heard other people in government say, no, there won't be, but yes, there will be, there will be economies of scale. And I can even cite you some now, where the U.S. Government is buying European equipment because it is cheaper than what is being manufactured in this country for the same purpose.

MR. WILKINS: I would like to comment.

MR. MARSHALL: Sure.

MR. WILKINS: The only response I would say is that I have been pro-market obviously, but I am not advocating a complete -- an abolition, I think, of the rules and regulations, and oversight of the FCC, or any of its State regulatory

commissions, the issue becomes how efficiently to allocate the spectrum.

And I think from our standpoint as a market maker, although I would love to have an auction tomorrow -- and we would love to handle that auction for everyone by the way for a nominal fee.

But the issue would be that there is a way to do this, and maybe an evolutionary period. I am not saying over several years, but there is a way to maybe reach this at a much faster pace. Again, to take advantage, because again obviously from a market perspective, there are buyers and there are sellers, and there is unused product.

And there are buyers who want to obtain this product, and I think from the various standpoints there is a way to put the two together.

MR. MARSHALL: Your comment was made that there is no loser, and I think to represent the potential losers, I think what you have got is a great way to capture an efficient allocation today.

But I think one has got to also challenge any framework with 10 years from now as new technologies emerge, do they negotiate it with

a hundred-thousand fire chiefs to aggregate 24 kilohertz pieces, or can they argue in a national forum.

We went through a discussion of 3G, and it was a national discussion about a national asset, and we reached some conclusions. There seems to be no replacement for that in a process that snapshots incumbent rights, arguably more or less efficient, but if one has got to challenge that, and not today, but what is happening 10 years, or 20 years, from now.

And how do you bring out large-scale spectrum dependent systems without forcing people into dealing with something that looks like Europe after the fall of the Roman Empire, and lots and lots of little Duchies and such would be my one comment.

And so I think one cannot take the framework that, yes, I may not be a loser today. Everybody gets something for it today, and it is dividing up the empire. The question one has got to challenge is what is in it 10 or 20 years from now.

MR. FITCH: Well, I just wanted to add one thing in response to Diane's question, where I

think there is actually a pretty fair amount of FCC history along this path, and there have been long periods where they have done a lot of removing kind of sub-barriers and aggregating, and grouping in larger blocks.

On the other hand the process at the ITU is horrificly the opposite. I mean, they are really in the slice and dice mode over there, and kind of the more detailed regulation about the introduction of every new use, or service, or sub-category of anything.

And you see that just in the proliferation in the international radio regulations. So I think that would be a very hard thing to turn around, and it would take considerable effort and probably considerable time to get back to that concept internationally.

MR. ENGELMAN: Thanks. There is at least one person out here who hasn't had a chance to speak yet, and I would like him to speak. His hand has been up for about 15 minutes. Gene.

MR. RAPPOPORT: Thank you. My name is Gene Rappoport, and I am with Winstar Communications, and I would just like to support the views that have been expressed here about the

enablement of secondary markets, and widening that, and enhancing the spectrum efficiency.

And we would also deal with the issues where you think that you have bought certain property rights at an auction, and then you fight for years after just trying to protect those from interference.

As was suggested here, is that if you would have a spectrum manager for that portion that you bought, and then you could allow the amount of interference based on an economic basis, it would prevent that ongoing continuing, discussion about how much interference is acceptable, and what you need to accept, and what property rights did I actually buy when I bought that license at auction.

I would also like to support Mike Fitch's view that in the international community in recent years, the United States seems to be following more what the international community is doing, rather than trying to lead where it thinks the international community should go.

So I would like to support that view that perhaps we should look towards taking more of a leadership role again as we have in the past. Thank you.

MR. ENGELMAN: Okay. One last comment, and then we will close. Carl.

MR. STEVENSON: Thank you. I would like to address a couple of the comments that were made. First of all, the comment made by the young man in the back, talking about granting rights for 40 years. Forty years is in perpetuity, in terms of the pace of technology.

I think that is far too long of a term to grant anything resembling some sort of an exclusive property right. And the idea of that we are going to take everything and put it into an auction, where licenses that were given away decades ago to people like the broadcasters that have made billions and billions of dollars on it, I personally think -- and this is my personal view, I personally find it at least borderline obscene to contemplate the idea that they could turn around and reap billions of dollars selling that spectrum that was given to them for free in the first place.

I think a take it back approach is maybe more difficult, but I think it is more fair to the public, and I would like to echo what Mike said and what Gene said about harmonization and the U.S. following rather than leading.

We have been trying to get globally harmonized spectrum at 5 gigahertz for wireless access systems and wireless LANS. And we are having trouble in the United States with that. The Europeans have already done it. It is already a done deal over there under an NERC decision.

I have spoken with most of the delegations from the Latin American countries at the CETO meeting about a month ago, inquiring as to what their views were, and there seems to be a lot of support there.

It seems like the whole world is looking at harmonization here, and the U.S. is lagging behind. And I think U.S. industry can end up suffering from that in the long run. We need some sort of harmonization to generate economies of scale.

That will benefit the public, as well as the industry, and those were the things that I just felt like I really had to comment on, and I thank everybody for their patience with my saying so much today. Thank you.

MR. MARSHALL: I want to thank everyone for coming to this. This has really been interesting, and issues about policy and

regulations would be uninteresting and uncontentious, but I am glad that wasn't true. And thanks very much.

MR. ENGELMAN: And a thank you to all of our panelists, and also don't forget that on Friday there will be another hearing on rights and responsibilities. Thank you.

(Whereupon, the workshop was concluded at 3:05 p.m.)