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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:

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:

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

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(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