

1 adjustments in antenna patterns, implementing CTCSS  
2 and other techniques to minimize the effects of  
3 nuisance interference, those are all things that we  
4 do on an everyday basis.

5 As we start to experience interference  
6 coming from outside the public safety community, I  
7 think that's one area in which the practices become  
8 a little less precise and followed. The rules  
9 don't specifically require good coordination  
10 between the different frequency coordinators and so  
11 at times we do see some conflicts, the parties on  
12 each side of a frequency boundary or a geographic  
13 boundary doing their own thing, saying the rules  
14 allow me to do this and it's almost as if -- they  
15 think there's a Faraday shield that goes up and  
16 nothing crosses over which isn't reality. So  
17 that's when we do start to get some conflicts.

18 Certainly, as time has gone on, and  
19 starting getting into the future challenges and  
20 I'll minimize my comments here, but we're seeing  
21 the changes in technology are having an impact on  
22 the interference equation. So again, many of us

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1 realize that we're all in this together. We have  
2 to work together in order to make it work because  
3 if we don't work together, it isn't going to work.

4 So you just have to be a part of, as I made the  
5 comment, play the game, be a participant in it  
6 because that makes it better for all of us.

7 MR. DELMORE: Can you elaborate on the  
8 particular changes that you're referring to?

9 MR. NASH: The question was getting  
10 into changes in technology.

11 What we've been seeing over the last  
12 few years is a trend from single user/single  
13 frequency type systems to multiple user type  
14 systems and so you go to TDMA, you go to CDMA, you  
15 have many users using a much wider bandwidth. And  
16 from a spectral efficiency standpoint that may be  
17 very well good. From an interference standpoint  
18 what you need to really -- the underlying  
19 performance of filters is an issue of bandwidth and  
20 so as you make the bandwidth, either the  
21 transmitter or the receiver has to be wider in  
22 order to accept the desired signal. It also is

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1 wider and is open to more undesired signals. So  
2 that's just one area in which we've seen what I  
3 believe really is an increased susceptibility to  
4 interference is by going to these technologies that  
5 require and operate at wider bandwidths.

6 We're also seeing radios that have many  
7 more individual frequencies in them. When I  
8 started in this industry 30 years ago, a 4-channel  
9 radio, that was a highly capable radio. We tuned  
10 the front end of it. The maximum frequency spread  
11 was maybe a megahertz. We now routinely have  
12 radios that are operating with 200 plus frequencies  
13 in them. The front ends of those now have to be  
14 tuned so that they operate over 10 or 15 megahertz  
15 and 800 megahertz with trunking systems where  
16 you're dynamically assigning channels.

17 Again, we've had to open up the  
18 receivers in order to accept a much broader range  
19 of possible inputs. That has an impact on receiver  
20 performance, as far as its ability to reject to  
21 undesired signals. So I think as we've seen these  
22 moves towards having radios that are much, by

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1 design, are wider in bandwidth, the engineering  
2 trade off we're making is that by design, they're  
3 more susceptible to interference.

4 MR. LARSON: Anybody else have any  
5 comments or problems they want to bring to our  
6 attention here at this point before we move on?  
7 Yes, in the back?

8 MR. EPSTEIN: Good morning, Bart  
9 Epstein from Latham and Watkins. And I have a  
10 question about the expectation of users. I'm  
11 reminded of when I had my first car which I bought  
12 for \$200, prearrived with quite a number of dents  
13 and the first time I bumped into something I looked  
14 and I couldn't even tell which dent was new because  
15 it had so many already. But now with my new car,  
16 if I have a dent, my expectations have changed and  
17 that dent is not acceptable at all. And it strikes  
18 me that either there is or there should be an  
19 understanding at the Commission that certain uses  
20 of the spectrum consumers and businesses and the  
21 military have different expectations of what's  
22 acceptable.

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1           When consumers start spending several  
2 thousand dollars for a digital television or they  
3 upgrade their car stereo to receive satellite  
4 signals, they're expecting high quality,  
5 uninterrupted digital signal which they're often  
6 willing to pay a premium for as opposed to free or  
7 over-the-air signals which although greatly  
8 improved, still occasionally have interference  
9 problems.

10           Is that something which the panel  
11 thinks the Commission should or should not be  
12 doing? It seems like a lot of the disputes we have  
13 are based on expectations and once we have -- once  
14 we have set an expectation, the public is awfully  
15 unhappy being disappointed.

16           MR. LARSON: Anybody want to respond  
17 that here?

18           MR. BRISKMAN: Amen.

19           (Laughter.)

20           MR. BRISKMAN: Yes, the Commission,  
21 obviously has to address these matters. They're  
22 difficult matters. Some are, I suppose the word is

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1 subjective, which makes it very difficult again,  
2 but they have to be considered. People and  
3 hopefully, won't object, and occasionally had a  
4 dropped call, miscall, I don't think that's a  
5 problem. But as you say, a person who's paying for  
6 a service, has great expectations like digital  
7 television or satellite radio. I think that has to  
8 be a very high criteria for quality of service.  
9 And the Commission has to address these matters.

10 MR. LARSON: And as I said in my  
11 opening, the Commission plans to vigorously address  
12 interference issues like this.

13 I was looking at the clock here and we  
14 have a lot of ground to cover here. Do we have any  
15 other questions first on this, on the current  
16 problems before we move on? Yeah, in the back,  
17 Peter?

18 MR. PITSCH: Peter Pitsch with Intel  
19 Corporation. I just wanted to ask a question  
20 following up on Andrew Clegg's description of  
21 output oriented interference restrictions and how  
22 well that seemed to work.

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1           Is that an approach that would have  
2 application elsewhere, problems in extending it  
3 elsewhere?

4           DR. CLEGG: I think as long as you  
5 allocate spectrum so that the services that are in  
6 that spectrum are fundamentally compatible, I think  
7 you can follow this technique where you give the  
8 licenses out, you put as few technical restraints  
9 as possible and as long as the services are  
10 fundamentally compatible, I believe, generally,  
11 things will work out like they have for the PCS  
12 band. The problem at 800 megahertz is you've got  
13 systems that are fundamentally incompatible.  
14 You've got other examples of, for example, trying  
15 to put terrestrial repeaters for some of the  
16 satellite digital audio radio systems. Some people  
17 may argue that that use of that spectrum is  
18 incompatible with the wireless communications  
19 service spectrum. But generally, I believe that as  
20 long as the Commission is careful to allocate  
21 spectrum to compatible services and give those  
22 compatible services exclusive access to that

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1 spectrum, I think this technique of flexible  
2 allocations are putting as few technical  
3 requirements on the licensees, I think has proven  
4 to be quite effective in PCS and I think it can be  
5 effective in other bands as well, other services.

6 MR. LARSON: Okay, I'll take one more  
7 question here before we move on. Yeah, go ahead,  
8 sir.

9 MR. RAPPAPORT: My name is Gene  
10 Rappaport with Winstar Communications. I'd just  
11 like to express support from the commercial  
12 industry for the remarks Mr. Hatfield made that  
13 when you buy a spectrum license at auction, and  
14 then you expect certain interference protection  
15 goes along with that license that you've paid money  
16 for, but many cases you then have to spend years  
17 trying to protect those rights from interference  
18 both on the domestic basis and on the international  
19 basis, so there has to be some accommodation  
20 between the rates that you require and the  
21 interference protection that you then have to fight  
22 for on an

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1 on-going basis. Thank you.

2 MR. LARSON: Thank you. Let's refocus  
3 the discussion here. Let's now look toward the  
4 future here. Way down the line, you know, 5, 10,  
5 even 20 years ahead, and Dale, I'll turn it over to  
6 you.

7 MR. HATFIELD: Okay, I think the stage  
8 has already been pretty well set in terms that we  
9 know that with increased flexibility people can  
10 choose different wave forms, they can choose lots  
11 of different modulation techniques and so forth and  
12 we're seeing also because of flexibility they can  
13 do that and we're also, of course, seeing this  
14 proliferation of devices and so forth. So when you  
15 look, because of these changes, when you look  
16 towards the future, what sort of challenges do you  
17 see and why don't we start down -- I'll start down  
18 here on the right, Lynn, and ask you looking  
19 forward what do you see the major challenges that  
20 will face the Commission, things that are maybe  
21 just beginning to emerge?

22 MR. CLAUDY: Well, I'd go back to your

1 remarks earlier that that maybe it's time for the  
2 Commission to look closer at receiver standards. I  
3 think that is an area where there hasn't been a lot  
4 of Commission involvement and it's been marketplace  
5 only, at least in the broadcast case and the market  
6 place may not work some of those issues out  
7 ultimately. So if you really desire interference  
8 free service in the areas where you think you have  
9 that, and that's an important public interest goal,  
10 there has to be some involvement to make sure that  
11 that indeed happens and not just happens by  
12 happenstance.

13 So I think receivers standards is a new  
14 area for the Commission to really look at. I agree  
15 with the comments of taking like services and  
16 putting them in the same bands and that the  
17 interference management problem becomes more  
18 tractable by doing that. There will be increased  
19 pressure on services like broadcasting to be  
20 extremely spectrum efficient. The reclamation of  
21 the spectrum in the VHF/UHF bands, the reclamation  
22 of spectrum for the mobile satellite service and

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1 the two gigahertz band. There will be a lot of  
2 continued quests toward doing more with less and I  
3 think that again goes back to receivers being  
4 smarter, adaptable and having more tools available  
5 to operate either in a smaller bandwidth or with a  
6 more rich interference environment. So that's  
7 again a driver for the Commission to look at both  
8 the transmit and the receiver side.

9 MR. HATFIELD: One of the things that  
10 might be useful to explore later on is the  
11 difference between the broadcast service where you  
12 buy the television set in a single transaction and  
13 don't have any further relationship with the  
14 service provider compared with the cellular example  
15 where there's a continuing relationship and a  
16 financial relationship between the customer and the  
17 provider. I think that distinction is an important  
18 one and a lot of the things I saw here when I was  
19 at the Commission related to where the person made  
20 the single transaction. You've got a million TV  
21 sets, hundreds of millions of -- you know, and it  
22 gets very difficult politically to change things.

1 Larry, can we go on down? Moving right  
2 down the line.

3 MR. MILLER: Okay, thank you. I'd like  
4 to second those comments regarding receiver  
5 standards and I guess from the land mobile  
6 perspective, I think the Commission has tried some  
7 things. Obviously, everyone always wants more  
8 spectrum. I think the Commission tried with re-  
9 farming to generate more voice paths in the  
10 existing spectrum. But I don't think they did it  
11 aggressively enough. They depended on the market  
12 place to encourage and essentially manage the  
13 transition to new technologies. It hasn't  
14 happened.

15 In a lot of cases the users and I know  
16 from my personal perspective, I used to work for  
17 state government and if I went in to the budget  
18 director and says I need a certain amount of money  
19 to upgrade my system because I want to improve  
20 performance, etcetera, no matter how much  
21 documentation I had, it was kind of a hard sell,  
22 but if I said the FCC just issued a rule and by

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1 this date I have to do this, somehow the money was  
2 found. So I think with respect to the efforts of  
3 the Commission on re-farming, additions of date  
4 certain that all systems have to operate within  
5 certain bandwidths, that would be a good step  
6 forward. You need receiver standards because my  
7 experience as a frequency coordinator is that when  
8 you try to intermix new narrow band digital  
9 modulation schemes with the older wide band analog,  
10 you can run a path profile in a computer model and  
11 it looks like it will work, but when they plug the  
12 equipment and turn it on, you don't get the same  
13 results. So I think again, receiver standards  
14 would help them in that area.

15 With respect to the 700 megahertz  
16 spectrum, the way the rules are written, it's  
17 fairly ambiguous as to whether the broadcasters,  
18 the incumbent broadcasters really ever have to  
19 vacate and I think in order to get the kind of  
20 commitment from governmental entities and perhaps  
21 even the band manager users, the Commission needs  
22 to be a little more aggressive to make sure that

1 when land mobile systems are constructed in those  
2 bands, that the television broadcasters have, in  
3 fact, vacated, so that the new MOUs can use that  
4 spectrum.

5 And that's as much as I think I need to  
6 say, but I'm sure you have a lot of other  
7 commenters here.

8 MR. HATFIELD: Yes, the thing that  
9 jumps in my mind too is the difference between  
10 where you have exclusive use like in the cellular  
11 case where efficiency gains accrue to you in terms  
12 of more revenue where you're in a public safety,  
13 nonprofit sort of organization where it doesn't  
14 necessarily accrue to you.

15 Paul?

16 DR. STEFFES: Well, the first thing I  
17 wanted to restate was how happy the passive  
18 community has been with the support we've received  
19 from the Commission. I think when I was quoting  
20 problems I wanted to state that over the years that  
21 I've been involved with this the Commission has  
22 been extremely sensitive to the highly sensitive

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1 nature of passive science, use of the radio  
2 spectrum.

3           However, the problem, of course, for  
4 the future is complexity. Obviously, the number of  
5 users and the management of the problem becomes  
6 dramatically enhanced. I was talking with Paul  
7 Kolodzy before and we were saying that it's at  
8 least a six dimensional problem meaning spatial, x-  
9 y-z, frequency, time and wave form and of course  
10 since the wave form can be infinitely complicated,  
11 you can make it an n-fold problem which it  
12 basically has more variables than you have numbers.

13           So as a result, the complexity issue, I  
14 think, presents the Commission with an especial  
15 challenge and I think that a lot of the solutions  
16 will be technological and those technological  
17 solutions for compatibility of services can, in  
18 fact, be found in many cases. However, in a lot of  
19 ways, the holistic problem needs to be looked at a  
20 top level. In other words, not just solving one  
21 service's compatibility problem with an adjacent  
22 one, but giving the Commission the technical

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1 resources it needs to look at the higher level  
2 problem. What is the current level of spectrum  
3 usage nationwide? You know, the NTIA, thankfully,  
4 back in the 1990s made a few studies of certain  
5 urban environments and suburban environments, but  
6 those were just first steps. We really don't have  
7 good metrics on what's going on technologically and  
8 I think that that might be one of the biggest  
9 contributions the Commission could gain or one of  
10 the biggest assets the Commission could gain in the  
11 next decade.

12 MR. HATFIELD: Thank you. Bob?

13 MR. BRISKMAN: I have to support  
14 grouping of like usages, but just to be honest  
15 about it, I hope I'll live that long to see it. So  
16 going to more practical ways to address the long  
17 term problem, one thing I have not heard and which  
18 I think would help everybody is more severe  
19 requirements on filtering and one thing nobody has  
20 talked about yet is severe requirements on how much  
21 filtering there is at the transmitter because that  
22 is what is generating the interference to begin

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1 with. And therefore, if you have requirements  
2 there, this is the so-called  
3 out-of-band interference, you're helping everybody  
4 on both sides of you throughout the spectrum. This  
5 is sort of polluting the commons, I suppose, is the  
6 acute way of saying that.

7 And secondly, of course, let us talk  
8 and this is my last point on the receiver, there  
9 are modulation techniques that are more resistant  
10 to interference than others. Unfortunately, these  
11 almost always require for the same through put more  
12 bandwidth and obviously bandwidth and spectrum have  
13 become very difficult to get and very expensive.  
14 So people are because of that design systems to get  
15 the maximum capacity out of the spectrum and to do  
16 otherwise would probably be uneconomic.

17 On the other hand, certainly they could  
18 filter the receiver so that it would receive little  
19 to no out-of-band interference. So I would  
20 recommend that.

21 The last point I would like to make is  
22 again a new point. I would think that most of the

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1 new services, not all of them are digital. And  
2 another criteria of control or specification is bit  
3 error rate and the nice thing about bit error rate,  
4 it's not subjective, it's measurable. One should  
5 look at that as another tool that the Commission  
6 could use in the allocation of frequencies and the  
7 result of interference to a digital signal. And  
8 hopefully, there could be some reward for those  
9 that design their system to be more resistant to  
10 interference. Thank you.

11 MR. HATFIELD: Yes, thank you. Glen?

12 MR. NASH: As I've already indicated, I  
13 think the trend is towards technologies that in  
14 many ways are working against us on this  
15 interference issue. And the public wants those  
16 technologies, industry wants those technologies.  
17 They're new, they're better and yet, we're not  
18 recognizing the fact that they carry with them a  
19 certain cost and one of those costs is in the  
20 interference area.

21 One of the things I would really like  
22 to see the Commission look at for the future is we

1 develop a vision about what it is we're trying to  
2 accomplish and having a vision recognize that it's  
3 going to take time, it's going to take effort to  
4 attain that vision and the fact that it's going to  
5 take time and effort is not a reason to not make  
6 the effort. And I think I've seen that a little  
7 bit. We tend to say that well, television  
8 broadcasting could be a lot better, but we have 200  
9 million legacy television sets out there, so we  
10 really can't do anything because we have all these  
11 legacies out there. Well, yes, we can do  
12 something. We can have a vision, work toward  
13 something better, recognize that the legacies out  
14 there are going to make the conversion take longer,  
15 but if we don't have the vision, if we don't start  
16 down a path toward something better, we will never  
17 get to something better. And so we really have to  
18 start the process.

19 The other thing is that I think many  
20 cases, all of us in our individual industries are  
21 making choices about what we do, how we design  
22 things and we're doing that, if you will, in a

1 vacuum. We look at our own little community and we  
2 say this is best for us, this is what we're going  
3 to do and often times, we don't look outside to see  
4 what is the impact on others.

5 PCS, one of the advantages they've had  
6 is that often times those decisions were made  
7 within a company. They were given a block of  
8 spectrum and something to do and so decisions they  
9 made were within the company. What we find in  
10 other industries and public safety, I think, is a  
11 real good example. There are thousands of  
12 individual public safety entities out there.  
13 Today, I'm here and Larry, you're here. We  
14 represent associations that represent those  
15 industries, but the associations do not own and  
16 operate radio systems. We can make recommendations  
17 and suggestions that we say are good for the  
18 industry, but when it comes down to actually  
19 implementing it, we have no authority to implement  
20 anything.

21 So we do need to be aware that  
22 decisions have to be driven from a higher level.

1 They have to, as Larry indicated, it's much easier  
2 when the FCC says this is the way you're going to  
3 do it because it is in the best good of everybody  
4 that it be done this way. We really need that  
5 because when you get down to those individual  
6 people, making decisions on themselves, they tend  
7 to look at only their own best interests and often  
8 time they don't make the best decisions in that  
9 case

10 MS. COWEN-HIRSCH: Well, in terms of  
11 challenges for the future there are so many. It  
12 was identified, Paul identified that there were at  
13 least six dimensions. I think there are at least  
14 two more. One is the economic benefit and since  
15 I'm from the public sector, I will not comment on  
16 that, but also there is the priority issue and  
17 that's something that we know a great deal about.

18 But looking towards what the challenges  
19 facing the FCC and certainly the NTIA and the  
20 public sector are how do we respond to this new  
21 advent of technology? How do we address what is  
22 going to be required in terms of a new sharing

1 etiquette, the bill of rights?

2 We haven't talked a lot about this in  
3 this panel and I'm certainly going to tease  
4 something up for the next panel that will address  
5 the technologies and that's the issues associated  
6 with opportunistic use and dynamic reallocation,  
7 software defined radios. How do you begin to  
8 address what those systems bring into the mix in  
9 terms of exploitation of this finite resource?

10 The current service rules simply do not  
11 allow for that flexibility. I'll toss a bone over  
12 here. Flexibility certainly allows for greater  
13 opportunity to explore the use of this finite  
14 resource. But you need to look at the quality of  
15 service trades and the opportunities for secondary  
16 benefits to be able to do that.

17 Receiver standards certainly worked for  
18 the Department of Defense in the past and once  
19 standards became not the mandate, we certainly took  
20 into place those considerations in our design and  
21 our material solutions. So standards are one way  
22 to do it if you want to levy a requirement against

1 somebody, but quality of service begins to say what  
2 can you tolerate, what is your probability of  
3 interference and what's the impact of that, what  
4 wave forms do for you, what they do not? So  
5 there's some areas that we'll definitely look at,  
6 that will challenge you.

7 One thing, when you get into the advent  
8 of software defined radios and they are here, when  
9 you look at opportunistic sharing and reallocating  
10 systems, you need to look at having behavior  
11 confidence. That's something that we simply  
12 haven't addressed to date. In the federal sector  
13 we look more at a hardware certification than a  
14 behavior confidence that the software and the  
15 technology presents for us. So that ought to give  
16 us something to wrestle with for the next several  
17 years.

18 MR. HATFIELD: Yes, indeed, thank you.

19 DR. CLEGG: I think I can predict the  
20 future fairly confidently that we're going to see  
21 as far as interference, we're going to see the same  
22 that we see today, but we're just going to see a

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1 lot more of it. I mean that's basically what we're  
2 going to see. And it's going to be a gradual  
3 thing. It may not be so obvious on a day to day  
4 basis, but the interference will increase.

5 I'm a little more optimistic in that I  
6 think that the same technological advances that are  
7 allowing us to do all sorts of new things that we  
8 could do before and perhaps creating more  
9 interference than we had before, along the same  
10 lines, the same technological advances are allowing  
11 us to do things to mitigate interference that we  
12 could do before and I think that's more the topic  
13 of the next panel, but I think in the long term, I  
14 just am thinking about what we as a cellular and  
15 PCS operator are doing as far as interference, both  
16 infra-system interference and interference from  
17 others. We're working on or have already deployed  
18 power control as tightly as we can, dynamic  
19 frequency allocation. We're using MIMO, multi-  
20 in/multi-out which is a space and modulation  
21 diversity scheme for improving performance and  
22 facing environments. We're working on single

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1 antenna interference cancellation algorithms.  
2 We're working on adaptive antennas. And we're  
3 certainly always working on or at least the handset  
4 and bay station manufacturers are always working on  
5 various DSP implementations that address and can  
6 mitigate some of the interference.

7 So I'm hoping that in the long term, at  
8 least a partial solution is the same technology  
9 that's creating more interference will also help us  
10 try to adapt to it.

11 MR. LARSON: We'd like to now welcome  
12 Martin Rofheart, did I get that right? Martin's  
13 the co-found and CEO of Xtreme Spectrum, an ultra  
14 wideband service provider.

15 Martin, we had a lively discussion  
16 yesterday on the unlicensed bands and things like  
17 that, people trying to underlay services under  
18 other services. What do you see the challenges for  
19 the Commission down the road, 5, 10, 20 years from  
20 now from your point of view?

21 DR. ROFHEART: Well, that's a huge  
22 problem and it's hard to envy the Commission having

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