to manage it. So you'll get companies like you've just heard which resonate very strongly with organizations like mine where our companies will turn over technology on 6, 12, 18-month windows and at the same time we live in an environment and certainly the Commission more than we even live in an environment where systems are fielded for 10, 20, 30 years. Literally, that's 20 dB of dynamic range in technology turnover. And that's sort of at the crux of why it is so complex for the Commission to manage.

Exactly in line with the set of comments we've heard here, ultra-wide band is sort of the ultimate from an unlicensed technology perspective in using signal processing and error-correcting codes and modulation methodologies in order to recycle and clean up a spectrum and use those very advances in the ultimate and wide-end front ends that receive all interference from all users to use signal processing and advances in semiconductor processes to clean that up and build a very robust system. And ultimately, the best

metric and the most satisfying one is end user market acceptance. The customers, the marketplace, all of us when we go out and shop, are the folks that make the decision about what quality of service really means and have embedded in that buy decision the economics as well as the six dimensions and more of the problem.

MR. LARSON: Should we go to the audience?

MR. HATFIELD: Yes, why don't we turn to the audience unless there's some panelist that has a burning sort of comment.

MR. LARSON: The panelists can question each other too, if you like.

MR. HATFIELD: Exactly. If not, why don't we go to the audience?

If not, I've got a question or two. Yes, please, over here?

MR. EMERSON: I'm Daniel Emerson, I'm representing the National Radioastronomy Observatory.

I'm a radioastronomer. Some of the trainings that

we see in the future are very worrying indeed to a radioastronomer.

In designing a communication system to be interference immune and everybody seems to accept that the interference environment is going to get worse, with a communications system you can design at both ends. You can choose the appropriate modulation wave form that can then be demodulated in a way that makes it immune to interference.

The passive services don't' have that choice. Nature has decreed what sort of wave forms are there for us to detect. We just don't have that freedom of choice to play around with the modulation techniques.

Now some of the advanced technology coming along, the more efficient use of the spectrum, unfortunately, it's a law of nature, I guess, that the more efficient you make a wave form, the more it looks like a natural signal. The more complex wave forms we're hearing about look like Gaussian noise, if you don't have the key to

demodulate them. Gaussian noise is exactly what the passive services detect.

So whereas in the good old days when the spectrum was used very inefficiently, if you had an interference in your radioastronomy band, had a huge strong carrier, you could excise that, you could recognize it. With the new technologies it's much more difficult to use these excision techniques that we could have applied. We did apply in the good old days. So I'm worried that not only is the level of interference, the number of interfering sources are going up, it's getting harder and harder for the passive services to apply technology techniques to get rid of this interference. So it's a double whammy for the passive services. And I'm worried about that.

One thing that can certainly help is, as has already been mentioned on the panel, filter technology, the reduction of out-of-band emissions at the transmitter with better filter technology. That has to help us all. Thank you.

MR. HATFIELD: Other questions,

comments? I'm sorry, come close to the mike, please?

MR. SHEPARD: Hi, I'm Tim Shepard. I'm an engineer and I've been thinking about how to engineer systems perhaps in a context where there was no regulation of emissions and this is a very fascinating area.

I'd first like to -- one thing I'd like to point out about the previous comments about radioastronomy is there are actually freedoms in radioastronomy to place your receivers wherever in the world you'd like or perhaps even off of this world and perhaps you could use some of the flexibility you have in some of these six dimensions to mitigate the interference. And there also seems to be no limit on the amount of directional gain you could use to increase your signal-to-noise ratio. Of course, there are costs with that and then we have to discuss -- and that gets into -- it's impossible to figure out the question of the benefit of radioastronomy versus the economic benefits of what other -- what the

technologies can do for our society.

Now, if that wasn't provocative enough, I would like to hear especially from the panelists, because I think in some sense we've got on this panel a very good representation of all of the legacy systems and in some sense have a lot of receivers out there and it does take 30 years perhaps to change, if we came up with something, if we came up with a way of not requiring receivers to bear more of the responsibility or perhaps even all of the responsibility of mitigating interference, perhaps every system in the world should be an anti-jam system and then what do you need an FCC for?

You needed an FCC, 70 years ago when frequency-selective filters were the only technology you could use to separate radio signals.

Is there any hope of perhaps moving all of the burden to the receiver and perhaps at that point we can eliminate the problem of regulatory interference as getting in the way of what somebody

would like to do.

MR. HATFIELD: Hear, hear.

MR. SHEPHERD: I filed comments, I filed a comment in the proceeding, pointing out that if you think about 100,000 people going to a football stadium and you think about the narrow acoustic spectrum, and start thinking like a traditional radio system engineer or perhaps a regulator, you might think that you'd have to regulate who is allowed to speak at the football stadium because, of course, if everybody spoke at once then it would totally destroy the spectrum and it wouldn't be a communication anymore, but we all know that we can still have a conversation with our neighbor. And even if everybody talks at once, the public address system can still be engineered so that it's effective despite the fact that everybody is cheering the team on the field. Etcetera.

I'd actually like to hear from the panelists. Is there any hope of getting there in 20 years? I sometimes like to think about what spectrum regulation is going to look like in a 100

or a 1,000 years, but can we get there in my lifetime where we can basically do what we want in this spectrum?

MR. HATFIELD: I think some of this will be for our next panel as well, but I'd sure be anxious to get any reactions. Yes, please?

DR. ROFHEART: So Tim, there's a de facto regulation in the fact that the broadcaster, the one in the public address system is the only one that's allowed as a sole use at high power and it's only the individual speakers in the stadium that are the unlicensed speakers that are very low power, that amazingly reflects exactly what the Commission has wound up with.

(Laughter.)

DR. STEFFES: Another comment, since the question was made about remoting radio telescopes to the far side of the moon, I think the point is that the spectrum, like land, is not uniform. You have to manage it because certain aspects of the spectrum are different than others, any more than we'd say that a highly polluting

chemical plant can be located in any arbitrary land position. There are just parts of the spectrum and times in the spectrum that are more important than others and so uniform management is not an efficient use of the resource.

MR. HATFIELD: Other comments? Okay, a question back here then? Or a comment?

MR. WARNER: I'm David Warner from the Commonwealth of Virginia, Department of Information Technology and I'm coming from the public safety kind of perspective and I've heard terms like managing interference, this is going to be the wave of the future. I've heard comments that expect more interference.

From the public safety side, I guess what my concerns are and what I've heard echoed by our public safety and Department of Defense panelists is the rights, a bill of rights for different systems. I can understand what the cellular industry -- and that they have customers, they have to make a profit. They're in an environment that they're trying to serve, but they

don't always cooperate and the interference is the backlash of that in the sense that they've put up a system that they know may cause interference with the public safety which is a different type of architecture.

I think we do need to have a bill of rights that the rights of the individual whoever that individual might be, whether it be cellular or public safety, has to take into account the rights of the rest of the people that they're going to impact. So that's our perspective.

MR. HATFIELD: I think just to comment myself here, there -- as I tried to say, I think it's probably rights and obligations, both, because I don't think you -- I would doubt if you would advocate if the public safety entity put it in a totally wide open receiver that would just be susceptible to almost any interference anywhere, you wouldn't suggest that that's a good idea, so it seems to -- I don't believe you would, I would guess you would, so it seems to me there would have to be some -- I think what we're talking about here

is balancing the obligations of the people who are transmitting with some obligations on the part of the receiver, not to be susceptible, so susceptible to interference that you can't allow other people to do things that are economically beneficial as well. It's a balance. It's a trade off, it seems to me.

MR. WARNER: Can I follow up? Perhaps when they design a system, let's say in the Washington, D.C. area, a perfect area to pick, is they need to notify before they put the system up, and before they give expectation to their corporate managers, they need to say well, we need to work with public safety because our systems are not compatible. We have the same spectrum, but we have dissimilar architectures. So they go in there. They set it up and they do some field tests and it's -- it can save a lot of headaches and it can brief the people who are in the corporate structure and say look, we want to have the build out here, but it is going to have some adverse effects. Perhaps we need to add a few transmitters in other

areas, so as not to cause interference to public safety which is dealing with life and property.

DR. CLEGG: If I could respond. First of all, unfortunately, Nextel isn't here to address some of these questions --

(Laughter.)

But I'll try to help them out a little bit, the best I can. Honestly, the vast majority in your example of the interference is not caused by the cellular industry. It's caused by the SMR industry, specifically, Nextel. That's widely recognized in the entire proceeding.

We as a cellular company actually do now take into account, at least in areas where we've had problems, the potential impact of public safety. I was reviewing last night some cell site plants in Maryland where they specifically indicate on here that this particular site may cause some problems, especially if Nextel is co-located there and that we need to follow up on that with public safety as that site is deployed.

So we actually are -- we really are

becoming a lot more sensitive to that, but I also have to echo Dale's comment that the problem is at least half do to the design of the public safety radio receivers. And in fact, it's the combination of the spectrum allocation with the interspersed Nextel and public safety channels with the design of the public safety radios. Those two components right there basically explain 99 percent of the problem. But we are, of course, willing to work with public safety to mitigate interference on a case by case basis, the best we possibly can.

MR. WARNER: By your very statement, you know that that's the problem, but yet systems are implemented with the foreknowledge that interference is going to be a result. I'm getting back to the "bill of rights" that was introduced by our Department of Defense panelists. I think there needs to be some up front cooperation and this can be transparent to other industries as well.

As Mr. Nash stated, you know, we're all in our little world, but there are other people out there who are impacted by the decisions and by the

things that we do and that's -- and yes, there are cellular, I have seen and maybe Mr. Nash can affirm or otherwise dispute, but I have seen from interference reports that there are more cellular companies that are starting to interfere as well, and yes, you are correct that Nextel is the main one, but there are cellular providers who are causing problems and I have to deal with that from the state perspective.

Thank you.

MR. LARSON: Thank you for your comments. We're starting to run a little bit short on time on this panel. Time always seems to move too quickly. I had another area that I wanted to tee up and I'm probably going to have to buck the larger part of the discussion to our third panel this afternoon.

Could I get my next slide put up, please?

(Pause.)

Where I was hoping to go here, there is it, the definition of interference itself. This is

one of the questions that we raised in the June 6 public notice. And we got a lot of comments on it. Should the Commission change its decades old definition? Will this help us deal with our spectrum allocation decisions that we have to make with our licensing processes? Will it provide a more clearly defined interference rights to users and service providers?

The current definition is subjective. It does not reflect modern technology per se. And so we asked whether or not it should be changed. Commenters were kind of divided on this. There were folks that said look, this is an ITU definition that's used around the world and for the purposes that it serves, it's a good definition, don't tamper with it. Perhaps what's needed here is to interpret the definition of interference and the definition of harmful interference in the light of particular services.

There are other folks that said you need a new definition. You need a new definition that reflects modern technology. Other people said

you don't need one definition, you need many definitions that are tailored toward particular classes of spectrum users. But the current definition handicaps us a little bit because harmful interference is defined in terms such as "serious degradation" which begs a definition of its own in communications services. "Repeated interruptions", what does that mean? That's probably different for different services.

And I think in the afternoon panel, I think one of the issues I'm hoping that you guys can explore will be the definition of interference, how should that be changed, if at all, perhaps. We've heard some discussion today of metrics. Maybe the definition could include a metric, desired, undesired signal ratio, bit error ratio, raising the noise floor, that kind of thing.

And so that's an issue that I hope will be discussed this afternoon. We've also heard about some discussion of the importance of receiver standards. And receivers will be discussed in the next panel and perhaps even in the afternoon panel

to some extent. There have been discussions of the benefits of grouping like users. You could construct a tree, I suspect. It would be a hard thing to do where you would branch out the users, for example. You might have those users who transmit point-to-point services versus those that transmit point to multipoint. There's a whole bunch of ways to do it. Those that require the use of a propagation model and those that don't. That's something else that perhaps can be taken up in one of the subsequent panels today as a possible way of meeting the Commission's challenges.

And then there was something else that was discussed yesterday which might be interesting as a way of doing it. How about the idea of just characterizing an environment and saying these are the signal levels that you can expect in this environment, design the equipment accordingly.

And so with that, I leave you with those thoughts.

Dale, did you have any concluding thoughts here?

MR. HATFIELD: No, I thought your last point was an excellent one, I think, regarding characterizing the environment.

MR. LARSON: Any closing thoughts from any of the panelists here? We have time. We have a couple of minutes.

Glen?

MR. NASH: I'd like to add to your consideration of interference. Is part of the equation needs to be the consequences that result from interference? On one end of the scale and some of the things that we've had in discussions with the different land mobile user groups is that there's a recognition that some user groups, interference is an inconvenience. You have to delay your conversation, you have to move to another location. It has an impact, but at the other end of the scale, we like to think public safety is there, is that interference can result in the loss or damage to life or property. And so the consequence of having interference, I think has to be part of the equation because some user groups

can accept interference more than other user groups can. And then certainly Larry brought up earlier the issue of the difference between what we in the public safety market refer to as the difference between nuisance interference and destructive interference which again comes in a little bit of your definition of harmful.

There's a certain amount of interference you can live with, but you hit a threshold where again it becomes destructive to what you're trying to do, to what the mission is.

MR. BRISKMAN: I have one last comment, it might be helpful. We all have said that we expect to see more interference. Right now, I suppose our only avenue of recourse at the Commission I suppose is the Enforcement Bureau which also, by the way, I compliment and does a good job. But I suppose my thought is and I've heard this before, the possibility of having active spectrum manager that tries to actively work these interference problems and get them resolved rather than just the question of enforcement which is

right now, if it interferes, you shut them down.

Anyhow, that's a thought I'd like to inject. Thank you.

MR. LARSON: Thank you, Rob. Any other panelists have any concluding statements here?

Okay, if not, we thank you, panelists for being here today and sharing with us, taking out of your valuable time and we're going to take now a 15 minute break until 11:15 and then we'll pick it up again with the advanced technologies panel. Thank you very much, ladies and gentlemen.

(Applause.)

(Off the record.)

MR. REPASI: Well, good morning, everybody. I see that everybody has pretty much made their way back in from the break and I thank you for being timely. I want to open up Panel II. This is the Advanced Technologies Panel in the Interference Workshop. This panel will -- this segment of the workshop will go on until 12:30. And at 12:30, we'll take a lunch break. So I'd like to accomplish a lot in the next hour and 10

minutes or so.

Before I do, I would like to introduce the panelists. I want to thank the panelists, one, for being here. I understand that some of them had to cut vacations short and it's a pleasure to have them on the panel and I really truly appreciate the participants that we have here.

To my left is co-moderator. Maybe I should introduce myself first. I'm Ronald Repasi. I'm with the Federal Communications Commission, International Bureau. I'm the Assistant Chief Engineer for the Policy Division in the International Bureau.

To my left I have Brian Woerner from Virginia Tech. He's a Professor at the Bradley Department of Electrical Engineering.

Further down the line here, we have Jack Rosa, who is president and CEO, Vice Chairman of the Board for Hypres, Incorporated.

To Jack's -- this could be confusing -- to Jack's left is another Jack, Jack Wengryniuk from Hughes Network Systems. He's the senior

director of regulatory affairs for Hughes Network Systems.

To my right, you remember Dale Hatfield from the previous panel. Thank you, Dale, for participating as well on Panel II. Of course, you know he's the independent -- an independent consultant and adjunct professor for the University of Colorado at Boulder.

To Dale's right we have Doug Lockie. Thank you, Doug for being here. Doug is founder and Executive Vice President for Endwave Corporation.

And to Doug's right, we have Ray Pickholtz from -- he's a professor at George Washington University School of Engineering and Applied Science.

Thank you all, again, for being available today.

I'll just a little bit of an opening remark, what we're trying to accomplish here, how we've set up the segments and the panel. We're going to have three segments that we'd like to go

through in Panel II. One segment is what are the driving forces for the advances in technology that we've seen to date and what do we see as the driving forces in years to come, and even 20 years out.

What are the capabilities of the systems that are designed out there today and what do we expect the capabilities of those systems to be in the future?

The third segment, I'd like to address, how the Commission's rules have affected the advances in technology that we've seen today which I think would be a good lead in to Panel III which is going to be looking at a better process in dealing with the interference environment and so forth. So I'd like to understand from the panelists and from the audience what in the Commission's rules to date has driven or given them flexibility that individuals have needed to make the advances that we've seen to date.

I think the way we'll break this down is Brian is going to co-moderate the first segment

on the driving forces for the equipment, for the advances and technology, but I wanted to point out that this panel is a little bit smaller than the other two panels, so what I'd like to do is if there's an opportunity for Brian to comment as a non co-moderator, I'd like to give him the opportunity to participate in the panel from that perspective as well.

So Brian, if you'd like to take on the first segment?

MR. WOERNER: Thank you, Ron. I guess our first segment, as Ron indicated, will be in the area of driving forces. How we have gotten to the current technology situation within the communications area and certainly over the last few years we've seen a lot of things change. We've seen the way that we look at interference change as was indicated in the first panel session.

We've also have seen the role that the regulatory process takes in looking at that interference change. I think first of all, we'd like to ask our panel members to make a few remarks

about what they see the current driving forces are which have helped radio technology to the point where it is right now. And maybe we'll start at the far end with Jack Wengryniuk.

MR. WENGRYNIUK: Good pronunciation there. Well, I currently work for Hughes Network Systems and I guess like the previous panel list, Ron Briskman, I'm representing the satellite community here today.

Let's see, the satellite industry, as was pointed out by Rob in the last panel, started some 35 years ago with fairly simple satellites. You had what we had bent-pipe satellites. The signal came up, was frequency translated, came down on a different frequency. Fairly large beam coverage, either global beams that covered the entire field of view or hemispherical beams that covered very large land masses.

What you see today are something that's considerably more sophisticated, particularly in higher frequency bands you see extensive use of spot beam technology. You see the use of what's