1 problems, and two real problems. One is that the
2 technology got so complex that most of the radio
3 amateurs who are now appliance operators, and that
4 is kind of a buzz word I guess which is used, are
5 not capable in buying the computers, the
6 microprocessors, and actually doing something with
7 it.
8 And, second, the FCC is in the way,
9 because by definition you need a license to operate
10 a ham radio station. And, number two, you cannot
11 transmit something which the FCC can't listen to.
12 So this collides with the fact that you
13 are supposed to be experimental, and some of the
14 questions of efficiency and coverage, and other
15 things which are going to be today's topic here,
16 cannot be experimentally validated by people who
17 have -- this is a hopping on charge weight, they
18 are actually forbidden for doing this.
19 And I would recommend that the FCC
20 really looks at this whole issue of restrictions,
21 because the cell phone certainly could have been
22 invented by ham radio, and you could have gone to
23 jail, with a kind of frequency hopping, time
24 domain, code division, multiplex, all the things
25 which are involved here, totally violate the laws.

1 And so this is an issue I think which
2 there may be a side question here, but you have a
3 large resource of people who could do something
4 useful if they get permission to do it.
5 And I would like to add one more thing
6 which happened to me about 20 years ago. I bought
7 a car, and forgot to add cruise control. So I went
8 to Sears Roebuck and bought a cruise control.
9 And then I went on one of the national
10 highways and there was a police car next to me.
11 And I set my car at 55 miles an hour and didn't
12 think anything evil. And then the police guy
13 talked into the microphone, at which time my car
14 went faster.
15 And then he stopped talking and I
16 slowed down. So we did this two or three times,
17 and the police stopped me then and said what are
18 you doing here, playing with my radio; and I said
19 just the opposite, that you are playing with my
20 speed control here.
21 And this is some kind of interference
22 in noise which was pointed out. You have
23 legitimate operators here, like the police and
24 others which transmit on frequencies, and then you
25 have a poor system which is susceptible to

1 radiation, and you measure distance, two cars side
2 by side.
3 And so these are all issues which are
4 kind of buried in my opinion in this question of
5 efficiency, because you are transmitting into my
6 car, and not to the police headquarters. You are
7 transmitting into my car and being a nuisance.
8 And the two things -- and I have not
9 seen these other panel activities, but when they
10 are conducted and radiated into fields goes both
11 ways. Whether or not you have a cell phone, which
12 you then conveniently place in front of your
13 television set, or in front of your computer
14 screen, at which time the computer goes bananas.
15 Or likewise you are expecting to get a
16 call here, and then the computer talks into your
17 cell phone, which at that time the cell phone goes
18 bananas.
19 These are all issues which have to do unfortunately
20 with the wave forms, and the type of transmissions
21 you have.
22 And that's why there is a subconscious
23 message
24 that I am going to send out to everybody is not
25 only look at definitions of what efficiency is, but

1 look at the type of modulations, and type of
2 methods in which you are transmitting in, because
3 some are more noise friendly than others.
4 And some of them are more advanced than
5 others, and the FCC has a great deal to do and to
6 say about what modulation you do and how you do it.
7 Thank you.
8 MR. WEINREICH: Thank you, Dr. Rohde.
9 Yes, that certainly is a consideration, a very big
10 consideration as to how we develop future systems,
11 and one of the important things that I think that
12 is going to be an aspect of future systems is how
13 immune to interference they are.
14 And it is not going to be just one type
15 of interference, but it is going to be a lot of
16 types of interference. So that is one thing that
17 we have to as developers of systems have to keep in
18 mind for the future. Are there any questions that
19 the audience would like to ask?
20 Okay. Carl, first. If you will please
21 state your name, and some kind of affiliation, and
22 go ahead with your question.
23 MR. STEVENSON: Thank you. If you will
24 forgive me, I am going to refer to something in my
25 notebook, and so I am not going to stand up. My

1 name is Carl Stevenson, and I am with Gear Systems,
2 and I also represent IEEE Project 802.
3 I was very interested with Mr. Weiss'
4 observation, and also I believe Paul's observation
5 that frequency reuse is becoming a more important
6 factor. In fact, in the comments that IEEE 802
7 filed with the task force, we proposed a wireless
8 efficiency metric which takes into account the
9 capacity of the system in delivering information
10 bits per second after decoding, demodulation, and
11 including the vagaries of the network protocol and
12 duty cycle.
13 And the number of logical connections
14 or users in the network within the coverage area
15 utilizing the allocated bandwidth B, and where that
16 is of course in hertz; and the area covered in
17 units of square meters. So you come up with
18 something that is sort of bit users per meter
19 squared, per unit bandwidth.
20 The old measures of modulation
21 efficiency, simply looking at bits per second per
22 hertz just tells you how efficient a particular
23 modulation scheme is in terms of utilizing
24 bandwidth, but it doesn't tell you the whole
25 picture about spectral efficiency.

1 This sort of plays into the other
2 comments that were made about to the effect that
3 due to incidental radiators and other factors,
4 noise floors tend to be rising.
5 And at least within the wireless
6 network standards that IEEE 802 produces, we look
7 at our environment as being interference limited
8 rather than at Gaussian white noise-limited, and
9 frequency reuse is a very important part of our
10 approach to how to get increased spectral
11 efficiency and capacity.
12 We have over the years gone from one
13 megabyte to 11 megabytes, to 54 megabytes. We are
14 looking at 200 megabytes and beyond in essentially
15 the same bandwidth. So we are looking at more
16 efficient modulation and coding techniques.
17 But we are also pushing the envelope
18 more on frequency reuse, and I think this is a
19 principle in this metric that we have proposed is
20 something that scales very well to all sorts of
21 systems. And I would encourage the commission to
22 think in terms of promoting frequency reuse.
23 And in cases where it is practical,
24 encouraging people to design systems that are
25 capable of operating in an interference limited

1 environment, rather than a noise floor limited
2 environment, because the noise floor is only going
3 to continue to rise as we use more and more
4 electronic gizmos of all kinds. Thank you.
5 MR. WEINREICH: Thank you, Carl. There
6 was another hand over here. Please raise your
7 hand. Okay. There we go.
8 DR. HARASETH: Thank you. Ron Haraseth
9 with APCO International Public Safety, and I am
10 interested in your comments from Mr. Weiss and Mr.
11 Rinaldo about the frequency reuse, and the
12 interference models that we are looking at.
13 But that is a model that you are
14 capsulizing, and that is exactly why we have the
15 problem right now in public safety with the
16 interference from that very model. So we have to
17 be very careful that that model isn't incapsulized
18 to the point where it doesn't look at its effect
19 upon other services that are not interference
20 limited on the noise limited systems like public
21 safety has.
22 If we were all using the same
23 technology and the same given bandwidth, then that
24 one model would probably be correct. But if we are
25 all using -- if we are using any other models at

1 all that are counter-indicated you might say in
2 this case, then that model can be a problem.
3 MR. WEINREICH: Okay. Thank you. I
4 can't remember your name.
5 DR. GOLDBURG: Marc.
6 MR. WEINREICH: Marc from ArrayComm.
7 DR. GOLDBURG: Yes. Marc Goldburg from
8 ArrayComm. I have a question for the panelists.
9 We heard some discussion and some comments from the
10 other audience members that it might be possible to
11 develop some sort of spectral efficiency measure
12 that takes into account through put per unit hertz,
13 and takes into account interference.
14 Maybe it is bits per second, per hertz,
15 per square kilometer. Some value. And then we
16 also hear people mentioning that whatever this
17 quantitative metric is, it would have to be adapted
18 to the particular service.
19 So one would have different targets
20 potentially for cellular ribose, versus broadband
21 data, versus public safety, because there is other
22 externalities there that have to be considered.
23 Would the panelists feel that it is
24 possible to develop such a scheme, and develop some
25 performance targets, and possibly expect those

1 performance targets to improve over time as
2 technology improves?
3 MR. WEINREICH: Thank you, Marc. Who
4 is going to raise their hand? Mr. Blust again,
5 please.
6 MR. BLUST: I think it is quite
7 possible within a technology or a service to look
8 at developing a model that describes that service.
9 We have done that, for example, in commercial
10 wireless in the past for WRC and other
11 preparations, where we developed a model that
12 looked at spectrally efficiency or effectiveness on
13 a technical basis.
14 And a deployed basis in order to be
15 able to predict future spectrum, and certainly that
16 model, and the data that went into that model, for
17 example, looked at a mix of current systems and
18 future system capabilities.
19 You never change your generations of
20 technology overnight, and so one also has to look
21 at a critical mass in a mixed environmental issue
22 of old, new, and newer technologies.
23 So I think you can develop models that
24 apply perhaps narrowly for specific purposes. It
25 is much more difficult to take that model and

1 generalize it beyond its intended bounds and its
2 intended applications.
3 I think also most services today, at
4 least those driven by the business economics, are
5 always continuing to look at how they use their
6 systems, their resources, their engineering
7 criteria, more and more effectively to get more out
8 of the same infrastructure and devices that are
9 already deployed.
10 It is just a business principle that
11 drives us more and more into the -- especially in a
12 consumer-oriented realm. Thank you.
13 MR. WEINREICH: Anybody else? Charlie.
14
15 MR. TRIMBLE: I think the issue
16 principally comes when you have overlapping
17 services that frankly don't work together. Clearly
18 the cellular is an example of improving the
19 throughput and handling the issue of capacity
20 problems by adding to the infrastructure, and
21 basically worrying about interchannel interference,
22 and driving specifications internally that frankly
23 are tougher than the ones that the Commission put
24 on the system.
25 And there inside of an economic

1 service, you are going to see a migration and an
2 improvement. On the other hand, you look at
3 license-free bands like the 2.4 gigahertz band, and
4 basically it is who is the last man standing as the
5 overlapping services start interfering with each
6 other.
7 MR. WEINREICH: Thanks, Charlie.
8 Anybody else on the panel want to give us --
9 MR. ENGELMAN: If I --
10 MR. WEINREICH: Go ahead, Rick.
11 MR. ENGELMAN: If I could just ask the
12 question again a little bit. I think what I would
13 be interested in hearing is in answer to the
14 question is if we could develop models within
15 services, which is what I think the question was
16 asked, would people feel that you could also then
17 set goals and targets for people to shoot at over
18 time.
19 And I would like to hear some more
20 focus on is that practical to do.
21 MR. WEINREICH: Who wants to -- the
22 first responder here, Steve. What can I say?
23 MR. BLUST: I think you can develop a
24 model, and you can perhaps apply it over time. You
25 can set those goals and objectives. The question

1 then becomes what is the goal, and objective, and
2 the metric that you set, and how good is the model
3 as you project it forward in time.
4 I think that in any industry or service
5 segment that you will probably find great debate
6 over what you should set for an executive. I
7 think, however, as we have seen in the past, if you
8 make the time horizon far enough out where you
9 consider that you are in the next generation of
10 technology to be deployed or to be in place in the
11 systems, as opposed to displacing so to speak, then
12 I think it is possible and practical, and perhaps
13 appropriate, to set some sort of baseline criteria.
14 I think what goes with that perhaps is
15 a recognition that when you exceed that baseline
16 criteria are much better than that. There perhaps
17 needs to be some credence, or credit, or
18 appropriate weight given to doing that, or else you
19 will always have systems which are just defined for
20 that particular minimum, which is maybe not the
21 desired objective.
22 MR. WEINREICH: Thanks. That is an
23 interesting thought. We should ask people to meet
24 a certain level or give back their license, or
25 something like that. I know that you didn't say

1 that, but you could go in that direction. Anybody
2 else? Merrill, please.
3 MR. WEISS: In listening to the
4 discussion, one thing that came to mind thinking
5 back at the original introductory words that we had
6 about being future oriented, and not being locked
7 to what we have had in the past, suggests to me
8 that as we think about models, we should also be
9 thinking about how those models themselves will
10 improve over time, and must e maintained over time.
11 We can't just move from one fixed model
12 to another fixed model and say we are done, and
13 that is going to be the measure that we are going
14 to use going forward.
15 If you look, for instance, at
16 propagation models, something that is going to
17 underlie a lot of what we do, you can take your
18 choice of Longley Rice, or Tirem, or you name your
19 model, and you will get different results.
20 And different people have spent lots of
21 time going out and developing those models. They
22 have tried to measure what goes on in the
23 environment, and from that derive some kind of
24 numerical analysis process that lets them predict
25 what will happen over a particular path under

1 certain environmental circumstances.

2 Yet none of those models is universally

3 applicable. None of those models, depending on the

4 application that you put it to, necessarily does a

5 good job.

6 Yet, we have had to administratively

7 select models and say that is what we are going to

8 use to predict what we expect to happen between

9 radiators and receivers in a given service and

10 under certain circumstances.

11 We will probably have to continue doing

12 that, because there is no way to prove that you

13 have got the perfect model. But decisions will

14 have to be made going forward to say, all right, we

15 are going to move from the model that we have now

16 to some new model, and we need to make sure that

17 the process then allows that new model itself to be

18 improved so that we over time arrive at perhaps a

19 better way of evaluating what systems can do, and

20 what the real efficiency is.

21 DR. ROHDE: Can I add something?

22 MR. WEINREICH: Certainly, Dr. Rohde.

23 DR. ROHDE: If I look at the current

24 situation and look forward as Paul Kolodzy has

25 recommended we should do, the systems at the moment

1 have an analog system, and most of the police still
2 in this country uses analog radios, with all their
3 deficiencies and advantages, whatever you think
4 they are.
5 And likewise you have a digital system,
6 and I think as was rightly pointed out, the
7 cellular telephone, in spite of all the
8 competition, and all the price wars you car hear,
9 have found a common efficient battleground with
10 minimum interference.
11 So you have two systems in place at the
12 moment. One is this analog system, and then there
13 is the digital, and if I look at the question of
14 efficient handling, I think one of the issues that
15 has to be really addressed is similar to cars with
16 emission standards.
17 You have leftover cars which still
18 don't meet the emission standards, and then you
19 have the modern cars. The system is the same, and
20 you have to make the transition from the current
21 analog 25 kilohertz or whatever channel, which have
22 lousy capabilities, which have a lot of
23 interference, to a trunking or digital system which
24 is more efficient, and more reliable, and just
25 better.

1 Then you have these overlap things
2 here, and even if it doesn't show up on this agenda
3 here, I think it is an important issue to look at
4 how we migrate from A to B, because the sooner that
5 we do this, the better coverage we get, and because
6 of the particular wave forms that I have tried to
7 point out before, you get different emissions.
8 And I really am not totally convinced
9 that it is really true that we have to accept these
10 increasing noises. I mean, it sounded to me for a
11 moment like that it is god-given that there is a
12 function of time, and the electric emissions
13 overall go up, and we have more noise, and the old
14 noise models are incorrect.
15 They may have been correct, but I don't
16 understand totally why we just go out and allow
17 everybody to transmit garbage, and then have a
18 higher level of garbage out there.
19 It doesn't appeal to me, nor does it
20 make sense to me. But maybe somebody else from the
21 panel can educate me on this.
22 MR. WEINREICH: Thank you, Ulrich.
23 Steve.
24 MR. GILLIG: Yes. I wanted to make a
25 comment about the upgrading of the models with

1 time. First off, I agree that that has to be done,
2 and one example of why that might have to be done
3 is if you look at some of the more futuristic
4 things, like ad hoc networks, if you talk about
5 just a transmit and a receive, and you look at the
6 efficiency of that single transmit and receive, you
7 get one number.
8 On the other hand, if you look at an ad
9 hoc network where you have possibly a hundred
10 different ad hoc units that might be required to
11 send a message from point A to B, you are going to
12 get quite a different number.
13 So I think the one thing that we can
14 say about the models is that if we are going to
15 look at efficiency, we need to look at an end to
16 end efficiency and delivery of the information,
17 rather than just a unit to unit modulation type of
18 approach.
19 MR. WEINREICH: Thank you. Well, we
20 are getting on towards I think the second group of
21 questions that we wanted to address. We have
22 pretty much looked at spectrum efficiency, and how
23 it is going to be measured, and how it can be
24 defined, and the effect it has on different types
25 of services.

1 And one question that was put forward
2 or developed during the preparatory work for this
3 session was should efficient use of the spectrum be
4 a policy goal, and I think that goes without
5 saying.
6 If we go back to Steve Blust's comments
7 about systems that are going to be designed --
8 future systems that are going to be designed to
9 meet a certain spectrum of efficiency, and then if
10 possible exceed that, then what do you do with the
11 older systems.
12 Dr. Rohde has also talked about that,
13 and is there some -- there seems to be a need for
14 some kind of -- I hate to use the word regulated,
15 but some kind of goal for spectrum efficiency that
16 various users would have to reach in a certain
17 amount of time.
18 Of course, the question becomes how
19 long is that amount of time, and what is the --
20 where are you going to set the bar for the level of
21 spectrum efficiency. That, of course, assumes that
22 you already know how to measure it.
23 But I think one question that goes
24 beyond that is how -- what are the policy goals and
25 subjective considerations that affect the analysis

1 of spectrum efficiency.

2 Do we have any -- have we already

3 covered that or are there more specific comments

4 about that one? What subjective considerations

5 need to be taken into account to analyze spectrum

6 efficiency? Charlie.

7 MR. TRIMBLE: Clearly, you have got the

8 problem of grandfathering, and changes with things

9 that belong in the grandfather category have to be

10 measured. You have got a couple of different

11 choices, and you clearly can set goals in the

12 future that demand the movement.

13 You can go back to the pollution

14 environment, and start trading in pollution

15 credits. So, you can provide an economic

16 incentive, because in those services where there is

17 a monetary toll gate to the transference of

18 information, the companies that have ownership of

19 that portion of the spectrum are highly motivated

20 to increase its efficiency.

21 So the place that you do not get

22 increases in efficiency from the natural economic

23 environment is where things are given for free, or

24 things are given for public safety reasons, and in

25 those cases you are going to have to mandate

1 improvements.

2 MR. WEINREICH: Thanks, Charlie. Well,

3 I guess that begs the question as to how would we

4 mandate them.

5 MR. TRIMBLE: Well, you have already

6 discussed the modeling of improved goals that over

7 time -- for example, the analog radios are going to

8 have to go to narrower bandwidths or digital

9 technologies. I mean, that would be a set of

10 mandating.

11 MR. WEINREICH: Thanks. Steve.

12 MR. BLUST: I wasn't going to answer

13 your second question. I was going to more address

14 your primary question. I think there is three

15 points with regard to this question. The question

16 was where it should affect. I think it is not a

17 should affect. I think it will affect.

18 I really believe that when you look at

19 it in terms of underlying policy and the subjective

20 aspects that they will determine to some extent the

21 definition and the application of that definition

22 to spectrum with regard to trying to understand

23 efficiency.

24 It is sort of the other way of looking

25 at it. It goes hand-in-hand, I believe, with the

1 fact that I think that the desired answer may
2 indeed influence the definition you put in place.
3 And I think furthermore as we have seen
4 from the discussions that in any of this discussion
5 of efficiency analysis, deployed or technical
6 measures of systems or whatever, that you don't get
7 answers that are what I will call undeniable
8 foundations of truth.
9 You tend to get answer that you might
10 be seeking, and so I think we need to be cautious
11 about doing that. I think it is a complex task
12 that we are discussing here today by any means.
13 MR. WEINREICH: Thank you, Steve. Yes,
14 that goes with definitely, almost without saying,
15 that it is a complex task. So, go ahead,
16 MR. ENGELMAN: Can I ask -- I think
17 what I heard from Mr. Trimble was a thought that in
18 services, and in systems where there are economic
19 incentives to be efficient, that maybe there is
20 less of a need or no need for having these goals
21 defined.
22 But in the other services where there
23 isn't such an economic incentive, there might be.
24 And I guess I would like to pursue that a little
25 bit further in that regard. And maybe pick on some

1 of the panelists that are involved in certain
2 services. I will start on my left.
3 Merrill, what do you think about the
4 broadcasting services? Is there adequate incentive
5 there to be efficient? I will just pick on
6 somebody.
7 Is AM really ancient modulation?
8 MR. WEISS: Well, I tend to think in
9 terms of the television side of the world. It has
10 been a long time since I did radio. And you have
11 in some ways a disincentive to efficiency after a
12 certain point, because you have a huge number of
13 consumers spending large amounts of money to buy
14 equipment that they expect to be able to use for 20
15 years, and to be able to take from market to market
16 and know that it is going to work.
17 I mean, think about how many television
18 sets you have in your house, and think about how
19 old some of them may be, and you tend to pass them
20 down from your living room, to your family room, to
21 your kitchen, to your bedroom, whatever.
22 And many people have -- well, I'm in
23 the process actually of measuring some now where I
24 find 7, 8, and 10 sets in a home. So people don't
25 want to have to throw out that assortment of

1 equipment and start over very often.

2 Now, we are going through that process

3 right now in the move to digital television.

4 Granted, it has had some fits and starts in getting

5 going. The extent to which it will be success

6 certainly depends a lot on what the Commission does

7 and what the various industry segments do.

8 I think when you are in an environment

9 like that, you have to have an organized approach

10 for how you are going to make the change, and you

11 have to have some centralized authority driving it.

12

13 Now, whether that is the Commission, or

14 whether there is some other -- you know, I am using

15 the term centralized authority in a broad sense,

16 there has to be something that drives it, because

17 you need to get coordination between industry

18 segments.

19 And when you look, for instance, at the

20 cellular telephone industry, basically they are the

21 masters of their own fates. An operator can decide

22 that I am going to switch from TDMA to CDMA, and I

23 am going to set up a system where I have certain

24 channels that will allocate, and I will gradually

25 switch my customers over to that.

1 But when you talk about a broadcast
2 kind of environment, where you have consumers
3 spending a lot of money, and -- at least they
4 perceive it as a lot of money, and you have to get
5 perhaps the entertainment industry, as well as the
6 broadcast industry, as well as the consumer
7 electronics, as well as the cable industry, and the
8 satellite television industry, all to agree on what
9 the interface standards are going to be, for
10 instance.
11 That takes -- and especially when those
12 industry segments have diverging interests. I
13 mean, just look at the must carry issue between
14 broadcasters and cable, and you will see what I
15 mean about diverging interests.
16 To get all of that coordinated takes a
17 substantial amount of effort and planning, which
18 one might argue hasn't been sufficiently done for
19 the digital television conversion that we are in
20 the process of going through now, and that that may
21 be part of the issue.
22 So those are the kinds of things that
23 need to be looked at, I believe, in dealing with a
24 transition of that sort. And it is a much more
25 extensive kind of change than you might have. And

1 under the control of a lot of disparate interests
2 that you may not have in some of the other
3 services.
4 MR. WEINREICH: What kind of -- in your
5 opinion, what kind of incentives could be offered
6 to, say, the various broadcasters, or even the
7 cable providers, to encourage them to go to more
8 efficient means of utilizing the spectrum?
9 Is it a carrot or is it a stick? I
10 mean, do you need to beat them over the head and
11 say you have to do this in five years, or is there
12 a way to --
13 MR. WEISS: Well, we are trying that
14 right now, and it is not exactly working. At least
15 it is not exactly working as planned. You know,
16 there were targets set, and there were goals set,
17 and some might argue that the goals that were set
18 were not achievable in the first place.
19 And I could make some pretty strong
20 arguments about that, and yet at the time -- well,
21 just for background. I did a lot of the work for
22 the advisory committee on implementation issues,
23 and we pointed out where the delays were going to
24 come from.
25 And it turned out that we are about 98