Testimony of R. Preston McAfee

in

FTC v. Rambus

June 25-7, 2003
Aug 1, 2003

Excludes in-camera portions

UNITED STATES OF AMERICA
FEDERAL TRADE COMMISSION

In the Matter of:)
Rambus, Inc.) Docket No. 9302
----------)

Wednesday, June 25, 2003
9:33 a.m.

TRIAL VOLUME 35
PART 1
PUBLIC RECORD

BEFORE THE HONORABLE STEPHEN J. McGUIRE
Chief Administrative Law Judge
Federal Trade Commission
600 Pennsylvania Avenue, N.W.
Washington, D.C.

Reported by: Josett F. Hall, RMR-CRR

APPEARANCES:

ON BEHALF OF THE FEDERAL TRADE COMMISSION:
M. SEAN ROYALL, Attorney
GEOFFREY OLIVER, Attorney
JOHN C. WEBER, Attorney
MICHAEL FRANCHAK, Attorney
Federal Trade Commission
601 New Jersey Avenue, N.W.
Washington, D.C. 20580-0000
(202) 326-3663

ON BEHALF OF THE RESPONDENT:
GREGORY P. STONE, Attorney
STEVEN M. PERRY, Attorney
PETER A. DETRE, Attorney
SEAN GATES, Attorney
Munger, Tolles & Olson LLP
355 South Grand Avenue, 35th Floor
Los Angeles, California 90071-1560
(213) 683-9255

APPEARANCES:

ON BEHALF OF THE RESPONDENT:
A. DOUGLAS MELAMED, Attorney
Wilmer, Cutler & Pickering
2445 M Street, N.W.
Washington, D.C. 20037-1420
(202) 663-6090

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

JUDGE McGUIRE: This hearing is now in order. Before we start this morning, any housekeeping tasks we need to take up?

MR. PERRY: Yes, Your Honor. We have a few exhibits to move in, if we could, from yesterday's examination of Mr. Lee.

JUDGE McGUIRE: All right.

MR. PERRY: There are ten exhibits. I shared the list with Mr. Oliver, and he has informed me that complaint counsel have no objections, so if I could just read the numbers?

JUDGE McGUIRE: Go ahead.

MR. PERRY: RX-1527, JX-40, CX-1314, RX-757, RX-763, RX-765, RX-2061, RX-2062, RX-2064 and RX-2070.

We would move in those exhibits at this time.

MR. OLIVER: We have no objection, Your Honor.

JUDGE McGUIRE: All right. All those at this time are entered to the record.

MR. PERRY: Thank you, Your Honor.

(RX Exhibit Numbers 757, 763, 765, 1527, 2061, 2062, 2064 and 2070 were admitted into evidence.)

(JX Exhibit Number 40 was admitted into evidence.)

(CX Exhibit Number 1314 was admitted into evidence.)

JUDGE McGUIRE: Anything else?

Mr. Stone.

MR. STONE: Yes, Your Honor. Two other housekeeping matters.

The first is, as you know, we discussed with you the date on which respondent's case would start.

JUDGE McGUIRE: Yes.

MR. STONE: Because the case has gone a bit longer than any of us have anticipated, we have been trying to juggle vacations, sabbaticals and a honeymoon of some of --

JUDGE McGUIRE: You know, I need all three of those things right now.

MR. STONE: Well, I don't think you're alone in that, Your Honor.

We had talked with complaint counsel. Because of some travel problems, if we could delay the start by one day to July 9 of our case --

JUDGE McGUIRE: That's fine with the court.

Is it the expectation that -- and I asked you this I think on Tuesday, Mr. Oliver, and you said that or you indicated the other day that you anticipated the completion of the complaint counsel's case in chief by

7099

the end of June, which would be next Monday.

Do you anticipate you're going to go beyond that date at all, like up to the 2nd or the 3rd perhaps?

MR. OLIVER: Your Honor, if I could explain in a little more detail where we stand. This may actually raise a second issue that Mr. Stone -- at this point we expect that Professor McAfee will be our second to last witness. He was originally of course scheduled to be our last witness, but we of course had to take Mr. Vincent out of order.

In addition to that, we still have remaining reading from the deposition testimony of Mr. Joel Karp. If time permits on Friday, we hope to finish with the deposition testimony of Mr. Karp on Friday.

We expect to take Mr. Vincent next Monday. If we don't finish Mr. Karp's deposition Friday, we expect to finish it Monday. That would complete the live witnesses for us.

In addition, we still have a number of other depositions that we and respondent have agreed can be submitted in paper.

JUDGE McGUIRE: Okay.

MR. OLIVER: But we are -- after consultation, what we would propose to do is during the break,

7100

perhaps up to about July 9, 10 or 11, whatever it takes to accommodate their break as well, we would focus on consolidating the designated portions of the depositions, including those portions without objections and those portions with objections. We'd then offer those to you sometime on July 10 or 11.

JUDGE McGUIRE: That's fine.

MR. OLIVER: That would then be the completion of our case.

JUDGE McGUIRE: So again, you anticipate being done with your case by next Tuesday perhaps?

MR. OLIVER: I believe that, again, assuming that there's time on either Friday or Monday to complete the reading of Mr. Karp's deposition, I think we can finish by the end of the day Monday.

JUDGE McGUIRE: Great. Okay. Anything else?

MR. STONE: Just one other item, Your Honor.

And we have talked with complaint counsel about the depositions and I think we will give you probably a joint brief that sets out what deposition testimony will come in, what objections you would need to rule on as you read it, and I think it's possible that there will be a few objections people might want to argue orally and we'll propose -- we'll tell you which those are and propose a time that might work for that, if we

7101

could.

JUDGE McGUIRE: All right. Very good.

MR. STONE: My one other point, in preparing for Mr. McAfee's examination, we realized that two of the exhibits on complaint counsel's exhibit list, of which they gave us notice, CX-1680 and 1681, which are license agreements entered into by Rambus with third parties and which set out royalty rates for DDR and SDRAM devices, were not by us included in our motion for in camera treatment as the other license agreements were.

We would ask that the court afford those two exhibits provisional in camera treatment today. We'll file a motion before the end of the week seeking formal --

JUDGE McGUIRE: That's fine.

Any opposition?

MR. ROYALL: Your Honor, I don't think we have any opposition to that. Mr. Stone says they're going to file a motion. We'll look at that and see if we have any response.

JUDGE McGUIRE: That's fine. At the time it comes up, then I will grant it provisional in camera treatment.

MR. STONE: And we have talked with complaint

7102

counsel. They have some royalty rates in Professor McAfee's demonstratives, but I understand they're going to treat those as in camera for the purposes of his testimony, and that will deal with that issue.

And I think complaint counsel and Your Honor both got a copy of the brief. I hope. If not, I have hard copies.

JUDGE McGUIRE: Are you talking about the brief for the proposed slides that they're going to show?

MR. STONE: Yes. That at some point will come up today. I'm not sure when.

JUDGE McGUIRE: I'd just gotten that brief about fifteen minutes a ago. I have just had a couple of moments to go through it.

Do you have any comments you want to make to any of this, Mr. Royall?

MR. ROYALL: Well, Your Honor, like you, I'm not even sure if I saw it fifteen minutes ago, but I have quickly looked at it and I do think that there is a response that I think should resolve the issue and create -- make it a nonissue.

The motion, as I understand it, is predicated upon Your Honor's motion in limine ruling.

7103

JUDGE McGUIRE: On April 21, right.

MR. ROYALL: This was a ruling relating to Professor McAfee's testimony.

JUDGE McGUIRE: Right.

MR. ROYALL: And as you may recall, in that ruling, you granted, in part, Rambus' motion, finding that the issues were moot because we had explained in our opposition that we had no intention of Professor McAfee -- he made clear --

JUDGE McGUIRE: It was complaint counsel who had advised the court that those issues were I think moot.

MR. ROYALL: Yes.

JUDGE McGUIRE: Because you had no intention to inquire regarding state of mind, the patent disclosure policy of JEDEC, and some of the other

issues involved, so that's where the court came up with that language.

MR. ROYALL: Exactly. That's exactly correct.

And in explaining why we believed it was moot, which then you reflected in your order, we explained that citing to Professor McAfee's own deposition testimony that he doesn't intend to -- he's not a patent expert. He's not a legal expert. He's not an expert on JEDEC's rules.

7104

On the other hand, we explained very clearly that he has made assumptions about facts and he has understandings about facts that supply a predicate for his economic analysis. And we cited quite a bit of case law that says that where an expert testifies, his assumptions not only are appropriate to be explained, but it's really quite necessary because the strength

of the testimony can stand or fall on the nature of the assumptions that are made and whether those assumptions prove to be true in terms of the facts that are proved.

And so that was the point that we were making. And I recall after your motion in limine ruling -- I forget exactly the context, but you had asked if we had any comments, and I recall that was the one point I had commented on, is that I just wanted to make clear that -- I do now recall exactly the context. It was a question I had raised -- and this may help you to recall -- of whether we needed to redact anything from Professor McAfee's reports.

JUDGE McGUIRE: Of course I also said at the time that was in case his expert report would be offered and come into evidence, but I've since issued an order that there would be no expert reports into evidence.

7105

MR. ROYALL: Yes, Your Honor. But I'm just recalling now that it was in that context that I made the point that we understood your order not to limit us in terms of bringing out the nature of the assumptions as long as they're so stated and as long as it's very clear that he's not testifying about what JEDEC's rules or what patents cover, et cetera, et cetera.

And I think that really resolves this whole issue.

Obviously Rambus is responding to slides that may give very cryptic explanations, and I understand that they have some concern, but I can tell you that we do not intend for Professor McAfee to testify as to what patents cover what, what JEDEC rules do or do not provide.

He is going to, however, explain the bases of his assumptions and those can be then resolved through the evidence.

JUDGE McGUIRE: Okay. Mr. Stone, did you want to respond to that?

MR. STONE: Your Honor, I think -- I think what's best is to wait as we go forward. We've sort of laid out the underlying premise of law, and I think if his testimony runs afoul of where we think --

7106

JUDGE McGUIRE: But the point is -- and I understood your arguments and now I understand his.

The point is, if he or his colleagues indicate at the time of the inquiry that this is not -- that this testimony is not offered for the state of mind or some of these other areas, is that going to be adequate for your -- for the purposes of your opposition in this brief, as long as it's stated clearly in the record as to what his testimony is not to entail?

MR. STONE: I think to the extent what Professor McAfee does is if he says "For purposes of reaching my expert opinions as an economist I have assumed the following," and if he states them simply as assumptions -- "That's what I've assumed" -- and if they're important or necessary for his opinions, I think that does address our issues.

JUDGE McGUIRE: Then you can always go into that on cross-examination.

MR. STONE: And I think if we go beyond that then we may have an issue.

JUDGE McGUIRE: Then I'll entertain at that time any objections, but let's try to -- I think we have an understanding here pretty much.

So let's be clear from the point of view from,

7107

I guess, complaint counsel that upon your inquiry then make clear on those areas that these are based on his, I guess, assumptions and not a statement as to his conclusions in some of these areas that we've discussed, and hopefully that will address the crux of these problems.

If it doesn't, then I'm sure you'll stand up and we'll hear from you again.

MR. STONE: Thank you, Your Honor.

MR. ROYALL: And we fully intend to do that. The only point I make is in case, as we also stated in our opposition to the motion in limine, it's appropriate in defining assumptions for the expert to explain what, if any, basis he had in making the assumption --

JUDGE McGUIRE: Right.

MR. ROYALL: -- I may ask questions along those lines.

MR. STONE: We may get into an issue as to whether he can rehearse evidence in this case in order to support an assumption, because an assumption is simply an assumption, and if he rehearses testimony in this case to support an assumption, he's then making the assumption part of his opinion. He's then testifying that this is an assumption based on

7108

evidence.

And the appropriate way for this is simply to say "I have assumed that," and then we will argue to Your Honor at the end of the case whether the evidence supports his assumption or not.

JUDGE McGUIRE: Right. Right.

MR. ROYALL: Your Honor, I strongly disagree if what he is saying is that the expert should not -- is not permitted to point to evidence that the expert has seen as relating to or giving corroborating assumption.

Again, we cited and included Supreme Court cases on that point in our original motion. We can deal with it when it comes up.

JUDGE McGUIRE: Right. But I want to be careful. I think one of the concerns that has been raised in this brief is that we not sit here and have him summarize unduly fact testimony of which he has no firsthand knowledge.

Now, to the extent that some facts are part of his overall assumption, then you'll be able to lay that foundation. But I don't want to spend a lot of time on him going back over and restating the facts of other individuals who have testified in this hearing. That's not his role.

7109

But I will give you some leeway in that regard, but if you overdo it, then I want to intervene and cut you off in that regard.

MR. ROYALL: I understand, Your Honor.

And I will tell you that we do think it's appropriate to draw out at certain points what, if any, facts he has seen to support his assumptions, but we don't plan to do that in any great deal and we expect that most of the fact issues may come up on cross as opposed to direct.

JUDGE McGUIRE: Okay. Very good.

MR. STONE: I think we'll --

JUDGE McGUIRE: Mr. Stone, one last thing.

MR. STONE: On that point, Your Honor, I do think rehearsing facts which are already in the record would be both cumulative and is not necessary to support an assumption. If they're necessary to support an opinion, that's different. I don't think they should be offered to support an assumption.

But I do think it's best to deal with this in the context when it arises.

JUDGE McGUIRE: I agree.

And I will advise you, though, for guidance that I will give him some leeway in that regard, the extent of which will be determined at the time that you

7110

stand for objection.

MR. STONE: Thank you, Your Honor.

MR. ROYALL: Thank you, Your Honor.

JUDGE McGUIRE: Are we set?

MR. ROYALL: Yes, Your Honor.

JUDGE McGUIRE: Then at this time complaint counsel may call its next witness.

MR. ROYALL: At this time complaint counsel calls as its next witness Professor Preston McAfee.

JUDGE McGUIRE: Would you please approach the bench and be sworn by the court reporter.

- - - - -

Whereupon –

RANDOLPH PRESTON McAFEE

a witness, called for examination, having been first duly sworn, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. ROYALL:

Q. Good morning.

A. Good morning.

Q. Professor McAfee, can I ask you for the record to state your full name.

A. Randolph Preston McAfee.

Q. And where are you employed?

A. The University of Texas at Austin.

7111

Q. And is that where you reside as well?

A. Yes.

Q. And what position do you hold at the University of Texas at Austin?

A. I'm the Murray Johnson professor of economics.

Q. Is that in the economics department?

A. Yes, that's in the economics department.

Q. And how long have you been employed as an economics professor at the University of Texas?

A. Since 1990.

Q. Have you taught at any other universities?

A. Yes. My first job out of graduate school was at the University of Western Ontario.

Q. And how long did you teach there?

A. Seven years.

Q. In the economics department?

A. That's correct -- actually I was on the faculty for nine years. I then went on leave to Cal Tech.

Q. California?

A. Institute of Technology.

Q. And did you teach economics there as well?

A. I did, yes.

Q. And after teaching at Cal Tech, what did you do then?

7112

A. That's when I went to the University of Texas.

Q. And I think you said that was 1990?

A. That's correct.

Q. Since you have been a professor at the University of Texas, have you taken leave to teach at any other schools?

A. Yes. I've taught at MIT and also at the University of Chicago.

Q. And at MIT, were you teaching in the economics department?

A. I was. I taught industrial organization in the economics department.

Q. And at the University of Chicago what department of the school did you teach in?

A. The Graduate School of Business.

Q. Was it an economics class that you taught in the Graduate School of Business?

A. Yes. The economics of strategy.

Q. Do you specialize in any particular area of economics?

A. Yes. I specialize in industrial organization.

Q. Could you explain to the court what is industrial organization.

A. Industrial organization is the study of firm behavior and the performance of markets.

7113

Q. And do you have any understanding as to whether industrial organization has any relationship to antitrust or antitrust policy?

A. Yes. Antitrust issues are generally an important branch of industrial organization, for the reason that it's the study of market performance and antitrust issues very much concern market performance.

Q. Are you currently, by which I mean not today but in this year, academic year, are you currently teaching classes?

A. Yes.

Q. And what classes do you teach?

A. I teach an undergraduate managerial economics, which is about corporate behavior and firm decision-making, and then I teach a graduate-level course called the economics of strategy, which is about a similar topic.

Q. And was it -- it was fairly recently that you were visiting at the University of Chicago; is that right?

A. Yes. Three years ago.

Q. And what class, if you didn't already mention it, what class did you teach there?

A. It's essentially the same course, the economics of strategy. I think they may just call it

7114

strategy.

Q. Besides managerial economics and business strategy, have you taught other types of economics classes?

A. Yes. For most of my career I've taught industrial organization both at the graduate and undergraduate level.

Q. Let me ask you to describe briefly your own personal educational background.

A. I graduated from the University of Florida in

1976. I went from there to Purdue where I completed master's degrees in both economics and in mathematics, and then I finished a Ph.D. at Purdue in 1980.

Q. Have you --

A. In economics, so...

Q. And have you worked in academia since finishing your Ph.D. in 1980?

A. Yes.

Q. Have you ever worked in government as an economist?

A. I had a -- I spent a long summer, five-month period, at the Department of Justice Antitrust Division in 1987.

Q. And what was the nature of your position or your role at the Antitrust Division?

7115

A. At that time -- and I think actually they may have restarted it -- but at that time they had an annual program where they brought an academic in to assist with various -- well, with their mission, their antitrust mission. The informal name of this program was the scholar in residence.

Q. And what is the nature of that program?

A. Well, I worked on a variety of matters that were going on at the time. They were particularly interested in collusive bidding in auctions, that is, bidders who collude together, and that was one of the reasons they picked me. But they had -- I worked on a variety of matters during that period.

Q. Have you published any articles relating to economics?

A. Yes. Over 60 articles.

Q. And is there any particular area in economics that has been the focus of your academic articles?

A. Well, broadly speaking, most of the articles are in the field of industrial organization. The specific topic I've published the most on is in auctions. I've published on antitrust, on market pricing, and a variety of other topics.

Q. How does economics relate to the issue of auctions that you mentioned?

7116

A. Well, auctions are a form of market organization, and so auctions -- the study of auctions is very much a matter of the study of market performance and market behavior.

Q. You mentioned that you've written on the subject of antitrust or antitrust-related topics.

Can you give an example of an antitrust-related topic that you've written on?

A. Yes. I've written several papers on mergers -- these are coauthored papers I should mention. But I've written several papers on mergers and antitrust policy. I've written papers on cartel behavior and collusion.

Q. And in terms of business strategy, are there any particular topics relating to business strategy that you've focused on in your academic writings?

A. Well, in fact I've written a book on business strategy that's just come out.

Q. I think we may actually have a slide that -- yes. The first slide here.

Your Honor, I don't know where we are in terms of DX numbers.

JUDGE McGUIRE: It should be DX-120.

MR. ROYALL: DX-120.

BY MR. ROYALL:

Q. Is this a picture of the cover of your recent

7117

book, Professor McAfee?

A. It is. Or the dust jacket I guess.

Q. And what does this book relate to?

A. It's a book on business strategy that's useful for teaching both graduate and undergraduate courses on the economics of strategy.

Q. And I take it this is a book that you've recently completed?

A. Yes. It came out in December of 2002.

Q. Now, in addition to your own writings, have you ever edited the work of other economists?

A. Yes. For over nine years I was a coeditor of the American Economic Review, and this is the -- among peer-reviewed economics journals, this is the one that has the most subscribers, and I think by more than a factor of four. AER has four times as many subscribers as the next leading peer-reviewed economics journal, and so it's one of the most important economics journals.

Q. And can you explain what you mean by the term "peer-reviewed"?

A. Yes. So I guess perhaps the best way to explain it is in terms of the well-known phrase "publish or perish."

Generally, as a professor, you're expected to

7118

publish in journals where the work is edited by or considered by -- considered for publication by other academics, and "peer-reviewed" means that it's gone through a scholarly process where it's been checked by other experts, so as opposed to a magazine where the articles are written by people who work for the magazine.

Q. In addition to the work that you did as a coeditor of the American Economic Review, have you served as an editor of any other economics publications?

A. Yes. I'm currently -- actually I'm also an associate of the American Economic Review. I was a coeditor, which meant that I handled a quarter of all of the manuscripts they process. Now as an associate editor I handle way fewer than that.

I'm also an associate editor of the Journal of Economic Theory, which, even though the name is associate editor, it's actually more like a coeditor except there are forty of us, approximately forty of us, so I handle, again, a much smaller volume of manuscripts for that journal, and it's one of the leading journals in economic theory.

Q. Are you a member of any honorary societies relating to the field of economics?

7119

A. Yes. I'm a fellow of the Econometrics Society.

Q. What is that?

A. Econometrics Society is probably the leading group of economists who deal with economic theory and econometrics. Econometrics is the study of economic statistics, and this is sort of one of the leading societies, and a fellow is an elected, honorary position.

Q. In addition to your academic work, have you during your career done any type of consulting work?

A. Yes. I've consulted on a variety of antitrust matters.

Q. And other than consulting on antitrust matters, what other type of consulting work have you done?

A. I've done a good bit of auction work and I've advised companies with respect to auctions. I've also advised the federal government and governments in other nations about how to auction the radiofrequencies or the spectrum, the radio spectrum.

Q. Let me start with antitrust-related

consulting.
JUDGE McGUIRE: Let me inquire here. I'm not sure what you're talking about, sir. You said you've done some auction work. What exactly are you -- can

7120

you tell me what you're talking about in that regard?
THE WITNESS: Sure. I'm quite proud of it and I'm happy to talk about it further.
In 1994, the federal government, the Congress, passed a law that required the Federal Communications Commission to auction the rights for the next generation of cellular phones, which are called the PCS phones.
And the Federal Communications Commission didn't know how to do this, they had never run any auctions, and so they sought the advice of companies and companies, not knowing anything about auctions, sought the advice of academics, and because one of my articles was actually cited in a congressional report, they came to me.
In the end, three of us, two professors at Stanford and myself, designed the auctions which have now been used to raise over $20 billion for the federal government. These are sometimes called the FCC auctions.
JUDGE McGUIRE: Okay. We don't have to go quite to that extent. I just want to make sure that when you talk about auctions, it's in its everyday parlance and it wasn't something that I wasn't aware of.

7121

THE WITNESS: Yes, it is.
JUDGE McGUIRE: All right. That's fine.
You may proceed.
BY MR. ROYALL:
Q. Just to be clear, we don't need to go into detail on this, but the consulting work you said you did for foreign governments, was that relating to similar-type auctions?
A. Yes. I sold spectrum for cellular phones and also for microwave spectrum, which is communication, terrestrial communications, in Mexico, and we raised $1.1 billion for the Mexican government.
Q. Now, putting aside consulting relating to auctions, you said that you had done consulting work relating to antitrust.
Was any of that -- has any of that consulting work involved work in which you were retained by a government agency?
A. Yes. In particular, I've worked extensively with the Federal Trade Commission on several different merger matters.
Q. Can you give an example of a merger matter or some merger matters that you've worked with the Federal Trade Commission on?
A. Yes. The FTC retained me to help them analyze

7122

the Exxon-Mobil matter, which at the time was the biggest merger ever proposed. And I provided expert advice on that merger, which ultimately was not challenged.
They also hired me to provide advice on the BP-ARCO merger, which at the time -- well, in fact maybe even still today but which at the time turned out to be the largest merger ever challenged by a U.S. government agency.
Q. Other than this case and other than the merger matters that you've worked on with the FTC, have you worked with the FTC on any other consulting-related matters?
A. Yes. Phillips-Conoco. Monster-HotJobs, which was a proposed merger that was ultimately not consummated by two on-line employment companies. And there might be other matters that I --
Q. Are there any nonmerger matters other than this case that you've worked with the FTC on?
A. I'm forgetting as I sit here.
Q. Okay. Let me ask you this.
Have you ever testified before Congress?
A. Yes. I actually have testified twice before senate subcommittees.
Q. And on what issues?

7123

A. And that actually now prompts me on whether I helped the FTC on other matters.
Yes, I helped the FTC on midwest -- in the year 2000 or 2001, gasoline prices went to $2.50 in Chicago, and there was an investigation. The FTC launched an investigation, and I assisted in that matter and ultimately testified before Congress before two congressional subcommittees on gasoline prices, one specifically targeted to the midwest gas price hike and one more generally on the determinants of gasoline prices.
Q. Now, I've asked you about your government-related or some of your government-related consulting experience.
Have you also consulted with private parties?
A. Yes.
Q. And relating to antitrust matters?
A. Yes. I've worked on a variety of matters, antitrust matters, for the private sector.
Q. And your antitrust-related consulting, has it extended to more than one industry or has it been focused in only to a particular industry or small group of industries?
A. No. Actually it's been quite broad. I've worked on software. I've worked on defense-related

7124

matters, that is to say, military weapons systems. On pulp and paper. I've worked on a variety of matters. Lead.
Q. Are you currently affiliated with any private consulting firms?
A. Yes. I work with two firms, Market Design, Inc. and KeyPoint Consulting.
Q. And do you have an ownership interest in either of these firms?
A. I have an ownership interest in both of them.
Q. Have you ever testified before in litigation?
A. Yes. I've been deposed about a dozen times and testified twice in court.
Q. In what types of cases have you testified?
A. One was for the pulp and paper industry and the other one was in real estate.
Q. And what was the nature of the legal dispute, as you recall?
A. The pulp and paper case was a merger and it was -- my role was an analysis of everything from market definition to remedies.
And in the real estate matter, I was actually testifying on admissibility of economic testimony.
Q. At some point in time I take it you were contacted by FTC attorneys about litigation or

7125

potential litigation against Rambus; is that correct?
A. Yes, that's correct.
Q. Do you recall when that was?
A. Yes. It was in the spring of last year. And I believe we have a -- we have a --

Q. We have another slide here. This is DX-121 I believe.
JUDGE McGUIRE: Correct.
BY MR. ROYALL:
Q. And the slide that has just popped up -- by the way, the slides -- have you brought slides with you today for purposes of your testimony?
A. I have.
Q. And this particular slide, as the title suggests, relates to your assignment. You mentioned you were retained in the spring of 2002.
At the time that you were first contacted by the FTC in the spring of 2002, to your knowledge, had the FTC already instituted litigation against Rambus?
A. I don't believe so.
Q. At the time that you were contacted, did you have an understanding of the purpose for which the FTC attorneys were contacting you?
A. Yes, I did.
Q. And what was your understanding?

7126

A. Well, that's -- I set this out on a slide to remind me of the -- as an aide-memoire. It was, broadly speaking, to conduct an economic analysis of Rambus' conduct.
Q. Before getting to the substance of the slide, I'm going to ask you just a few more questions.
You obviously agreed to be retained; is that correct?
A. I did, yes.
Q. And have you been working with the FTC on the Rambus matter since roughly the spring of 2002?
A. That's correct.
Q. Have you been paid for your work?
A. I have.
Q. Are you paid on an hourly basis?
A. Yes, I am.
Q. And what is your hourly rate?
A. $400 an hour.
Q. Is that the normal rate that you charge for consulting services?
A. I have a government rate and that is my normal government rate.
Q. In your work on this matter, have you received any support or assistance from any consulting firm?
A. Yes. From KeyPoint Consulting.

7127

Q. What type of assistance have you received from KeyPoint Consulting?
A. KeyPoint Consulting has several -- well, actually they have a variety of talent. They have everything from Ph.Ds in economics to people with bachelor's degrees on the other end, and I've received a variety of economic help.
Q. To your knowledge, has the staff at KeyPoint, the staff members that have assisted you, have they been compensated as well by the FTC for their work?
A. Yes. They are compensated in the same manner, in the sense of hourly.
Q. Now, getting to the slide, when you were retained by the FTC, were you asked to take on any particular assignment?
A. Yes. Broadly speaking, I was asked to conduct an economic analysis of Rambus' actions.
Q. And does this slide reflect the nature of the initial assignment that you were given by the FTC attorneys when they retained you?
A. It does. In addition to a broad economic analysis, I was to analyze the competitive nature and the competitive effects of the conduct and determine the appropriate remedies.
Q. And in describing your assignment here, you've

7128

referred a couple of times to Rambus' alleged conduct or to alleged actions.
In conducting the work that you have been asked to take on in this case, was it important for you to have or to develop an understanding of what conduct Rambus was alleged to have engaged in?
A. Absolutely. That would be -- that would form the starting point of an analysis, would be the conduct.
Q. And can you just elaborate on what you mean by the conduct forms the starting point for the analysis?
A. Well, as I understand the question, the questions I was asked by the Federal Trade Commission, to perform an economic analysis, I'd have to have something to analyze.
In this case it's the conduct of Rambus in the setting of the marketplace in which it operates, and so the alleged conduct is very much the starting point of economic analysis of, for example, the competitive effects of the conduct. I have to understand conduct to understand competitive effects, for example.
Q. And what, if anything, have you done to gain an understanding of what conduct Rambus is alleged to have engaged in?
A. Well, I've done -- in addition to reading the

7129

complaint, I've done a great deal of work to appreciate just how Rambus has behaved in this market and the nature of its actions.
Q. But are you here to testify as a fact witness as to what Rambus may have done or not done?

A. No, I'm not.
Q. And when you say that you've conducted an investigation into the facts relating to Rambus' conduct, is that for the purpose of conducting an economic analysis?
A. Yes. Generally an economic analysis -- the conclusions of an economic analysis are only going to be as good as the assumptions on which they're based, and so it's important to base your assumptions on what will prove to be correct or what will be demonstrated to be true, that is, to have correct assumptions.
Now, my role is to reason from the assumptions to the conclusions, but it's important for the conclusions to be valid, that is, valid in the actual circumstance as opposed to just valid given the assumptions, that the assumptions be correct.
Q. Well, and have you in fact made assumptions as to the nature of the conduct that Rambus is alleged to have engaged in, that is, the nature of the conduct that you understand to be the focal point of the FTC's

7130

claims?
A. I have.
Q. And what is your understanding in that regard?
I believe you may have a slide relating to this as well.
A. Yes, we have a slide.
Q. And that will be DX-123 I believe?
JUDGE McGUIRE: No. 122 I think.
MR. ROYALL: I'm sorry. Is it 122?
BY MR. ROYALL:
Q. Now, can you explain to us, generally speaking, before we get into any details, what this slide is intended to show?
A. So the first part of this slide sets -- so broadly speaking, this slide is about the FTC

allegations. These are my understanding of the allegations. Actually let me -- that's the answer to your question.

Q. In each of the bullet points here, are each of these bullet points assumptions that you are making, or do any of these bullet points reflect conclusions or opinions that you're offering?

A. Some of these bullets are assumptions and some are conclusions, and I'm happy to explain.

Q. Please do.

7131

A. The -- for example, the first one, the subversion of the open standard-setting process, that's an assumption that's a factual matter.

Q. Can I stop you there? Why don't we go through them one at a time.

You say that that's an assumption about facts.

To be very clear about this, are you here to testify as to what JEDEC's rules do or do not require?

A. I am not.

Q. Are you making assumptions as to what JEDEC's rules do or do not require?

A. I am.

Q. What assumptions are you making?

A. Well, actually the assumption I'm making in this part is not specifically about what JEDEC's rules do or do not require but, rather, that Rambus did not -- that Rambus violated whatever rules or expectations that -- or actually the process, whatever process, that Rambus took actions which subverted the process.

Q. That is your assumption?

A. That is my assumption.

Q. And do you assume anything as to the manner in which Rambus took actions to subvert the JEDEC process?

7132

A. Well, it's through the non -- it must be -- in order for my conclusions to be valid, it must be related to their intellectual property and in particular to the nondisclosure of their intellectual property. This will I think come out very clearly as we -- when we go through the analysis.

The assumption is that Rambus withheld its intellectual property and that JEDEC -- that JEDEC in essence reacted to that lack of knowledge.

Q. Let's go to the second bullet here.

Does this reflect an assumption that you are making for purposes of your economic analysis?

A. Yes, it does. I have no -- as an economist, I have no independent ability to look at a DRAM and say that it contains intellectual property, nor can I actually appreciate the patents, so I'm assuming that the JEDEC standards do in fact incorporate Rambus intellectual property.

Q. And are you assuming that Rambus has patents over the intellectual property or technologies incorporated in the JEDEC standards?

A. Yes, I am.

Q. Let's go to the third bullet.

Does this relate to an assumption that you are making for purposes of your economic analysis?

7133

A. It does. I am assuming that Rambus is attempting to enforce these patents against the manufacturers of JEDEC-compliant DRAM and also against -- it doesn't say this on the slide, but it's also against the manufacturers of controllers and the like.

Q. You use the term in this bullet "JEDEC-compliant DRAM."

Are you making assumptions as to whether products produced by DRAM manufacturers that purport to comply with JEDEC's SDRAM and DDR standards do in fact comply with those standards?

A. No. I have no ability to ascertain whether they do or do not and I would have to assume that they were complying with the JEDEC standards.

Q. And are you in fact making such an assumption?

A. Yes, I am.

Q. Turning now to the fourth bullet point, does this bullet point relate to facts that you are assuming or is this reflecting an area in which you are offering an economic expert opinion?

A. This is solidly inside the realm of economic analysis; that is, given the assumptions, one of my conclusions will be that Rambus' behavior eliminated alternatives.

7134

Q. I don't know if you need a glass of --

MR. STONE: Your Honor, may I rise? If I can, I don't mean to interrupt taking a drink of water, but this last answer does raise the issue directly of your in limine.

If Professor McAfee is going to testify, as he suggested now, that certain alternatives were commercially viable, if that's an opinion he's going to render, as this testimony we just heard suggests, that runs exactly afoul of Your Honor's order, which says that he is not permitted to testify to any aspect of the cost or performance of alternative technologies.

I can understand that he might assume that there are alternative technologies that were commercially viable, but Your Honor has directly ruled and his prior testimony has established he doesn't have the expertise to opine as to whether they were or were not commercially viable, and we just heard him say that that's something he intends to give an opinion on. He says it's solidly inside the realm of economic analysis.

JUDGE McGUIRE: Any response, Mr. Royall?

MR. ROYALL: I'm sorry, Your Honor. I'm looking to see if I can identify the portion of your

7135

motion in limine ruling Mr. Stone is referring to.

JUDGE McGUIRE: All right. Take a moment.

MR. ROYALL: Could I have a moment?

JUDGE McGUIRE: Sure.

MR. ROYALL: Thank you.

(Pause in the proceedings.)

Your Honor, I think that Mr. Stone may be misreading your order. Your order, as I read it, denies the aspect of their motion in limine relating to cost and performance of alternative technologies. I believe that's right.

MR. STONE: Well, let's just proceed and see where we go, Your Honor.

JUDGE McGUIRE: All right. Very well.

BY MR. ROYALL:

Q. The purpose of this slide, as the title suggests, is to reflect your understanding of the FTC allegations; is that right?

A. That's correct.

Q. And I think that the point that you were making earlier, just to reorient us, is that some of these bullet points, although they reflect your understandings, some of them squarely fall in the areas where you are making assumptions, you're not expressing

any conclusions, and then some of them fall by contrast
7136
in the area in which you are expressing conclusions; is that right?
A. That's correct.
Q. And so of the five bullet points here, the first bullet point that falls into that area where not only is this your understanding of the FTC's allegations but it relates to conclusions that you reached, the first of those bullets is this fourth bullet that we just discussed; is that correct?
A. That is correct.
Q. Okay. Now, going on then to the final bullet, does this relate to an assumption that you are making or does this fall into an area where you are reaching economic expert conclusions?
A. This is in the area of economic conclusions.
Q. And can you elaborate within the context of what's stated in this fifth bullet point?
A. Certainly. Assessing the extent of competition and harm to competition and the levels of competition and assessing the monopolization are things that industrial organization economists do as part of their ordinary practice.
Q. And in connection with this fifth and last bullet point, are you purporting to offer conclusions as to legal issues?
7137
A. No, I'm not.
Q. Is there any aspect of your testimony in which you are purporting to offer legal conclusions of any sort?
A. I am not.
Q. Are these the only – the issues that are identified here in this slide, are these the – is this the full extent of your understanding of the FTC's allegations?
A. No. These are what I took to be the five major ones, most important ones.
Q. Now, you've explained that you're not here to testify as a fact witness but, rather, as an expert in economics.
What economic issues have you sought to address through your work on this matter?
A. Well, I've actually organized my inquiry around answering a set of questions which –
Q. Could we have the next slide.
Now I believe we are at DX-123.
What, very generally first before we go into the substance, what is this slide meant to show or to display?
A. As part of performing an economic analysis and for the Federal Trade Commission, I tried to set the
7138
project of performing an economic analysis into stages. And this sets out a, if you want, research methodology or a program for understanding, for addressing the question of assessing the competitive effects and remedies associated with Rambus' conduct.
Q. And who developed these particular questions that are listed in DX-123?
A. Well, I did working with my staff.
Q. And are these in fact the economic issues that you have sought to address through your work on this matter?
A. Yes, they are.
Q. Let's start with the first question, which relates to relevant antitrust markets.
Could I ask you first of all to explain what you mean by the term "relevant antitrust markets."
A. So a relevant antitrust market is – it defines the context of an economic industrial organization analysis. It identifies the products and the firms that produce those products that are the relevant players for the analysis.
And the purpose here is to identify who are the important players and who can be safely ignored and what are the important products, the relevant products, and what products can be safely ignored.
7139
And so this is generally the starting point because it provides the context, if you want, it draws the boundaries around the inquiry and sets the scope of the analysis.
Q. And are relevant antitrust markets or the definition of relevant antitrust markets, is that something that's important in any economic analysis relating to antitrust?
A. Yes. Virtually every antitrust analysis starts with the definition of relevant markets.
Q. And let me ask you to go on to the second key economic question and explain what the nature of this question is and why you regarded it as an important issue.
A. Actually can I add to the relevant markets?
Q. Yes, please.
A. I think it's actually correct -- well, certainly it's the case that in almost every case that I've worked on, my starting point was the development of the relevant antitrust markets; that is to say, this is what one normally does when one performs an economic
antitrust analysis.
Q. And by that you're referring to your prior experience in consulting with the government or with private parties on antitrust issues?
7140
A. That's correct.
Q. Now, going to the second key economic question here, let me explain -- let me ask you to explain what the nature of this question is and why it was important to you to focus on this question for purposes of your economic analysis.
A. So what this question is about is assessing whether Rambus has power, market or monopoly power, in the markets defined in question 1. And the reason that that's relevant is a firm without market power, that is, a firm that's normally considered to be a competitive firm, that being the alternative of a firm with market power -- I should say economists use the term "competitive" in a somewhat specialized way because generally that means perfectly competitive when you say "competitive" as opposed to just aggressively competitive.
A firm that lacks market power has no ability to set terms of trade, to influence the evolution of a market. It doesn't have control of any major aspects of that market.
And so consequently, in order to -- in order for there to be any relevant conduct, a firm has to have power in the marketplace, and so it's important to assess whether a firm has market or monopoly power
7141
because, absent that, the firm would have no ability to influence the evolution of that marketplace and to set the terms of trade.
Q. You used two terms here I believe, "market power" and "monopoly power." Is there a difference between those two things?
A. Yes. Monopoly power is a strong form of market power.

There's some ambiguity in the way economists use these terms; that is to say, there's not a complete agreement or consensus on the use of these terms. But I think there's a widespread -- all economists use "monopoly power" to be a stronger term and generally to involve durability; that is to say, the market power will persist.

And also it must be -- in order to be monopoly power, it must be significant. That is, one can imagine having a tiny degree of market power, but a tiny degree of monopoly power is an oxymoron.

Q. Let's move to the third key economic question, and let me ask you the same questions as I asked before: What do you mean by this question, what is the nature of this question, and why did you find it important to your economic analysis?

A. And let me start by saying what is exclusionary

7142

conduct. Exclusionary conduct is generally understood by economists to mean behavior or conduct that would exclude an equal or superior competitor from the marketplace.

And so exclusionary conduct is -- and the reason economists care about that is generally having more and better competitors is good for a marketplace, but having inferior competitors may or may not be good, but you can't certainly conclude that it's good for a marketplace.

And so economists are worried about the exclusion of equal or superior competitors because those will tend to harm competition.

And the reason for question 3, that is to say, was the acquisition of market or monopoly power through a process of exclusionary conduct, the reason that matters is, from an antitrust perspective, economists would not want to deter firms from, say, building a better mousetrap and having a superior product and thereby acquiring market or monopoly power. Not only is there no harm to competition in such circumstances, there's actually a benefit to competition in those circumstances.

Instead, economists are concerned about exclusionary conduct, that is, conduct that -- not

7143

through building a better mousetrap but conduct that actually excludes a superior or equal competitor from the marketplace.

Q. Now, going to the fourth question, can you explain the nature of that question and why it was important to your economic analysis?

A. Yes. In principle, one can have acquired monopoly power through exclusionary conduct and it still wouldn't matter because -- either because the marketplace was so small that it was an insignificant marketplace or there was no potential for damage to the marketplace through the conduct.

And so this is -- question 4 is about an assessment of what were the effects to the marketplaces of this acquisition of monopoly power.

Q. And what do you mean by the term "threatened" or "threatened harm" or "threatened effects"?

A. In some cases the harm may not have been experienced yet; that is, it may appear to lie in the future. Some kinds of damages take a long time to be felt, and so "threatened" refers to the potential for future damages.

Q. And finally, if I could ask you to explain the nature of the fifth key economic question and why you found that question to be important to your economic

7144

analysis.

A. Well, given a finding of harm, one of the natural questions for industrial organization economists is what can you do about it. In fact, much of industrial organization is focused on the question of how to make marketplaces work better.

And so a natural question given a finding of harm is, well, what can be done about it, and that's what that question is about.

Q. Without going into detail at all but just generally speaking, do you personally, Professor McAfee, have experience in addressing the types of economic questions that you've identified in this slide?

A. Yes. All five of these questions have come up in multiple cases on which I've worked.

Q. And does your expertise in industrial organization bear on these issues?

A. It does. As I mentioned, this would be a normal part of an industrial organization analysis.

MR. ROYALL: Your Honor, at this time I would proffer Professor McAfee as an expert in the field of industrial organization economics.

MR. STONE: No objection, as so stated, Your Honor.

7145

JUDGE McGUIRE: I'm sorry?

MR. STONE: I have no objection to him being qualified as so established.

JUDGE McGUIRE: Then he shall be qualified in the area noted. And I'm sorry. Again, Mr. Royall, that was in the area of industrial organization?

MR. ROYALL: Yes. Industrial organization economics.

JUDGE McGUIRE: And economics? Industrial organization economics.

MR. ROYALL: Yes. Yes, Your Honor.

JUDGE McGUIRE: Okay.

MR. ROYALL: The field of economics that he has testified that he specializes in.

MR. STONE: I didn't mean to interrupt. I think I might have misspoke. I meant to say I had no objection to him being qualified as so described.

JUDGE McGUIRE: I understand.

MR. STONE: I think I misspoke.

JUDGE McGUIRE: I understood.

BY MR. ROYALL:

Q. Now, Professor McAfee, let me ask you if you could, now that we've identified or you've identified for us what you believe are the key economic questions relating to your assignment in this matter, let me ask

7146

you if you could describe for us or begin to describe for us the type of work that you have done in addressing these key economic questions.

A. The starting place for an analysis of these questions is an understanding of how the marketplace works, and so my first efforts at working and in fact continuing efforts at understanding this marketplace or answering these questions is to understand how the marketplace operates.

And so in that regard, I've read a very large amount of material, I talked to a lot of people, and I've generally tried to get a sense of what determines outcomes and what determines choices and how choices are made in this marketplace from an economic perspective.

Q. And as part of that work, did you interview anyone?

A. Yes. In fact, let me correct a typo on this.

This should say "DRAM plant manager." I believe I interviewed only one plant engineer.
But I spoke with DRAM engineers, with a DRAM plant manager, with JEDEC participants and with DRAM users.
Q. And just to identify the slide that we now have up, I believe it will be marked as DX-124.

7147
Before I ask you about these particular interviews that you conducted, let me ask this.
Is it common for economists in addressing the types of issues that you identified to conduct interviews?
A. Well, it's certainly not uncommon. It's pretty common. That would be -- the purpose here is to understand the economic determinants of the marketplace, and talking with market participants would be a natural way to gain an understanding of how the marketplace operates, and so yes, that would be a normal thing to do.
Q. Well, in referring to the types of people that you identify here as having interviewed, let's take the first item, DRAM engineers. What.
Was your purpose in interviewing DRAM engineers?
A. Well, we haven't of course gotten to my market definition yet, but the markets at issue here are technology markets, and so participants in technology markets are often engineers, and I need to understand the influences on those engineers.
Q. And what was your purpose in interviewing the DRAM plant manager that you mentioned?
A. Well, we'll talk about the economics of DRAM

7148
production at some length, and a plant manager is well-positioned to have an appreciation of the economics of production of DRAM.
Q. Have you ever seen DRAM being produced or the production process? Have you ever seen that in person?
A. Yes. I've toured the Infineon plant in Virginia.
Q. You did that as part of your work on this

case?
A. I did, yes.
Q. And why was it important for you to actually -- or why did you deem it important to personally tour a DRAM production facility?
A. Well, I don't want to say it was absolutely essential to tour it. It was certainly useful to see it because it's one of the most extreme production processes in the United States in the sense of the investment on a per-worker basis is about as large as investments in plant and equipment ever get.
Q. And that's something that touring the plant helped you to appreciate better?
A. Absolutely.
Q. The next item, JEDEC participants, what was your purpose in interviewing JEDEC participants?

7149
A. Well, to foreshadow the conclusions, JEDEC wields a large amount of influence in the selection of standards -- and there's been a great deal of trial testimony to that effect -- in the selection of standards which are then adopted by the marketplace, and so understanding the incentives of JEDEC participants is an important part of an economic analysis of this marketplace.
Q. And finally, DRAM users you mentioned on this slide, DX-124.
What was your purpose in interviewing DRAM users and what do you mean by the term "DRAM users"?
A. Well, there are two levels of DRAM users. There are the people who put DRAM in the devices, which tend to be companies, and then there are ultimately consumers and businesses that buy computers and fax machines and other devices that have DRAM, and so there
are really two levels of DRAM users.
Economists are very much all about supply and demand. The users are actually the demand side of the equation and it's important to appreciate their motivations or -- not motivations -- their incentives in terms of product and I will use my knowledge of DRAM users in several spots.
Q. In addition to conducting interviews, did you

7150
have occasion as part of your work to review or rely upon any written materials?
A. Yes. I think of all the cases in which I've worked, I've read -- and that includes Exxon-Mobil -- I read more materials for this case than any other, and it's a very large volume of documents and that's summarized on this slide.
Q. Just to identify, the slide that's now on the screen would be DX-125, which has the title Materials Reviewed and Relied Upon.
Before asking you about a couple of these items, let me ask, to follow up on your last answer,

why is it that you found it necessary in this case to review such a large volume of written material?
A. Well, partly because it spans a very long period of time, partly because there are multiple levels of markets, so that is to say -- let me give a thumbnail big picture, if you will.
To understand the technology markets you need to understand the demand for technology which is derived actually from the marketplace for the physical product. And so then that proved necessary to understand the or gain an understanding of the DRAM market as opposed to the technology markets that are inputs to the DRAM production process.

7151
To understand the DRAM market you have to understand the products in which DRAM is used, and so computers and the like and the determinants of economic performance of those markets, and so it wound up being a large number of markets, which in many cases operate in a fairly complicated way, and so I think that would be the reason -- that would summarize the reason why it took more investigation to reach conclusions in this case.
Q. And in terms of the nature of the written materials that you reviewed and relied upon, let me ask you about that.
The first item on DX-125 refers to business records from Rambus and third parties.
Is this referring to records produced in the litigation?
A. It is.
Q. And taking Rambus first, did you review a large volume, a small volume? How many Rambus internal business records did you review?
A. Well, it's certainly a large volume. I don't -- it's been over the course of more than a year, so I don't actually -- I'm not sure how large a volume it is. The set of documents occupies -- that I personally reviewed -- and I should say my staff also

7152

reviewed documents, but I'm only relying on the documents that I personally reviewed.

But the set of documents that I personally reviewed fills at least ten Bankers boxes.

Q. What was your purpose in reviewing so many Rambus internal business records?

A. Well, part of it is just being careful and having a good appreciation, but Rambus business records are generally very important to making correct assumptions about conduct, for example. And Rambus itself had an understanding of the marketplace which was an input to my understanding of the marketplace.

So there are a variety of uses for Rambus business documents.

Q. And you reviewed third-party business documents as well?

A. That's correct.

Q. And just generally speaking, what was your purpose in doing that?

A. Again, my goal is to achieve a correct understanding of the economics of these -- of the various relevant markets, and these are participants in those markets and they have useful information.

Q. The next bullet point on this slide, DX-125, refers to minutes and presentation materials from JEDEC

7153

meetings.

Why was it important to your economic analysis to review written materials of that sort?

A. Well, I believe I've already said that JEDEC wields an important influence in selection of technology in the DRAM marketplace, and so the way that JEDEC makes decisions and the issues that arise in the making of those decisions are quite relevant for an economic analysis.

Q. The next item refers to, first of all, deposition testimony.

Are you referring here to depositions that were taken in this case?

A. In this case and also in earlier related cases.

Q. And do you have any idea how many deposition transcripts you've reviewed for purposes of your work on this matter?

A. A very large number. It's a very large volume. But I can't, as I sit here today, tell you how many that is. It's more than twenty.

Q. And was your purpose in reviewing depositions similar to your purpose in reviewing the business records of Rambus and third parties?

A. Absolutely.

7154

Q. And trial testimony, are you referring to the trial testimony in this case?

A. Yes. I've also read trial testimony from the Infineon trial, but what I was specifically referring to was the trial testimony in this case.

Q. How much of the trial testimony in this case have you reviewed, if you can say?

A. I've read all of it up to but not including this week.

Now, let me add one exception.

Mr. Vincent's -- I gather that some of -- that something was read of his into the record?

Q. And you haven't seen that?

A. Well, I've seen the listing of things that were read but not the actual what was read into the -- but otherwise, it's up through but not including Terry Lee.

Q. Skipping down to the last item, which refers to publicly available materials, trade press, analyst reports, et cetera, what was your purpose in reviewing this type of material?

A. Well, this includes a large variety of types of information, so this includes everything from analyst reports, which may -- you know, the analysts may be very well-informed or may not be so well-informed,

7155

and -- but other -- it includes company sources, which often have biases in them. It includes the trade press, which is probably unbiased on average, but there are -- it's all over the map in terms of its reliability.

And so the purpose -- but there's often useful information on average in the trade press and in the analyst reports, and so I reviewed a large volume of this to get a picture, although there's a lot of noise in that information as well, and so in order to eliminate the noise you have to read actually a pretty large amount of it.

And the purposes again are the same. It's to understand the economic determinants of behavior in the marketplaces.

Q. And besides the interviews that you conducted and you talked about the written materials that you've reviewed and relied upon, were there any other things that constituted a portion of your underlying work on this matter?

A. Well, actually are you skipping ahead out of this slide? Because I also read a book on semiconductor manufacturing which gave me a picture, maybe a bit dated, a book called Microchip Fabrication.

Q. Are you referring -- is that something that

7156

comes up under the second to last bullet?

A. Yes, it does.

Q. And what was your purpose in reading the book on microchip fabrication?

A. It was to understand the -- well, partly it was just to be able to read the deposition testimony and to have an appreciation of what the witnesses are talking about when they talk about the process.

Q. Now, actually before we do leave this slide, let me also come back and ask you, when you refer to reports of FTC and Rambus experts, indicating I assume that you reviewed those, is that limited to the economic experts or does that extend to other types of experts?

A. No. I think I've read the reports of all of the experts, including the technical experts.

Q. And what was your purpose in reviewing the reports of the technical experts, the FTC and Rambus technical experts?

A. Well, again, my purpose is to understand economic influences on this market, but the economic influences are very much determined by the technology and the available technologies, and so in order to have an appreciation of the economic choices that these markets make, I need to understand the technical

7157

constraints or at least to have an appreciation of the technical constraints that the market participants face.

Q. And did reviewing the reports of either the FTC's or Rambus' technical experts factor into assumptions that you've made for purposes of your economic analysis?

A. Well, they're certainly part of the information that on which I base my assumptions.

Q. Now, going back to the question I asked earlier, other than materials that you've reviewed and

the interviews you've conducted, were there any other things that constituted a portion of your underlying work on this matter, any other types of work?
A. Well, one of the things -- so one of the things that I've done in order to -- that I and my staff have done, because I had assistance with this, in order to -- it's more in the form of summary rather than information collection -- is to produce what's known as a case study, which is --
Q. Can I ask you, what is a case study?
A. A case study is a generally chronological analysis of the evolution of a firm or a market, and so a typically chronological presentation of who did what when but with explanations and analysis associated with it.
Q. And is a case study, is that a methodology that is used by industrial organization economists?
A. Yes. And also with business strategists. Actually both groups use a case study as a common tool for analysis of an industry or a firm.
Q. And what was the nature of the case study that you conducted as part of your work on this matter?
A. This case study looks at the evolution of DRAM technology and standards in the period 1990 to, roughly, 2000.
Q. And for what purpose did you find the need to conduct a case study focusing on that issue, the evolution of DRAM technology and standards?
A. So there are many uses. Partly it's a way of documenting and understanding the determinants of the -- the economic determinants of the marketplace choices.
So it's a way of ensuring that -- it's a way of organizing all of the information that's been collected and putting it in a framework that makes it possible to actually draw broad conclusions from it and also a way of ensuring that you do understand how it -- how the marketplace outcomes are determined.
And so for example, if there were lots of sources that contradicted the case study, that would show up in the process of trying to organize all that information into a coherent framework.
Q. Did you, in connection with your work on this matter, Professor McAfee, did you prepare an expert report?
A. I did.
MR. ROYALL: Your Honor, may I approach?
JUDGE McGUIRE: Yes.
MR. ROYALL: Would you like a copy of this?
JUDGE McGUIRE: Yes. Thank you.
BY MR. ROYALL:
Q. Professor McAfee, I've just handed you a document.
Do you recognize this?
A. Yes. It appears to be a copy of my expert report.
Q. And who wrote this report?
A. I wrote this report with the help of my staff at KeyPoint Consulting.
Q. And the case study that we were discussing a moment ago, is that included as part of this expert report?
A. Yes, it is. It's Appendix 3 to the report, which is the last roughly or just under 200 pages I think of the report.
Q. I think if you started from the back and you thumb up to the page, the first page 1, would that be the beginning of the case study?
A. That's correct.
Q. And so it's roughly -- it looks to be around 187 pages?
A. I think that's correct.
Q. And that 187 pages is the description of the chronological analysis of the evolution of DRAM standards that you were discussing earlier?
A. It is.
Q. And does your report contain a copy of your resume?
A. It does.
Q. Let's see if we can identify that.
A. I think that's Appendix 1.
Q. Yes, Appendix 1.
So it's slightly more than an inch into your report, Appendix 1. That's a copy of your resume. Do you see that?
A. That's correct.
Q. Is this a current resume?
A. No. Pardon me. No, it's not. In fact, I think my second child was born about two weeks -- I have my children listed on my resume and my second child was born about two weeks after the report was filed. She is not listed.
Q. So it's not updated in this version?
A. It is not.
Q. And then everything that comes before the resume, before Appendix 1, this roughly inch stack of paper that I have here, is that your expert report itself?
A. Yes. That's the main body of the report.
Q. By contrast to the case study or Appendix 3 that we mentioned?
A. That's correct. Although the main body of course references and relies on the case study at many points.
Q. And immediately after the curriculum vitae or your resume, there is something entitled Appendix 2?
A. That's correct.
Q. What is Appendix 2?
A. That's a list of all the documents that I relied on and the witnesses that I interviewed and my sources generally.
Q. And are these documents that you personally reviewed and relied on or does this also include materials that your staff reviewed but that you personally did not review?
A. I've looked at all of the documents relied on for producing the report, and so it's -- these are my -- the documents that I looked at.
Q. And did you at some point produce another report relating to this matter?
A. I did.
Q. And was that a report in response to the expert reports of Rambus' experts?
A. That's correct. It's labeled a rebuttal report I believe.
Q. Now, you can put the report aside for now.
You identified earlier, Professor McAfee, what you have deemed to be the key economic questions in this case or at least the key economic questions that relate to the assignment that you were given by the FTC attorneys when you were first retained in the spring of 2002.
Have you reached conclusions or have you developed expert opinions in response to those key economic questions?
A. Yes, I have.

Q. Now, the first question I believe that you identified earlier, the first -- I've just been handed a note. Before I leave this slide, the case study, that's DX-126.

The first of the economic questions that you identified earlier related I believe to relevant markets.

And have you reached conclusions as to what market or markets you believe are relevant to an economic analysis in this case?

A. Yes, I have. And I've prepared a slide that sets out the major points of those conclusions.

Q. So that this slide will be DX-127.

And this slide relates to -- it's a summary of the conclusions that you reached on the first of the five economic questions; is that correct?

A. That's correct.

Q. Did you -- you refer in the first point here to four relevant technology markets.

Did you define only four relevant technology markets?

A. I also defined a market that involves all four technologies lumped together, which is more for the purposes of convenience than it is for a strict market definition, but there are -- most of my analysis on market definition is devoted to the four technology markets.

Q. And you say in the second point under the conclusion heading here that each market consists of commercially viable alternatives for addressing specific DRAM design issues.

Do you see that?

A. Yes. That's correct.

Q. Can you explain what, in this summary slide, what you mean by that language?

A. Yes. Generally, economists in performing market definition are looking for -- start with a product and then look for other products that are price-constraining or influential on the selection of the product in question.

So that is to say, you start with one product and you say suppose you had a monopoly on that product, would that be a valuable monopoly, and the answer is no if there are a bunch of alternatives, and the answer is yes if that product is a valuable monopoly in its own right.

If the answer is no, that is, you haven't reached a market yet, you then add the close substitutes until you come up with a product with its relevant substitutes.

And so the specific language I've used here is that what I'm looking for are the price-constraining or commercially viable alternatives to the -- for the specific purpose of the product in question.

Q. And each of those commercially viable alternatives that you identify from your analysis you included in the separate relevant technology markets that you defined?

A. That's correct.

Q. And do -- did you reach conclusions as to the geographic scope of these relevant technology markets?

A. Yes. Technology markets usually are worldwide in scope, and that's simply because users of technology typically don't care about the source of the technology, where it originates. Technologies -- in other words, I'm saying technology is easily transportable, has low transportation costs. The technology markets tend to be worldwide.

In this case these technologies are no exception.

Q. Let's go to the next slide, which I think relates to the second key economic question. This would be DX-128.

Can you walk us through in summary form the conclusions that you reached in response to this second question relating to the issues of market and monopoly power?

A. Yes. I find that Rambus does have monopoly power in each of these four technology markets, and as the slide says, the source of this monopoly power is that the technologies have been incorporated into the dominant standards, so that is to say into the standards that have come to dominate the DRAM industry. Because those incorporate Rambus technology, that provides or confers monopoly power on the Rambus technologies.

Q. In your answer, I think you said that you find that Rambus possesses monopoly power in each of the four relevant technology markets that you identified.

Does that conclusion apply also to the fifth cluster or collective market that you mentioned earlier?

A. Yes. And for the same reasons.

Q. Can you explain briefly the summary conclusion, the second summary conclusion point on this slide?

A. Yes. The source or the origin of the monopoly power is the fact that the -- or actually it's an assumption, but appears to be correct, that the Rambus technology was incorporated into standards which have then by the marketplace come to dominate the DRAM technology.

So that is, the nature of the monopoly power is the incorporation of the technology into what has then become the dominant industry standard.

Q. And the standards that you're referring to as the dominant industry standards, are those the JEDEC standards, DRAM standards?

A. Yes. That's correct. The SDRAM standards for two of the technologies or -- excuse me -- yes, for two of the technologies and the DDR SDRAM standards for all four.

Q. Let's go to the next summary slide. This will be DX-129.

And this summary slide relates to the third economic question that you identified earlier relating to the issue of exclusionary conduct and whether Rambus acquired market or monopoly power through exclusionary conduct.

Have you reached conclusions on that issue?

A. Yes, I have. I find that Rambus's alleged conduct is in fact exclusionary.

Q. And can -- again in summary form, can you walk us through the basic conclusions that you've reached in that regard?

A. Yes. Providing false or misleading information -- and I will remind you that I'm making assumptions rather than conclusions about the specific conduct -- but generally in terms of market performance, so that is the economic analysis of false or misleading information, that often has the effect of being exclusionary.

And the reason is false information causes decision makers to incorrectly evaluate the various alternatives they face, and when decision makers are

trying to choose the best product, they may fail, they may choose an inferior rather than a superior product because they have incorrect information about the alternatives.

And so the provision of distorted information is often exclusionary, and this case is no exception.

Q. The second bullet point under the exclusionary conduct point relates to exclusion of equally efficient or superior alternative technologies.

How does that relate to your conclusion that Rambus' challenged conduct or what you've assumed to be Rambus' challenged conduct is exclusionary?

A. Again, the definition of "exclusionary" is the exclusion of equal or superior competitors, and so in this case the competitors are alternative technologies and the nature of the exclusion comes about from the provision of misleading or incorrect information.

Q. And then the third subbullet refers to a

7169

conscious choice to jeopardize the enforceability of patented intellectual property.

Do you see that?

A. I do.

Q. How does that point relate to your conclusions that Rambus' challenged conduct is exclusionary in the economic sense?

A. So there is a substantial amount of evidence -- and again, I'm not here to testify about the evidence. I'm relying on the evidence.

MR. STONE: Your Honor, may I interrupt the witness to interpose an objection.

You had said in your in limine order that he would not be allowed to testify about any aspect of the issue that included respondent's state of mind. And for him to go in and say there is a substantial amount of evidence, whether it supports an assumption or a conclusion, is testifying about his evaluation of the evidence on an issue that is clearly within the court's province to decide, Rambus' state of mind, and not something that economists or engineers or others have any particular expertise.

JUDGE McGUIRE: Mr. Royall?

MR. ROYALL: First, I'd ask that Mr. Stone not interrupt the witness' answers to make his objections

7170

because I think his answer would have made clear that he is not speaking as to the state of mind of any Rambus representative or anyone else. He's talking about economic theory that relates to conscious choices and evidence that bears on that economic theory.

JUDGE McGUIRE: I'll hear the testimony and then I'll rule.

BY MR. ROYALL:

Q. Let me go back and re-ask the question, Professor McAfee.

Could you explain how this last bullet point in the list of the three subbullets on DX-129, that is, the point that refers to conscious choice to jeopardize the enforceability of patented intellectual property, how does that point relate to your economic conclusion that Rambus' challenged conduct or what you assume to be its conduct is exclusionary?

A. Perhaps I can best put it this way.

The choice -- it's a -- it would be a very large cost, a very large economic cost, to risk patented technology when you are a firm that deals only in patented technology, when that's your product, and so risking the enforceability of your product would be a very large cost.

7171

If it's found that Rambus in fact did take such a risk, then a natural economic question is why, what was the economic purpose of undertaking such a risk. And I find that the chance of enforcing -- the prospect of creating a monopoly on the JEDEC standards is a compensating gain for undertaking what would be such a large risk.

Q. And does this element to your exclusionary conduct analysis that relates to the taking of risks in this context relating to the enforceability of intellectual property, do your views in that regard have a basis in economic theory or in economic literature?

A. Oh, yes, they do. And in fact, it's quite parallel to the antitrust reasoning on or the economic reasoning on predatory pricing.

The question with predatory pricing is how do you understand -- so let me back up and say what is predatory pricing.

Predatory pricing is charging below cost as a way of driving out competitors or excluding competitors, and so it comes from the exclusionary conduct area of industrial organization.

And the question is why would a firm, why would it ever be rational for a firm to charge below cost,

7172

and the answer is, if you're successful in excluding your rivals, then you can enjoy the fruits of the monopoly; that is, you can recoup the costs you've incurred through the benefits of monopoly. And this is quite a parallel analysis to that.

Q. Now, before we move on to the next slide --

JUDGE McGUIRE: Before we move on, let me rule on the objection. It's overruled in the context of his testimony, and that's an area you can properly take up on cross-examination.

MR. STONE: Based on the answer, Your Honor -- and counsel is right, I shouldn't have interrupted him, and I recognize we don't have a jury here and we can move to strike when it's done -- after I heard the testimony as it was limited, I agree that the objection should have been withdrawn, and if not --

JUDGE McGUIRE: Thank you, Mr. Stone. Mr. Royall, you may proceed.

MR. ROYALL: Thank you, Your Honor.

BY MR. ROYALL:

Q. Before we go to the next slide, Professor McAfee, let me ask you about the very last item on this slide, DX-129.

Can you explain the point that you're making in that last bullet point?

7173

A. Yes. The nature of the exclusionary conduct is -- operates through JEDEC's standardization process. That is to say, it is the distortion of the information available to JEDEC that is the driver or the basis on which the monopoly power has been obtained.

And so the nature of the exclusionary conduct is the distortion of JEDEC's standardization process.

Q. Now, let's go to the next slide, which corresponds with the fourth of the five key economic questions that you've identified earlier, specifically the question of whether Rambus' conduct or what you assume to be Rambus' challenged conduct resulted in anticompetitive harm, actual or threatened.

Can you explain in summary form the nature of the conclusions that you have reached on that issue?

A. Yes. There are a variety of anticompetitive harms that are created by the monopolization. And some of those are directly in the technology markets themselves. We've seen the prices increased over what they would have been in the relevant technology markets.

Q. And for the record, I believe this will be DX-130.

In addition to the point that you just made

7174

relating to the increase in prices or that effect of -- economic effect of Rambus' conduct, you mentioned several other points. Let me ask you to take each one at a time.

Let's start with the second subbullet that refers to actual or threatened distortions of competition.

Can you explain what conclusions, if any, you've reached relating to that issue?

A. Yes. There are a variety of distortions to behavior that have arisen as a consequence of the -- of a monopolization.

One is that innovation itself has been misdirected. It's been directed in -- it's been directed at an avenue that it would not have been but for the conduct.

Another is that royalties themselves have a -- create a disincentive to further innovation and it's -- a simple way of seeing that is that when a DRAM manufacturer invests in a die shrink or in another way of reducing its costs and hence produces a larger volume, part of the benefits flow to the royalty -- through royalties, so that is, it's a dampening of the incentives to innovation because part of the benefits

flow to Rambus.

7175

And so there's a variety of harms to innovation in that way in these technology markets themselves.

Q. In the prior point that we focused on, I believe in response to my question you said that you've concluded that Rambus' challenged conduct or what you assumed to be its challenged conduct has had the effect of substantially increasing prices in the relevant technology markets?

A. Yes.

Q. Was that the point that you made?

A. Yes.

Q. Have you reached any conclusion as to whether Rambus' challenged conduct has had price-related effects in markets for the physical DRAM products themselves as opposed to technology markets?

A. I would put that as it threatens to have that effect. As an economist, I expect it to have a long-run effect.

The nature of DRAM production is such that even a 5 percent royalty would not typically cause them to reduce their current production, and as a result you wouldn't expect to see the current prices of DRAM rise even in the face of a 5 percent royalty.

On the other hand, that such a royalty does

7176

produce a disincentive to further plant building, to going to a larger wafer size and other means of producing more output in the future, and as a result you would expect in the long run that those royalty costs would be passed on to consumers and hence have the effect of lowering output in the downstream DRAM market.

Q. And would the lowering of output in downstream DRAM markets have any effect on price in those markets?

A. Yes. It would have the effect of increasing the price.

Q. And the final point you make in this slide relates to undermining confidence in open standards and standards processes.

Can you explain what you mean by that?

A. Yes. The open standards and standard-setting processes are very important not just in this market but in other markets as well. And the ability for those standards to be monopolized is a threat to the standard-setting process, to standard-setting processes more generally, not just to DRAM standards.

Q. And do you conclude that Rambus' challenged conduct has had such an effect in the markets that you've focused on?

7177

A. Well, let me say that it certainly threatens to.

Q. And let's then go to the final key economic question and the summary of your conclusions on that question. This will be I believe DX-131.

And the question is: What remedy, if any, is needed to restore competition or to alleviate the anticompetitive effects of Rambus' conduct?

Have you reached conclusions relating to that key economic question?

A. Yes, I have.

Q. And can you explain the nature, in summary form, the nature of your conclusions?

A. Well, economists normally start to remedy questions by trying to undo the damage that has been done. That would be the normal benchmark.

In this case, because so much time has gone by, literally, undoing the damage doesn't seem to be feasible, and as a consequence economists go to a second best approach of trying to undo the effects of the monopolization or the effects of the challenged conduct. And here undoing those effects requires undoing the monopolization itself.

Q. I'm sorry. Do you have views from the standpoint of economics as to a manner in which through

7178

a remedy the effects of Rambus' anticompetitive conduct could be undone or mitigated?

A. Yes. If the intellectual property that should have been disclosed -- and I should say I'm not the person to testify as to what should have been disclosed -- but if the intellectual property that should have been disclosed cannot -- the patents on that cannot be enforced against DRAM, that would go -- that would undo the monopolization of those markets.

In addition, that -- those markets are worldwide, and so the enforcement would have to be both -- the undoing would have to be both for the U.S. and for foreign countries.

Q. You mention in this slide, DX-131, you mention a date, June 18, 1996.

What's the significance of that date?

A. Oh, that's my understanding of the date that Rambus withdrew from JEDEC, but I should say that's -- that's a fact as opposed to an economic conclusion.

Q. And how does that fact, understanding that you're making an assumption that that is a correct date, but how does that fact factor into your conclusions as to the appropriate nature or scope of economic remedies to address the anticompetitive conduct?

7179

A. Well, again, it's the -- so this is actually in the nature of an assumption -- is that the -- that what should have been disclosed, the intellectual property that should have been disclosed, was that that was available prior to June 18, 1996. But that's not for me to find.

Q. And finally, the last point that you make on this slide, DX-131, can you explain the point that you're making here?

A. Yes. These remedies will restore competitive pricing because they eliminate the monopolization and they will mitigate in an ongoing sense the anticompetitive effects.

Now, they don't fully undo all the effects because you do have misdirection of efforts as an issue, but they would go very far towards mitigating the effects.

MR. ROYALL: Your Honor, for me this would be a convenient stopping point.

JUDGE McGUIRE: Then let's take a break for ten minutes.

The court is in recess.

MR. ROYALL: Thank you.

(Recess)

JUDGE McGUIRE: You may proceed, Mr. Royall.

7180

MR. ROYALL: Thank you, Your Honor.

BY MR. ROYALL:

Q. Professor McAfee, we've now covered the nature of your assignment, your general understanding, your assumptions about Rambus' conduct, the key economic questions that you've identified, and in a summary way we've covered some of the conclusions that you've reached.

Now I'd like to ask you about the process that you went through in reaching your expert conclusions on these economic issues.

Can you tell me, with all of the information that you've collected and that you've reviewed that you described earlier, what, in terms of your methodology or your analytical approach, what was the first thing that you did or needed to do in order to reach conclusions on the issues that you've identified?

A. The basic starting point is an economic model of the DRAM industry, and that includes the technology industries, DRAM itself and the related devices, and so this is a model -- it's to produce a model and an understanding of how this industry functions, how it operates.

Q. Before we go into the substance of what you

7181

have to say on that, let me ask you this.

Why was it important for you, in reaching conclusions on economic issues relating to this case in the context of the allegations in this case, why was it important for you to develop an understanding or an economic model for competition in the overall DRAM industry?

A. Well, this is the basic tool of economic analysis, is the economic model of the competition and the behavior in these marketplaces, and so this is very much the heart of an analysis, is an understanding or a model of the economic influences and determinants of outcomes in the marketplace.

Q. And when you refer to economic influences, are you -- and determinants, are you referring solely to economic influences and determinants in the DRAM technology markets that you've identified earlier as the relevant markets?

A. No, I'm not. In fact, in order to understand the DRAM technology markets, I need to understand the markets in which those technologies are applied, and that would be DRAM manufacturing and the manufacturers of related products like chipsets. But it doesn't stop there.

In order to understand DRAM manufacturers, I

7182

need to -- and the influences on DRAM manufacturers, I need to understand their customers, and those are -- this is set out in this slide -- are the PC original equipment manufacturers, servers, fax machines, and other uses for DRAM technology.

And in order to understand those market participants, I need to understand their consumers, the people that they sell to, and the -- so the final consumers for the product.

And so ultimately to understand the influences on the technology market, those are all derived -- it's what economists call derived demand -- derived ultimately from the final consumer.

Q. And just to be clear, when as you've said you need to gain an economic understanding of competition at these various levels, is that for the purpose of defining relevant markets or does it relate to other key economic issues that you have identified?

A. It relates to all of the -- I think all five of the issues are related to this. And it's not just for

defining markets, because in order to understand the economic incentives in the technology markets, one needs to understand how those incentives were derived or what were they derived from.

Q. We have on the screen now a slide entitled

7183

DRAM Industry Overview. I believe this will be DX-132.

Is that correct, Your Honor?

JUDGE McGUIRE: Yes.

BY MR. ROYALL:

Q. Is this a slide that you've prepared, Professor McAfee?

A. It was prepared under my direction, yes.

Q. And can you walk us through -- there's a diagram here. Can you walk us through generally what this diagram shows and why it's significant to your testimony?

A. Yes. This diagram shows at the top the markets that will be the relevant technology markets and it shows the technology providers. That technology goes directly into two kinds of manufacturing, into the DRAM manufacturers and also into -- the technology also goes into the manufacturing of products that are related to that, so it includes everything from processors to chipsets.

So the same technologies are flowing into both of those markets.

Both of those products are then used in the PC market, in the servers and other products that involve DRAMs, and so that's shown in the third-level box.

7184

Q. And then what does the fourth-level box show? And by that I'm referring to the final bottom level where there's a reference to consumers.

A. It shows that the influences on those companies besides, of course, the technology influences that flow down in this diagram are also derived from the final consumers to which they sell.

So for example, the influences on a Dell, Dell Corporation, are the willingness to pay by the final consumer.

Q. And by "final consumer" here are you referring to commercial consumers or to household consumers?
A. To both. The final consumer includes businesses -- there are PCs all over the room -- and it includes individuals and households.
Q. And in the third level of boxes or figures here you refer to PCs and servers.
Are those products that you understand to use or incorporate DRAM?
A. Yes. I think all PCs have DRAM and servers are actually large users of DRAM as well.
Q. Are there other products that you understand use or incorporate DRAM devices?
A. Yes, there are. And I've prepared a slide.
Q. I'm sorry. This next slide entitled DRAM

7185

Buyers will be DX-133.
I'm sorry. Can you explain what you mean to depict through this slide?
A. Yes. This sets out major uses for DRAM technology in various -- in various different devices, and so you can see that the lion's share goes to personal computers.
Let me say that memory modules -- a memory module is not a final use. It's a device which is then plugged into another device, so if you go to buy DRAM to upgrade your own PC, you buy a memory module which you then plug into your -- onto the motherboard of your PC.
And so that use is going to be distributed among the other uses, but I don't have a specific breakdown of those, of that 19 percent.
Q. And so in addition to personal computers and memory modules, what other types of products are DRAMs used in?
A. Well, there's printers, routers and fax machines, for example, is one category. The workstation is actually a personal computer; it's just a specially brawny personal computer, specially powerful personal computer.
Servers are devices that route Internet traffic

7186

and for that matter they're a specialized kind of personal computer that is used for distributing documents and Internet traffic.
There are other -- you know, mainframe computers are the big machines like IBM makes, Cray. And then there are other uses of DRAM that are relatively specialized.
Q. And to your knowledge, are the same types of DRAM devices used in each of these various applications, or do the types of DRAM devices differ with the application?
A. Well, broadly speaking, the same types of DRAM are used in most of these.
Now, let me say that there are old technology that are used in very low-end devices and there are -- is generally new technology coming into the market or specialized RAM that's used in very high-end devices. There's a tiny amount of RAM that's hardened to withstand a nuclear explosion and in such a small amount that it wouldn't show up here, but its use is classified. There are some specialty DRAMs. But broadly speaking, it's the same DRAM being used in these devices.
Q. And do you have an understanding as to why firms in these various different application markets

7187

that you've identified in DX-133, do you have an understanding as to why firms in such diverse markets, generally or broadly speaking, all use the same type of DRAM?
A. Yes. It flows from the basic economics of determinants of DRAM use. And the basic economics of the DRAM industry.
Q. And do you have a slide related to that issue?
A. I do, yes.
Q. Let's go to the next slide. This will be DX-134. This slide entitled is entitled Basic Economics of the DRAM Industry.
And are the points that you list here, do these relate to your understanding of the economics of the DRAM industry, broadly speaking?
A. Yeah, they do.
Q. Let me ask you if you can walk through each of them starting with the first point, large capital requirements. What are you referring to there?
A. This is the -- what economists refer to as the minimum efficient scale of DRAM production is enormous and growing.
So a minimum efficient scale is what's the smallest plant that you can build that's cost competitive and that's the capital requirement for a

7188

plant in that industry. And the minimum efficient -- I have a slide that sets out the costs of DRAM fabrication plants.
Q. Let's go to that slide quickly and we can come back. This will be DX-135.
Is this the slide you're referring to?
A. Yes, it is.
And this slide shows that the minimum efficient scale or the efficient scale plant associated with DRAM manufacture has grown from roughly $200 million to over one and a half billion dollars over this time span.
Q. And the one and a half billion dollars, is that the most recent figure that you're aware of or is that a figure that's --
A. It's the most recent figure that this particular diagram shows, but this is actually an eight-inch, so that refers to the wafer size that's being used, an eight-inch wafer and a .25 micron, so a quarter micron feature size, and they are already at a tighter feature size than that and I don't know if anyone has actually deployed a twelve-inch wafer yet, but I know that the next size wafer is supposed to be twelve-inch wafers and those will be substantially more expensive plants to build.

7189

Q. And the cost that you're referring to in this slide, DX-135, which for 1999 appear to be north of $1.6 billion, is that the cost of producing or the cost of building a single DRAM plant or is that a cost for multiple plants?
A. That's -- my understanding that's the cost of a single plant.
Q. Let's go back to the prior slide, DX-134.
And you were explaining when we went to that slide the issue of large capital requirements. I think you may have touched on economies of scale, but can I ask you to come back to that point and ask you to explain what you mean by that?
A. So economies of scale refer to if you make more of an item or of any product, it costs less per unit. And many products have this feature, that if you make more of it, it will cost less per unit. The DRAM industry is no exception.
Generally when you get very large capital

requirements, you get long economies of scale for a fairly large interval of production possibilities, and so DRAM is an example of an industry with major economies or significant economies of scale, part of which flow out of the large capital requirements.

Q. Let's go to the next point, interoperability.

7190

What are you referring to there?

A. So interoperability refers to the need of DRAM to work with other components in the system. That is to say, DRAM by itself is generally not used for very much. It's only used in the context of -- in fact, it's pretty close to useless by itself. It's only used in the context of other electronic components like controllers and processors, and so forth.

So interoperability refers to the need for DRAM to work with other components in the system. And this is something about which there's been a substantial amount of trial testimony.

Q. Let me ask you if you could explain your economic views on the issue of interoperability by reference to a demonstrative that was identified earlier in the trial.

A. Yes. I have –

MR. ROYALL: This is a picture, Your Honor, a digital picture of what was previously marked in the case as DX-30 during the testimony of Mr. Heye, the AMD witness.

BY MR. ROYALL:

Q. Do you see this on your screen, Professor McAfee?

A. I do.

7191

Q. Now, Mr. Heye explained what this diagram meant to him as somebody who's in the microprocessor business.

What, if anything, do you have to say about this diagram from the standpoint of your economic testimony on the issue of interoperability?

A. Well, this diagram also illustrates the economic concept that is sometimes known as network externality, that the design of the memory -- memory has to work with other products. It has to work with the chipset, which is represented here in the form of the Northbridge. It has to work with the processor because the memory -- the processor is what will actually use the output of the memory.

Mr. Heye also testified it works with the BIOS. It has to be designed to be compatible with the BIOS.

And all of this shows the set of components with which the memory has to interoperate, that is, the memory has to function in a coordinated manner with.

Q. And that's when DRAM memory is used within a PC system or network?

A. That's correct.

Q. And would there be different interoperability

7192

issues when DRAMs are used in other contexts other than the PC system?

A. Yes. For example, with a fax machine or a printer, you typically have a chip that's a controller which often will have the both processing and memory controlling capability, and the DRAM has to work with that chip, and so it then has a specialized part number.

The PC is a larger device. There tend to be more interoperability issues on a PC than on a fax machine or a printer, but the same kind of interoperability requirements arise.

Q. Let's go back to DX-134. You were explaining these points on the basic economics of the DRAM industry. We just covered interoperability.

Let's go to the next point, price sensitivity. What do you mean by that?

A. So -- and there's been testimony on this point as well, but it's an economic concept of price sensitivity, what economists call actually elasticity of demand. Consumers are very sensitive to price.

And price sensitivity refers to the unwillingness to pay for -- to pay increased prices or the general loss in quantity demand when prices rise. And here those are driven by the PC user ultimately.

7193

So when memory prices fall, you see a large amount of upgrading of PCs, you see a large increase in the sales, and generally we've seen lots of testimony about the resistance by consumers to paying price -- paying increased prices for increased performance.

And if I could, I would like to explain the reason for consumers to feel that way.

Q. Now, let me ask you to do that, and just to be clear, this -- you're offering a view from the standpoint of economics as to the economic explanation for the price sensitivity that you've heard discussed by witnesses --

A. Yes.

Q. -- and seen referenced in documents?

A. Yes.

Q. Okay. What is the economic explanation or what do you have to say from the standpoint of economics on that issue?

A. A major portion of the economic -- of the use of DRAM is in the PC industry. And if a consumer looks at having a small amount of very fast DRAM, so if you have 128 megabytes on a modern machine, a very fast DRAM, on occasion your system will not have enough memory to store what the processor needs, and

7194

what it will do in that instance is actually write to the hard drive. It will store information on the hard drive. And compared to even the slowest DRAM, hard drives are very slow.

And so the effect -- it's what's known as virtual RAM. The effect of this is that a system that has a small amount of very fast RAM will not perform as well as a system that has a large amount of slower RAM. And this means that consumers generally are just trying to get more RAM rather than get fast RAM.

Now, that's not to say that they don't value fast RAM. They do value fast RAM. But the trade-off is often located for consumers on the what I really need is more RAM as opposed to fast RAM. And that puts both price sensitivity towards new technologies or faster technologies and this emphasis on very large volumes of commodity kind or basic DRAM.

MR. STONE: Your Honor, I'd like to move to strike the testimony about consumer behavior and what consumers do unless it's simply an assumption this witness has made.

He was not qualified as an expert on consumer behavior nor has any foundation been laid for any sort of consumer survey.

So as to what consumers do in buying PCs, it's

7195

outside the area of an industrial organization economist, outside the area of any of the foundation he's testified to, unless he's simply saying "I'm making that assumption" and then that assumption will

rise or fall in the evidence in the record.
JUDGE McGUIRE: Mr. Royall?
MR. ROYALL: Your Honor, I think that this is squarely within the scope of industrial organization economics as he explained earlier, so I think there is a foundation.
He's talked about that an industrial organization economist studies markets and how markets operate from a supply and demand standpoint, and in referring to consumers, he's simply referring to the demand or the demand side of the marketplace and what economic conclusions he's drawn.
He certainly can be cross-examined on that issue, but I see no reason to limit his testimony. Indeed, it would be a serious problem if an economist were not permitted to give economic testimony about the demand side of the markets that he's focused on.
MR. STONE: Your Honor, this is not an issue on which he gave us a report. If he's being proposed as someone who can give expert testimony on what consumers do in the marketplace, it's not within scope of his

7196

report.
More importantly, no foundation has been laid that he has any basis for testifying to it. It may be the subject on which economists do from time to time testify, but it's not a subject on which they've laid any foundation that he has expertise to testify or that he's done any work.
If he's simply saying the evidence in this case will establish whether consumers act that way or not, then we can go back and look at the record and see if there's evidence to support that.
JUDGE McGUIRE: All right. Is he basing his testimony on his assumptions of the evidence in this case or is he -- the other question I wanted to ask, are these conclusions included in his expert report?
MR. ROYALL: Your Honor, I would submit to you that his expert report, the principal portion of which is nearly 200 pages long --
JUDGE McGUIRE: My question isn't how long. My question is: Is this proposed testimony included in there in some way, shape or form?
MR. ROYALL: Yes, it is, Your Honor. There is an entire section in Professor McAfee's expert report that relates to factors that influence demand of DRAMs and the factors that influence consumer decisions in

7197

DRAM markets.
There are other sections of his report that discuss factors that influence the demand in DRAM technology markets.
For Mr. Stone to say that they have not been given a report on that issue is quite incorrect, and we could take the time to demonstrate that. But again, I don't see the point in this.
This is squarely within the scope of his testimony, it's within the scope of his expert report, and it would be a serious artificial limitation on the testimony of this witness if he weren't able to get into these issues and explain his views.
JUDGE McGUIRE: Mr. Stone, one last comment.
MR. STONE: Yes, Your Honor.
Setting aside whether we can go through the report to find a reference to that, the support for that is under the decision of Daubert in Merrell Dow, which holds that this witness has to have been qualified as someone who has particular expertise in consumer behavior.
That expertise has not been shown, and for him to testify I have an opinion as to why consumers do or do not make certain purchasing decisions is outside his area of expertise.

7198

JUDGE McGUIRE: I'm going to hold this in abeyance until I've had a chance to hear all the testimony, and that is certainly an area I expect you to go into on cross-examination, and I will then determine post-hearing the proper weight, if any, to give this line of inquiry.
MR. STONE: Thank you, Your Honor.
MR. ROYALL: Thank you, Your Honor.
BY MR. ROYALL:
Q. Now, let me go back to where we were, but first of all, just to cover the foundational issue, let me ask, Professor McAfee, in connection with the type of economic analysis that you've done in answering the five key economic questions that you identified earlier, was it important for you in any way to consider factors that influence the demand of either DRAM or DRAM technology?
A. Yes. Of course economists always needs to know both supply and demand and to have an understanding of supply and demand and that would be a normal part of the inquiry.
And because demand for DRAM technology is derived from the demand for DRAMs themselves and the demand for DRAMs themselves is derived from the demand for the final products in which DRAM is used,

7199

ultimately the demand for the technology traces back to the demand for the final good.
And so it's important to have an understanding of the demand for the final good to understand what is the derived demand for the DRAM technologies.
Q. And you mentioned earlier that your area of expertise in economics relates to something called industrial organization economics.
A. That's correct.
Q. Does industrial organization economics in any way relate to the study or analysis of consumer behavior?
A. Well, consumers are the final demand for most of the products that industrial organization economists study, and so an understanding of consumer demand is integral generally to the study of those marketplaces.
Q. And in performing your economic analysis in this case, have you undertaken any sort of study relating to consumer demand or consumer behavior or choice?
A. Yes. I have reported on consumer demand in my report and I have labored to understand the determinants of consumer demand as a way of understanding the derived demand ultimately for the

7200

technologies at issue in this case.
Q. And does your analysis of issues relating to consumer behavior and consumer demand, does that have an important bearing on your ultimate conclusions on the key economic issues that you identified earlier?
A. Yes, it does. In fact, I have – this issue of price sensitivity about which we spoke is one that shows up at several points in the analysis.
Q. Now, let's go back to slide DX-134.
I was asking you earlier I believe about price sensitivity, and in your answer I think you may have referenced the word "commodity," which is the next point.

Let me ask you now to turn to that last point on DX-134, commodity nature of DRAM. What are you referring to by that language?

A. So that actually refers to -- economists call wheat a commodity, a product in which you don't care who makes it, so it's the classic commodity. You don't care the name of the farmer. It's not branded.

A commodity refers to a product where the identity of the manufacturer is for all intents and purposes irrelevant. The products that are commodities are perfect substitutes for each other, that is, within a given commodity segment.

7201

So wheat from one farmer is a substitute for wheat from another farmer and is traded as such.

And DRAM, it's not a perfect commodity, although few things are perfect commodities, DRAM is very close to a perfect commodity in the sense that the standardized DRAM from any manufacturer will work in any particular type; that is to say, a PC133 SDRAM will work in any computer that takes a PC133 SDRAM, and it doesn't matter whether it's Samsung or Micron or Infineon who made it.

Q. And what are the economic implications of this commodity nature of DRAM?

A. Well, there are a variety of them. One is the consumers -- the consumers value this partly to have multiple sources of supply -- here by "the consumers" I'm referring to the original equipment manufacturers -- they value the commodity-type DRAM because that gives them multiple sources of supply which reduces their risk and other -- and ensures price competition.

In addition, consumers, final consumers, have some value for it. What makes it more likely that the product will be available when they go to upgrade.

All of these factors influence in turn the way in which the technologies are selected. And the reason

7202

is given the value that's placed on the commodity nature of DRAM, the process by which technologies are selected put an emphasis on standards that applies to all companies that are in the marketplace.

Q. In connection with your work and your economic analysis in this matter, Professor McAfee, have you gained or sought to gain an understanding as to who produces, that is, what companies produce commodity DRAM devices today?

A. Yes. And I have a slide to show the --

Q. Let's go to the next slide, which is DX-136.

What does this slide show?

A. Well, this slide shows the home countries of the various DRAM manufacturers in the marketplace today. The major manufacturers.

So it shows Micron from Boise, Idaho; Infineon from Germany; and Samsung from Korea, and so on.

Q. If I didn't ask already, let me ask now. What was the time frame for your economic analysis, what period of time did it span?

A. 1990 to roughly 2000-2001.

Q. Are these companies depicted on DX-136, are these the companies that have been producing DRAM to your understanding throughout the time frame that's relevant to your analysis?

7203

A. No. And I've prepared a slide to illustrate, illustrate that.

Q. Let's go to the next slide, DX-137, I believe.

JUDGE McGUIRE: Yes.

BY MR. ROYALL:

Q. What does this slide show?

A. This shows on -- I've forgotten what year, but this shows DRAM manufacturers in the past and shows that there used to be in fact a lot more distinct companies manufacturing DRAM.

Now, some of the plants of these companies are still in operation; that is, they've been incorporated into the existing companies today. But this shows that there were a lot more players.

For example, some of the Japanese companies have merged -- their operations have merged and have a new name. In fact, it's fairly hard to keep track of all the companies, the current names of the companies producing DRAM.

Q. Are there any U.S. companies that in the past during the time period you focused on were producers of DRAM but today are no longer producers of DRAM?

A. Yes. This slide shows three, IBM, Intel and Texas Instruments.

Q. Now, I believe that you mentioned in your

7204

earlier answer that there has been consolidation in the DRAM manufacturing business. Is that your understanding?

A. That is my understanding.

Q. And have you had occasion as part of your economic analysis, have you had reason to probe why there has been a consolidation over time in the DRAM manufacturing business?

A. Yes, I have.

Q. And what views or conclusions have you reached in that regard?

A. Well, they also flow from the economics of DRAM production. And I've prepared a slide to --

Q. Let's go to the next slide, which is DX-138.

Is this the slide you're referring to?

A. Yes, it is.

Q. And this slide -- we had a slide earlier that I believe you titled Basic Economics of the DRAM Industry.

How does this slide differ from that earlier slide?

A. This slide is about DRAM production, so this is -- the earlier slide was about an overview of the industry itself. This is only about the supply side of the industry, which is determined by the production

7205

technologies and costs.

Q. So this slide -- we talked earlier about the distinction in your analysis between supply side considerations and demand side considerations.

This slide is only referring to the supply production side of your analysis?

A. Yes. That's correct.

Q. And let me ask you to explain what you mean by the points that you list here relating to DRAM production and starting with the first point, high fixed costs.

A. So we already saw a slide about the increasing cost of plants, and that's what this refers to, that the scale of operation in the plant, the minimum efficient plant size, has grown over time. And this fact probably by itself explains the consolidation in the DRAM production, DRAM industry, that the increasing capital requirements and fixed costs and technological costs, costs of testing and the like, have forced a shake-out and consolidation in the industry.

Q. What about the next bullet point, volatility, cyclicality? What are you referring to there?

A. From an economist's perspective, one of the

most interesting features of the DRAM industry is its
7206
extremely volatile and cyclical nature. And one way of understanding the volatility and cyclicality of this is -- arises out of the production process and the sort of basic economics of the production process.
When there's a die shrink or other changes to the production, often it takes a while to perfect that process; that is, there is a substantial amount of learning by doing. And the effect of this is that you may go from, according to the industry reports, you might go from only having half of your chips on a given wafer actually function to having over 90 percent of them, and that's nearly a doubling of supply and that may happen in a twelve-month period.
That along with the coordination of the industry in its production process means that you get pretty large increases of supply in a very short period of time, and that can cause prices to plummet. And so you get a -- you get a cycle, a price cycle essentially, driven by the technology.
Q. And referring to the third bullet point in the slide, intense price competition, what are you referring to there?
A. When manufacturers sell different products, they all have what you could think of -- what economists call market power, but you can think of
7207
little local monopolies. They have something that's unique about their product.
When manufacturers sell identical products, they have nothing unique about their product, and the effect of this is the customers make the determination of what to buy essentially only on price. And you know, there may be some minor, minor considerations like whether the -- other than price, that is, the company may be a little bit better at packaging or something, but primarily price is the major determinant. And that makes for -- the fact that the products are identical -- and we talked about the commodity nature of DRAM -- makes for intense price competition.
Q. Moving to the next point, maximize capacity utilization/yield, what are you referring to there and how does that relate to the economics of DRAM production?
A. Well, I actually have a slide to -- that talks about the methods of this, but let me say first, before we go to the slide, that the high fixed costs, these very large fixed costs of the plants, dictate that -- and the intense -- the combination of the high fixed costs and the intense price competition dictate an extreme pressure on cost.
7208
That is to say, the focus of the DRAM manufacturers needs to be on cutting costs, because if their costs are a little bit higher than the going price, they'll slowly go out of business. They'll bleed to death. And so -- and whoever has the low cost enjoys the proceeds of that low cost, and so the effect of this is to create enormous pressure on cost reduction. And I have a slide that --
Q. Before we go to that slide, is cost reduction or cost-cutting related in any way to the point you make in the fourth bullet here about maximizing capacity utilization and yield?
A. Yes. In fact that maximizing capacity utilization is a consequence of intense cost pressure and the combination -- and the fixed costs. The fact that you have very large fixed costs means that you want to run your plants full out.
Q. Well, let's go to the next slide, which will be DX-139.
Now, is this -- in this slide are you giving more detail to the points you mentioned earlier about cost reductions and increasing capacity or yields?
A. Yes.
Q. Is that the purpose of this slide?
A. Yes. This illustrates some of the means by
7209
which manufacturers attempt to minimize their per-unit or average cost.
Q. And what -- the first bullet refers to 24/7 operation. What are you referring to by that term?
A. That's operation every hour of the day every day of the year or every day of the week.
The Infineon plant attempts to never shut down, that is, to operate continuously. They did actually

shut down for a snowstorm once. They attempt never to shut down because it's an extremely expensive plant and you want to amortize the cost of that plant over as many wafers and chips as possible.
Q. And so running the plant twenty-four hours a day seven days a week is -- you understand that that is motivated by the cost -- the pressures to reduce cost that you'd mentioned earlier?
A. Yes. This is a way of lowering the average cost because it amortizes the fixed cost over a larger volume.
Q. What about the next point, clean rooms? What does that refer to and how does that relate to reducing costs or increasing yields?
A. So at a .2 micron feature size, at a very small feature size, a speck of dust that falls on the chip
7210
will actually tend to short-circuit that chip, that is, disable the chip.
And so they go to extraordinary lengths to -- I think there's been testimony to this effect -- to have the cleanest facilities possible and to have one part per cubic foot of dust, and just to give a comparison, a cubic foot of dust is something like two million particles every hour.
Q. And have you seen these clean rooms directly when you toured the DRAM facility, did you see this in operation?
A. Yes. And when you take the tour, they require -- you like have to put your shoes in a -- in containers to keep them -- keep dust off your shoes, you know, a head net. You can't take notes except on special paper that is dust-free and they have a special pen so the ink doesn't float around.
And this is not going actually into the clean room; this is they want the room next to the clean room to be also clean, because every time someone goes into the clean room, there's a chance for dust in the next room to filter into the clean room.
And so they go to extraordinary lengths and produce much cleaner facilities than any other operation.
7211
Q. And you understand that those efforts are related to costs and yields?
A. Yes. Again, every speck of dust potentially destroys one of their chips and so they try to -- they expend very large amounts of money to try to reduce the loss in yield.
Q. And the next bullet point refers to extended equipment life. How does that relate to costs and to

yields?
A. The equipment that is used to manufacture DRAMs is quite expensive and getting more expensive every time they shrink the feature size because a major component, for example, of the equipment are the masks which you use to photoetch the silicon wafers, and as they -- as the feature size gets smaller, the technology used in those masks -- again, all of this stuff is not visible. The feature sizes are not visible to the naked eye. It's minuscule -- are shrunk. Given the cost of those, you would like to amortize their use over as many wafers as possible.
And so the expense of the equipment creates an economic incentive to use the equipment for longer periods of time if possible.
Q. Let's go to the next point, optimize production process. How does that relate to costs and

7212
to yields?
MR. STONE: Your Honor, before we start this answer, if I might object.
We've heard this testimony from Mr. Becker and we heard this testimony from Mr. Williams. This is a matter of fact in the record of how many dust particles humans give off and how clean the rooms are, and I don't think -- all this witness is doing now is simply repeating evidence that's in the record. I think it's unduly cumulative of what we've already heard.
JUDGE McGUIRE: All right. Let me be clear on this, Mr. Royall. He can refer to prior testimony, but I'm not going to allow him or any other expert to sum it up.
So maybe you're walking a fine line here, but there are points where you're going to cross it and I'm not going to allow it, so you know, you decide how you want to proceed on that, but I'm not going to add time to this proceeding with testimony that we've already heard.
Now, if he wants to make a reference to it, that's one thing, but again, I'm not going to allow him to sum it up.
MR. ROYALL: I understand, Your Honor. And I

7213
did not intend to ask Professor McAfee to provide a summary of what others have said, but I do think it's important and fully appropriate for him to give an economic explanation of the factors that he's identified that influence the economic functioning of the markets that he studied.
JUDGE McGUIRE: Well, that's fine and he can do that.
And this is also for you, Mr. McAfee, and keep what I've said in mind when you respond to some of these questions. Okay?
THE WITNESS: Yes, Your Honor.
MR. ROYALL: Thank you.
BY MR. ROYALL:
Q. Now, going to the next point -- and again, I'm asking for your explanation of the economic conclusions that you've reached relating to these various points -- what, if any, conclusions have you reached in your economic analysis relating to the optimization of production processes and how that affects costs or yields in the DRAM production business?
A. An important conclusion from the testimony concerning the efforts taken to optimize the production process is the lead time, that is, production

7214
process -- the optimized production process doesn't happen overnight. There's actually a substantial amount of time that's taken.
And so in -- what's important for the economic analysis is that the efficient or the expedient way to introduce a new generation of product, for example, is you run small batches -- and this has been testified to -- you run small batches for a period of time until -- and maybe revising those designs, learning by doing, while you're producing in large volumes some other product.
And that the lead times in that case are actually substantial. That there may be six months, twelve months, even eighteen months of lead time, depending on the nature of the production process.
Q. Going to the next point, and again not -- I'm not asking for you to summarize what -- you testified earlier that you've read essentially the trial record. I'm not asking you to summarize what you've seen in the

trial record relating to this but just to explain what economic conclusions, if any, you have drawn relating to now the next point, die shrinks, and the economic significance of that issue in connection with costs and yields in DRAM production.
A. So one economic -- one component of the

7215
economic significance of die shrinks is that sometime after they occur you tend to get actually jumps in the supply, that is to say, when you make a 20 percent increase in the supply associated with a single die shrink. And so that makes for sort of lumpy quantity outcomes.
Q. Are there any other economic conclusions that you've reached in relation to the issue of die shrinks that have any bearing or impact on your testimony?
A. Not as I sit here today.
Q. Okay. Let's go to the final point.
What, if any, economic conclusions have you reached relating to larger wafer size and the bearing of that issue on costs and yields?
A. So this is another form of scale economy -- oh, I'm sorry. I do actually remember what I'm going to rely on later with respect to die shrinks. May I go back to my previous answer?
Q. That's fine. Let's do that. We'll come back to the other question.
Just so the record is clear, the question I had asked you earlier is: Are there any other economic conclusions that you've reached in relation to the issue of die shrinks that have any bearing or impact on your testimony?

7216
A. This is so embarrassing. I've now managed to forget. I'm sorry.
Q. The question -- just to give reference to the question, we've been discussing ways the DRAM manufacturers reduce costs and increase yield, and I think that your earlier answer relating to die shrinks had something to do with lumpy supply.
Is there a cost -- is there a cost implication of die shrinks?
JUDGE McGUIRE: All right. Mr. Stone?
MR. STONE: If Mr. Royall wants to prompt the witness to something that I think he expects him to say and has probably just forgotten at the moment, I have no objection to this so we can just expedite this.
JUDGE McGUIRE: Noted.
MR. STONE: That would be fine.
JUDGE McGUIRE: You can prompt him.

BY MR. ROYALL:
Q. Thank you, Your Honor.
And I'm not sure whether there is anything to draw out here, but it's -- it's just Professor McAfee thought he recalled something and I'm just asking whether -- you mentioned something related to supply implications I think with respect to die shrinks. Is

7217
there a cost implication to that?
A. Yes. What I had forgotten was, in some cases these manufacturers are making multiple products, and when they are making multiple products, a die shrink essentially represents a fixed cost for them.
That is, there's an amount of effort that's taken to produce a die shrink. You need masks. You need to actually redesign your production process. You may need different chemicals and photoetching. Essentially it's all fixed -- it's not related to the quantity of wafers that you run through the production process -- the cost of producing the die shrink.
And so the effect of this is, from an economic perspective, if you've got two products that you might apply a die shrink to, you're going to apply it to the product that you're producing the most of. That is to say, the product with the -- that you're producing the most of will be the product you shrink first and it will be the product you shrink most.
And that has the -- and since a die shrink lowers cost by producing more chips per wafer, there's a cost reduction associated with a die shrink, the effect of that is the product that you're producing the most of is the product whose cost falls the fastest, and that's actually very important from an economic

7218
analysis perspective.
Q. Now, very quickly, the last point you mentioned on this slide, DX-139, relates to larger wafer size.
What, if any, economic conclusions have you reached relating to larger wafer size and the bearing of that issue on costs and yields in DRAM production?
A. Well, they would actually be parallel to the die shrink conclusions. That is to say, again, if you were moving to a larger wafer size, you would do it on a product that you expected to sell a lot of or were selling a lot of, and in particular with wafer size, you'd do it to a product where you expected to sell a lot in the future because, again, it's a big fixed cost to move to the next wafer size.
Q. Now, we've been discussing with this slide and some prior slides --
A. I'm sorry. I didn't actually quite finish that answer.
Q. I'm sorry. Go ahead.
A. And it's the feedback effect that's important from an economist's perspective. That is to say, we apply our cost reduction to our majority product and that has a feedback effect of lowering the cost of that product which then through the marketplace leads that

7219
product to even grow even larger as a proportion of the total demand.
And it's the feedback effect that's important from the economist's perspective.
Q. This slide, DX-139, and at least one of the prior slides, if not more, relates to DRAM production, and you mentioned earlier that as part of your economic analysis, an important part of your economic analysis, you focus also on demand side or consumer issues relating to these markets.
Have you reached any conclusions as to the economics of DRAM demand?
A. Yes, I have. And I've prepared a slide to illustrate some of those conclusions.
Q. This slide will be DX-140 I believe.
A. Yes.
Q. Again, you have a number of bullet points here related to the economics of DRAM demand.
Let me ask you to start with the first bullet point and explain what, if any, economic conclusions you have reached and what significance or bearing they have on your overall opinions and conclusions in this case.
A. This DRAM demand -- we actually have multiple levels at issue in this case in the vertical chain of

7220
production, what economists call the vertical chain of production.
Just to place this, this is the level of the original equipment manufacturer, so this is the demand for the DRAM product, not by the final consumer, although of course that is shaped by the final consumer, but for the OEM.
And one of the major factors for the OEMs that's an important attribute of DRAM demand is the requirement or the desire for multiple sourcing. As a factual matter, I think there's been a great deal of testimony on that. But from the economic perspective, the value -- there's a couple of values in multiple sourcing. One is that it reduces risk. It also ensures price competition.
And this is not just a feature of this industry, actually it's a feature of many industries, the desire to have multiple sources for inputs.
Q. Let's go the next point, long lead times.
What economic conclusions have you reached, if any, relating to that issue in the context of the economics of DRAM demand?
A. Long lead times refers to the -- as you change the -- so when a new generation of DRAM comes out, there is a series of things that have to happen, and

7221
we'll go into that somewhat more. But other products have to be, as I mentioned earlier, other products have to be designed that work with that.
And one of the characteristics, which again is actually more of a factual matter, is that some of these take a very long time, and so that's going to have -- that long lead time on the demand side, which that -- to get the product actually used is going to be relevant to the analysis, but that actually is more of a factual matter, that there are long lead times needed, rather than a conclusion which I'm drawing.
Q. And backwards compatibility, do you draw any economic conclusions relating to the subject of backwards compatibility?
A. Yes, I do. Backward compatibility refers to -- backward compatibility refers to some features or maybe all of the features -- different people seem to use this term differently -- being consistent as you go from one generation of product to the next.
Now, from an economic perspective, the value of that is in the reuse of existing knowledge, and so one of the characteristics of demand as a cost minimization matter that manufacturers are likely to reuse their existing knowledge, not reinvent the wheel, and that leads to a demand for backward

7222
compatibility.

So there, backward compatibility is actually a consequence of features of the demand by OEMs.
Q. Minimizing costs per bit, what are you referring to by that term?
A. Actually you see a fair amount -- a fair amount of testimony that cost per bit is a very critical aspect.
We already talked about the price sensitivity. An implication of the price sensitivity of final consumers is a desire on the part of the OEMs to minimize their cost per megabyte or per bit for demand for their product, for DRAM.
Q. Are there any economic implications of that that you've identified?
A. Oh, absolutely. That puts pressure on the supply side to do -- to produce the absolute lowest cost, so that is a contributor to the pressure on the manufacturers to have the absolute lowest cost per megabyte basis.
Q. And finally, minimizing design, testing and qualification costs, is that a subject that bears on your economic analysis?
A. Absolutely. This -- the costs of design, testing and qualification in this industry appear to

7223

be quite substantial, and that's a factual matter, but they do appear to be quite substantial. And as a consequence of those, those create an economy of scale.
That is to say, when design, testing and qualification costs are large, you want to try to use a single or not too many different flavors or varieties of DRAM so that I don't have to go through the whole design, testing and qualification process over and over and over again.
And so this creates more pressure for having a single, dominant flavor of DRAM.
Q. And when you say it creates this pressure, are you talking about economic factors that influence the supply of DRAM?
A. That's correct. Well, in the marketplace choice, not just supply, but also the marketplace choice of DRAM.
Q. So the demand side as well?
A. That's correct.
MR. ROYALL: Your Honor, this is a convenient stopping point for me.
JUDGE McGUIRE: Okay. Very good.
It's about twenty-five after. Let's take a break for lunch and we'll reconvene here at 1:45.

7224

MR. ROYALL: Thank you.
JUDGE McGUIRE: Hearing in recess.
(Whereupon, at 12:22 p.m., a lunch recess was taken.)

7225

A F T E R N O O N S E S S I O N
(1:46 p.m.)
JUDGE McGUIRE: At this time you may proceed, Mr. Royall, with your examination.
MR. ROYALL: Thank you, Your Honor.
BY MR. ROYALL:
Q. Just to reorient us after the lunch break, we talked about the economics of the DRAM industry and you explained certain views and conclusions relating to both the economics of DRAM production and the economics of DRAM demand.
Let me ask you now, Professor McAfee, do any of the economic factors that we've discussed in your testimony to this point have bearing on whether standards are important in the DRAM industry?
A. Yes, they do.
Q. And how is that?
A. For example, this issue with die shrinks that the same -- the product that's in the majority of demand tends to get the die shrinks fast and hence its costs fall faster. That encourages a single product to be the dominant product and that's going to make the standard by which that product is manufactured important.
As does the requirement of having multiple

7226

suppliers or the value that buyers put on having multiple suppliers. Again, that would tend to encourage a single product or not very many products as being a dominant standard.
Q. And have you as part of your economic analysis sought to investigate or study the extent to which in the DRAM industry there has at any given time been a dominant industry standard?
A. Yes. And I've prepared a slide.
Q. Let's go to that and I think we're now up to DX-141.
This slide is entitled Evolution of DRAM Standards. It's very colorful, but let me ask you if you can explain what you're seeking to depict through this slide.
A. This slide shows at any given time and across time which product is -- well, the market shares of the various products available for sale in the market.
And just to give an example, defining market share of fast page mode, which is the product -- it's an asynchronous design colored in a greenish color.
In 1995 -- in 1995, one looks at the green color, which starts around 8 percent and ends around 93 percent, and the percentage of the market that would be devoted to fast page mode is the difference between

7227

those two, that is, 93 minus 8.
The proportion of the market that's EDO, extended data out, which is another memory type that was available in 1995, that's associated with the orange color and that would be the difference between 100 and roughly 93, or 7 percent of the market.
I'm just approximating the numbers.
And so this shows the proportion of the market at each year devoted to the various products for sale, at least in the large quantities.
Let me say that the years from 2002 on are

projected and we already have -- the 2003 numbers are now available and they are -- DDR actually has a larger market share than is illustrated on this picture.

Q. And you testified earlier that you have focused as part of your analysis on the JEDEC SDRAM and DDR SDRAM standards.

What portion of this chart or graph, DX-141, corresponds with those standards?

A. Well, the "other" is actually not identified, so I don't know about the "other." And the RDRAM, the Rambus product, which is colored in red, is not a JEDEC standard. And the other four technologies are standardized.

7228

Q. But which portion corresponds with -- which portion or portions correspond with SDRAM DDR?

A. I'm sorry. I misunderstood your question.

The blue is the SDRAM and the yellow is the DDR SDRAM, so the blue color represents SDRAM.

Q. And does this graphic have any bearing on what, if any, conclusions you reach as to whether in the DRAM marketplace you have seen the existence of dominant industry standards?

A. Yes. This diagram shows that generally the standards get off to what I think was a slow start. It's sometimes called the S curve because the shape is kind of -- is mirroring an S, at least a stretched-out S a little bit.

They get off to a somewhat slow start, and then market penetration speeds up, and then at some point it tails off again and with its being replaced by a subsequent standard.

Q. And the lines and the changes of colors, those represent transitions from one industry standard to another; is that correct?

A. Well, the -- so the transition across time is represented by the subsequent product's share growing, and you see that by the fall-off in the previous standard.

7229

So as the -- for example, as EDO gives way to SDRAM, the right-hand side of the orange area starts to decline steeply.

Q. Have you, Professor McAfee, in connection with your work on this matter, developed an understanding of what economic factors, if any, cause the DRAM marketplace to transition from one industry standard to another?

A. Yes, I have.

Q. What factors have you concluded impact that transition from one standard to another?

A. I'm sorry. Can I get you to repeat the question?

Q. What -- you said that you have developed an understanding of economic factors that cause the DRAM marketplace to transition from one industry standard to another, and I'm simply asking you what economic factors bear on that transition.

A. Well, the cost of the subsequent product would be a leading candidate for -- a leading economic factor. That is to say, as the cost of a next technology falls, you see initially niche applications for a new standard.

That is, the things like video RAM or the most high-value use for fast memory will be the initial

7230

users and they're paying a relatively high market premium. As the number of buyers grows for this memory, at some point you get a market tipping, or what's called a market tipping, and that's driven by a factor we've already talked about, which is you apply your cost-saving activity most to the product that you're making the most of, and so that tends to drive down -- as the product gets a larger market share, it tends to drive down the price, thus reinforcing the inclination of the market to buy that product.

And ultimately that leads to, the market will tip to the new product.

Q. Have you reached any conclusion as to whether from an economic standpoint standards are an important element of the competitive landscape in the DRAM industry?

A. Yes, they are.

Q. And do you have an understanding or have you developed views as to why standards are important in this industry?

A. Yes. And I will -- provided a slide which in fact echoes many of the market factors that we've already talked -- already discussed.

Q. And this is DX-142 I believe.

I don't want you to recover territory that

7231

we've already covered, for instance, on interoperability, but could I ask if you could just generally explain your views from the standpoint of economics as to why standards are important in this industry.

A. Well, we have talked about interoperability and we've also talked about the cost reductions and the requirement that the DRAM actually work in multiple applications in order to drive down the price. Well, that is to say the effect of cost falling more rapidly for the majority product.

And the effect of this is that the standards, because they allow multiple suppliers, because they allow interoperability, because they allow leveraging the costs of the design, standards are very important for making the product -- for in essence minimizing the cost of delivery or the cost -- the total cost of system products.

Q. And the last bullet point on this slide, DX-142, refers to facilitating price competition. Can you explain what you mean by that?

A. Yes. By setting a common design and adhering to a common standard, the -- an advantage to the marketplace as a whole is that it benefits from price competition associated with the -- from the

7232

manufacturers, and I think I already spoke about price competition.

And identical products or products I should say that for all intents -- for most intents and purposes identical from the different manufacturers will be subject to more intense price competition.

Q. Have you, Professor McAfee, in connection with your work on this matter and your economic analysis,

have you found it important to gain any understanding of the nature of DRAM standards, that is, what DRAM standards -- what information or function -- information they provide or function they serve?

A. Yes, I have.

Q. And why is that something that's relevant to your economic analysis or important to your economic analysis?

A. Well, it's a central allegation of the case that there was a manipulation or misdirection of a standards-setting organization, so understanding what kind of standards and the economics of the standards being used would be important for my understanding of

the allegations of the function of the marketplace.
Q. And do you have a slide that summarizes your understanding as to the nature of DRAM standards?
A. I do.

7233

Q. Let's go to that, which this slide will be DX-143.
You have several points here relating to the nature of DRAM standards. Let me briefly ask you about each of them.
Starting with the first, which refers to basic design specifications/protocols, what are you referring to there?
A. So my understanding of the standardization process -- and I should say this is in the realm of assumptions rather than -- or facts rather than my economic conclusions -- my understanding of the -- is that the standardizing process does not try to specify every single feature of the manufacturing process.
In fact, it's about a base of design and about the protocols with which the DRAM communicates with the outside world rather than the specifics of this is going to be how the product is designed. It's more about the protocols and the language with which the DRAM will communicate with the outside world.
And that's actually come about as an evolution from what was initially just specifications of pins and voltages and a very crude specification relative to modern times.
Q. And the evolution that you're referring to in

7234

the nature of DRAM standards, is that an evolution that has occurred during the time period that you focused on for your economic analysis?
A. Yes. Although I'm actually referring to somewhat before that time period as well, that is, starting in 1980, even in the late '70s, but in 1980.
Q. Let's go to the next bullet where you state "focus on interface."
What are you referring to there?
A. Well, this is -- I already foreshadowed that point with -- the focus is on how the DRAM communicates with the outside world as opposed to how it's manufactured in its manufacturing process.
So that is to say, from the perspective of what purposes -- and that's important economically from the perspective of what purpose the standards are serving.
The standards are serving to define the characteristics of the DRAM in such a way that the chipset makers, the processor users know enough about it to know how to design their products. They don't need to know how the DRAM is manufactured. They need to know how the DRAM communicates with the outside world and how the DRAM behaves.
And so the focus of the standards as I

7235

understand it is primarily on the interface, the input/output behavior, the reaction of the DRAM to the rest of the world, to the rest of the system, rather than on, for example, manufacturing standards.
Q. The next point refers to parametrics. What do you understand that term to mean and how is that relevant to the points you're making in this slide?
A. So parametrics refer to specifications within a standard; that is, my understanding is that you can have a standard which can then be more tightly defined by what are known as parametrics.
And for an economist, this phrase refers to additional specification or a tighter specification. And it's something that comes up in the standard-setting on occasion, that is, the need for further refinement of the standards, if you will.
Q. And do you understand that to be part of the, referring to the first and second point, part of the basic design specification or interface specification, or is this something separate or in addition to that?
A. I would say in addition rather than separate. That is, it's a more tightly defined or an additional requirement on the specification.
Q. And then the final bullet on this slide refers to module standards. What are you referring to there?

7236

A. Well, some users use -- some users of DRAM actually use DRAM directly. The PCs tend to use modules; that is to say, the DRAM is put on what is itself a circuit board and that circuit board is plugged into the PC.
And so an additional set of standards that are potentially relevant are module standards, that is, the standards on how a module communicates with a PC, which

might be silent to how the DRAM works inside the module.
Q. This slide that we've been discussing refers to your understanding or assumptions about the nature of DRAM standards.
Have you, as part of your economic analysis, investigated the manner in which standards are set in the DRAM industry?
A. Yes, I have.
Q. Do you have a slide relating to that?
A. I've prepared a slide.
Q. And this is the slide you're referring to?
A. This is it.
Q. This would be DX-144.
Now, what are you referring to in this slide?
A. Well, these are three competing mechanisms for setting standards associated with DRAM. I should say

7237

that these are also three of the four competing mechanisms for setting standards more generally, the fourth being the government.
The three methods are:
You can have a standard-setting organization, and there are several -- at least going back historically, there were several candidates for standard-setting organizations.
You can have private consortia, and we see private consortia such as ADT that attempt to set standards. SyncLink was also a private consortium.
And then you can have proprietary. That's a consortium of one, a single firm, of standards, proprietary standards.
Q. You said, if I understood you correctly, that these types of or manners of creating standards could exist in any industry.
Do you have an understanding as to whether all three of these approaches to standards-setting have been utilized at some point in time in the DRAM industry?
A. Yes. As I mentioned, JEDEC is a standard-setting organization, ADT was private and SyncLink was both private consortia, and Rambus is a proprietary standard.

7238

Q. Do you have an understanding as to whether any one of these approaches has been more successful than others in the DRAM industry in terms of setting standards that are accepted in the marketplace?
MR. STONE: Objection, Your Honor. This

calls -- this improperly calls for opinion testimony outside this witness' area of expertise and lacks the foundation.

If it's simply an assumption on his part and underlies any of his opinions, I don't object. But if he's testifying to this as an opinion of his own or a conclusion, it lacks foundation.

JUDGE McGUIRE: Mr. Royall?

MR. ROYALL: Your Honor, as the question clearly stated, I was asking for his understanding, which is a term I've used to refer to the factual predicate or assumptions he's making.

JUDGE McGUIRE: To his assumptions. Okay.

MR. STONE: To his assumptions. Okay.

JUDGE McGUIRE: All right. Noted.

BY MR. ROYALL:

Q. Do you have the question in mind?

A. Yes. And I am assuming –

JUDGE McGUIRE: Can we assume that's going to be the case until we hear otherwise?

7239

MR. ROYALL: I'm sorry?

JUDGE McGUIRE: Could we assume that the predicate of all your questions to this witness are based on those assumptions? I know you'd indicated that earlier. It's just so we can avoid having to go through this again.

MR. ROYALL: I'll try to -- there are certainly going to be instances --

JUDGE McGUIRE: Just try to keep us up-to-date on the foundation under which you're asking him these questions.

MR. ROYALL: And I will say that when I use the word "understanding," unless I follow up to seek a conclusion or an opinion, by "understanding" I'm referring to understanding the facts and assumptions in that regard.

JUDGE McGUIRE: All right. Very good.

BY MR. ROYALL:

Q. Do you still have the question in mind?

A. Yes.

Q. Okay.

A. I am assuming that JEDEC has been very successful at establishing the standards for DRAM.

Q. And you said "very successful."

Are you assuming anything with respect to

7240

whether JEDEC has been more successful in establishing DRAM standards that have received market acceptance compared to the other two types of standards-setting that you refer to in this slide?

A. Yes. The JEDEC standards have dominated the industry, and I'm assuming as a factual matter that that's because of their success in standard-setting.

Q. Now, putting aside your assumptions, let me ask whether you've developed any economic conclusions relating to the factors that bear on whether a given approach to standard-setting or a given standard is successful in the DRAM marketplace.

A. Yes, I have.

Q. And again, do you have a slide relating to that?

A. I have a slide listing factors that are relevant to the success of standards in DRAM.

Q. This will be DX-145.

Now, again, can you explain to us what -- before we go through the various factors, can you explain to us what you were seeking to convey through this slide or what it relates to?

A. These are factors which I find to be important in the success of a standard. Whether it came from a standard-setting organization or a private consortium,

7241

these are factors that matter to the marketplace, that have consequences for the marketplace and hence matter to the success of the standard -- of a proposed standard.

Q. And when you say that these are factors that matter to the marketplace, by that are you saying that they are factors that you have concluded have economic significance in this marketplace?

A. That's correct.

Q. Let me ask you about, starting with the first bullet point, open, consensus-based process.

Can you explain first of all what you mean by that term?

A. Yes. What I mean by that is a process by which many viewpoints are aggregated or averaged into the standard, so that is a process by which -- that represents the market participants as a whole and not a select sample of market participants.

Q. And could you explain why you have concluded that this is a factor that has economic significance in terms of the success of DRAM standards.

A. Yes. If you'll imagine -- so I should say, in making investments -- to back up a little bit, we talked earlier about the long lead time.

In making investments in a technology one very

7242

much wants to forecast which technology will be successful; that is to say, you don't want to make investments in, say, supporting a product that won't ultimately be used by the market.

And this creates a coordination issue. That is, all of the market participants are in the position of trying to forecast which product is going to be successful in the marketplace, and that's what economists call generally a coordination problem.

And as a result, the -- and so factors that influence those forecasts, ultimate forecasts of success, will ultimately influence the success of the standard itself; so that is to say, if a factor makes it more likely that the participants forecast the ultimate success of the standard, the standard is more likely to be successful.

An open, consensus-based process has the advantage of, by involving more market participants, helping to make the forecast by more of the participants that the standard will ultimately be successful.

Q. Let's move to the second point that you mentioned here, open availability of standard.

First, can you explain what you mean by that, that phrase?

7243

A. So this is a term that refers to whether anyone who wishes to can manufacture to that standard, so that is to say is the standard available to all or is the standard a, for example, trade secret, which it's not published or not published openly.

And so open availability helps by making the standard more widely available, it makes it more likely to be successful.

Q. And the third bullet relates to royalties. What do you mean by that and why is that a factor that you've concluded has economic significance with respect to the success of DRAM standards?

A. Well, economists would refer to what's known as the first law of demand, that demand slopes down. When you increase the price of something, you sell less of it.

Royalties have an influence on the success of standards because they are charges for the use of the standard, and so insofar as the standard requires royalties, it's less likely to be successful. And the higher the royalties, the less likely. And that's other things equal. If a standard with royalties was actually better performing, it might still be successful.

Q. Implementation costs is the next point. Can

7244

you explain what you mean by that and why that is a factor that you've concluded has economic significance with respect to the success of DRAM standards?

A. Yes. I'd actually like to take manufacturing and implementation costs together if you don't mind.

Q. Fine.

A. The manufacturing cost has a direct effect on the manufacturer. The higher the cost of making the product, the less likely the product is going to be successful, but really it's the system cost that matters.

And you can think about this as being derived from the final demand for the product. The customer cares in some sense about the delivered cost of the computer, so he doesn't care whether the cost is in the DRAM or in the chipset. Those two costs get added together in terms of the final demand for the consumer, and hence the final demand for the -- or the demand for the intermediary, the OEM, and then that works back to the standard. What matters is the total cost, not the specific DRAM cost or the specific chipset cost.

Q. And finally, you refer in the last bullet to evolutionary/revolutionary. Can you explain what you mean by that and why you find this to be a factor with

7245

economic significance to the success of DRAM standards?

A. Yes. Other things equal, an evolutionary approach will tend to be more successful than a revolutionary approach. And by "other things equal" I mean wholly performance-cost benefit.

And the reason for that is an evolutionary approach has an advantage of reusing knowledge, so that is to say there's less to work out. The implementation costs will tend to be lower. The risks will tend to be lower with an evolutionary approach.

And so an evolutionary approach has the -- has an advantage over -- typically has an advantage over a revolutionary approach, again, other things equal.

Q. One moment, please.

I want to be clear for the record what you mean by these terms "evolutionary" and "revolutionary."

Let me first ask you to define what you mean by the term "evolutionary" in this context.

A. So by "evolutionary" I mean built on the existing product or existing knowledge base as opposed to a dramatic change from the existing product or knowledge base.

Q. And what do you mean, to make the record clear,

7246

by the term "revolutionary" in this context?

A. So to a lesser extent built on the existing base or it is a radical departure, a major departure from the existing technologies and products. It's more new, if you wish.

Q. And am I understanding you to say that between evolutionary and revolutionary, that the more revolutionary a DRAM standard is, all things equal, the more likely it is to succeed?

A. No. If I heard your question correctly, it's the more evolutionary the DRAM standard is, the more likely it is to succeed.

Q. I did misspeak. Forgive me.

Let me ask you this. Are there -- in your view, is there an economic underpinning to that concept, that is, the relationship between the evolutionary nature of DRAM standard and its likelihood of succeeding in the marketplace?

A. Yes, there is.

Q. And do you have a slide --

A. I have prepared a slide.

Q. This will be DX-146 I believe.

Let me ask you to take us through the points that you make on this slide, starting with the first point where you refer to the reuse of existing

7247

knowledge/infrastructure. How does that relate to the economic underpinnings of the point you were making about evolutionary technology?

A. So just in general, an evolutionary approach means that some of the components or subassemblies or some of the pieces you already know how to do. And what makes it evolutionary is that you're building on a knowledge base and a design or a product or a technology that you've already gotten experience in.

So the reuse of knowledge is you don't have to reinvent a whole bunch of wheels in the process of implementing the technology. And that's not to say that there aren't problems to solve even with an evolutionary approach; it's just to say that the nature of evolutionary approaches means that there are more available solutions from history than with a revolutionary approach.

Q. You refer in the next bullet to increasing marginal cost of changes. What do you mean by that?

A. So that's a feature of DRAM -- I should say that I'm assuming increasing marginal cost of changes rather than deducing it.

But what that refers to is, if I make four changes, the cost of debugging, the cost of making four changes work if I make four simultaneous changes is

7248

going to be larger than if I sequentially make those same four changes; and so that is to say, if I try to do a whole lot at the same time -- and this is a common economic notion of increasing cost -- if I try to do a whole lot at the same time it's going to cost me more than if I do it sequentially.

And where that has a role in evolutionary changes versus revolutionary changes, one way to think of it is if I change my entire design of a DRAM and something goes wrong, I don't have any way of saying, well, this is what went wrong, or it's going to be much more challenging to identify what went wrong.

On the other hand, if I have a functioning product and I change a single feature and it doesn't work, the new product doesn't work, I know it was the single feature that I changed that caused the problem, and so that sort of a consideration leads to a preference for evolutionary changes. And the preference is not -- it's just lower cost of making evolutionary changes relative to revolutionary changes.

Q. And just to be clear, when you use the term "preference," are you referring to economic incentives or are you referring to the literal state of mind of participants in this marketplace?

7249

A. The economic incentives of the firms in the

marketplace as driven by their customers.
Q. And I think in that last answer you may have covered the next bullet, debugging and testing, or is there more that you have to say on that aspect of the slide?
A. No. I think that was covered.
Q. Skipping then to the fourth bullet, system-level design, what do you mean by that and how does that bear on this issue of evolutionary versus revolutionary technology?
A. It has bearing because, as I've mentioned earlier, it's the total delivered cost of the product that matters rather than the individual costs of each component, at least to the final consumer, and when you make a radical departure in the DRAM design, that's going to require bigger and more changes of chipsets and other -- and logic -- system logic and other components and so that's going to also add to those costs. And it's going to be another source of cost.
Q. And finally, the last bullet on DX-146 refers to risk. What do you mean by use of that term in this context?
A. The more new something is, the more it's

7250

going -- you're not going to be able to predict how much time is going to be necessary to make it work and how much effort and how much cost is going to be necessary to make it work. And so as a result, there's a large systemic risk associated with a radical departure from technology than with a small departure from technology, just as a general matter.
Q. Now, earlier you said that you have assumed, you have an understanding and you made an assumption about the relative success of the JEDEC standard-setting process as compared to other ways of setting standards in the DRAM industry. Do you recall that?
A. I do.
Q. As part of your economic analysis in this case, have you studied the JEDEC process?
A. I have.
Q. And is that -- is studying the JEDEC process relevant in some way to your economic analysis?
A. It is. Very much so. In fact, as I believe I've already testified, the JEDEC standards, because of their importance in the marketplace, the JEDEC standards matter to how this market behaves and how it performs. As a result, it's important for me to understand how JEDEC behaves and performs.

7251

Q. And in terms of understanding how the JEDEC process functions, is that something that you have made assumptions about for purposes of laying a predicate or a foundation for your economic analysis?
A. I have. And I have prepared a slide.
Q. Let's go to the next slide, which would be DX-147.
Is this the slide you're referring to?
A. It is.
Q. And does this slide identify factors about the JEDEC process that have formed important assumptions related to your economic analysis?
A. It does. It does provide such -- yeah.
Q. Let's take a moment then to walk through what you mean by these various terms.
Let's start with the first bullet, diverse views/preferences. What were you referring to there and why is that relevant or important to your economic analysis?
A. As I testified earlier, many different kinds of users ultimately use the same form of dynamic random access memory, and so that's going to give rise to a situation where there are diverse opinions about what the design of, say, the next generation should be.

7252

And just as a simple practical matter, the video -- for much of this period, the video graphics card producers needed faster RAM than the PC makers. That is, the value to the video graphics card producers for faster RAM was higher.
And so one of the factors of JEDEC is that it does represent a variety of industry viewpoints and it's not, for example, only representing manufacturers, only representing PC producers or only representing graphics card producers.
Q. And how is the diversity of views or diversity of representation within JEDEC relevant to your economic analysis?
A. It's that -- and this shows up on the slide.
It's that the outcome of the JEDEC process is going to be in some sense a consensus product, that is, a product that strikes a balance between the needs of various industry participants.
Q. The second bullet refers to choice among alternatives. What are you referring to there and how is that important to your economic analysis?
A. Well, as I said, there are -- in the first point, there are diverse views, and those diverse views are going to give rise to diverse preferences and diverse preferences when presented with alternatives,

7253

and one of JEDEC's role in the industry is to choose among the set of alternatives available for various DRAM design technologies.
Q. And the choices you're referring to, are these choices made during the process of seeking to finalize a particular DRAM standard?
A. Well, I would have said the choices that are made during the entire process.
Q. Yes.
Then the fourth bullet, I think you may have covered the need for consensus, but the fourth bullet refers to time to market. What are you referring to there?
A. The PC industry generally runs pretty rapidly. There's been a great deal of technical change, technological change, and as a consequence, time to market is more important here than in, say, the automobile industry.
So that is, the importance of having a standard rapidly is more important -- it's more important in this industry than in, say, in many industries.
Q. And how is that relevant to your economic analysis?
A. It tends to put pressure on a fast decision

7254

over, say, the perfect decision.
Q. The next bullet refers to cost/performance considerations. What do you mean by that term?
A. In terms of settling on technologies and representing diverse views, an important aspect of the decision-making process is what does it cost versus -- this is what economists call cost-benefit analysis. But it's what does it cost versus how well will it perform.
Q. And again, how is that relevant or important to your economic analysis?
A. Well, it guides my understanding of the

decision-making process; that is to say, the nature of the technological choice will be one that has good cost-performance characteristics and again for a -- in a consensus sense, not necessarily for any one participant.

Q. Moving to the second to the last bullet, which refers to IP considerations, first of all, let me ask you, what do you mean by that term?

A. So this is proprietary or intellectual property, and we already talked about how royalties matter to the success of standards, so IP will matter in the -- will matter in this industry as well.

And I should say the speed at which this

7255

industry moves perhaps makes IP more important, again, than in some other industries. Just there's more technological change, more technological advance, in this industry than in many industries.

Q. Going to the last point, satisficing, what does that term refer to?

A. So "satisficing" is an economic term for once you get something that's pretty good, you stop with it. That's a term I believe introduced by Herbert Simon who later won the Nobel Prize.

And "satisficing" refers to we're not going to actually get the absolute best product that's possible; we're going to get something that's pretty good, pretty much represents what the consensus view or the consensus preference is of the organization, and we're going to stop there and move on.

And it's a way of summarizing – it's an economic term. It summarizes a kind of decision-making that seems applicable in this case.

Q. And when you say that, are you applying that term in this case based on your assumptions of how the JEDEC process works?

A. Yes.

Q. And how is that concept or how is this term relevant to your economic analysis?

7256

A. Well, it's actually relevant in a number of respects, but probably the largest one is the choice of a technology doesn't necessarily mean it was even the best available technology. The choice was this was the first one looked at that was workable. And that is, it satisfied most of what was desired.

And part of this is driven by time to market, but that is to say, once we have a product that will do the job, we move on.

And so its importance in terms of the economic analysis is that this says generally you can't conclude from the very choice of the technology that it was necessarily even the best of the available alternatives. It just means it was in the top set or the top group. It had good qualities.

Q. Now, just to be clear, you said that the term "satisficing" is important in a number of ways to your economic analysis.

Is there something else, some other way that it's important, or did you summarize what you had to say in response to the earlier question?

A. It's important in that it's a -- it represents my understanding of the JEDEC decision process and the JEDEC decision process is itself important for understanding the behavior in this marketplace.

7257

Q. Going back to the previous bullet, I asked you I believe what you meant by the term "IP considerations." I'm not sure that I followed up and asked you how that factor is important to your economic analysis. Could you explain.

A. Yes. IP matters because the big picture is standardization will create value, that is to say, the -- as I mentioned, the product that's in largest supply, which tends to be the standardized product, will get the die shrinks, will be -- have large investments made in it.

And intellectual property provides a route at which or provides a method by which some of the value of those investments could be expropriated, and so IP has a role because it could influence the ultimate success of a standard.

Q. Now, when you say that -- you used the term "expropriated." You said that the value of those investments could be expropriated in relation to your discussion of IP considerations.

What specifically are you referring to? Is this an economic concept?

A. Yes, this is an economic concept called hold-up.

Q. And do you have a slide relating to that?

7258

A. I do actually have a slide from my own book.

Q. Okay. I think we have that now. This will be DX-148.

There's a quote, a quote here. Did you say this is a quote from your book?

A. It is.

Q. The book the cover of which we saw in an earlier slide?

A. That's correct.

Q. And let me ask you if you could read the quote here and then I can follow up.

A. "The hold-up problem arises because investments that are specific to another party are vulnerable in renegotiation -- the other party can extract some or all of the value of the investments. The value of specific assets -- those specific to a relationship with another party -- are vulnerable to expropriation by that other party because the assets have low or no value without the other party's participation."

Q. And is this essentially a definition of the economic concept that you referred to as hold-up?

A. It is.

Q. You refer in this language that you just read, you refer to specific investments with specific assets,

7259

or I guess in the first line it's investments that are specific.

What do you mean by the concept of specific investments?

A. So generally what specific – a specific asset or a specific investment is – it's actually defined at the end of this. But it's an asset that has low or no value unless another party participates or does something; that is, it requires another party to do -- to behave in a certain way.

And I've actually prepared an example, which is a classic economic example of specific investments.

Q. Before we go to that, that example, let me ask, before we leave this slide, how is it that where there are specific investments of the sort that you've described that parties may become vulnerable to expropriation?

A. Having made a specific investment, if the terms of trade change, that is to say, if my agreements are renegotiated or I just have no agreements, then I've got a large sunk -- not necessarily large, but I do have a large -- I have a sunk asset which is now lost, and as a result I may – the terms of trade could

change in such an adverse way that the value of my investment could be lost.

7260

And so I'm vulnerable to the loss of that -- the loss of the value of that asset.

Q. Let's go now to -- you said you had an example relating to this.

Is this the slide you were referring to?

A. It is. This is an example of what's -- well, it's the beginning of an example of a hold-up problem. This is actually referring to lock-in, which is to say, once you've made your investment, you're now tied to something related to the nature of your investment.

Q. First let me identify this as DX-149.

There is a picture on this slide of a power plant and then in the -- just to the right of that a number of different potential fuel sources are listed.

Can you explain how that information relates to the concept of specific investments?

A. Yes. Prior to building a power plant, I have a lot of choices for the nature of the energy source for my power plant, and so prior to actually making the investment in the power plant, that is, prior to starting construction, I have a lot of available choices. And in this case it lists five potential fuel sources for my power plant that I might have available.

And then what the next slide shows is that once

7261

I've built a power plant, I'm locked into one form of energy or one source, so I'm now -- I now have an investment which is at least specific to the energy source. A coal-fired plant is going to not be able to use solar power.

Q. So let's pause here for a moment and identify this next slide as DX-150.

And following up on what you just said, am I correct that in DX-150 what you're depicting is that the power plant, hypothetical power plant in this example, has made a choice of what type of fuel that it will design the plant to use?

A. That's correct.

Q. And that choice of one of among various alternative fuel sources, is that a form of specific investment?

A. Yes. The investment would be specific to the coal-powered fuel source, and so they are now, having built the power plant, they're now locked in. If the price of coal goes up, they will be unable to shift to solar power, because even at a substantial hike in the price of coal, it won't pay to try to use solar power. It won't even be feasible much less profitable.

Q. And by that you mean that once the plant has been designed to use coal, it's difficult, potentially

7262

costly to try to redesign the plant to use some alternative fuel source?

A. Yes. That's correct.

I might add as a practical matter, they have built plants to burn, say, oil and natural gas. Typically a coal-fired plant would not shift to any other fuel, but there are plants that can substitute between oil and natural gas, and that's actually an advantage to those plants, is that flexibility.

Q. Do you have an understanding, to refer to that, do you have an understanding as to what economic factors influence decisions of that sort to use two alternative sources in the fuel plant or power plant?

A. Yes. That provides them flexibility in the face of changing prices. When the price of natural gas goes up, as it did a couple of years ago, goes up dramatically, the plants that were able to shift to oil actually had much lower energy costs than the plants that were locked in and could only burn natural gas.

Q. Is there more to this example, of the power plant example, in your slides?

A. There is.

Now having locked the power plant into coal, we're going to ask where in the country it should be

7263

built.

Q. And let's go to the next slide. This will be DX-151.

And can you explain, Professor McAfee, what you're depicting through this slide?

A. I should say this is the classic economic example of specific investments. Normally a coal plant wouldn't consider where to locate in the entire United States. It might try to decide where to locate in Illinois or in a smaller geographic region.

But what this slide is intended to illustrate is that there may be multiple mines and you can decide where to locate your plant and you might want to locate your plant near an inexpensive source of coal. And since transportation costs are important in the price of coal, locating near an inexpensive source of coal is a way of saving on transportation costs and lowering the total price of the coal.

Q. Is there, in this example, is there an economic basis upon which the power plant builder would likely choose among alternative locations?

A. Yes. That's illustrated in the next slide. It would look at how much does coal cost and it would typically want to locate near an inexpensive source of coal, in this case mine number 1 whose price is $10 a

7264

ton.

Q. So other things equal, other considerations aside, economics, basic economics, would tell you that the preference, in referring to this slide which is now -- will be DX-152, that the power plant will choose to locate near the least-cost source of coal?

A. Yes. Again, other things being equal, that's true. And that's illustrated in a subsequent slide.

Q. Let's go to the next slide. I think I'm keeping track here. This one is DX-153.

This slide has a different title. It's now referring to an example of lock-in as opposed to an example of specific investment.

Let me ask you first to explain what you mean by the use of the term "lock-in" on this slide, DX-153.

A. It's essentially the same thing as a specific investment. That is to say, having located next to the coal mine number 1, mine number 1, the power plant is now locked into the use of that coal in the sense that alternative coals -- alternative sources of coal are actually substantially more expensive. That's an identical, from an economic perspective, an identical statement to it's made a specific investment in coal mine number 1 and it's locked in in the sense that it

7265

could lose its specific investment to that mine.

Q. Well, in the context of your example, isn't it true that by locating near mine number 1, which is in your example the lowest-cost source of the chosen fuel, coal, by doing that, hasn't the power plant achieved the optimal outcome in terms of minimizing its cost of fuel?

A. Provided that it has a firm contract with that mine. This is illustrated in the next slide.
Q. This will be DX-154.
And again, you're referring to the example of hold-up, but what is it that you're seeking to depict through this slide?
A. So in this case, once a power plant is built next door, the coal mine has a great incentive to increase the price that it charges for coal. And that's because the mine -- the power plant is now locked in or has made a specific investment, and even if the price of coal goes up substantially, the power plant won't shut down. It will continue to operate and pay the higher price because that's a better alternative for the power plant than to actually shut down.
Q. If we can go back to the prior slide for a moment, in the prior slide, 153, were you making any

7266

assumptions about whether contracts existed or when contracts were signed between the power plant and the coal mine?
A. Well, in this slide it doesn't say one way or the other whether there's a contract. It just says the power plant located next to the mine.
Q. Well, then let's go to DX-154, the next slide, and here you say in the heading of the slide that the power plant signs the contract after building. What is the significance of that?
A. Once the power plant has sunk hundreds of millions or even half a billion dollars into building the power plant, its willingness to absorb a price increase is enhanced. Essentially you can think of it's going to sell electricity for whatever it can sell electricity for.
Once it's spent hundreds of millions of

dollars on the plant, an increase in the price of coal by $10 a ton isn't enough economically to put it out of business. It may render the original decision to build the power plant unprofitable, but it won't actually cause the plant to shut down; that is, the plant will still cover its variable costs, it just won't be able to pay the debt associated with its investment.

7267

And in this case it's -- this is what's known as hold-up. Once the power plant has made its investment, the rational move of the coal mine is to actually increase the price.
Q. And is this what you meant in the quote from your book that we looked at earlier about the potential for specific investments to make parties vulnerable to expropriation?
A. Yes. This would be the expropriation of the power plant's specific investment.
Q. And it's the fact that the power plant made the investment before entering into a contract with the coal producer that made it vulnerable to the investment?
A. That's correct.
Q. And does economic theory suggest anything in terms of how parties in this type of situation can avoid or might be able to avoid this type of expropriation?
A. Yes. One method of avoiding expropriation, which is shown on the next slide, is to contract in advance or do what's called ex ante contracting, contract before building the plant.
At that time the power plant still has viable alternatives in the form of other locations, and it can

7268

threaten the coal mine with -- the mine number 1 with the alternative of building elsewhere. Once it's built, it's now locked in to its geographical location and that threat is now empty.
And so by contracting prior to the building of the mine, the power plant contracts when it still has a great deal of bargaining power.
Q. Are these concepts that we've been discussing, specific investment, lock-in, hold-up, the manners of avoiding hold-up, are these concepts that are addressed in the economic literature?
A. Yes. These are very important and central concepts to industrial organization. And I've prepared a slide with a few references, a few of the more important references in that literature.
Q. Let's go to that. This would be DX-155.
I don't want to ask you to summarize the detailed contents of these various articles or books that you are referring to here, but generally speaking, do you have something to say about these or other portions of the economic literature relating to hold-up?
A. Yes. The first paper represents one of the most popular economic theories of vertical integration, and I think it's fair to say that in both the Grossman

7269

and Hart and the Williamson book and actually other works of Oliver Williamson, they have subsumed the entire economic theory of organizations and of corporations to the question of hold-up. That is to say, hold-up is central to the understanding of how firms are organized.
MR. ROYALL: Now, before we go any further, I just want to make sure that we have identified the right demonstrative exhibit numbers.
I believe that this exhibit that we now have on the screen, the economic literature on hold-up, would be DX-156.
MR. STONE: You skipped the earlier one entitled Avoiding Hold-Up before which was DX-155.
MR. ROYALL: The avoiding –
MR. STONE: The Avoiding Hold-Up should be DX-155.
MR. ROYALL: Thank you. So the prior slide Avoiding Hold-Up will be DX-155.
BY MR. ROYALL:
Q. Professor McAfee, have you, as part of your work on this matter, part of your economic analysis, considered whether the hold-up problem that you have described has application in the context of standard-setting?

7270

A. I have.
Q. And what, if anything, have you concluded in that regard?
A. I've prepared a slide which sets out the broad conclusions.
Q. Let's go to that.
Is this the slide you're referring to?
A. It is.
Q. This would be DX-157.
And can you explain what you're seeking to convey through this slide?
A. This slide lists the most important factors for the risk -- associated with the risk of hold-up for a standard-setting organization. And in particular -- so these are actually common from the hold-up literature itself.
The size of the specific investments matters;

so that is to say, how big are the investments in the standard will matter.

How costly it is to change the standard, that corresponds to how hard is it -- in going back to the previous example, it would correspond to how hard is it to move the power plant once it's been built.

The importance of intellectual property would be the risk of hold-up associated with intellectual

7271

property, and the more important is intellectual property, the more at risk the standard would be at being held up by intellectual property.

And finally, the ease of reaching agreement would have a bearing again on the cost of changing the standard. That would be another factor on how hard it would be to get out from under intellectual property that whose purpose was to hold up the standard.

Q. And are these factors that the economic literature suggest have bearing on whether a hold-up is likely to be a problem in any given industry?

A. Yes. These would be -- well, other than the importance of IP, since normally hold-up is coming through other means besides intellectual property, these would be the standard analysis of risk of hold-up in any industry.

Q. And have you as part of your economic analysis reached conclusions as to whether these factors are present in the DRAM industry?

A. Yes, I have.

Q. And have you reached a conclusion as to whether the existence or presence of these factors in the DRAM industry creates a risk of hold-up?

A. I find that it does.

Q. And you in your example earlier, the coal mine

7272

example, you ended by explaining that economic theory suggests that there are ways to avoid the hold-up problem when it exists.

Have you considered whether in the standard-setting context economic theory suggests any way or ways to avoid the type of hold-up problem which you describe?

A. Yes. In the power plant example, the method of avoiding hold-up that was illustrated was to sign contracts prior to building the power plant, that is, ex ante contracts.

In this case -- and I prepared a slide -- it would be to try to prevent the hold-up of the standard ex ante in much the same way.

Q. Let's go to the next slide, and this I believe will be DX-158.

This is the slide that you have entitled Application of Hold-Up to Standard-Setting, and then below that you refer to mechanisms for mitigating risk of hold-up ex ante.

Are what you list below that -- let me just ask you to explain what are you seeking to convey through the list of items that you have on this slide.

A. So the parallel to contracting in advance would be to try to contract on IP in advance. And these are

7273

three different levels of advanced contracting that one might imagine not necessarily JEDEC but any standard-setting organization adopting.

You could imagine them just requiring disclosure, requiring licensing, and requiring searches to establish the disclosure was actually full.

Q. Let me ask you briefly about each.

How would, in the context of a standard-setting organization, how would requiring IP disclosure or disclosure commitments mitigate the risk of hold-up?

A. It would help ensure that if intellectual property was included in the standard, it was done so in a conscious and deliberate manner.

Q. What about the next point, IP licensing commitments?

Well, before I ask you about that, let me ask you to define a term. In the second of the three subbullets you use the term "RAND," R-A-N-D. What are you referring to by that?

A. That's reasonable and nondiscriminatory contracting. And it's a restriction on the kind of licenses that can be offered.

Q. Now, how can IP licensing commitments or the source of RAND or reasonable and nondiscriminatory

7274

licensing commitments that you've described, how can that mitigate the risk of hold-up in the context of a standard-setting organization?

A. Well, let me give a more extreme example.

If the licensing commitment was for free licensing, that would completely eliminate the risk because it would say any participant agreed to give their IP away and not charge for it, so there's no mechanism by which hold-up would occur.

RAND is a less severe, substantially less severe requirement for licensing, and so it's not going to eliminate the risk of hold-up, but it might mitigate or reduce the risk of hold-up.

Q. And finally, the last subbullet refers to IP searches. How is that concept something that relates to the potential for mitigating the risk of hold-up in the standard-setting context?

A. So in addition to disclosure requirements, you could have a standard-setting body actually search for intellectual property or have a requirement for the members to search for intellectual property, and that would be a way of providing more -- identifying more potential intellectual property and hence reducing the likelihood that the standard is held up.

I should say that numbers 1 and 3 on this --

7275

they're not numbered, but the items 1 and 3 on this list, both of those refer to ensuring that the standard-setting organization has better information and makes deliberate choices and is then not held up after the fact by making inadvertent choices that embody intellectual property.

Q. And is the existence of information or wholesome information in any way important to mitigate the risk of hold-up?

A. Yes. The better the information, the better the choices that will be made, as a general economic matter.

Q. Now, you explained earlier that it has been important to you in conducting your economic analysis to gain an understanding about and to make assumptions about how JEDEC's process works.

Have you gained an understanding or made any assumptions about how JEDEC's process works with respect to any of these issues that are listed in DX-158, including IP disclosure, licensing commitments or intellectual property searches?

A. I have. My understanding -- and again, this is an assumption more than a conclusion -- is that there are both disclosure requirements and disclosure commitments and RAND licensing commitments expected of

7276

JEDEC members.

Q. Let's go to the next slide, which will be DX-159.

Does this slide, DX-159, set forth your understanding and assumptions or certain assumptions relating to the manner in which IP disclosure is dealt with in the context of JEDEC?

A. Yes, it does. These are assumptions that I've made on IP disclosure for JEDEC.

Q. And before we go through the assumptions, can you explain how these assumptions or -- how these assumptions are important to your economic analysis, or just to state that differently, why it was important for your economic analysis to make assumptions relating to this general issue?

A. Well, one of the important issues, one of my list of important issues, involved whether or not it made a difference, Rambus' conduct made a difference, and if there were no requirements for disclosure, I don't see how the conduct could have made a difference.

And so that -- so in particular, it plays a role in that, in that finding. But as I said, these are assumptions, not my conclusions.

Q. Well, let's go through and just make sure we're

7277

clear on what assumptions you are making.

Referring to the first bullet point, which states "preference to avoid patents," what assumption are you making relating to that and how is that important to your economic analysis?

A. So I'm assuming that JEDEC has a preference for avoiding patents, which I understand to be an expression of the hold-up problem; that is to say, a patent creates a risk of hold-up and a preference to avoid patents would be a natural consequence of the threat of hold-up.

Q. Referring to the second bullet, early disclosure/good faith, what do you mean by that and how is that important to your economic analysis?

A. Well, early disclosure is important also in avoiding hold-up because it gives the committee, the JEDEC committee, a better chance to avoid hold-up. The earlier they know, the better their decisions will tend to be.

So that's actually an economic statement. The disclosure requirement that goes along with that economic statement is one for early disclosure and one for full disclosure.

Q. What about good faith? What do you mean by that and how is that relevant to your economic

7278

analysis?

A. That's in essence a -- actually let me back up and say I don't actually see any evidence -- I see contrary evidence that JEDEC requires searches; that is to say, there have been witnesses who have said JEDEC does not require searches.

So in the absence --

JUDGE McGUIRE: Mr. Stone?

MR. STONE: Oh, I didn't mean to interrupt. I will wait.

BY MR. ROYALL:

Q. If you could complete your answer.

A. In the absence of a requirement for searches, it would help in avoiding hold-up to have a requirement of providing as much information as you actually have access to.

And so that's the -- that's my understanding as to good-faith requirement, that is, to not try to change the outcome of the process by manipulating it.

Q. And let's go then to the next, to the third bullet point, where you say, "Disclosure applies to patents/patent applications relevant to JEDEC standards/work."

What do you mean by that language and how is that important to your economic analysis?

7279

A. So this is stating what must be -- what I understand to be required, and the form of disclosure is intellectual property that might ultimately permit hold-up.

That is to say, what's -- so the only thing that can be held up are the actual standards, and so it would be intellectual property relevant to the standards and it would include both patents and patent applications as either one ultimately permits hold-up.

Hold-up is obviously something that happens in the future, not immediately, and so patent applications, because they tend to lead to issued patents, give scope for hold-up.

Q. Going to the next point, you've already defined what you mean by the term "RAND." You make two points in the fourth bullet point. Let me take them separately.

The first one is you say "mandatory for JEDEC." What do you mean by that?

A. That is to say, if JEDEC is aware of intellectual property, it's not supposed to incorporate that intellectual property into a standard absent a guarantee from the intellectual property owner of a reasonable and nondiscriminatory licensing.

Q. And that's an assumption that you're making as

7280

to how JEDEC's process works?

A. That's correct.

Q. And what do you mean by the latter part of that same bullet point where you refer to the "voluntary for members"?

A. A member is not obliged to offer a RAND agreement. That is to say, it is my understanding and my assumption that a member may/can choose to either offer a RAND license or not as they see fit.

However, when combined with the first assumption, what that means is if the member fails to offer a RAND license, JEDEC is forbidden by its own rules to incorporate that intellectual property into a standard.

Q. And how are those understandings or assumptions relevant to your economic analysis?

A. I will find it necessary to ask a question of whether Rambus would have offered a RAND license had it

disclosed, and as a consequence, it's important for me to know both was it required to and, second, what consequences does the failure to offer a RAND letter have for JEDEC's decision-making process.

Q. And finally, the last bullet point refers to valid technical justification. What do you mean by that and how is that relevant to your economic

7281

analysis?

A. My understanding of the JEDEC rules is that they prohibit -- and again, this is an assumption -- they prohibit the incorporation of intellectual property, proprietary intellectual property, absent what is called a valid technical justification, which my understanding of that is that there has to be sort of a showing that it's needed or a conclusion within JEDEC that the technology is needed or that it's well-justified.

Q. Earlier in discussion of an earlier slide and

just -- I don't think we need to go there, but for the record, I'm referring to DX-157 -- you listed four points that are relevant in determining whether in a given industry there may be a risk of hold-up. I didn't ask you to go through each and to state whether or how you found them applicable to the DRAM industry, but I think you may have a slide that does that or that relates to that.

Let's go to the next slide. This is DX-160.

And you list here the same points that were on DX-157, but I think you may be conveying some additional information here, so let's walk through that quickly.

Referring to the first bullet, size of

7282

specific investments, and below that you have a check mark and the word "substantial." What do you mean by that?

A. Just that specific investments, that is, investments that are specific to particular standards, are quite large. You have a large number of companies who are making substantial investments in the specific technology and hence the size of specific investments is in the hundreds of millions of dollars, is a very large number.

Q. And all of these points you're making here are with reference to the DRAM industry specifically; is that correct?

A. That's correct. This is a threat to the DRAM investment from hold-up of the standard-setting process.

Q. The next bullet is "cost of changing standards" and below that you refer to switching costs. What do you mean by that?

A. This is just the cost of changing the standards is quite substantial in the sense that a large number of components all have to be changed, redesigned. There are testing costs, qualification costs, a large variety of costs, some of which we talked about this morning, to changing the standards. So those costs

7283

tend to be substantial.

MR. STONE: Your Honor, could we just be clear we're still on the assumptions or understanding of this witness, not -- he's not testifying now to factual conclusions that he's drawn?

MR. ROYALL: I would like to clarify that.

I am asking Professor McAfee in the context of this slide about conclusions that he has drawn on economic issues predicated on assumptions about facts. I'm not asking about assumptions here.

MR. STONE: Your Honor, then I think this is an issue on which, if these are his conclusions, then he hasn't established that he has a foundation to draw these conclusions and these conclusions are outside his area of expertise.

MR. ROYALL: Well --

MR. STONE: I think these can be assumptions. I think these could be assumptions for his conclusions as an economist, but I think saying that this is the cost of changing a standard, so in other words purporting to actually have knowledge of the cost of changing from one standard to another, is something I don't think he has a foundation to testify to.

I had understood this -- and I apologize for not trying to clarify it sooner -- that this was simply

7284

a summary of the assumptions that he had testified to earlier. If in fact he's drawing a conclusion, then I don't think there's been a foundation laid that he has a basis on which to draw this, other than the assumptions. And if this is simply a summary of the assumptions, the factual assumptions he made earlier, then I don't have an objection.

JUDGE McGUIRE: All right. Mr. Royall?

MR. ROYALL: I think we're not really in disagreement here, that -- I think if by re-asking the question I can --

JUDGE McGUIRE: All right. Good.

MR. STONE: Thank you.

BY MR. ROYALL:

Q. Relating to this slide, which I think we've previously identified as DX-160, what are you seeking to convey through this slide?

A. So I'm certainly not seeking to convey that I'm the factual witness on the cost of changing the technology. Rather, in trying to understand whether the DRAM industry is subject to hold-up, I identified the economic factors that were important, and in this slide I have actually summarized facts that have bearing on those -- on that economic analysis.

So when I say "substantial," it's a fact

7285

question about whether it's substantial and it's an economic question about whether that matters to the threat of hold-up, in particular, the size of specific investments.

So my role as an economist I would say is to list the factors with the blue squares and the conclusion is drawn when added -- when the facts are added.

Q. Well, and the conclusion that you're seeking to convey here, if I'm not mistaken, is the conclusion that, based on these factors and what you're assuming about the facts as they relate to these factors, you have drawn the economic conclusion that the hold-up problem that you described is a problem that exists or that is relevant in the DRAM industry?

A. Yes. That the risk of hold-up is high within this industry and for these standard-setting issues.

JUDGE McGUIRE: Okay. Mr. Stone, does that satisfy your objection?

MR. STONE: Let me just -- Your Honor, let me just see if I can clarify my understanding maybe what I mean by this, to try to speed it up.

If the witness is saying there are four economic factors indicated by the blue squares, size of the specific investments and so on, and the that if the

7286

court were to find that those -- the size was substantial, the switching costs were high, the IP importance was high and the ease of reaching agreement was difficult and time-consuming, as he will explain what he means by those terms, then as long as the fact-finding is something that's left to the court and he's only saying "Given these factors, if the facts are found that way, and I'm assuming they are, then you should draw this conclusion," then I really have no quibble with what he said, and I thought that's what I just heard him say and I --

JUDGE McGUIRE: Even if that's not quite what he said, ultimately that's going to be my determination in any event. Is it not?

MR. STONE: Right. I just don't want to have to cross-examine on him on costs that he's assumed.

JUDGE McGUIRE: Are we all clear on that? Is that the import of his testimony, Mr. Royall?

MR. ROYALL: I think we are, Your Honor. He will certainly -- as we get further into the testimony I expect he will have things to say from the standpoint of economics about whether the costs that he assumes

exists or sees -- made assumptions about, whether they constitute switching costs and how that relates to hold-up.

7287

JUDGE McGUIRE: I just want to make sure the two of you are on the same page, and if that will save some time on cross, let's clear it up.

MR. STONE: And I think Mr. Royall later may go into this, and I'm not saying anything now that prevents him from doing it later.

When I did say a moment ago -- I know we're all being so careful with our words -- when I said I have no quibble with that, what I meant was I have no quibble with this witness' expertise to express opinions as to the four economic factors, not that I agree with his opinions, just so I don't get misquoted later.

MR. ROYALL: And I think, Your Honor, I think certainly for purposes of this slide, I think we have an understanding that I'm eliciting what factual assumptions he has made relating to these points that bear on his economic conclusion that hold-up is a problem in this industry, and there will be later issues that we'll get into where I think we may need to parse these assumption and conclusion issues --

JUDGE McGUIRE: And the court understands that distinction at this point.

BY MR. ROYALL:

Q. So then, Professor McAfee, I don't want to

7288

belabor this or spend too much more time on this particular slide, but I think you've explained what you're seeking to convey through this slide.

Can I -- would it be fair to say that the bottom line in terms of what you're seeking to convey through this slide is that based on the understanding that you have about these factors in the DRAM industry that you have concluded that the hold-up problem is, from an economic standpoint, is a problem that arises in the context of the DRAM industry?

A. Yes, I have.

Q. Let's move on to something else then.

Let me ask you, from the standpoint of economics or economic theory, does it matter within the standard-setting context whether IP disclosure occurs early or late in the process?

A. Generally it matters a lot.

Q. And if I could ask you to explain why from the standpoint of economic theory it does matter a lot whether IP disclosure occurs early or late in the process.

A. I have actually prepared a series of slides that will address that point.

Q. Let's go to the first one of those, which we will mark as DX-161.

7289

Can you explain what you're seeking to convey through this slide?

A. Yes. This slide shows three possible technologies all as candidates for standardization or for incorporation into standardization and illustrates the standard-setting process with a funnel, which will be the motif that will be followed through the remainder of the slides.

And this is actually an action slide, is it not?

So this is actually just introducing the funnel.

Q. Well, let's pause for a moment and just identify -- you said that there's some motifs that are represented here that are reflected in later slides. Let's make sure we identify what you're seeking to convey.

Let's start with the funnel. What is it precisely that you're seeking to convey through depicting the standard-setting process as a funnel?

A. The standard-setting process tends to narrow the choices as choices are made, and so this is using a funnel to depict that process in the sense that only one of the candidate technologies will be selected.

Q. And what are you seeking to depict through the

7290

three blue arrows pointing into the funnel?

A. Those are candidate technologies which might be used for standardization.

And if I could give a specific example, think about battery size. This could be the size of the battery, it could be the voltage of the battery, it could be any of the specifics of a battery.

Q. So we're clear on that, by that are you suggesting that if the standard-setting process that we were focusing on was, let's assume, a process through which the battery industry were setting standards about the voltage of batteries, then what you would be depicting through the three arrows would be alternative proposals as to what voltage should be identified as the industry standard?

A. That's correct.

Q. Now, I understand you do have a series of slides here. Let's go to the next, which we will mark as DX-162.

Can you explain what you are seeking to depict through this slide?

A. So this slide shows the standard-setting process actually involves selection of multiple features. Here we have feature 1, feature 2 and feature 3, each of which in this example have three

7291

candidate technologies.

For example, feature 1 has candidates A, B and C.

And the standard-setting process requires selecting each of a technology or a choice for each of the features.

And so in the battery example, the choices are being narrowed to two each. In the battery example, the choices might be both voltage, length, diameter of the battery, would represent three different selection choices.

Q. And as you were speaking, the -- this is an animated slide -- three of the arrows dropped down and changed colors in the process to white.

What are you seeking to depict through that animation?

A. There, the choices have been narrowed, so for example, with feature 1, there's been a consensus that A or B is a better choice than feature 3 and so that -- excuse me -- than feature C, and so for feature 1, choice C has dropped out of the running and we're now down to the choices of A or B; that is, there are two choices left. And similarly for features 2 and 3.

Q. So keeping with the example here that you're illustrating, certain alternative proposals for these

7292

certain -- for these features have been dropped out or rejected in the process, and the standardization body is still considering for each of the features identified -- at least in this case they're considering two alternatives still for each of those features; is

that --
A. That's correct.

Q. -- right?
Now, is there further animation on this slide? Let's do that.
Can you explain in the animation that just occurred in the movement of three of the arrows what you're seeking to depict?
A. The selection process now has selected feature B for -- excuse me -- technology B for feature 1, technology F for feature 2, and technology G for feature 3. That is, the standard-setting funnel has actually picked one of the three technologies for each feature.
Q. And are these, these technologies, B, F and G, which went through the first series of funnels, have those, in this example, have those features become a standard yet or is there still something more that has to happen?
A. Not yet. They've been selected as the leading

7293
feature, but at this point the standard-setting process has not produced the final standard.
Q. And in this -- in this view of DX-162, what are you seeking to depict as to alternatives A, E and I?
A. Well, they have not dropped out yet, so the process of dropping out is for them to fall to the bottom and they are not selected, they're not the leading candidate, but they're still there.
Q. Let's then go to the next level.
We just witnessed a further animation of DX-162. What were you seeking to depict through that?
A. Well, at this point features B, F and G have been incorporated into the final standard and that standard is now set, and so at that point the remaining candidates have now fallen aside.
Q. And by showing the remaining arrows falling to the bottom and changing color, are you again seeking to depict those alternatives were rejected in this particular standard-setting process?
A. That's correct.
Q. Do you have another slide that relates to that --
A. Yes, I do.
Q. -- example?

7294
Let's go to that.
This -- is this the beginning slide?
A. So that wasn't quite what I expected to happen.
Q. I'm not sure that --
A. So but --
Q. Let's first identify this. This is DX-163.
And is this -- do we have the initial view of this slide up?
A. There they are.
Q. Now I believe we have the initial view in this slide and this again is animated.
What are you seeking to convey through the initial view of DX-163?
A. Well, this is a reprise of the earlier slide with three candidate technologies, although it's also added the process has moved on some in that there are some rejected technologies lying at the bottom, which are actually labeled D, E and F, but I can't actually read that on the screen.
Q. Is there another view of this slide?
Okay. And in that animation that just occurred which leaves only the C arrow at the top, what were you seeking to depict?
A. So technologies A and B in this case have not

7295
been selected, C has been selected and it will move through the standard-setting process.
Q. Let's see that view.
A. And become part of the standard.
At that point the value of C tends to rise, which is illustrated by this green -- the appearance of this green dollar sign down below, because C now is incorporated in the standard. And the value is going to rise only insofar as that standard becomes successful, but it's going to -- that's going to tend to rise because of its incorporation in the standard.
Q. And that concept, the concept that an alternative selected through a standard-setting process and embodied in the standard, that that alternative increases in value as a result of standardization, is that something for which there is some economic underpinning or rationale?
A. Absolutely. In fact, I suspect that every economics article on standardization has the statement that standardization confers value or may confer value. Certainly that's in most of them if not all. That's a common economic conclusion.
And the source of it is actually quite simple to explain. It's just that the standardization, because it becomes a popular product through

7296
standardization or insofar as it becomes a popular product through standardization, that increases the value of the components of the standard.
Q. And is that the basic point you're seeking to convey through this slide, DX-163, the economic concept that standardization confers value?
A. It is.
Q. Let's go to the next slide. This will be DX-164.
Can you explain what you're seeking to convey through this slide?
A. Well, this slide has added another component. The standard-setting process is still represented by a funnel as in the previous slides, but what this standard -- what this slide adds to that is over time, as the standard is rolled out, that is, as the standard is adopted and the industry uses it, so over -- time is on the bottom axis -- over time as the standard is rolled out, the value of the standard tends to rise.
So you'll see the dollar signs indicating the value associated with the standard or with control of the standard, and as plants are designed, as compatible feature or compatible products are introduced, because as -- as manufacturing arises, all of that is going to

7297
tend to increase the popularity and the importance of the standard and create an enhanced value for each of the features in the standard.
Q. There are four smaller green arrows in the left-hand side of this exhibit, DX-164. What are you seeking to convey through those arrows?
A. Those are the -- they convey the things that develop over time or the items that develop over time that tend to be industry commitments to that standard.
So this is compatible parts, plants being designed, investments in interoperability and finally manufacturing of the products. All of these things are specific investments to the standard.
Q. Does this slide have anything to do with the term "lock-in" that you've used earlier?

A. It does. The specific -- as I said earlier, specific investments create lock-in, and these are the specific investments, which then lead to the industry being locked into the standard and it's locked into the extent to which it's made investments specific to the standard.

Q. And you used the terms in this slide, DX-164, you used the terms "ex ante" and "ex post." Can you explain what you mean by use of those terms?

A. Yes. As you can see in this slide, time is

7298

actually a continuum, and in fact that's the best economic model of the phenomenon. But generally, early in the process, what's known as the ex ante period, there has been little or no investment or a small amount of investment in the standard. The industry is not very locked into the standard and it's made few specific investments.

Over time and at some point that I'm referring to as ex post, the size of those investments has grown, and the more time that goes by, it tends to be the larger the specific investments to that standard itself.

Q. You'll recall that we started discussing these slides when I asked you about the economic implications of early versus late disclosure of intellectual property in the context of a standard-setting organization.

Does this slide bear on that issue?

A. It does.

Q. And how does it bear on that issue?

A. Early -- in the left -- and this is actually illustrated beginning with the following slide.

Q. Let's go to the next slide. This will be DX-165.

A. Early in the process, prior to the specific --

7299

Q. Okay. We have this up. Is this the slide you're referring to?

A. It is.

Q. And this relates to what you have to say about early disclosure of IP in the standard-setting process?

A. Yes. Early in the process, so indicated with the red flag early on, early in the process or in the ex ante period, there have been few investments, so that's to the left, few specific investments, and the industry is not -- has very little exposure in the form of specific investments or locked in to this particular standard. And so early in the process, disclosure permits the industry to revise the standard if needed.

Q. And can early disclosure of IP, depending on the factual circumstances, alter the outcome of a standard-setting process?

A. Yes. That's correct. And I've illustrated that with another slide that involves scales.

Q. Let's go to that. This is DX-166.

Can you explain to us what you're seeking to convey through this slide?

A. Yes. In this slide there are two technologies A and C that are being considered for incorporation

7300

into a standard. The assumption is that the red technology C has intellectual property attached to it and it is the winner absent patent disclosure; that is to say, it is the selected technology.

Once the disclosure occurs, that is, once it's found out that C has intellectual property attached to it and A does not, as a method of avoiding hold-up and risks, the industry chooses or the standard-setting organization chooses technology A, and so that is A is the selected technology with disclosure.

Q. Now, through this slide are you meaning to suggest that anytime that intellectual property is disclosed within a standard-setting organization that it will in fact alter the balance of considerations causing one alternative to be chosen over another?

A. No, I'm not. And in fact, if the technology C was sufficiently superior to the technology A and at least in the JEDEC case if it came with a RAND assurance, then in fact it might be selected in spite of having intellectual property, and of course there are standards that embody intellectual property.

Q. So the point that you make --

MR. STONE: Your Honor, I rise only to make clear that his statement about JEDEC is simply a statement of his assumptions again, not that he's

7301

testifying to the state of mind of JEDEC members or other areas covered by the in limine.

MR. ROYALL: I'm happy to make that clear, that we do not intend to elicit nor do I believe that Professor McAfee intends to testify as to any issues relating to the state of mind of JEDEC members.

JUDGE McGUIRE: Noted.

MR. STONE: Thank you, Your Honor.

BY MR. ROYALL:

Q. Before we leave this slide, just to make it clear, all you're seeking to depict through this slide is that early disclosure of intellectual property in the context of a standard-setting process can alter the outcome of the process; is that a fair statement?

A. That is a fair statement.

Q. From the standpoint of economic theory, is there any preferred time for IP disclosures or intellectual property disclosures to be made in a standard-setting process?

A. Yes. As I believe I testified earlier, the earlier actually any economic agent, not just a standard-setting organization, has access to information the better. Decisions with early information is good, but the earlier the information, the better.

7302

Q. And do you have a slide relating to that?

A. I do.

Q. Let's go to the next slide. This will be DX-167.

Can you explain, Professor McAfee, what you are seeking to depict through this slide?

A. Well, in the context of several of -- of a series of slides, this slide is going to illustrate very early revelation of relevant information, so that is to say before the decision is made, and it's illustrated in this way by having a red flag before the funnel, that is, early in the process. And on the -- towards the left of the process. And that's going to cause the standard that has intellectual property attached to it, in this case C, not to be selected.

And here what's happened now is that A has been selected.

Q. When disclosure of intellectual property occurs early in the standard-setting process, does that give rise to opportunities within the process that would not exist or might not exist if the disclosure occurs later?

A. That's correct. That allows for a deliberation that involves better information.

7303
Q. And do you have a slide that seeks to depict that concept?
A. Yes.
Q. Let's go to the next slide. This is DX-168.
And could I ask you, Professor McAfee, to explain what you're seeking to depict through this slide.
A. This slide depicts a disclosure that occurs middle way through the process, that is, after the -- after some amount of deliberation has already occurred. And what happens in this slide is that first the technology C is the leader, then the disclosure occurs, but because it's not -- it's still in the midst of the process, technology A will then go on to win the -- to be selected.
Q. And you refer in the title to this slide to the term "work-around." What are you referring to by that term?
A. Yeah. So let me say that I've actually assumed with JEDEC that the process takes time and effort on the part of the participants, that is to say -- this is a factual assumption on my part -- that when proposals are made, they actually go back to their labs and examine how that proposal affects them.
And having made that assumption, the later in
7304
the process, the more effort that's been devoted to candidate technologies without full information, but if it's not too late in the process, there's still time to actually investigate alternatives, and that's what this refers to as a work-around option.
Q. And when we saw the animation earlier of this slide, DX-168, as alternative A went through the funnel, I believe the balance at the bottom of the slide shifted with A dropping down and C moving up.
What are you seeking to convey through that?
A. Well, this is a reflection of the earlier slide in which the revelation of intellectual property shifted the balance from technology C to technology A, and as I said, that's -- can happen. It need not be the outcome of the -- in that case.
Q. So we've talked now about, in terms of economic theory and this hypothetical context, the benefits of early disclosure.
What, if anything, does economic theory suggest about the consequences of late disclosure of intellectual property in a standard-setting process?
A. Well, I've prepared a slide on this.
Late disclosure which I'll refer to as ex post disclosure after the investments are made exposes an industry to hold-up.
7305
And so in this case, late disclosure after complementary products have been developed and investments made in plant and equipment exposes the industry to classic hold-up as we've discussed.
And you see that depicted in this diagram by the increasing size of the dollar signs. Those are the values of the technology.
And I should say the value of the technology that's depicted there is meant to represent the value that's been conferred by the standardization itself. The technology of course may have additional value in some other application.
Q. I think you have a second slide relating to the concept of late disclosure. Let's go to that. This one, by the way, I believe is DX-169. If we go to the next slide, this would be DX-170.
A. So in this case no ex ante disclosure or no early disclosure is made. As a consequence, following the earlier examples, technology C will be selected, and then at the time the disclosure is made, the industry has made specific investments and is now locked into that technology.
Q. And by "lock-in" in the context of this slide, DX-170, are you referring to the fact that when the industry learns that the alternative that it chose or
7306
that the standard-setting process chose as its standard, when it learns that that technology or that alternative is subject to a patent that it, the industry, has already invested substantial specific investments relating to that standard?
A. Yes. That is the -- that is what I mean by "lock-in. Specific investments in the plant and equipment, complementary goods and other investments that are specific to that technology.
Q. And in that situation, understanding that you're discussing these issues in a hypothetical context, but in that situation, when it occurs, what, if anything, does economic theory tell you about whether the industry can go back and resurrect alternatives A and B which were rejected in the initial standard-setting process?
A. Well, generally the industry has suffered or experienced lock-in to that standard and the size of the lock-in is measured by the size of those specific investments. So the industry might be able to go back to technologies A and B, but not without losing the specific investments.
Q. And you've talked earlier about hold-up and about the potential to be vulnerable to expropriation.
Does that condition in the context of this
7307
hypothetical, does that condition exist in what you're depicting here?
A. Yes, it does. It's a consequence of hold-up. The problem of hold-up is the vulnerability to expropriation and the size of the vulnerability is the size of the specific investments that have been made.
Q. And in the example that you depict in DX-170, specifically whom is vulnerable to expropriation?
A. Well, the users of the technology, which would be all those who have made specific investments in the technology, would be the ones vulnerable to the expropriation of the size of the specific investments.
Q. And what is the nature of the expropriation that they're vulnerable to?
A. It's charging royalties that are beyond the ex ante value of the technology but are conditioned on the specific investments that have been made.
Q. And when you say that they're vulnerable to expropriation by being forced to pay royalties that exceed the ex ante value of the technology, precisely what do you mean by "the ex ante value of the technology"?
A. The ex ante value is the amount that the industry participants would have been willing to pay to use C over its best alternative, which ex ante were
7308
technologies A and B in this example. And ex post, the value is that same value over the technologies A and C plus the entire specific investment that's been made in the technology -- into the standard.
Q. And just to follow up on that last answer, when you said that the ex ante value is the value that the participants would have been willing to pay for C over its best alternatives, by that do you mean the value that the participants would have been willing to pay for C if the participants had known at the time of the

standard-setting process that that technology was subject to patents?
A. That's correct.
MR. ROYALL: Your Honor, this would be a convenient point for me to take a afternoon break. I don't know if others are ready for a break.
JUDGE McGUIRE: I think we're all ready for a break. Let's take a ten-minute break.
MR. ROYALL: Thank you.
(Recess)
JUDGE McGUIRE: You may proceed, Mr. Royall.
MR. ROYALL: Thank you, Your Honor.
BY MR. ROYALL:
Q. Professor McAfee, you'll recall that earlier today you identified for us five what you've termed

7309
key economic questions relating to your assignment in this case of an economic analysis that you've conducted.
And the first one of those was the question: What are the relevant antitrust markets in this case?
And I'd like to turn to that issue now.
Let me ask you as a starting point, can you explain to us precisely what a relevant market is or relevant antitrust market is and what role definition of such a market plays in an economic analysis of the sort that you've conducted?
A. Yes. And I've prepared a slide to that effect.
Q. Okay.
A. Market definition -- I think we talked briefly about this morning -- is -- concerns setting the scope of competitive activity, defining the technologies, products and firms who are relevant to the analysis.
So it defines the scope. It also defines a context for performing analysis. It's the setting. It's the environment in which -- which is analyzed.
Q. You say in this slide, which we should identify it as DX-171, you say in the third bullet point, your words are "common starting point for economic analysis and antitrust-related inquiries."

7310
What do you mean by that?
A. This is the normal starting point for really any antitrust or investigation, economic investigation of an antitrust matter. It's in the Departm ent of Justice and the Federal Trade Commission Merger Guidelines. It's the beginning point of most if not all antitrust economic inquiries.
Q. You talked earlier about matters that you've worked on as a consultant, other than this matter, as a consultant to the Federal Trade Commission, such as the Exxon-Mobil merger, the BP-ARCO merger.
In those matters, did your economic analysis involve definition of relevant markets?
A. Yes. And in both matters relevant market was required.
Q. And without going into identifying the specific matter, but in the other consulting, private consulting matters or litigation-related matters that you've been involved in in the antitrust area, have you typically started your economic analysis with the definition of relevant markets?
A. Yes. That would be the normal starting point and I've even been -- dealt with matters in which I was defining technology matters that began with market definition.

7311
Q. We'll come to that in more detail, but you did mention earlier today that the markets that you've defined are technology markets --
A. That's correct.
Q. -- is that right?
And what other matter or matters other than this case have you been involved in in which you've defined relevant technology markets?
A. There was a relevant technology market in the BP-ARCO merger concerning oil exploration technology.
In addition, I worked on the Lockheed-Northrop merger, which in the end was not consummated, and in that case all of the markets that were involved were technology markets.
Q. Are there contexts in which an economist is able to render opinions or conclusions about such things as market power and anticompetitive effects without defining a relevant market?
A. There are such contexts.
Q. Can you think of an example?
A. In some cases you can actually observe the exercise of market power directly and you're not in a position where you need to infer the exercise or conclude the existence of market power but in fact can see the effects of market power directly.

7312
But this is not one of those cases.
Q. You say that this is not a case in which -- if I'm understanding you correctly, you as an economist are able to render opinions and conclusions about market power and anticompetitive effects without defining a market; is that your --
A. That is correct.
Q. -- point you're making?
A. Yes.
Q. And why in this case is it necessary in your view, if that's the point you're making, to define a relevant market before you can render conclusions, economic conclusions about market power and anticompetitive effects?
A. Well, the nature of exclusionary conduct is the elimination from the marketplace or the threat of elimination from the marketplace of equal or superior competitors. If you haven't identified the market, you aren't in a position to say whether alternatives have been excluded or not.
Q. Is there any well-accepted methodology among economists for defining relevant markets in antitrust cases?
A. Yes. And I have prepared a slide illustrating that methodology.

7313
Q. This slide I believe will be DX-172.
Let me ask if you could to explain -- start with the first point -- explain what you mean here when you say that the analysis starts with market hypothesis.
A. This is an approach which is iterative in nature. That is, it starts out with a market hypothesis and then seeks to say is that -- and tests whether that hypothesis actually constitutes or comprises a market, and if not, it adds products or technologies to the market and then goes back and tests again is this a market, and so in that sense it's a self-referential or a looping definition that works like a computer program in some sense as a method.
And so it starts with a market hypothesis, which you would -- your natural starting point is whatever the relevant product or products -- the product or products that are relevant to the issue at

hand, so in a merger, it tends to be products that are produced by both firms.

In this case it's the challenged technologies that I start with.

Q. And when you say that typically the market definition process starts with the product or products

7314

at hand, does that relate to your second bullet point?

A. That's correct. You tailor the initial hypothesis to the antitrust issues under consideration, so as I said, in a merger, it would be the relevant -- the products that are an overlap of the two companies.

In this case it's the technologies that are relevant in the alleged -- about which the alleged conduct concerns.

Q. What do you mean by the third bullet point on DX-172, assume hypothetical monopolist?

A. The goal here is to identify products that don't have serious constraining alternatives, so to identify products or in our case technologies which lack price-constraining alternatives.

And the approach is to say, well, suppose I controlled all of the technologies in the market, would I be constrained by products outside the market, would I feel that is a major constraint or would I actually enjoy a substantial monopoly power.

And so the approach, which is taken both by the Federal Trade Commission and the Department of Justice guidelines, is to assume a hypothetical monopolist who controls those products and say does that monopolist have serious price-constraining alternatives or can they exercise monopoly power on the products that are

7315

in the market.

And the basic logic is, if it's no use to be a monopolist over a set of products, then that set of products is not a market. There are other products that are relevant to that market and must be included.

And so that's the sort of underlying logic of the market definition.

And this is a method of identifying -- if we go to the fourth bullet, identifying the competitive constraints on that marketplace.

Q. And did you say that the methodology for defining markets that you've just described is reflected in Department of Justice and Federal Trade Commission guidelines?

A. Yes. That's correct. These guidelines have evolved over the years, but they continue to have the hypothetical monopolist market definition logic.

Q. And when you were working as an economist at the Department of Justice in the Antitrust Division, did you apply those same guidelines that you're referring to in defining markets?

A. Yes, I did. Or to be exactly accurate, I helped others in that, in the sense that I never did it alone at that time.

Q. And in the antitrust-related matters, unrelated

7316

to this case, but in the other antitrust-related matters in which you've served as a consultant to the Federal Trade Commission, did you, in defining markets in those matters, follow these same FTC/Department of Justice guidelines that you referred to?

A. Yes, I did.

Q. Do you have a slide that graphically depicts or illustrates the process of defining a relevant market?

A. I do.

Q. Let's go to that. This will be DX-173.

A. And so as I indicated before, one starts with a relevant product or products, and in this case the product we'll start with is C.

Q. And what are you depicting here with the other letters other than C?

A. These are other candidates for inclusion in the marketplace. These are other -- if we're talking about technologies, these would be other technologies which are potential substitutes for the technology C.

Q. I think this again is an animated slide. Let's go to the next view.

A. And so here we are starting with the technology C and asking the question: Does C comprise a market in its own?

7317

Q. Well, let's stop there.

Does this relate to what you mentioned earlier, in the context of the earlier slide, that the market definition process is tailored to the antitrust issues or the products that are presented?

A. Yes. That's correct. So if the issue involves technology C, one would start with technology C as a candidate market, candidate market.

Q. And then let's go to the next view of DX-173.

A. So if C does not comprise a market, that is, a monopoly over C faces significant price constraints and would face significant substitution from alternative technologies, the next step is to include the closest substitutes into the market, that is, the technologies which are the most price-constraining for technology C.

In that case those technologies are A, B and D, and so those are incorporated into the marketplace. And then we go back to the beginning of the market definition and say do the technologies A, B, C and D together comprise a market; that is, if we had a monopoly over those technologies, would we face significant price constraints from outside or would we actually be able to profitably charge a higher price.

Q. And in asking that question, are you in essence

7318

asking whether the products that you've now defined in your provisional market, A, B, C and D, whether those products face material price competition with the products that are outside of the circle?

A. That's correct.

Q. And let's go to the next view.

We've just seen another view of this same slide. What are you depicting here?

A. So what's depicted here are that A, B, C and D face significant price constraints from technologies E, F and G outside of the market, and so those technologies have been added in as -- into the marketplace now to give A through G as the set of technologies in the marketplace.

And in this case, in this example, technology H is not going to be a significant price constraint, and so the process stops there. That is to say, A through G, if a hypothetical monopolist controlled all technologies A through G, they would not face significant price constraints from technology H and would be able to substantially increase the price and enjoy the benefits of monopoly pricing.

Q. And in that case would you stop at this point and define the relevant economic market or relevant antitrust market to consist of all of the products

7319

depicted here except H?

A. Yes. That's correct. So technologies A through G would be the technologies.

And I should also say there's a principle called the smallest market principle. The goal is to stop with the fewest number of market members. And the purpose of that is not to include spurious candidates but just include the minimum number of technologies or products that are required to reach market status.

Q. And what you've depicted in this, in these slides, is this an attempt to illustrate the same market definition process that you just described being contained within the FTC/Department of Justice guidelines?

A. It is.

Q. Now, in conducting this type of economic market definition analysis, what information would you need as an economist to make judgments about whether the various alternative products that you're considering do in fact impose material price constraints on one another?

A. Well, I need information about substitution by the buyers or selectors of the technology; that is, the information I need -- and this would be parallel to in

7320

any market definition -- is I need information about what buyers will substitute to.

So when I'm defining gasoline markets and markets for retail gasoline, what I need to know is when the price goes up at one station or a set of stations, how far will consumers drive and how much substitution is there to more distant but less expensive stations. And so I need information on the choices that consumers make in that marketplace.

Q. In performing this type of market definition analysis, would it be helpful to you as an economist to have historical data relating to relevant changes in price, actual changes in price that have occurred in the marketplace that you're studying?

A. Absolutely.

Q. And why would that type of data be helpful to you?

A. Well, as I indicated, what's important is actually substitution by buyers, so that is to say an alternative is price-constraining if, when you try to raise the price of the products in the marketplace, the buyers substitute in a meaningful way, in a significant way, to a product outside of the marketplace.

If you can directly witness that substitution

7321

through historical data is of course a major advantage in identifying which products are in the marketplace and which products are not.

Q. Is that type of historical pricing data generally available to you as an economist in instances in which you're seeking to define relevant antitrust markets?

A. Well, sometimes it is and sometimes it isn't. It's certainly not always available and in some cases it is available.

Q. Are there some industries of which that type of historical pricing data tends to be more readily available than in other industries?

A. Well, physical products that are traded frequently will often have more of a history of data than in this case, which involves technology markets where you don't see frequent trades or even any trades in some cases.

Q. How do you go about defining relevant markets in industries in which you do not have historical pricing data relating to actual sales or transactions?

A. Well, the general economic approach is to nonetheless try to understand buyer substitution and so to try to understand the buyers.

And when I worked on the technology markets for

7322

the Department of Defense, my procedure was actually to talk to buyers of technology -- in this case they tended to be colonels -- and ask them about their decision process and try to model in my model how they make their decisions of which technologies to buy to try to understand the decision-making process.

And in addition, I relied on industry reports and that sort of evidence so that I could reach an understanding of the decision-making process of the buyer and thereby assess the substitution that buyers would make when faced with price increases.

Q. So in instances in which pricing data, relevant pricing data of the sort that you've described, in instances in which that data is not available, are you saying that one of the sources of information you might turn to would be data gleaned through interviews of the relevant purchasers in the marketplace that you're studying?

A. Yes. That's correct.

Q. And in defining markets in merger-related matters in which you've worked with the FTC as a consultant, have you or have other economists working with you conducted interviews in part for the purpose of gaining information to factor into a market definition analysis?

7323

A. Yes. That's true for both the Exxon-Mobil and for the BP-ARCO mergers, for example.

Q. And you told us earlier today about various interviews that you've conducted in relation to your work in this case and the general types of people that you interviewed.

Was your purpose for conducting those interviews, was that at all in relation to the market definition aspect of your work?

A. It was a critical input to the market definition, in particular to understand the substitution by the buyers in terms of technology choice.

Q. And when you use the term "buyers" in the context of the markets that you've defined in this case, who specifically are you referring to?

A. Well, the buyers are the firms that select technologies. The importance of JEDEC, as we already discussed, in the standard-setting process -- now, JEDEC is not a monopoly in the standard-setting process, but the importance of JEDEC means that the JEDEC process itself is part of the technology selection and the buyers of the technology -- and here buyers may just be selectors; they're the ones who choose the technology -- include DRAM manufacturers who

7324

are then driven by their customers, and so all of the market participants are in some sense the buyers of the technology.

Q. Now, you've mentioned several times that the markets that you've defined in this case, the relevant markets, relevant antitrust markets, are technology markets.

What do you mean -- to be clear, what do you mean by the term "technology market"?

A. So technology markets are markets for ideas or inventions, markets for discovery, markets for technology-related products, where technology is itself a product.

I have actually a slide concerning technology markets.
Q. This slide I believe will be DX-174.
Does the market definition methodology that you described earlier, does that methodology apply in the case of technology markets as opposed to physical product markets?
A. Sure. It's -- actually the concept or the logic of it is no different than in physical products, and that's recognized by the Department of Justice intellectual property guidelines. I think it's well-accepted in economic analysis.

7325

Q. And you say in the third bullet point in this slide, DX-174, you state, "Data on price/sales may be more limited."
What do you mean by that?
A. There are many technology markets, but one sees few trades.
For example, in the Department of Defense technology markets you would see at most one trade, the ones that I worked on, and so often the sales data is just not available. You don't have -- it's not like gasoline where you see millions of transactions. In fact, it's kind of the opposite. You see very few transactions and so you often -- with technology markets you're often in a situation where you have little data, direct data, on pricing.
Q. And related to your earlier testimony, does that suggest that in technology markets you're more often in the situation as an economist defining markets in which you need to seek to gain information directly from relevant purchasers through interviews or other sources?
A. Yes. That's correct.
Q. You've mentioned in the second to last bullet on DX-174, you say, "Geographic scope is generally worldwide."

7326

What do you mean by that?
A. Users of technology generally don't care about the source of their technology. They don't -- they care about the quality of the technology, they care about the price of the technology, but they don't care if it comes from the United States or Japan.
And so the effect of that is that technologies tend to compete worldwide, which is really just another way of saying that the transportation cost on technology tends to be low. That is, an idea doesn't -- you don't have to ship an idea in a ship; you can actually just send it over a fax machine.
Q. In defining relevant technology markets in this case, did you in fact apply the methodology that you've described for us earlier in terms of comparing alternatives and making judgments about the extent to which alternative products constrain the prices of other products?
A. I did.
Q. Can you tell us now precisely how then you went about defining relevant markets or relevant technology markets in this case?
A. Yes. The starting point was to try to identify a universe of potential technologies that would be the candidates for the markets, so that is to identify,

7327

referring back to the previous slide with the circles on it, the A through H, that is, the technologies that would be candidates for inclusion in one of the technology markets.
And I did that by looking at what experts said about technical feasibility; so that is to say, I relied on others to identify whether technologies in a sense could do the job, that is to say, were they feasible for the issue at hand.
Q. And do you have a slide relating to that?
A. I do.
Q. Let's go to the next slide. This is DX-175.
Let me ask you first of all to define for us what you mean by the term "technical feasibility."
A. So the technology markets -- let me remind you that we start with the technology that's one of the relevant technologies, so we're starting with the technology, so technical -- the technologies that are technically feasible are technologies that have some related performance to the technology at hand and can actually be carried out.
Now, it's somewhat of a challenge in this case, it's fortunately not my challenge, but it's somewhat of a challenge in this case because my understanding -- and again, this is an assumption rather than a

7328

conclusion -- my understanding is that all of these technologies had problems to be solved in order to implement them; that is to say, none of them worked in a sense right out of the box, they all took work to implement or to use.
And in that sense, what's technically feasible when you haven't actually solved all of the problems associated with the technology is going to be a challenge. But it's not my challenge; it's something on which I rely on the testimony of others.
Q. Are you a technical expert?
A. No.
Q. Are you an engineer?
A. I'm not.
Q. Are you intending through your testimony to offer your own opinions or conclusions about technical issues relating to DRAM designs or the benefits from a technical standpoint of any given DRAM design?
A. I am not.
Q. You say that you've relied on others with regard to such technical issues; is that correct?
A. That's correct.
Q. Who have you relied on in that regard?
A. Well, there is a list presented here. The engineers who have testified, both at trial and in

7329

deposition. Professor Bruce Jacob -- is it Jacob or Jacobs?
JUDGE McGUIRE: Jacob.
MR. ROYALL: Jacob.
THE WITNESS: And discussions that I've had with engineers.
BY MR. ROYALL:
Q. And to be clear, what have you relied on these various technical sources for?
A. For a -- well, for a description -- in this case what this slide refers to is for -- it's the conclusion in the universe of technologies that are potential candidates for market inclusion.
So again, to refer back to the circle diagram, it's A through H, all of the things that are going to be considered as potential candidates.
Q. And we don't need to pull it up, but by that are you saying that by determining what technologies are technically feasible for a given DRAM design purpose you are essentially defining the universe of the various options from which you will then assess through economic means whether various options should be included in the same relevant market?
A. That's correct.

Q. So since you are not yourself a technical
7330
expert and you are not offering conclusions about technical feasibility, once you have determined through others and through relying on others which technologies are technically feasible, what then do you do from the standpoint of economics to make judgments about relevant markets?
A. Well, the next step in the process -- and there's a slide to this effect -- is to examine which of those technologies are price-constraining on the technology at issue.
So that is to say which of the technologies are commercially viable, which are the ones that in the event of a price increase associated with the technology in question would have been adopted or were adoptable, were preferred over a significant price increase of a technology in question.
Q. Let's identify this new slide, the slide on the screen now with the title Commercial Viability, let's identify that as DX-176.
Relating to the text of this slide, let me ask you first of all to define for us what you mean by the term "commercial viability."
A. Well, this is -- what I mean by this is just the technology exercises a constraint on the pricing of a technology in question.
7331
So that is, when we did the hypothetical market experiment, we asked, well, if you controlled these technologies, would you face serious price constraints from an attempt on -- an attempt to increase the price. If you do, then we had to include those technologies. The ones that exercise such a price constraint or constrain the prices of our hypothetical monopolist are the commercially viable technologies.
And so what I mean by that are the technologies which would have an impact on the buyers or would be substitutes for the buyers.
Q. What do you mean here in DX-176 by the second bullet point, which states "parallel to the SSNIP" -- S-S-N-I-P -- "test for markets with no price data"?
A. So the SSNIP test comes directly from the Federal Trade Commission and Department of Justice Merger Guidelines. It hypothesizes a small but significant and nontransitory increase in price.
So that is, take the products in the marketplace, increase the price that is charged for them by a small, not too large amount, but still nonetheless significant -- and significant is in the eyes of the market participants; that's the meaning of it -- and nontransitory. That is, you don't do it for a week, but you do it for weeks. The price increase
7332
has to survive.
And you increase the price, and if you get substitution away significant enough that the hypothetical monopolist would not like to increase the price, then in that case you have not found a market and must add products.
And so that's parallel in the sense that the commercially viable technologies are exactly those that don't survive the SSNIP -- that would be included or would be price-constraining under a SSNIP test.
Q. And so are you saying that the analysis that you've conducted to define markets involving the identification of which technologies are, economically speaking, commercially viable, that that methodology is in your view parallel to the SSNIP test reflected in the FTC/DOJ guidelines?
A. That's correct.
Q. And when you say here "for markets with no price data," what do you mean by that?
A. Well, you would like to carry out the SSNIP test generally by actually asking how substitution would occur. Here, we don't have historical data on substitution, so the approach that I'm taking is then to examine whether the market participants view these technologies as being price-constraining alternatives
7333
or being good substitutes.
And so it's like a SSNIP test, but it's being applied in a technology market without historical price data.
Q. Below the reference to the SSNIP test you have three subbullets. Let me ask you about those.
What do you mean by the first point, well-informed market participants treat as good substitutes?
A. A technology is going to constrain an existing technology, that is, a second technology will constrain the first technology in price and hence be commercially viable if the buyers of the technology would substitute, and so in this case what I'm looking for is evidence that well-informed market participants view these technologies as good substitutes. And if they do, that would be evidence that they are price-constraining alternatives. If they don't, that would be evidence that they aren't price-constraining alternatives.
Q. And again, was this -- did this have something to do with your purpose in conducting the interviews that you've conducted?
A. It did. This is part of the investigation of the facts which I'm using as evidence for market
7334
definition conclusions.
Q. And to the extent that you have gathered information about whether well-informed market participants treat certain alternatives, technology alternatives, as good substitutes, are you relying solely on interviews that you've conducted or is there some other source of information that you've relied on for this purpose?
A. Well, as this slide suggests, that consideration of JEDEC -- and it's not just any consideration, but serious consideration -- is also suggestive that the buyers of the technology, in this case the market participants, viewed those technologies as significant substitutes and hence price-constraining substitutes.
Q. And what do you mean by the last point here, qualitative judgments of knowledgeable engineers?
A. So engineers today have knowledge -- of course unfortunately over time the base of knowledge that they have is changed, it's improved, but it also means that it's hard to go back and say as of 1992 were these price-constraining disputes, but the judgments of the engineers are certainly informative about whether technologies are substitutes. And if in the view of knowledgeable engineers they're substitutes, then that
7335
makes them substitutes.
Q. Does this issue of commercial viability have any connection to the JEDEC standardization process or your understanding of that process?
A. Yes, it does. And I've prepared a slide that lists some of the considerations that are relevant.
Q. Let's go to that. This will be DX-178.
Oh, I'm sorry. 177.
Before I ask you about the various points that

you list in DX-177, let me ask you, first of all, what are you seeking to convey through this slide?

A. This slide is listing considerations which are relevant to the evaluation of the technology as commercially viable, that is to say, as a price constraint on one of the relevant technologies.

So these are listing the kinds of considerations that would inform such a judgment.

Q. Let me ask you what you mean by the first point, which refers to time to market.

A. Well, I spoke earlier about satisficing behavior. Now, that as an assumption on JEDEC's -- as an assumption -- well, the term "satisficing" is an economic term, but its application to JEDEC would be an assumption.

And that arose out of the time-to-market

7336

issues, and what that meant was or what that entails is that for commercial viability is that several products can easily be commercially viable in that they aren't trying to make it perfect. They're trying to get a workable product that everybody or most of the companies can manufacture and that the buyers can use in their installations in a rapid and expedient manner.

And given that assumption, what that does is make products with similar performance essentially equal.

Q. And how is that relevant to your consideration of whether various technology alternatives are commercially viable?

A. Well, so it -- in a process that took an extremely long period of time, it could be that two technologies which were barely distinguishable but one was slightly better in performance were not in the same market because the market participants would choose the superior technology.

In this case the decision-making under satisficing behavior would actually make -- would render such technologies equal.

Q. Let's go to the second bullet on DX-177, which refers to IP/royalties. What are you referring to

7337

there and how does that relate to the process that you conducted in analyzing issues of commercial viability?

A. Well, again, I'm assuming that JEDEC has a preference to not adopt intellectual property; that is to say, that's a factual question. But given that assumption, it has implications for commercial viability because it says an intellectual property is actually -- you can think of it as hobbling a technology; that is, it makes it less likely to be selected. And that's not to say that it will never be selected but, rather, to say that it's less likely to be selected.

So that has the effect of making other technologies, that is, technologies other than the one with intellectual property, more likely to be commercially viable.

Q. The third bullet refers to the cost of the solution to DRAM manufacturers and others. Can you explain how that relates to your views on commercial viability?

A. Yes. If I can, I'll take that bullet and the subsequent bullet in the same answer.

The industry generally, that is, both the buyers and the sellers care both about the cost of manufacture and the performance. And I should say just

7338

as a matter of basic economics, buyers care about costs because costs tend to get passed on to buyers; that is, buyers ultimately bear the cost.

So both the buyers and sellers care about both the cost and performance, and in fact the general economic model is that the goal of the organization -- and it doesn't actually matter whether it's a firm or a standard-setting organization -- is approximately to try to get the biggest performance bang per dollar or the most performance given the cost.

And so cost is going to matter to commercial viability. If a technology is extremely costly to manufacture, it's going to make it less likely to be commercially viable. And similarly, performance matters. The more the technology -- the better it performs, the more likely it would be to be commercially viable.

Q. Now, going to the second to the last bullet point on DX-177, which refers to strategic considerations that reflect the competitive position of each member, what do you mean by that and how does that

relate to the subject of commercial viability?

A. So we've talked about the diversity of interest among the firms, and what I want to highlight here is that there are differences among the firms even in

7339

their technical ability. That would actually be a fact assumption that there are differences. Although it's a normal fact assumption for economic analysts.

And the effect of that is going to make differences among members in terms of what kind of technologies are preferred by them in their preferences and there will be some disagreements and you can think of those as strategic considerations.

And I believe we already spoke about the graphics card manufacturers preferring relatively high-performance DRAM relative to a PC manufacturer.

Q. And finally, the last bullet uses a phrase that I think you may have used in an earlier answer, but I didn't ask you at the time what you meant by that, but you state here, "Every technology had problems to be solved."

What do you mean by that?

A. So again, this is a factual assumption, but it's a factual assumption that none of the -- it is my understanding that none of the technologies that are considered at JEDEC generally work right out of the box, that is, in the sense that until they've actually built some chips and learned about it, they don't -- they don't know exactly how the technology is going to work, how much it's going to cost, what the

7340

implications of the technology are. All of them had problems to be solved.

And that's important for the understanding of

commercial viability because, again, what it says is at the time that the technologies are selected, not all the facts are known. There is still substantial uncertainty attached with each of the technologies that were considered. And only in the technology that was actually exploited are those uncertainties all resolved.

That is to say, at the time that you make the determination, the time that the standard-setting organization makes the determination, they don't know all of the problems that have to be solved, and in fact it may be the case -- again, this is a fact question -- different manufacturers solve those problems in distinct ways.

The effect of this, though, from a JEDEC

perspective or from a buyer substitution perspective is that all of the technologies have uncertainty and hence that tends to blur the distinctions of the technologies.

And I guess the -- so a short way of summarizing what I'm assuming in that bullet is that the cost and benefits of these technologies are not

7341

known with precision, and as a result it will not generally be the case that necessarily the best technology is selected but, rather, the technology that's workable.

Q. And how does that bear on the economic judgments that you have made as to whether a given alternative technology is or is not commercially viable?

A. Well, the presence of uncertainty tends to blur the distinctions between the technologies and again would make more technologies commercially viable or make it more likely that a technology was commercially viable.

Q. Do you have an understanding as to how -- you mentioned in this slide both cost and performance. But do you have an understanding as to how cost and performance issues were dealt with within JEDEC's standardization process?

A. Yes. And I've prepared a slide that summarizes some of the issues that we've -- the fact issues that we've already discussed.

Q. Let's go to that slide. So this would be DX-178.

Can you explain what you are seeking to convey through this slide?

7342

A. Well, this is listing some of the -- it's listing actually two -- well, three separate points.

First, we've already talked about the different preferences both on cost and performance, and so I won't belabor that.

A different -- a distinct point, a distinct economic analysis point is the value of a technology may depend on the deployment of subsequent infrastructure. And there's a nice example of that. This would of course be a fact, but there's a nice example of that that's been given in the trial testimony, which is that AMD has engineered its processors to exploit a burst length of 8.

Now, it's done that only because a burst length of 8 was available. So that is to say, once the technology of programmable burst length which permitted burst lengths of 4 and 8 was deployed, that's the point at which it became possible for AMD to specialize its processors for the burst length of 8.

And it's made investments that exploit that possibility. Those investments would be lost if the programmable features of the processor were removed.

But the point I want to make in this is that the value of the technology wasn't fully realized until subsequent investm ents were made, and so as a result,

7343

when you look ex ante, before those investments are made, that technology has lower value than it does subsequently.

Q. And I think you covered the first three points either in reference to this slide or earlier slides, but let me ask you about the last point, costs are uncertain until DRAM is manufactured commercially. What do you mean by that?

A. So there are always unknowns, and I think I've already -- well, I've already assumed that, that there were unknowns, and this is actually just highlighting that point, that the actual costs of production generally are not going to be realized.

And in fact, it is my understanding that the companies guard their costs of production as trade secrets; that is, they try to keep that secret from the world at large and from their competitors.

The costs are uncertain because there are problems to be solved and there are technologies to be exploited. And developed. Excuse me. Technologies to be developed.

Q. And how, if at all, does that uncertainty about cost impact your analysis of questions related to commercial viability?

A. Again, in examining technologies, there's

7344

substantial uncertainty attached to them and the determination of which -- so that makes the solution look closer to each other.

That's a thumbnail way of summarizing it, but that the uncertainty about the technologies blurs the distinctions between the technologies because it could easily be the case and it could easily prove to be the case that the technology that looked least promising wound up being best.

Q. Now, I believe that you've explained this point that in defining the relevant markets that you defined, ultimately you defined them so as to include the commercial -- what you've determined, economically speaking, to be the commercially viable technologies; is that right?

A. That's correct.

Q. Now, I think you have a slide relating to that, but before we go to that, let me ask you on this slide before we leave it, DX-178, the final bullet or subbullet that you identified here relates to DDR. You say "DDR in 1998 versus 2003."

Before we leave this slide, can you explain what you mean by that?

A. Well, DDR in 1998, it wasn't clear that DDR was ever going to work, and in fact -- so to refer -- so

7345

this is a fact-intensive discussion.

To refer to -- I think it was Mr. MacWilliams who said that DDR, while it was less negative, it was still negative, had negative margins even in 1998. That is, it didn't appear that DDR was going to work to Intel.

So what that's referring to is an example from the factual record of products that are -- uncertainty associated with products. It appeared to quite knowledgeable market participants that DDR wouldn't work as of 1998, and of course it's available today.

Q. So over time that uncertainty was removed and with full information the market could better assess the value of the technology; is that the point you're making?

A. That's correct.

Q. Now, let's go to the next slide, which I think will be DX-179.

Can you explain what you're depicting through this slide?

A. Yes. This slide depicts two separate points.

The first is the determination of the relevant technology market, and here there are in this example things have been phrased in terms of cost, so you can think about this as cost per unit of performance, so a

7346

low number is good.

There are three technologies A, B and C that have roughly comparable costs. Those are constraints

on each other in the sense that if I started with technology A as a candidate market and tried to increase the price of technology A, the buyers would substitute to B or substitute to C.

And so I don't have a relevant market until I've included all of A, B and C. Once I include those three, however, the next best technology, technology D, is actually noticeably further away or it's significantly further away, and so it ceases to be -- it's not a serious price constraint on A, B and C and the price of those could increase significantly.

And so it illustrates the definition of the relevant technology market.

In addition, it illustrates the uncertainty by the fuzziness of the lines, that is, the cost of A is not – it's not a clear, sharp amount. It's actually uncertain.

So it's illustrating both of those points simultaneously.

Q. And by the last point that you're making about the fuzziness of the lines, are you – by that are you saying that there is some inherent uncertainty as to

7347

costs at the time that technologies are assessed for standardization process?

A. Yes. As I've assumed, yes.

Q. And to relate this to the earlier slide relating to market definition and the letters and the concentric circles, would D, E and F here, the alternatives that you don't define as being in the relevant technology market, if we were to go back to that earlier illustration, would those letters or products, would they fall outside of the circle that you defined as the relevant market?

A. That's correct.

Q. Now, you've explained that in defining relevant markets generally you start with a product or the products that you understand to be relevant from the standpoint of the nature of the allegation or the issue.

If it's a merger, I think you said it would be products that are overlapping in the merger. Or in a case such as this, if there's an allegation, you would start with the products that you understand to be the nature of the allegation.

Is that a fair statement --

A. Yes, that's correct.

Q. -- of your views?

7348

And did you in fact in defining relevant markets in this case start with any given product or products as the starting point for your analysis?

A. I did. And I prepared a slide listing the four products.

Q. Let's go to that slide. This will be DX-180.

Are these the products or technologies that you used as reference points to commence your relevant market analysis?

A. That's correct. These are the products that I took from the complaint which are the four products whose conduct is challenged.

Q. Well, let's start with the first product or technology listed in DX-180, programmable CAS latency.

And let me ask you if you could to walk us through the process that you conducted in defining a relevant technology market referencing that product.

A. Okay. So my starting -- let me -- I have a slide that begins that process.

Q. This will be DX-181.

A. The process starts with the -- well, it starts by identifying a universe of alternatives to programmable CAS latency, and those would be technologies used to set latency on a DRAM.

Q. Can I stop you there?

7349

A. Yes.

Q. The first bullet point, technology used to set latency on DRAM, by that are you referring to your understanding of what function this technology, programmable CAS latency, serves within a DRAM design?

A. Yes. That's correct.

I'm not testifying as to what programmable CAS latency is but, rather, taking from other witnesses the assumption that what that does is set latency and that there are substitutes for it.

I'm also not going to testify as to what the substitutes are for it; rather, I take those as from other witnesses who are more skilled than I am.

Q. And when you refer to substitutes, by that are you referring to what you understand from technical witnesses or technical sources to be technically feasible alternatives to programmable CAS latency for the purpose of setting latency on a DRAM?

A. That's correct.

Q. And the third bullet point here states, "Some alternatives are commercially viable"?

A. Right.

Q. Can you explain what you mean by that?

A. Well, I should say some alternatives may be commercially viable, but this is -- the process of

7350

market definition is to identify which of these technically feasible alternatives are commercially viable.

Q. And I think that's the point that you make in the final bullet point here; is that right?

A. That's correct.

Q. Let's go to the next slide. This will be DX-182.

Can you explain what you are depicting through this slide?

A. In this case I began with a list of technically viable alternatives as listed by Professor Jacob. These correspond to the alternatives that Professor Jacob identified as alternatives to programmable CAS latency.

Q. And having identified what you understood from other sources to be the technically feasible alternatives to programmable CAS latency, having identified the universe of such technologies, what did you do then in defining the relevant market?

A. Then at that point I tried to assess or set out to assess the whether these alternatives were in fact commercially viable given the procedure that we discussed earlier that was described in the earlier slide.

7351

That is, I examined four facts that would suggest one way or the other whether these alternatives were commercially viable.

And I should say we haven't talked about time, but the relevant time here is – well, the relevant time is a fact question, but the relevant time that I used was as of approximately 1992.

So that is to say, the question that I set out to address is whether in the -- whether market participants considered these and would have substituted to one of these alternatives in the event of a significant price increase, a small but significant price increase, in programmable CAS latency, that is, were these price-constraining

alternatives for the market participants to programmable CAS latency.
Q. And when you say "1992," by that do you mean that that is a reference point for your analysis in terms of a relevant time frame?
A. Yes. SDRAM was standardized in 1993, and so the relevant time for a disclosure would have been prior to the standard being issued; that is, an ex ante disclosure would be prior to the standard being issued.
So to identify a relevant market for that
7352
purpose I want something -- I want a market at the moment in time that's relevant, and so roughly 1992.
Q. And when you say at the time that's relevant, by that do you mean the earliest point in the time period in which you understand from your assumptions about the allegations or your understanding of the allegations that when would be the earliest point in time, roughly speaking, when Rambus allegedly should have made intellectual property disclosures?
A. Well, I don't know --
MR. STONE: Objection. Leading, Your Honor.
I think at this point he could simply ask him what you mean when you say the time is relevant as opposed to telling him and suggesting the answer.
JUDGE McGUIRE: Sustained.
BY MR. ROYALL:
Q. Well, you said in your earlier answer "roughly 1992."
When you say "roughly 1992," what do you mean by that?
A. So I wanted a time that's prior to the issuing of the standard and at which there might have been -- again, this is a factual question -- but that there might have been a disclosure requirement, and I chose 1992 -- I should say the analysis is not sensitive in
7353
the sense of whether it's 1991, 1992 or middle 1993. The analysis was not sensitive to the time to that level of precision.
And so when I say "1992," that's a short form for during the 1991 to 1993 period.
Q. And would information about the technical feasibility or commercial viability of alternatives for programmable CAS latency from the time frame of 1996 or 1995, would information of that sort be relevant for you to consider for purposes of defining relevant markets?
A. Well, it's certainly relevant. The -- generally economists in carrying out market definitions don't have the perfect information. In fact, it would be really unusual analysis in which the perfect information was available.
The information in 1995 in terms of a 1993 buyer would be imperfect but nonetheless informative.
Q. You've identified I believe a total of six technologies that you understand from other sources to be technically viable or technically feasible alternatives to programmable CAS latency.
When you conducted your economic analysis relating to market definition, did you conclude that any of these technically feasible alternatives was also
7354
commercially viable?
A. Yes, I did. And if we can go to the next slide, I'll illustrate that with fixed CAS latency.
Q. Let's identify this first of all as DX-183.
Now, this slide relates to one of the technically feasible alternatives that you identified on the earlier slide, DX-182; is that right?
A. That's correct.
Q. And have you reached any conclusion as to whether this alternative, that is, fixed CAS latency, was a commercially viable alternative to programmable CAS latency?
A. Yes. I've concluded that fixed CAS latency is commercially viable as an alternative to programmable CAS latency.
Q. And what was the basis for that determination?
A. This is a -- the basis is an examination of essentially all of the facts I had available to me concerning fixed CAS latency, including interviews, including testimony, deposition testimony, including documents. It's a -- I've attempted to actually apply all of the available information in assessing whether fixed CAS latency was for market participants a viable alternative or commercially viable alternative to programmable CAS latency.
7355
And this slide sets out a tiny fraction of the relevant information in making that determination.
Q. You mention in the first subbullet "presented at JEDEC" and then below that you have reference to a particular JEDEC meeting.
By this are you conveying that it is your understanding that this technology, fixed CAS latency, was at the point in time referenced here in 1995 presented as an alternative to JEDEC?
A. Right. It is my understanding that as a factual matter NEC made a presentation involving fixed CAS latency at that time.
Q. And what significance does that understanding have to your conclusions about the commercial viability of this technology?
A. Well, the implication is that NEC first itself believed that this was commercially viable, that it wasn't going to waste its time making a presentation that it thought was not going anywhere and, moreover, that it believed that it could muster substantial support.
Again, it would be a waste of time for a company to make a presentation which they thought had no hope of actually going anywhere.
And so while I think not a proof, it's
7356
certainly strong corroboration that a substantial fraction of the market participants viewed the technology as -- it's strong corroboration that one market participant believed that it -- that that technology was commercially viable and, moreover, believed that it could persuade others that the technology was commercially viable.
So it's significant evidence if not proof -- but not proof of commercial viability.
Q. And below that you have a reference to cost impact and then a reference to certain trial testimony.
Without -- I'm not asking you to read or summarize that testimony, but let me ask you from the standpoint of your economic conclusion about the commercial viability of this technology, what, if any, significance do you attribute to the testimony that's referenced in this slide?
A. Well, this testimony is not actually testimony I had at the time, available to me at the time that I made the determination. Its presence on the slide is to be illustrative of the kinds of information on which I'm relying, and so the purpose here is to illustrate the factual background that I investigated in trying to assess the commercial viability of the --

7357
of fixed CAS latency as a technology and I think it's representative of the kinds of information that I've collected.
Q. So I take it from that answer that there's other evidence that you have considered and relied upon in reaching the conclusion that fixed CAS latency is a commercially viable alternative to programmable CAS latency?
A. Absolutely.
Q. And I won't, in respect to the judge's rulings earlier, I won't ask you to summarize that evidence now. But let's -- well, let's turn to other alternatives.
Have you reached any conclusions as to whether other technically feasible alternatives to programmable CAS latency are also, in your view and from the standpoint of economics, commercially viable?
A. Yes. And I have provided similar slides to that one for three further technologies.
Q. Now, this next slide we'll identify as DX-184.
A. That's correct.
Q. And this slide relates to a technology identified as programmable by pin strapping; is that right?
A. That's correct.
7358
Q. You again refer in this slide, DX-184, to a JEDEC presentation?
A. That's correct.
Q. And what, if any, significance do you attribute to that?
A. Well, the presentation is of course much more recent, and so I would attach less significance to one that's more recent than I would to an earlier one, partly because the economics of DRAM manufacture has evolved over time. But nonetheless, it's suggestive of serious consideration by Micron in this case as a technology that is an alternative to programmable CAS latency.
Q. And the bottom half of the slide again refers to certain trial testimony. Without asking you to summarize that, let me ask you this.
Is your purpose in identifying that trial testimony the same as the purpose that you explained for identifying other trial testimony in the prior slide?
A. Yes. Although I might actually add in this specific testimony that there is more diversity of opinion on the cost of pins than there was on the fixing of CAS latency, and this testimony also has bearing on that, but that is to say that it depends on
7359
the -- it appears to depend on the implementation as to whether it's commercially viable and this testimony is suggestive of that.
Q. But you have concluded based on all of the evidence that you've reviewed that this particular technology is commercially -- is a commercially viable alternative?
A. Yes. And for the same reasons as with fixed CAS latency. Or in the same method, rather, is what I meant to say, as fixed CAS latency.
Q. In addition to fixed CAS latency and programmable by pin strapping, are there any other technologies that through your economic analysis you have concluded are commercially viable alternatives to programmable CAS latency?
A. Yes. There are two. The next one is programmable in the read command.
Q. Let's go to the next one. This would be DX-185.
And can you summarize the basis for your conclusion that this technology is a commercially viable alternative to programmable CAS latency?
A. Yes. Again, in parallel to the previous two technologies, there's a -- he surveyed a large amount of facts and concluded that this technology appears to
7360
be commercially viable, that is, appears to be a substitute for programmable CAS latency.
Q. And when you refer to cost impact on this slide, DX-185, what are you referring to there?
A. Well, this is actually from Professor Jacob who is discussing the advantages and disadvantages of programming CAS latency in the read command. It has some physical advantages. Actually I think it's the case that you don't eliminate the mode register. Again, this is a fact. You just reduce this piece of the mode register. I think that's what happens next in the trial.
But that you -- so it has some advantages in manufacture and it has some disadvantages in that it could suffer somewhat on performance, and on balance, these are approximately canceling.
Q. And in concluding that this is a commercially viable alternative, have you concluded that this technology would have a price-constraining effect on programmable CAS latency?
A. Yes. That's correct.
Q. And is that true of all of the technologies that you have concluded to be commercially viable alternatives; that is, in making that conclusion, have you concluded, based on your investigation and the
7361
facts that you've reviewed and your economic analysis, that those commercially viable alternatives are -- have a price-constraining effect on the technologies that were the focal point of your relevant market analysis?
A. That's the definition of commercial viability that I'm using, so they all must be price-constraining.
Q. You mentioned that there was one other technology that you found, based on your analysis, to be a commercially viable alternative to programmable CAS latency. I believe the next slide relates to that. This will be DX-186.
And the technology referred to here is setting by fuses?
A. That's correct.
Q. Can you explain the basis for your economic conclusion that this technology is a commercially viable or was a commercially viable alternative to programmable CAS latency?
A. Again, it's the same kind of basis as in the earlier technologies. I've examined a large amount of evidence bearing on the substitution possibilities of this technology. Evidence is all in the form of engineers, analyst reports, JEDEC meetings and the
7362
like. And some of that evidence is illustrated by this slide.
Q. Of the technologies that you understood to be technically feasible alternatives to programmable CAS latency, did you eliminate any as commercially viable; that is, did you conclude that any of those technically feasible alternatives were not commercially viable alternatives from the standpoint of the time frame that you were focusing on?
A. There's -- I didn't reach -- so the answer to

that question specifically is no, but I didn't reach a determination on one of the technologies.
Q. Let's go to the next slide. This will be DX-187. I think that this lists the five technologies here.
Is this the same list of the technologies that you started with as the set of what you understood from the technical sources that you considered to be technically feasible alternatives?
A. It is the same set, yes.
Q. And you said that you did not ultimately conclude, or to put it differently, you concluded ultimately that one of these technologies was not a commercially viable substitute or you could not conclude that it was a commercially viable substitute

7363

for programmable CAS latency?
Should I restate that? Are there too many double negatives?
A. I'm happy to answer the question.
Q. Let me restate it.
Was there any one of these five technologies that you, based on your analysis, did not conclude to be commercially viable, a commercially viable alternative?
A. I did not determine that scaling CAS latency with clock frequency was a commercially viable alternative primarily because I did not find out enough information to reach a determination in that case.
Q. And so the others -- this is an animated slide and there are now red check marks by four of the five alternatives.
Are these the alternatives that based on the information that you analyzed you concluded to be commercially viable alternatives to programmable CAS latency in the time frame that you focused on?
A. That's correct.
Q. And having determined that these technologies were commercially viable alternatives, did you then proceed to define a relevant market?

7364

A. Yes. This set -- the relevant market is -- contains those four.
Q. And the relevant market that you defined you termed the latency technology market; is that right?
A. That's correct.
Q. And to be clear, what you have termed the latency technology market, does that market consist of programmable CAS latency and the four technologies that are checked in DX-187?
MR. STONE: Objection.
THE WITNESS: That is correct.
MR. STONE: Objection. Leading, Your Honor.
The proper way is to say "Tell us what the latency technology market consists of," not to lead him to the answer.
JUDGE McGUIRE: Sustained.
Restate, Mr. Royall.
MR. ROYALL: That's fine, Your Honor.
BY MR. ROYALL:
Q. Tell us what technologies you included in the latency technology market.
A. Well, following my procedure, I started with programmable CAS latency and then I included the commercially viable alternatives, which are the technologies checked with the check mark attached to

7365

them in this slide. And so all five technologies are members of the latency technology market.
Q. Now, let's turn to the next of the four relevant technologies that you identified earlier. Let's turn to the next technology, programmable burst length.
A. So --
Q. Before we go any further, the slide that we're now looking at I believe is slide 188, or DX-188.
And this slide relates to the analysis that you conducted in defining relevant markets relating to programmable burst length; is that right?
A. That's correct.
Q. And the first bullet point, what does that relate to?
A. So again I'm relying on technical experts and technical knowledge, so this is a factual -- there's a factual matter embedded in this.
My understanding of programmable burst length is that this is something that sets the burst length. Programmable burst length normally refers to setting the burst length at either 4 or 8. And it determines how many steps the DRAM takes, what's called a burst, sometimes called a wrap.
And the -- so the technology -- the substitutes

7366

for programmable burst length are other technologies that set the amount of data read from a DRAM in response to a request for data.
Q. And in defining the relevant technology market with reference to programmable burst length, did you follow the same methodology that you described earlier with respect to programmable CAS latency?
A. Absolutely. And this slide illustrates that by being essentially identical to the earlier slide on programmable CAS latency.
Q. So having first identified the relevant product, you went on then to identify, based on the technical sources you considered, the universe of what you understood to be technically feasible alternatives?
A. That's correct. And again, to emphasize, that's an assumption on my part, not a conclusion.
Q. Let's go to the next slide. This will be DX-189.
And what does this slide present?
A. This lists Professor Jacob's technically viable alternatives for programmable burst length.
Q. And following the same methodology that you've described, did you conclude that any of these technically viable or technically feasible alternatives

7367

were also, from the standpoint of economics, commercially viable?
A. Yes, I did. And I followed again the same procedure that we used on programmable CAS latency.
Q. Let's go to the next slide. This will be DX-190. DX-190 relates to the alternative identified on the prior slide, the fixed burst length.
Did you reach a conclusion as to whether this technology was, based on your analysis, a commercially viable alternative to programmable burst length?
A. Yes. And the logic is in fact almost exactly parallel. The logic and the evidence is almost exactly parallel to fixed CAS latency, and there is highlights of evidence as before presented on the slide.
Q. And by that, you're referring to the substance of the slide being what's conveyed or the information conveyed being similar to the substance of what was conveyed in the earlier slide related to fixed CAS latency?
A. Similar or analogous.

Q. Did you conclude that any other technically feasible alternatives to programmable burst length were also commercially viable from the standpoint of economics?

7368

A. Yes. Again, using a pin, if we can go to the next slide --

Q. This would be DX-191.

Can you explain the basis for your conclusion that use of a pin or what's referred to here as programmable by pin strapping was a commercially viable alternative to programmable burst length?

A. Yes. And in fact the evidence is quite similar to the evidence in favor of programming CAS latency with pins. Programming CAS latency with pins may take more pins than programming burst length with pins, but otherwise, the logic is quite similar, and the testimony of witnesses is quite similar and the evidence quite similar.

Q. I want to move through these slides quickly because I know you have a number of similar slides, but just so the record is clear, do the slides that relate to the technologies that you've concluded are commercially viable, such as this slide, DX-191, do these set forth in full the factual basis for your conclusion that these technologies are commercially viable?

A. No, they do not. And in fact, I reached these conclusions prior to the time that the trial commenced, so the references to trial testimony were not actually

7369

part of my factual basis at the time that I reached the determination. They've since become available to me. But I illustrate them with the slides for relevance and as further information.

Q. Are the bases for your original conclusion that these technologies were commercially viable alternatives, are those bases set forth in your expert report which we identified earlier?

A. That's correct.

Q. Were there any other technically feasible alternatives to programmable burst length that you concluded, based on your economic analysis, to be commercially viable?

A. Yes. If we can go to the next slide, the programmable in read command, so this is a technology which embodies in the read command, so it's the request of the DRAM for data, how long a burst to send, I found to be commercially viable.

This technology has both advantages and disadvantages over programmable CAS latency.

Q. And what was your -- how would you summarize the basis for your conclusion that this technology was a commercially viable alternative to programmable burst length?

A. Again, I investigated the relevance of this

7370

technology as a substitute or its price-constraining ability on programmable CAS latency to -- its ability

to serve as a substitute to programmable CAS latency for the purposes of price constraint.

Q. And this slide, before we move to another slide, I believe should be identified as DX-192.

Were there any other technologies that you considered technically feasible technologies that you considered that, based on your economic analysis, you concluded to be commercially viable alternatives to programmable burst length?

A. Yes. The final technology is burst interrupt.

Q. Burst interrupt, and that's the subject of the next slide, DX-193.

And can you state or summarize the basis for your conclusion that the burst interrupt technology was a commercially viable substitute or alternative to programmable burst length?

A. So again, burst interrupt has advantages and disadvantages. It's actually technology that was already available in the standard. It has advantages and disadvantages over programmable burst length and as a technology for setting burst length, and those are relatively small advantages and disadvantages, which renders it a close substitute, and that was what I

7371

found from my examination of the facts.

Q. And what do you mean by the second bullet point here? You say "in SDRAM and DDR SDRAM standards and proposed for DDR-II."

A. So this is technology that's already available; that is, you use burst interrupt in an SDRAM in that it's possible to interrupt your -- so my understanding of burst length -- again, this is a factual question -- is that when I ask for data, I'm not going to be just given back one piece of data, I'm going to be given back a number of pieces data, and what the burst length is is a means of setting how many pieces of data I'll get back.

So again, as I understand the facts -- and this is a fact and not a matter of economic analysis -- the reason that's useful and the reason one cares about that is that it would slow down a DRAM if you had to say, each time you wanted a piece of data, give me one more piece of data, and the reason is you'd have to say that and then get it back, say it again, get it back, and that would add for a lot of requests. It speeds up the process to get a lot of data in a row.

A burst interrupt says, well, once I've gotten three pieces of data I can issue a burst interrupt command that stops the flow of data.

7372

Again, I'm explaining my understanding of the facts.

That has the effect of giving you programmable burst length in the sense that if I want a burst length of 4, I could ask for eight and then interrupt myself after four have come, and that gives you an alternative for programmable burst length.

And then the -- so that's a long -- somewhat long-winded answer to your question of this is already available; that is, it's possible to issue a burst interrupt command for SDRAM or for DDR SDRAM. That is my understanding of the facts, is it's already available in the standard.

Q. We've talked now I think about four alternatives, technically feasible alternatives to programmable burst length that you've concluded to be commercially viable through your economic analysis.

Were there any of the alternatives that you did not conclude to be commercially viable?

A. Yes. I didn't conclude it not to be commercially viable, but I did not reach a determination for using fuses to set burst length.

Q. Let's go to the next slide. This next slide is DX-194.

And you've just referred to fuses. Is that

7373

what's in DX-194, is that what's -- is that the technology referenced in the final bullet point?

A. That's correct.
Q. The other four bullet points identified here, were those all technologies that you did conclude to be commercially viable?
A. That's correct.
Q. And based on your analysis, did you define a relevant technology market related to programmable burst length?
A. Yes. I defined a burst length technology market consisting of programmable burst length and the four technologies that are checked on the slide.
Q. Now, let's go to the next --
MR. STONE: I just wondered if we might be getting close to a convenient breaking point or if this was one for the evening.

JUDGE McGUIRE: I can't hear you.
MR. STONE: I wonder if we were about at a convenience breaking point.
JUDGE McGUIRE: I was going to inquire of that. I assume you're going to be about another twenty minutes or so, Mr. Royall?
MR. ROYALL: Well, I'm going to be another -- probably another twenty minutes just defining these

7374
relevant markets.
JUDGE McGUIRE: Right. That's what I meant.
MR. ROYALL: Yes.
JUDGE McGUIRE: And then after that, what was your intention?
MR. ROYALL: After that, Your Honor, I don't have a time precisely, but I would expect that I'm likely to have roughly another hour and a half, could be slightly longer, but I would think we're in the range of an hour and a half. I would be happy to finish up in the morning.
JUDGE McGUIRE: When you say "another hour and a half," you mean with this witness or just for this evening?
MR. ROYALL: I meant with the witness after we finish relevant markets. Again, I need to review my notes, but I think that may be in the ballpark, and I'd be happy -- it would make sense to me to at least finish the relevant markets today and I'd be happy to finish the rest in the morning.
JUDGE McGUIRE: Okay. Are you asking now, Mr. Stone, for a break?
MR. STONE: No, no, no.
JUDGE McGUIRE: I'm just trying to get an idea of when we're going to break for the evening. Let's

7375
go ahead and spend the next twenty minutes or so and get over this topic and then we'll break for the evening.
MR. ROYALL: That will be fine. Thank you, Your Honor.
JUDGE McGUIRE: All right.
BY MR. ROYALL:
Q. I believe we've now covered your relevant market analysis relating to two of the four relevant technologies you identified earlier.
Let's move to the third relevant technology, and I think in the list that you provided in an earlier slide that technology was the dual-edged clock technology?
A. That's correct.
Q. And we have another slide now on the screen relating to dual-edged clock. I believe that this will be identified as DX-195.
A. That's correct. Oh, I don't...
Q. And I think we all recognize that this is similar to the earlier slides in explaining the basic methodology, but the top bullet point I believe is unique to this technology. Can you explain what you're referring to there?
A. Yes. Again, I'm relying on the testimony of

7376
other witnesses to characterize the dual-edged clocking, one of the technologies at issue, is used as a way of increasing the bandwidth or the amount of data that's transmitted from the DRAM to the controller or back.
Q. And with respect to this technology, dual-edged clock, did you follow the same methodology of initially, based on technical sources, identifying a universe of what you understood to be technically feasible alternatives?
A. I did.
Q. Let's go to the next slide, which will be DX-196.
And does this slide reference all of the technologies that you understood from the technical sources you relied on to be technically feasible alternatives to the use of dual-edged clock technology in a DRAM?
A. It does.
Q. Let me ask before we go any further, did the time period that -- did the time period that you were focusing on, understanding that it's a rough time period, but did the time period that you were focusing on for your market definition analysis differ with respect to this technology as compared to the two

7377
earlier technologies, programmable CAS latency and programmable burst length?
A. It did because these are technologies -- the dispute on these technologies involves DDR SDRAM rather than SDRAM and that technology was standardized later, so in this case the approximate time period that I aimed at was 1995.
Q. Based on your economic analysis, did you conclude that any of these technically feasible technologies presented in DX-196 was also, economically speaking, commercially viable?
A. I did. If we can go to the next slide.
Q. This will be DX-197.
And this slide refers to keeping each DRAM single data rate and interleaving banks on the module?
A. That's correct.
Q. Is this a technology -- a technological alternative that you concluded based on your analysis to be a commercially viable alternative to dual-edged clocking?
A. It appears to be, yes. That is, I did conclude that it's a commercially viable alternative.
Q. And what -- can you summarize generally what the basis is for your conclusion?
A. Again, I surveyed a great deal of evidence, I

7378
interviewed witnesses, and I read market reports to reach that determination.
Q. Were there any other technically feasible alternatives to dual-edged clocking that you concluded

were commercially viable?
A. Yes.
Q. Let's go to the next slide. This is DX-198.
And this slide relates to increasing the number of pins per module?
A. Yes. I put this slide in because I did not in fact conclude that this technology is commercially

viable; so that is to say, it does not appear to be commercially viable.

There is some contrary evidence to that, although the evidence is recent and in fact involves a graphics design, a graphics card designer.

So there is some contrary evidence, but overall this is a technology that I think I can rule out as being commercially viable.

Q. And by that, do you mean that you've not included it in any relevant technology market?

A. In fact, I've gone -- the others I was silent on. I've gone further and excluded this one.

Q. Were there any other technologies other than the prior technology, keeping each DRAM single data

7379

rate, that was referred to in DX-197, were there others besides that technology that you've concluded to be commercially viable alternatives to dual-edged clocking?

A. Yes. And the next slide will set that out.

Q. The next slide will be DX-199, and this refers to doubling the clock frequency?

A. Right.

Q. Is this a technology that you've concluded based on your economic analysis to be a commercially viable alternative to dual-edged clocking?

A. That's correct.

Q. And what was the basis for that conclusion or what -- if you could summarize the basis for that conclusion.

A. Again, I examined a great amount of information and facts to reach the determination that this was a commercially viable alternative to dual-edged clocking.

Q. Were there any other technically feasible alternatives besides doubling the clock frequency and the earlier alternative that you mentioned in DX-197 of interleaving banks and keeping the single data rate, were there others besides those that you concluded to be commercially viable alternatives --

7380

A. Yes.

Q. -- to -- there were?

A. Well, I actually reached the conclusion that toggle mode was commercially viable. But I have to say that the exhibit that I hold in my hand does not reflect that. And I'm not sure why that's true.

Q. Well, let's go to the next slide. Again, this is DX-200 I believe.

And I believe that this slide, which, as has been the case with similar slides, similar animated slides, starts by identifying the various technologies that you understood or assumed to be technically feasible, and with the animation you now see that there are checks by two of these technologies and there's an X by one.

What do you mean to depict by that --

A. Well --

Q. -- or to illustrate by that?

A. This was supposed to illustrate the data acceleration technology market that I had reached, but I have to say, I have actually determined that toggle mode was also a commercially viable alternative, and so we have an error on this document.

Q. How would you revise this demonstrative, DX-200, to make it accurately reflect your conclusions

7381

as to commercial viability and the definition of what you termed the data acceleration technology market?

A. I would add a red check to use toggle mode, and then I would conclude that dual-edged clock, keeping the DRAM single data rate and interleaving the banks on the module and doubling the clock frequency and using toggle mode, those four technologies comprise a data acceleration technology market.

Q. Now, I believe we've covered three of what you termed earlier the relevant technologies. Let's move then to the fourth, which is the on-chip PLL or DLL technology. And the slide that's now on the screen will be DX-201.

The first bullet point on this slide, does that refer to your understanding of the function served by use of on-chip PLL or on-chip DLL in a DRAM technology?

A. Yes. My understanding from factual testimony -- and it is my assumption from the factual testimony -- is that on-chip PLL/DLL has the effect of synchronizing the DRAM clock with the system clock. And that that's -- the technologies that serve that purpose are alternatives to on-chip PLL or DLL.

Q. And did you identify, based on the technical sources that you were relying upon, any technically

7382

feasible alternatives to on-chip PLL?

A. Again, my assumptions are set out on a subsequent page. These are I believe Professor Jacob's alternatives for on-chip PLL/DLL.

Q. And the side that's now on the screen will be identified as DX-202.

There are five technologies here. These are the technologies that you understand from the technical sources that you relied upon to be technically feasible alternatives to on-chip PLL/DLL?

A. Yes. That's correct.

Q. And did you through your economic analysis

conclude that any of these technically feasible alternatives were also commercially viable?

A. I did, and they're set out on the subsequent slides.

Q. The next slide will be DX-203.

And this relates to putting a DLL on the memory controller. Is that a technology that you concluded through your analysis to be a commercially viable alternative to on-chip PLL/DLL?

A. It is. In my review of the available evidence, it appears to be a commercially viable alternative to on-chip PLL/DLL.

Q. And in summary form, can you identify the

7383

general nature of the basis for that conclusion?

A. Yes. As before, I interviewed witnesses, I read trade reports, I read many documents that had bearing on this.

Q. Were there any other technically feasible alternatives to on-chip PLL/DLL that you concluded to be commercially viable?

A. Yes. Much like putting the DLL on the memory controller, one can put it on the module.

Q. And that's the subject of the next slide, which is DX-204.

A. Yes, that's correct.

Q. Did you conclude that PLL/DLL on the module technology referred to here was a commercially viable alternative to on-chip PLL/DLL?

A. Yes, I did.

Q. And were there any other technologies that through your economic analysis you concluded to be commercially viable alternatives to on-chip PLL/DLL?

A. Yes. Actually I'm not sure how to pronounce it. "Vernier" or "vernier" technique I determined is a

commercially viable alternative to on-chip DLL.
Q. And that's the subject of the next slide, DX-205.
A. Yes.

7384

Q. What -- again, in summary form, what basis did you have for concluding that this technology was a commercially viable alternative to on-chip PLL and DLL?
A. I reviewed a substantial amount of information and that had bearing on the vernier technique as an alternative and concluded that it was a commercially viable alternative.
Q. And were there any others, any other technically feasible alternatives to this on-chip PLL/DLL technology that you've concluded to be commercially viable?
A. Yes. One may be able to get away with no DLL at all.
Q. And that option is the subject of the next slide, DX-206.
And can I ask you to explain now your basis for concluding that the use of no DLL at all was a commercially viable alternative to the use of on-chip PLL/DLL?
A. Again, there are advantages -- so in my review of the facts, there are advantages and disadvantages of PLLs and DLLs on-chip, and at relevant speeds, at relevant DRAM speeds, actually not using a DLL at all appears to be a commercially viable alternative.

7385

Q. Of the technically feasible alternatives that you identified through reliance on technical sources, did you conclude that all of those alternatives were also commercially viable alternatives to on-chip PLL/DLL?
A. It depends on whether by "all" you meant the four we've just discussed or also the five that were on the original list.
No. I've concluded that the four that we discussed were commercially viable alternatives to on-chip PLL and DLL. But not achieving -- but not by adding more pins. And that one I did not make a determination one way or the other as to whether it -- whether it was an -- whether it was a commercially viable alternative.
And these four alternatives with the original on-chip PLL/DLL I concluded to be a clock synchronization technology relevant market.
Q. Let me make clear for the record that we're now -- we now have on the screen another slide, which should be marked as DX-207.
And I think your prior answer identified that the technologies in addition to on-chip PLL/DLL that you included in the market that you defined as the clock synchronous technology market; is that correct?

7386

A. Clock synchronization technology market, yes.
Q. Are there any other alternatives, other than the alternatives that we have been discussing and specifically the technologies that you've testified that you concluded based on your economic analysis were commercially viable alternatives to the four Rambus technologies, other than the ones that we talked about,

were there any other technologies that you, based on your economic analysis, concluded to be viable alternatives to Rambus' technologies?
A. Yes. I've concluded that asynchronous designs were relevant for at least some length of time, were relevant alternatives, in particular, well through 1995 and probably continuing thereafter.
Q. We now have a new slide on the screen, which we'll mark as DX-208, which relates to asynchronous -- the title is Asynchronous Alternative.
And in the first bullet you refer to asynchronous DRAM designs. Let me ask you first of all to define what you mean by that term.
A. So synchronous designs -- it's easier to define that -- well, let me say again that this is a fact question.
Synchronous design -- it's easier to explain what a synchronous design is.

7387

Synchronous design takes a clock on the DRAM and synchronizes it or synchronizes the action of the DRAM with the system clock rather than with just its own independent clock. It has its own synchronized clock.
So asynchronous designs did not. And the -- what preceded SDRAM were asynchronous designs, so fast page mode and EDO, extended data out, DRAMs were asynchronous designs.
There were -- there was quite a bit of debate at the time that JEDEC standardized SDRAM about whether to move to synchronous or stay with asynchronous designs. Asynchronous designs had evolutionary advantages over synchronous designs, but at that time JEDEC made the determination to move to asynchronous -- to synchronous -- move away from asynchronous to synchronous designs.
Q. Have you reached any conclusion as to whether asynchronous designs were commercially viable alternatives to synchronous designs in the time period that you focused on for purposes --
A. Yes.
Q. -- for purposes of your economic analysis?
A. Yes. Asynchronous designs had a number of advantages and some disadvantages over the synchronous

7388

designs that were ultimately chosen. And the -- they were constraining alternatives on these synchronous designs. And there's a wealth of information from the time that speaks of that.
Q. In the final bullet point on this exhibit, DX-208, you state, "Choice of synchronous DRAM diverted resources away from asynchronous designs."
Can you explain what you mean by that?
A. Yes. The asynchronous designs of 1992 and 1993 are slow relative to, say, modern DDR designs, and that's because a great deal of investment has been applied to SDRAM and its successor DDR. Had the industry stayed with asynchronous designs, it's economically reasonable that those designs would have progressed.
Generally in this industry I find that the application of engineering effort actually improves the product, and so the fact that they went to a synchronous design diverted resources away from asynchronous designs and made those designs less successful than they would have otherwise been.
Q. In this slide, DX-208, you refer in the first bullet point to something called burst EDO.
What is burst EDO?
A. Burst EDO was an asynchronous design that was

7389

proposed to succeed EDO -- we have a slide on this --

that was proposed to succeed EDO and it was an alternative -- it actually represented an alternative DRAM technology, an alternative to SDRAM, and hence an alternative to both programmable CAS latency and burst length.

That is to say, an alternative to using those technologies and many other technologies embedded in SDRAM was to use burst EDO.

Q. We'll mark this slide relating to burst EDO as DX-209.

Have you concluded, Professor McAfee, whether burst EDO was a commercially viable alternative to synchronous DRAM?

A. Yes. It was a constraining factor on -- it would be a commercially viable alternative. That is, it would be a price constraint on the SDRAM technology.

Q. Did you include the burst EDO technology or any other asynchronous DRAM technologies in the relevant markets that you defined?

A. I did not, although one could. They are -- they are -- when one looks at the individual technology, it would be a large departure to switch, in order to avoid an individual technology, to switch to

7390

an asynchronous design. It requires changing a great number of things relative to just changing that one technology.

That would be a more reasonable thought experiment when one was considering changing all four technologies rather than just one of the technologies.

Q. Let's go to the next slide. This would be DX-210.

And you see in DX-210 you've listed I believe the four relevant technology markets that you've identified in your earlier testimony.

Are these the only relevant markets that you have defined?

A. No. I also examined what's known as a cluster market, and that lumps these technologies together. That procedure is more a convenience than it is a -- it's a common convenience among economists, but it is more of a convenience than a strict market definition, and it's because the technologies tend to be used in the same products that one might want to treat them together in what's known as a cluster market.

And that is actually a common expedient in economic analysis.

And so using that common expedient, I found a synchronous DRAM technology market that refers to all

7391

four of those technologies.

Q. You've used the term "cluster market" and you've given an explanation, but I think you may have a slide that illustrates that concept.

A. I do.

Q. This would be DX-211.

Is this slide meant to illustrate the concept that you just described of a cluster market?

A. It is. This slide illustrates -- refers back to an earlier slide that we had, that through the standard-setting process we're going to select features for -- or we're going to select technologies for a variety of distinct features, in this case listed as features 1, 2 and 3, and we'll select specific technologies for those.

Insofar as those technologies relate to each other, that is, they must work together, for example, then it would be natural to cluster them together, so if there was a natural affinity of one technology for another, that is, they work well together, one would want to cluster them together.

Q. I believe, if I'm not mistaken, this may be another animated slide.

A. Yes. Here, the technologies B, F and G have gone through the standard-setting process. They are

7392

unrelated from each other in the sense that D is a standard for feature 1, F is a standard for feature 2, and G is a standard for feature 3, but because they are in some sense embodied in the same device, they can be treated together.

As I said, that's more of a convenience than it is a normal or -- excuse me. It is quite normal. It's more of a convenience than a strictly logical exercise. Since they are, after all, they -- they do different things. They aren't substitutes for one another.

Q. Am I correct that what you're illustrating here is that in defining what you term the SDRAM technology market or the cluster market that you described earlier, you were collecting the other technologies that you defined separately as separate markets into a single, consolidated market in the manner that you've depicted in this slide?

A. Yes. That's correct.

Q. Now, my final question -- and I'll be done with this topic and for the day -- relates to geographic market.

Have you reached any conclusion as to the geographic scope of the technology markets that you described or identified in your testimony today?

7393

A. Yes, I have. I find technology markets to be worldwide.

Q. And the next slide and the last slide for today is DX-212.

And let me just ask you if you could walk us through your reasoning for concluding that each of the relevant technology markets that you've defined is geographic -- or is worldwide in geographic scope.

A. I think I've already testified today that the buyers of technology, the adopters of technology, generally do not care about the geographic source of the technology. They want the technology that is the best for their purposes.

Technologies tend to be licensed worldwide, so that is to say technologies tend to flow across national borders.

In addition, the downstream product is produced and used worldwide. From a technological perspective, the fact that it's produced worldwide, has low transportation costs, means that the downstream product competes in a world market which indirectly forces the technologies to compete in a worldwide market.

And so -- and I think this is not controversial, that technologies tend to be worldwide

7394

markets, and this case is no exception.

Q. And I think you've touched -- may have touched on this in your answer.

But the negligible transportation costs, that's something that bears on your conclusion that this is a world -- that these relevant technology markets are world markets?

A. Yes. That actually -- so there are two instances of negligible transportation costs. The transportation cost of a product itself, a DRAM, that is, the physical product, is very low and that makes

DRAM a world market. In fact, they don't seem to mind shipping it across the Pacific Ocean -- this is a fact, but they don't mind shipping it across the Pacific Ocean just to package it.

So transportation costs are very low. But also the transportation -- but more importantly, the transportation costs on the technology is essentially zero, that is, it's trivial. It's a matter of flying the – those who know how to implement the technology to wherever the technology is to be used.

And so technology – the transportation costs associated with moving the technology are essentially zero, and that means that the buyers adopt the technology that offers the best technology independent

7395

of the origin of the technology.

MR. ROYALL: Your Honor, that concludes my examination on that subject. I will have some questions in the morning but will hope to conclude that in somewhat over an hour's time.

JUDGE McGUIRE: Very good, Mr. Royall. Thank you.

MR. ROYALL: Thank you.

JUDGE McGUIRE: Then that will take care of it for tonight. We will convene tomorrow morning, Thursday, at 9:30 a.m.

This hearing is in recess.

(Time noted: 5:50 p.m.)

7396

C E R T I F I C A T I O N O F R E P O R T E R

DOCKET NUMBER: 9302

CASE TITLE: RAMBUS, INC.

DATE: June 25, 2003

I HEREBY CERTIFY that the transcript contained herein is a full and accurate transcript of the notes taken by me at the hearing on the above cause before the FEDERAL TRADE COMMISSION to the best of my knowledge and belief.

DATED: June 25, 2003

JOSETT F. HALL, RMR-CRR

C E R T I F I C A T I O N O F P R O O F R E A D E R

I HEREBY CERTIFY that I proofread the transcript for accuracy in spelling, hyphenation, punctuation and format.

DIANE QUADE

7397

FEDERAL TRADE COMMISSION

I N D E X (PUBLIC RECORD)

WITNESS: DIRECT CROSS REDIRECT RECROSS
McAfee 7401 7524

EXHIBITS FOR ID IN EVID
CX

RX

DX

7398

UNITED STATES OF AMERICA
FEDERAL TRADE COMMISSION

In the Matter of:)
Rambus, Inc.) Docket No. 9302
----------)

Thursday, June 26, 2003
9:32 a.m.

TRIAL Volume 36
PART 1
PUBLIC RECORD

BEFORE THE HONORABLE STEPHEN J. McGUIRE
Chief Administrative Law Judge
Federal Trade Commission
600 Pennsylvania Avenue, N.W.
Washington, D.C.

Reported by: Josett F. Hall, RMR-CRR

7399

APPEARANCES:

ON BEHALF OF THE FEDERAL TRADE COMMISSION:
M. SEAN ROYALL, Attorney
GEOFFREY OLIVER, Attorney
JOHN C. WEBER, Attorney
MICHAEL FRANCHAK, Attorney
Federal Trade Commission
601 New Jersey Avenue, N.W.
Washington, D.C. 20580-0000
(202) 326-3663

ON BEHALF OF THE RESPONDENT:
GREGORY P. STONE, Attorney
STEVEN M. PERRY, Attorney
PETER A. DETRE, Attorney
SEAN GATES, Attorney
Munger, Tolles & Olson LLP
355 South Grand Avenue, 35th Floor
Los Angeles, California 90071-1560
(213) 683-9255

7400

APPEARANCES:

ON BEHALF OF THE RESPONDENT:
A. DOUGLAS MELAMED, Attorney
Wilmer, Cutler & Pickering
2445 M Street, N.W.
Washington, D.C. 20037-1420
(202) 663-6090

7401

P R O C E E D I N G S

- - - - -

JUDGE McGUIRE: This hearing is now in order. Any items we need to take up this morning before we begin?

MR. ROYALL: I don't believe so, Your Honor. My estimate is it may be about two hours before I'll be complete with the direct.

JUDGE McGUIRE: All right. Sir, you may take the stand again, please. And Mr. Royall, you may proceed with your examination of the witness.

MR. ROYALL: Thank you.

- - - - -

Whereupon --

RANDOLPH PRESTON McAFEE

a witness, called for examination, having been previously duly sworn, was examined and testified as follows:

DIRECT EXAMINATION (continued)

BY MR. ROYALL:

Q. Professor McAfee, before we go further today, let me ask, do you recall that yesterday there were a few slides that you noted, as you saw them when they were pulled up on the screen, you noted that there may

7402

have been errors?

A. That's correct.

Q. Let me ask that we pull up the slide that was previously marked DX-200.

And can we run the animation on that.

You'll recall I showed you a slide very similar to this one yesterday, and there was an error that you noted. Do you recall what the error was?

A. Yes. "Use toggle mode" had not been checked.

Q. And is this, what's now on the screen, is this version of the same slide correct?
A. Yes, this is correct.
Q. Let's mark this version of the slide as DX-213.
Was there -- in connection with this toggle mode issue, did you also note yesterday that there was a slide that you thought was missing from the presentation slides?
A. Yes. That's correct.
Q. Would you pull up the next slide.
A. That is not the slide.
MR. STONE: It should be the next one.
BY MR. ROYALL:
Q. Is this the slide that you recalled yesterday that was missing from the presentation?

7403

A. Yes, it is.
Q. And this relates to the toggle mode technology and your conclusions that this technology is a commercially -- or was a commercially viable alternative to the dual-edged clocking technology?
A. That's correct.
Q. Let's mark this as DX-14.
JUDGE McGUIRE: 214.
MR. ROYALL: I'm sorry. DX-214.
BY MR. ROYALL:
Q. Now, were there any other slides that you recalled yesterday that when you saw them you thought there were errors in the slides?
A. Yes. There was an omission on a slide as well.
Q. And let me see if we can pull that -- pull the next slide up.
Is this the slide that you recalled having an error?

A. Yes, it is.
Q. And I think this may be a new version of the same slide.
Do you recognize something in this slide that was omitted from the slide that you saw yesterday?
A. Yes. The last bullet point was not present on

7404

the slide yesterday.
Q. Let's mark this as DX-215.
Now, this slide relates to your conclusion, as you explained yesterday, that the alternative of keeping each DRAM single data rate and interleaving banks on the module, that that alternative was a commercially viable alternative to use of dual-edged clocking; is that correct?
A. That's correct.
Q. And you said that the last bullet point that is listed here on DX-215 was omitted from the slide that you saw yesterday. Now that we have a corrected version of the slide here in DX-215, let me ask you about that last bullet point.
And the statement you make in that bullet point is: "Royalties may be a problem."
Can you explain what you mean by that?
A. Yes. Generally, royalties for intellectual property impose a penalty on a technology with respect to market selection, and so the fact that this method, the method that I'm referring to here, at least in the implementation by Kentron, comes with royalties to Kentron, makes it a -- it may not be commercially viable against some of the other alternatives I've identified, although I think it would remain

7405

commercially viable in comparison to the Rambus technology.
Q. Despite this issue of royalties then, is it your conclusion that this technology that's discussed in DX-215 was a commercially viable alternative to the Rambus dual-edged clocking technology?
A. Yes.
Q. Now, before we go on, I'd like to briefly come back to something else that we discussed yesterday, and this relates to the distinction between assumptions that you've made and expert conclusions that you've drawn.
And in relation to that, could we pull up from yesterday DX-157.
Do you recall this slide, Professor McAfee?
A. I do.
Q. And you testified about this slide yesterday, and I believe you explained that the factors that are identified in the four bullet points at the bottom of the slide are factors that were relevant to your analysis as to whether the risk of hold-up, the economic concept of hold-up, would arise in a given industry.
Is that a fair summary of what you had to say about this?

7406

MR. STONE: Your Honor, I do object to Mr. Royall's summarizing of the testimony and to his leading the witness through the form of his question, which I believe is improper.
MR. ROYALL: Your Honor, I'm happy to restate. I'm just trying to speed things along. I'm just trying to clarify something from yesterday. But I'm happy to do that.
JUDGE McGUIRE: Okay. Go ahead and restate then.
BY MR. ROYALL:
Q. Without re-covering too much territory, let me just ask you to explain again what you were seeking to convey through this slide.
A. This slide lists the economic aspects of an economic environment or an economic situation which would tend to -- which would be informative about the risk of hold-up facing participants in the industry.
So for example, when the size of specific investments is large, the risk of hold-up is greater. And that's what this slide is setting out, the important characteristics of the environment that would relate to the risk of hold-up.
Q. Let's then go to DX-160.
Now, we now have on the screen DX-160 that was

7407

identified yesterday. Do you recall this slide?
A. I do.
Q. And what were you seeking to convey through this slide?
A. So this slide provides my assessment of these economic factors in the DRAM setting; that is to say, it provides my assessment of the size of specific investments, of the costs of changing standards, of the importance of IP and the ease of reaching agreement in relation to other industries with which I'm familiar.
Q. Well, let's start with the first point, size of specific investments, under which you have a red check mark and the word "substantial."
What do you mean to convey by that?
A. In my review of the facts and in comparing the facts to the economic concept of specific investments, I find that a substantial number of the total investment -- the total investment is very large, but not all of the investment is specific or represents

specific investments, and that a substantial amount of investment is specific to the DRAM technology, and so that is to the standard that is at issue.

Q. When you refer here to the size of specific investments in the DRAM industry being substantial, is that an assumption on your part or does that reflect

7408

your economic conclusion?

A. Well, it's a simple conclusion in the sense that it reflects my application of the economic notion of specific investments to the types of investments made in this industry.

So the input to this analysis -- it is an analysis. It's a simple analysis. The input to this analysis is the set of investments and a characterization of those investments as to what they do, and the output is to characterize those investments as either specific or not and assess whether the investments that meet the economic condition of being specific are in fact substantial or not.

Q. Moving to the second bullet point on DX-160, costs of changing standards, below that your slide has a check mark and then the words "switching costs."

What are you meaning to communicate or convey through those worth?

A. My use of the term "switching costs" is the economic concept of switching costs. I think it's actually in accord with the way lay people use the term "switching costs," that is, it's the costs of switching.

But what I've done here is look at -- is assess

7409

the costs of changing standards as to whether those are -- whether a significant proportion of those costs or a significant amount of the costs are in fact switching costs or are they just costs of doing business that would be incurred whether or not the standard was switched.

Q. When you refer here to switching costs in reference to the issue of the costs of changing standards, does that reflect an assumption on your part or is this part of your economic conclusions?

A. So again, this is part of my economic conclusions in the sense that I have characterized costs as being either switching costs or not and found that there are a substantial volume or substantial magnitude of costs that are in fact switching costs.

Q. The third point is "importance of IP," below which you have a check mark and the word "high."

What are you meaning to communicate through those words?

A. So this is in comparison to other industries, and intellectual property in this industry is both fast-paced and extensive, that is, there are a lot more patents in this industry than in a typical industry and they are also more rapidly paced, that is, there are more new inventions on an annual basis than you find in

7410

most industries, and that leads to the conclusion that intellectual property is important, from an economic perspective, in this industry.

Q. And how does -- well, before I -- strike that.

When you refer to the importance of IP in this industry, the DRAM industry, as being high, is that an assumption on your part or does that reflect an economic conclusion?

A. Well, that reflects an economic conclusion, the basis of which I just set out, which was in comparison to other industries.

Q. And does that economic conclusion bear on your broader conclusion that there is a significant risk of hold-up in the DRAM industry?

A. It does.

Q. The final bullet point on this slide refers to ease of reaching agreement, and below that your slide has a check mark and then the words "difficult and time-consuming."

What are you meaning to communicate through those words?

A. There's actually an economic theory associated with the ease of reaching agreement, and what I'm referring to in this bullet is my assessment of whether this industry has an easy time reaching agreement,

7411

which essentially arises from the theory when most of the participants have interests that are aligned, or whether they have a difficult time reaching agreement, which arises when you have diversity of opinion and widespread disagreements.

And so the ease of reaching agreement in this industry appears to be difficult and also time-consuming. The time-consuming is an empirical matter.

Q. When you say that ease of reaching agreement in this industry appears to you to be difficult and time-consuming, is that an assumption on your part or is that a part of your economic conclusion?

A. That's part of my economic conclusion.

Q. And does that conclusion have any bearing on your broader conclusion that there is a significant risk of hold-up in the DRAM industry?

A. It does. It is a contributor to my conclusion that there is a significant risk of hold-up.

Q. And how does that factor contribute to your conclusions on hold-up?

A. The ease of reaching agreement reflects on how difficult it would be to avoid hold-up by changing the standard, for example.

Q. I'd like to make clear -- you've used the term

7412

"assumption" and we've made distinctions between the conclusions and assumptions, and I'd like to make it clear for the record what you mean by the term "assumption" when you use that word relating to the work that you've done on this matter.

A. So I use "assumption" to mean anything I don't have firsthand knowledge of myself.

So that is to stay, if I -- I'm not a DRAM manufacturer, I have no firsthand knowledge of DRAM manufacturing processes, so what I understand about them is an assumption on my part and the facts that I use are assumptions. They are not part of my economics training.

Q. And for your purposes in reaching and explaining your economic conclusions, is it important to you to be clear about what assumptions you've made?

A. Yes. Conclusions generally are only as good as the assumptions on which they're based. False assumptions will tend to lead to false conclusions, and so as a consequence, it's important to me to be clear about my assumptions so that the context of my conclusions is clear and also to verify my assumptions so that I get the right answer.

Q. Have you done anything to verify or corroborate the assumptions that you've made in relation to the

7413

work that you've done on this matter?

A. Yes. I think as I testified yesterday, I've made a very extensive study of the facts in this situation, I've read a tremendous amount of -- a

tremendous number of documents, I've interviewed witnesses, and I've read the trial transcript as well up until this week to verify that my assumptions are in fact consistent with the true situation in this industry.

Q. Is the amount of work that you've done relating to verifying and corroborating facts in connection with your assignment in this matter, is that typical of the amount of factual investigation that you ordinarily conduct in connection with the government and private consulting assignments that you've had in the past?

A. I think this is actually the largest amount of -- my largest investment in fact-finding of any case that I've personally worked on.

Q. Is there a reason for that?

A. Well, it's a complicated case. It has a lot of aspects and several different market levels. In fact, one of our early slides -- one of my early slides showed three different market levels.

And so one of the complexities of this case is

7414

that the economics of the technology market are driven by the economics of the DRAM market and the economics of the DRAM market are driven by the economics of the downstream PC and other applications markets, so that makes for a more complicated market structure.

In addition, it's very challenging technology.

Q. Now, we touched briefly yesterday on your expert report and noted that the text of the expert report combined with the text of Appendix 3 to the report, which contains your case study, together those aspects of your expert report approximate 400 pages or slightly less than 400 pages.

Is that amount of length typical of the types of expert reports that you've generated in other government and private consulting assignments?

A. This is longer than any other expert report I've generated by a significant margin.

Q. And is there a reason why your expert report in this case is significantly longer than other expert reports that you've written in connection with other consulting assignments?

A. It would be the same reason that I gave earlier for doing more investigation, and this is in fact a reflection of the level of detail of investigation which I've done.

7415

MR. ROYALL: Your Honor, before I move on, I would like to mark Professor McAfee's report as a demonstrative exhibit.

JUDGE McGUIRE: Any objections, Mr. Stone?

MR. STONE: I don't understand what it would be demonstrative to, Your Honor.

If it's demonstrative to show that it's 400 pages in length, I don't think we need to mark it to prove that it's 400 pages in length.

If it's demonstrative because he wants someone to refer to the text of it later on in comparing findings or in reviewing this case on appeal, that would be inappropriate and inconsistent with Your Honor's ruling on its admissibility.

I'm not sure what it's demonstrative of except its length and I've allowed the testimony about its length to be -- there's no question that Professor McAfee with the assistance of his colleagues has written a very lengthy report, but I don't think it should be marked and --

JUDGE McGUIRE: Mr. Royall, you are cognizant of my earlier order on expert reports, so in what context are you now seeking to have this at least marked?

MR. ROYALL: Well, I do believe, Your Honor,

7416

that, respecting your earlier ruling about the admissibility of expert reports for the contents, the substantive contents of the report, that it is nonetheless relevant to have in the record as a demonstrative exhibits that have been used with experts.

I've used many slides today that help to explain the testimony, and reference to the expert report likewise does.

And the other point I would make is I do think it is highly relevant that this expert has done a substantial volume of work that he has done relating to facts and that that is simply what's reflected in the report itself.

MR. STONE: And Your Honor, I've allowed without objection -- and it likely would have come in had I objected in any event -- the amount of time he spent on this, the length of the paper that he's written. All of that is in the record.

The report itself is not demonstrative of any of his testimony. It's not a useful aid to understand his testimony. His testimony is here in the record.

The report is not demonstrative of or illustrative of his testimony except to the extent that it's voluminous, and I think to make a 400-page report

7417

a demonstrative simply to prove that it's 400 pages in length bends the demonstrative rule to the breaking point, and I don't think -- I think this is an effort to put it into the record for its substance and content which the court has correctly ruled it should not be put in the record for.

JUDGE McGUIRE: Let's be real clear as to exactly the context that you're offering this, because if I agree to have it marked, that's the only extent that it's going to be marked.

MR. ROYALL: Yes, Your Honor.

JUDGE McGUIRE: So let's be real clear on that now, Mr. Royall.

MR. ROYALL: Yes, Your Honor. I understand.

I will note, first of all, that I have used this as a demonstrative exhibit in the trial. I've used it by reference to help the witness explain the nature of the work that he did.

His CV and resume are included here, and I believe that that is a fully proper demonstrative exhibit as well, and also the list of materials that he reviewed and persons that he interviewed, which is included here for demonstrative purposes.

And the only thing I would note is I have no objection -- we will have no objection to Rambus' --

7418

JUDGE McGUIRE: No, you won't, especially if I have this marked, you will have no objection because I would offer them the same courtesy, so to speak.

MR. STONE: Your Honor, if I can just respond.

This is a disguised effort to get around your ruling in limine. It may not be intentional, but that is indeed what will happen.

If we're to look at this demonstrative to find out the names of the people that Professor McAfee spoke to, we are now looking at the report for its content and substance and it is being offered in evidence for its content.

If it's important to list the names of the people Professor McAfee talked to, that can be elicited orally in examination.

JUDGE McGUIRE: Here is what I want you to do. I am also concerned about the content of this report being offered in an attempt perhaps to go around my other order. I'm not saying that that's your intention necessarily.

What I would ask the parties to do is to confer and see if there are any pertinent portions of this report that you feel could be marked and that way we can avoid entering the entire report.

If you can then agree, so be it; if not, then

7419

I'll rule. Okay?

MR. STONE: We'll certainly do that, Your Honor.

MR. ROYALL: We can do that at another time.

JUDGE McGUIRE: Okay. Good enough.

MR. ROYALL: Thank you.

BY MR. ROYALL:

Q. Yesterday, Professor McAfee, I believe that we concluded the day by discussing your various relevant technology market conclusions, and the last point that we touched on was the geographic scope of the relevant markets that you defined. And with that, I believe that we've covered the first of the five key economic questions that you identified earlier in the morning.

I'd like to come now to the second key economic question, which, as you explained yesterday, is the question of whether Rambus possesses substantial market or monopoly power in the relevant antitrust markets that you have defined.

Let me ask you, before we go any further, in addressing that question, if you could define for us what you mean by the terms "market and monopoly power"

and how, if at all, those two things differ from one another.

A. Yes. I've prepared a slide on that topic.

7420

I think as I testified yesterday, there's not complete consensus or unanimity in the way these terms are used, but there is consensus in monopoly power being stronger than market power, being substantial and being durable and involving prices -- the ability for a company to maintain prices above competitive levels.

Q. When you use the term "durable" in the context of monopoly power, what specifically are you referring to?

A. For a significant period of time. That is, there are many firms that for a very short period of time increase their prices, but that would cause entry that would soon dissipate the profits and force the prices back down. Such a situation means exploitation of a temporary circumstance is not generally considered to be monopoly power. Instead, the power must be durable, long-lasting, in order to be considered monopoly power.

Q. Before we go further, let's mark this as -- I believe this will be DX-216.

Have you concluded, Professor McAfee, based on your economic analysis, whether Rambus possesses monopoly power in any of the relevant markets that you've defined?

7421

A. Yes. I've determined that Rambus possesses monopoly power in all of the relevant markets.

Q. All five of the relevant markets that we discussed yesterday?

A. That's correct.

Q. What factors did you consider in concluding that Rambus possesses monopoly power in all five of the relevant antitrust markets that you've defined?

A. There are three major indications of monopoly power which I've prepared a slide to indicate, three major indications.

Q. So this slide which is now on the screen will be DX-217.

Is this the slide you're referring to?

A. Yes, it is.

Q. Let me ask you to explain -- there are three points here. Let me ask you to explain what you're referring to by the first bullet point on DX-217.

A. The technologies that I had identified as commercially viable alternatives to Rambus' patented technologies are no longer commercially viable because of the incorporation into the dominant JEDEC standards, the incorporation of those technologies into the dominant JEDEC standards.

Q. And moving to the second point, which refers to

7422

substantial barriers to entry, is that a factor that you considered in concluding that Rambus possesses monopoly power?

A. Yes. Barriers to -- I spoke earlier in the definition of monopoly power about the need for it to be durable, and the reason for the durability, the requirement of durability, is that many firms can raise their prices only to prompt entry which would then undo the effects and force prices back down.

The notion of a barrier to entry is what prohibits that from happening and so hence is a requirement for finding of monopoly power.

Q. And the final bullet point on DX-217 refers to "Ex post pricing of Rambus' technologies substantially exceeds their ex ante value."

What do you mean by that?

A. What I mean by that is an indication of monopoly power is the exercise of monopoly power. Pricing at a level that's significantly above the ex ante value of the technology would suggest the exercise of monopoly power, which of course would be an indication of monopoly power.

Q. Now, going back to the first of these three points, in describing what you mean by the language in the first bullet point, you referred to Rambus'

7423

technology being incorporated into the JEDEC standards?

A. Yes.

Q. And is that relevant to your determinations about monopoly power?

A. It is. And I've prepared a demonstrative which refers back to the funnel model of technology choice that we discussed yesterday.

Q. This will be DX-218.

Is this the demonstrative you're referring to?

A. Yes, that's correct.

Q. And what are you seeking to convey through this demonstrative?

A. This demonstrative illustrates the incorporation of technology in the evolutionary progression of standards from SDR to DDR to DDR-II and it illustrates a number of things.

Starting with in 1993 with the SDRAM standards, the Rambus technology was one of several alternatives that we discussed yesterday, and the selection of the Rambus technology into the standard is illustrated by the -- it's the R in the middle coming out from the SDRAM's funnel.

Q. So to be clear about this, you have three funnels on this slide, DX-218.

7424
The funnel on the far left, that refers to the process through which JEDEC developed the SDRAM standard; is that correct?
A. That's correct.
Q. And the funnel in the middle refers to the process through which JEDEC developed the DDR SDRAM standard?
A. That's correct.
Q. And does the funnel on the far right refer to the process through which JEDEC has developed the -- or is developing the DDR-II SDRAM standard?
A. My understanding is it is developing the standard. It's not finalized yet. But yes, that refers to the DDR-II process.
Q. And the yellow arrow with the R attached to it in the far left of this demonstrative, that refers to Rambus technologies that were considered during the SDRAM standardization process?
A. That's correct.
So programmable burst length and programmable CAS latency, depending on which technology is at issue, could be one of the technologies labeled with an R where alternatives that we discussed yesterday are labeled with A and B. And those technologies are selected by the SDRAM standard and incorporated into
7425
that standard.
Q. And what are you meaning to depict by the yellow arrow with the R on it coming out of that first funnel, the SDRAM funnel?
A. Well, we had -- so that depicts the selection of that technology in SDRAM as an input into the next technology, the DDR standard.
And we had quite a long discussion yesterday of the evolutionary nature of the standards developments and the importance of evolution, evolutionary developments, and so that the tendency within JEDEC -- and we had a long discussion of the economics of this -- but the tendency within JEDEC is to build on the previous standard, and so this illustrates the incorporation of the SDRAM technologies into the DDR technologies.
Q. There's a second yellow arrow with an R on it pointing into what you've identified as the DDR funnel in the middle of this demonstrative. What are you meaning to depict through that second yellow arrow?
A. This depicts new technologies incorporated or potentially incorporated, that is, that are vying for incorporation, into the DDR standard and the yellow R there refers again to Rambus technology, such as dual-edged clocking or on-chip PLL/DLL.
7426
Q. And then there's another yellow arrow that is coming out of the DDR funnel. What are you meaning to depict through that yellow arrow?
A. That depicts the, again, the evolutionary nature of these standards, building on a platform created from the previous standard.
Q. And finally, there's one last yellow arrow coming out on the far right-hand side of demonstrative DX-218 to the right of the DDR-II funnel. What are you meaning to depict through that?
A. Well, my understanding is that the discussions of DDR-III have already commenced, although they are highly speculative at this time. This would indicate that another evolutionary standard would likely incorporate technology that had been incorporated in the previous standards, and so any future evolutionary standard, that is, something other than a major break, would likely reuse the existing technologies.
Q. Is there any significance to the fact that in DX-218 you have aligned these three funnels in the way that you have?
A. Yes. That reflects the evolutionary nature of these standards. That is, they're building on the platform of the -- each standard builds on the platform of the previous standard.
7427
Q. When you refer to the evolutionary nature of JEDEC's SDRAM standards, are you expressing an assumption or an economic conclusion?
A. That term is used of course in the industry quite extensively, but it's also used by economists, and so I'm using it as an economist. It is my understanding, and as I testified yesterday, it's my understanding that the meaning in which I use that term is consistent with the way that the industry uses it. But I'm using it in -- as an economic term.
Q. And by that do you mean your use of that term in this context reflects an economic conclusion on your part?
A. Yes. And we had a discussion of the economics of evolutionary developments yesterday.
Q. Generally speaking, does the mere inclusion of a patented technology in an industry standard necessarily give rise to monopoly power?
A. Not necessarily. There are standards that fail to be adopted in the marketplace and in such a standard incorporation would not give rise to monopoly power.
Q. And have you reached a conclusion as to whether the incorporation of Rambus technology in the DDR, the SDRAM and DDR SDRAM standards contributes to Rambus'
7428
monopoly power in the relevant markets that you've defined?
A. Yes, it does.
Q. And how does the incorporation of those technologies in the JEDEC standards contribute to the monopoly power that you've concluded Rambus possesses in those markets?
A. Well, the JEDEC standards have dominated the DRAM industry for most of the last ten years or all of the last ten years, and as a consequence, those standards have been very successful in the marketplace.
And I have a slide, which we've already seen --
Q. This slide that's now on the screen was marked yesterday as DX-141.
And in the context of your conclusions about monopoly power, what, if anything -- what, if any, significance do you attribute to the statistics or facts depicted in this slide?
A. That the JEDEC standards have been -- have dominated the marketplace for -- in DRAM and continue to dominate the marketplace.
Q. In this slide there are various colored regions or areas.
Which of these areas do you understand to
7429
reflect the presence of JEDEC -- or the impact of JEDEC standards on the DRAM industry?
A. So the green, the orange, the blue and the yellow are all, to my knowledge, JEDEC standards, that is, fast page mode, extended data out, SDRAM, DDR.
Q. Are there any regions or areas in this chart, DX-141, that are not associated with JEDEC standards or that you do not understand to be associated with the

JEDEC standards?
A. My understanding is RDRAM was never standardized by JEDEC, and that's the red area. And I just don't know about the gray area, which is other standards.
Q. And to be clear, before we leave this slide, why is the dominance of JEDEC standards in the DRAM industry relevant to your conclusions as to Rambus' monopoly power in the relevant markets that you've defined?
A. It's in essence the means by which the monopoly power is created. That is, this is the standard which has been adopted by the industry. The ability to charge for that standard provides monopoly power through the process that we discussed yesterday of the adoption of the standard; that is, to practice the standard requires paying for the technologies.

7430

Q. Do you have an understanding of what proportion of total commercial DRAM production in the world today is subject to Rambus patent claims?
A. Yes. And I've prepared a slide that illustrates that.
Q. I believe this would be DX-219.
What are you seeking to convey through this slide?
A. So this shows three major DRAM -- types of DRAM, RDRAM in the left circle, RDRAM, SDRAM and DDR, that is, the Rambus DRAM, SDRAM and the DDR SDRAM, and what proportions those were -- it says today, although these are actually mid-2002 numbers, and so it shows those proportions.
And in the right side of the circle it shows the patents asserted over the JEDEC standards SDRAM and DDR SDRAM by showing them in the same color as the RDRAM.
Q. And have you calculated what percentage of total DRAM, commercial DRAM production in the world today is subject to Rambus patent claims?
A. It's in the upper nineties. It's a very small percentage that I don't know that is subject to Rambus patent claims.
Q. And that small percentage being reflected by

7431

the green slice in the pie chart on the right-hand side of DX-219?
A. That's correct.
JUDGE McGUIRE: I'm a little confused here as to that answer. He's saying in the first instance it's in the upper nineties and then he's talking about a very small percentage.
I'm a little confused as to what you're referring to there.
THE WITNESS: It's the small percentage that's not subject to.
JUDGE McGUIRE: That's not. Okay. All right.
BY MR. ROYALL:
Q. So just to be clear then, referring to this demonstrative, DX-219, and the -- of the two pie charts, the pie chart on the right-hand side, does the region that is colored red or maroon in that pie chart, does that region reflect pictorially your understanding of the extent of the DRAM industry over which Rambus is asserting patent claims?
A. That is my understanding, although as I said, I don't know about that green wedge one way or the other.
Q. Now, if we could go back a couple of slides to DX-217, which we covered a moment ago.

7432

In this slide, which lists the factors that you considered as indicia of Rambus' monopoly power, in the first bullet point you refer to Rambus' technologies today being the only commercially viable alternatives.
Do you see that?
A. I do.
Q. And can you explain how you arrived at that conclusion and how it relates to your broader conclusions about monopoly power?
A. Yes. I'd be happy to.
Q. Do you have a slide that may help you explain that?
A. I do. I'd like to refer back to a slide that -- when we talked about commercially viable alternatives, I presented a slide that illustrated the market using circles.
And in this case, this illustrates a set of commercially viable alternatives to the technology C that is a -- all of those are price-constraining to technology C, and the process of standardization has the effect of locking in the industry to the technology selected, which might have been from an ex ante perspective any of those seven technologies that are commercially viable.

7433

But having chosen and having embedded the technology in the standard, the industry becomes progressively more locked in -- we should have some dynamics --
Q. Before we do that -- I'm sorry. Go ahead. This is an animated slide?
I'm sorry. Continue, professor.
A. The industry becomes progressively more locked in and then the other -- as investments are made in the standard and in the technologies embodied in the standard and in the practice of the standard, that is, developing the methods of production and the complementary goods, and the effect of that is to cause the other alternatives to fall away and become impractical.
Q. Let's go back to the first view of this same slide, which I believe will be DX-220.
Now, in the initial view of this slide, DX-220, we see again the same types of concentric circles that you used yesterday to describe the process by which you've defined relevant markets; is that correct?
A. That's correct.
Q. And so the -- just referring back to that explanation, the outer gray circle which encompasses

7434

the other two circles and all of the letters on this slide except H, does that outer gray circle comprise the, in this case, what you would term the relevant antitrust market?
A. That's correct. This is prior to the incorporation of any of these alternatives into a standard.
Q. And in your earlier explanation you were talking about the narrowing of alternatives or the elimination of alternatives, and by that are you saying that the -- over time there is a narrowing of the contents of a relevant market in a way that excludes products that in an earlier time period were included in the relevant market?

A. That's correct.
Q. And let's run the animation again.
Now, let's stop there. The second view of this slide, DX-220, has the word "ex ante" at the top. Can you explain what the significance of that term is as you use it in this slide?
A. Yes. As I testified, the starting point for this slide is prior to the incorporation of any of the technologies into a standard, that at that point all of the commercially viable alternatives are available or are price-constraining on the technology that will

7435

ultimately be selected.
Q. Then moving to the next view, and now in the third view of this slide, DX-220, the word "ex post" appears and the only letter that's circled is C.
Can you explain, just so it's clear for the record, what you mean to communicate through that view of this slide?
A. Yes. As the investments in the standard are made, the industry becomes progressively more locked into the standard, that is to say, the switching costs now grow over time and the specific investments grow over time, and those contribute to lock-in, that as those specific investments grow at some point you reach a point where the existing technology, that is, the technology incorporated into the standard, has monopoly power and the other alternatives are no longer commercially viable.
Q. You've now described the process by which a relevant market over time can be narrowed and products that were commercially viable alternatives through that process can be eliminated.
Have you reached any conclusion as to whether that type of narrowing and elimination of commercially viable alternatives has occurred in this case?
A. Yes. And it occurs for reasons that we

7436

discussed yesterday, but I've actually prepared a demonstrative to illustrate those reasons.
Q. And I think we now have that on the screen. This will be DX-221.
Can you explain what you're seeking to convey through this demonstrative?
A. Yes. This demonstrative -- so first from left to right refers to time in this demonstrative even though it's not labeled there.
This demonstrative illustrates that once a standard is issued and assuming that the standard is adopted, you get an increasing over time level of investment into the standard, and so you have manufacturers examining how to produce the standard, you have complementary components like modules, graphics cards, chipsets and the like being produced, and it takes -- so as a fact, it takes a substantial amount of investment to produce these complementary goods.
That's not something that I'm testifying to, it's something that I'm assuming, but I think there's adequate support in the record.
And this illustrates those investments being made and they grow over time. That is, the day the standard issues, those -- the size of those investments

7437

might be quite modest. Two or three years later, the size of those investments could be substantial, and those investments contribute to lock-in to that standard, so that as the volume production occurs or as the commercialization of the standard occurs, the industry gets progressively more locked in to that standard.
Q. And does this relate at all to what you were describing yesterday about the connection between the late disclosure of intellectual property and the hold-up condition?
A. It does. And I've prepared a demonstrative referring back to the discussion we had yesterday or the demonstratives used yesterday.
Q. Is this -- the demonstrative on the screen, is this what you're referring to?
A. Yes, it is.
Q. And this will be DX-222.
Can you explain what you're seeking to convey through this demonstrative?
A. This demonstrative begins with what appears quite similar to the demonstratives used yesterday in that it shows three competing technologies, one of which has been labeled Rambus or R for Rambus, that are potential candidates for being included in the

7438

standard. It should be understood that all three of those technologies are commercially viable candidates for being included in the standard.
And then it also illustrates, as we discussed yesterday, the deployment of resources locking the industry in and increasing the value of whatever technology is actually incorporated. And that's illustrated in this graphic by the increasing dollar signs as the -- moving to the right. So again, time in this picture goes from left to right.
Q. And I believe this may also be an animated slide.
We're now looking at the second view of this demonstrative, DX-222. Can you explain what you are seeking to convey through the animation that just occurred?
A. Yes. In this case the Rambus technology was selected by the standard-setting process, technologies A and B fall away, and the value of the Rambus technology, because of its incorporation into the standard, rises.
Q. You referred to the concept of lock-in. That concept is being depicted here through the increasingly larger dollar signs and the increasingly intense use of the color green; is that what you were

7439

saying earlier?
A. Yes. That's correct.
Q. And does the lock-in effect that you've described have any consequence in terms of the ability of the industry to respond if it learns late in the process of patented intellectual property being included in the standard?
A. Yes. Actually as we discussed yesterday, this is just a classic case of economic hold-up; that is to say, after the lock-in occurs, it's now possible for the owner of a patented technology to hold up the industry and expropriate some portion of the investments that have been made into this technology.
Q. Does the lock-in effect that you've described have anything to do with the costs that would be associated with changing standards after they've been adopted and industry investments, specific investment has taken place?
A. Yes. The size of the lock-in is essentially measured by the cost of changing the technology to a technology that did not infringe.
Q. And have you as part of your economic analysis considered what costs would be associated with changing JEDEC standards today?
A. Yes. And I prepared a slide that lists some of

7440
those costs.
Q. Is this the slide you're referring to?
A. It is.
Q. I believe this will be DX-223.
You have a number of points here. Let's take them one at a time.
Let me ask you to start with the first point where you say, "Develop new technology standards."
Would you explain what you mean by that and how that relates to the conclusions you've reached about the costs of changing JEDEC standards today.
A. Yes. A significant cost associated with attempting to get out from under Rambus IP in the JEDEC standards would be to produce an alternative standard that did not infringe, that is, that didn't use any of the four patented technologies, and so costs of doing that are one of the sources of lock-in of the industry. That is to say, if those costs are high, the industry is locked in by that -- at least by that amount.
Q. And does the cost of developing new technology standards relate in any way to the time that it would take to develop new standards?
A. Well, in fact perhaps the most important and certainly one of the most important aspects of the
7441
costs is not the actual financial costs but the cost of delay. That is, there's a substantial amount of testimony and there's also some economic analysis supporting the proposition that it does take a very long time to actually create a standard. And I've prepared a slide that is relevant.
Q. Let's identify this next slide as DX-224.
And this slide refers in the title to -- poses the question: How long would it take to create a noninfringing standard?
This is the slide you're referring to?
A. Yes, it is.
Q. And what are your seeking to communicate through the information presented in this slide?
A. So this slide actually seeks to illustrate -- well, so first let me say, the challenge of creating a new standard that gets out from under Rambus IP -- this is supposed to be suggestive, but I don't take it to be proof, of the delays necessary to create a noninfringing standard. That is to say, they are doing other things when they create these standards besides getting out from under an existing IP.
But this suggests -- this is at least suggestive of the lengths of time that it takes to both develop standards and to deploy standards.
7442
And I should say that it's not just the development of the standard that's the relevant time. To get out from under the intellectual property you have to both develop and actually commercialize the technology.
And so -- now, let me also add that the years listed on this are at least somewhat confusing.
The SDRAM standard took approximately two years to develop and another four years before full volume production was -- occurred. Ramp-up, that is, the point where the penetration starts to rise fairly dramatically, was maybe half of that period, so roughly 1995 or 1996.
So when it says two to six years, this is -- I find that at least confusing. Let me actually be more specific to say two years to develop the standard and somewhere more than four years before full deployment of the standard took place.
With DDR, the development of the standard took approximately four years and there was a shorter time before volume production, full volume production occurred.
And DDR-II, my understanding, is still not finalized as of today.
Q. Now, just to make this point clear, you've
7443
considered here by the two different color arrows in reference to SDRAM and to DDR SDRAM both, as I understand it, the time that it took JEDEC to define those standards and the time it took for the industry to ramp up to volume production?
A. That's correct.
Q. And from the standpoint of addressing the question that we were discussing in reference to the earlier slide, DX-223, which had the title Costs of Changing JEDEC Standards Today, from the standpoint of addressing that question, why is it relevant for you to look not only at the time that JEDEC in the past has taken to develop standards but also the time that the industry has taken to ramp up to volume production?
A. Because you don't get out from under a royalty, that is, you can't avoid paying a royalty until you're actually producing the alternative product in volume and can reduce the volume of the existing product.
This goes back to the basic economics of the DRAM industry, which is you want -- the plants are enormously expensive and you want to run them full out, that is, 24/7, as they say, during the -- well, you want to run them full out constantly, and so until
7444
you've actually ramped up the production, you'll be producing the infringing product and paying royalties.
Q. We've talked a fair bit conceptually about this economic concept of lock-in, but let me ask you this in case it isn't already clear.
How do you reach the conclusion, economic conclusion, as to whether the DRAM industry is locked in to the SDRAM, JEDEC SDRAM standard?
A. Well, lock-in is itself a continuum; that is to say, you could have in principle a small amount of lock-in or a large amount of lock-in.
I find, because of the scope and the size of the investments, that there's actually been -- into a standard that there's actually a relatively large amount of lock-in in this industry to the standard that's been deployed in volume.
Q. And is there a point in time at which, based on your economic analysis, that lock-in effect began to exist or materialize?
A. Well, even at the time a standard issues there has been some investment in the standard, although it's relatively modest compared to what will come after it.
As I said, it is somewhat -- it is a continuum, the concept of lock-in, and it's something that grows
7445
over time. It's certainly been accomplished by the time that ramp-up starts. At that point most of the specific investments in the complementary goods have been made by the producers. Because in order to deploy the standardized product in volume, it requires those complementary goods. Things like chipsets and the like are also being produced. And so that the industry is -- at that point has certainly been locked in by that time.
Q. Let's go back if we could to DX-141.

This is by now a familiar demonstrative. We've talked about it already once today and yesterday, and it relates to the evolution of DRAM standards.

Does this demonstrative, DX-141, help in -- help you in discussing the issues of ramp-up and lock-in that we were just touching on a moment ago?

A. Yes. You can see, the notion of ramp-up is that essentially that you will have a trickle of the output of the DRAM output for some period of time, and then ramp-up is when the volume starts to dramatically increase.

So you can see that for EDO, for example, the ramp-up is occurring somewhere 1994-1995, that that's where significant volume production is occurring, and

7446

in order to be ramping up at that time it must be the case that there are -- that the complementary goods, that is, the chipsets and the applications that use EDO, have already been provided.

So at that point the industry must be locked in and that the ramp-up must be occurred -- you can see the ramp-up occurring.

Similarly, for SDRAM illustrated with the blue, you can see the volume production starting in the 1996-1997 time frame. And so that corresponds to the ramp-up.

Q. Does the specific investments that you've described and the lock-in relating to specific investments, does that occur in this industry before ramp-up occurs?

A. Yes. The industry would never produce -- the economics of the industry dictate that the industry would never produce large volumes of DRAM if the uses of those DRAM had not yet been deployed.

So that is to say, they're not going to produce the DRAM for inventory in any large volumes and just sit on them hoping that the complementary goods would be provided in the future.

Q. Let's now go back to DX-223.

In connection with this issue of the costs of

7447

changing JEDEC standards today, the second bullet point in DX-223 refers to the difficulty of reaching consensus ex post.

What do you mean by that?

A. By that I mean the actual deployment of the standard itself can interfere with -- can create diversity of opinion within the industry -- I should say, when I say "within the industry," I mean both buyers and sellers; that is, I'm using it in the economic term, the economic notion -- can create disagreements within the industry.

And I've prepared a slide to illustrate the increase in -- the increasing challenge in reaching consensus after a standard has issued.

Q. Is this the slide you're referring to?

A. Yes.

Q. This would be DX-225.

A. That's correct.

Q. And this difficulty of reaching consensus ex post that you described, is this something that contributes to your conclusions about the difficulty of changing the JEDEC standards today?

A. It is. The thought experiment, the economic concept here is, once the standard has issued and has already been deployed, what would it take to get a

7448

consensus from the industry in order to change the standard to one that did not infringe. And a challenge for getting such a consensus to change the standard is that the companies have different positions with respect to the existing standard.

And so, for example, right at the moment, half of the market or approximately half of the market has licenses to produce the standard from Rambus and the other half does not. Now, the half that has licenses is going to feel quite differently about the costs of changing the standard than the half that doesn't, and in fact the half that has licenses might benefit from the lack of licenses of the other half.

Q. When you say here in DX-225 that about 50 percent of the market has licenses, let's be very clear here, who are you referring to and what licenses are you referring to?

A. So this refers to the licenses to produce SDRAM and DDR SDRAM and licenses issued by Rambus.

And I should also say what 50 percent refers to is capacity, not 50 percent of the number of producers but 50 percent of the manufacturing industry capacity.

And so roughly half the DRAM that's produced is produced under license and half that's produced is not produced under license.

7449

Q. And so you're saying that there is some number of DRAM producers whose output, total market output, adds up to roughly 50 percent of the total market that do have licenses from Rambus that permit them to, without infringing, produce SDRAM and DDR?

A. That is my understanding.

Q. And then are you saying that there is another roughly 50 percent of market output reflected by other producers that you understand those other producers do not have licenses from Rambus today that would allow them to produce these products without claims of infringement?

A. That's my understanding, yes.

Q. And how do those facts or those understandings that you have relate to this issue in the first bullet point of DX-225 about differing incentives?

A. This creates differing incentives. Having a license or not creates differing incentives ex post.

And let me draw the comparison of prior to the development of the standard these companies all had an interest in producing, in developing the best cost-benefit standard that they could produce. That is to say, they had a common interest in the economics of the standard.

And I don't mean to say that they had

7450

perfectly aligned interests because I don't believe they did. They had some differences in manufacturing capabilities and the like, but they nonetheless had fairly closely aligned interests in terms of producing a standard that buyers would buy and would actually advance the market.

Now, some of the producers, because they are licensed under Rambus, have an incentive actually perhaps not to get a new standard issued so that they'd be legal producers in the hope that the other producers are going to be shut down.

Q. And does that observation relate to your broader conclusions about the existence of lock-in in this industry?

A. Yes. As I said, one of the indicators of lock-in was the difficulty in changing the standard or the difficulty -- the ease of reaching agreement, and this is an impediment to the ease of reaching agreement.

Q. The second principal bullet point on DX-225

states, "Users of specific features have distinct incentives."

What do you mean by that?

A. So this refers to the nature of the investments that have been made in the existing standard can

7451

actually create disagreements about what alternative standards might be employed.

And a good example of this logic is actually the fact that AMD uses a burst length of 8 and Intel uses a burst length of 4. Now, if the original SDRAM standard had had a fixed burst length, probably both of those companies would use the same burst length, that is, the burst length associated with whatever was the cheapest commodity DRAM. And they would have designed

their processors to exploit the burst length that was the market consensus.

However, because the standard permitted programmable burst length, now, AMD would be very much

harmed -- and this is a fact issue, but there's been testimony by an AMD representative that AMD would be very much harmed if the industry chose a burst length of 4, and that's because they have invested a substantial amount of money in optimizing their processors for a burst length of 8.

And so this -- the existence of these features, that is, the possibility of specifying burst length, has itself created a disparity in incentives within the industry.

Q. And does this relate at all to the concept of specific investment that you discussed yesterday?

7452

A. Absolutely. The investments that AMD made in exploiting a burst length of 8, a specific investment in the programmable burst length feature of SDRAM and DDR SDRAM.

Q. Does this issue that you're describing, that you've just described, does this bear on your conclusions as to the existence or degree of lock-in relating to JEDEC's SDRAM and DDR SDRAM standard?

A. It does. As I -- and for the same reasons as the previous bullet point, that is, the ease of reaching agreement is relative to the scope of lock-in, and here is an example of a challenge to reaching consensus after the fact.

Q. Are there other factors that contribute to your conclusions as to the challenge of reaching consensus about changing the JEDEC standards in the ex post period?

A. I'm sorry. Can you re-ask the question?

Q. Just before we leave this slide, I wanted to ask whether there are any other factors that you haven't already discussed that contribute to your conclusions as to the challenge of reaching consensus about changing the JEDEC standards in the ex post period.

If there are not, we'll move on.

7453

A. Then perhaps we should move on.

Q. Let's go back to DX-223.

Now, we've just covered the first two bullet points on DX-223, the first two of six points relating to the costs of changing JEDEC standards today.

Let's go to the third point. Can you explain what you mean by that point?

A. So design, testing and qualification costs are all specific costs, specific investments, so that is the investments in designing a new DRAM chip, in testing it and in qualifying it for use in various systems would represent specific investments. So the size of those costs are part of the costs of changing JEDEC standards today.

Q. What about the next point that refers to existing component?

A. Existing components that -- I should say the slide doesn't say, but it should be complementary components, that is, components that are designed to work with the DRAM or to exploit features of DRAM, and those include everything from BIOS to chipsets to processors.

The redesign, testing and qualification of those components are also specific to the DRAM, and hence those costs would also be specific investments

7454

associated with the standard.

Q. And those design, testing and qualification costs referring to complementary components and then the other design, testing and qualification costs that you discussed in reference to the prior bullet point referring to the DRAM chips themselves, do those costs contribute to your conclusion about the overall costs and difficulty of changing JEDEC standards today?

A. Yes. Those costs are substantial, and that's a fact issue that the specific costs, for example, the design, testing and qualification costs, are substantial. The economic conclusion is that those costs are specific investments and specific investments of course can, as I've testified, contribute to the lock-in, and so those costs all contribute to the extent of lock-in within the industry.

Q. Let's move on then to the second to last point on this slide, DX-223, which refers to the term "opportunity costs."

Let me ask you first of all to define what you mean by that term.

A. So let me say that I want to refer actually to two different notions of opportunity costs. There's the standard economics notion, which in a normal economics principles class is actually a first piece of

7455

jargon to be introduced. And then opportunity costs refer to the economic notion of cost, which is not an accounting notion, that is -- so the cost of an activity is not necessarily the number of dollars you spend on that activity, which would be the accounting notion, but includes whatever you give up in the process. It includes the lost value of your second best alternative.

And so an opportunity cost in the economic notion is a broader notion than an accounting cost; that is, it includes all of the opportunities that have been forgone by an activity.

The phrases also appear -- or appears frequently in both the trial testimony and in other documents that I've reviewed and it seems to be used in a consistent way with the economic notion.

So here the opportunity costs from an economic notion and also as I understand it's been used in the record, although that's a factual question, the opportunity costs from the economic perspective is when I put a team of engineers on a project such as developing a new standard that gets out from under the Rambus intellectual property, I don't have that team available for other projects that may be valuable to me.

7456

And so the opportunity cost of creating a new standard and getting out from under the Rambus IP is that the engineering talent, the resources, the testing

facilities and all of the resources used are not available to other projects which may be profitable. And I believe that is consistent with the way that "opportunity cost" has been used in the course of this trial.

Q. And does this concept of opportunity cost that you've explained relate to your conclusions about the difficulty and costs of changing JEDEC standards today?

A. Yes, it does, because it refers to the -- or it is an example of a cost which is actually specific in the sense that it would be -- in this case it's a specific cost of the switching cost for -- that is, it's a loss in the process of trying to develop alternative standards.

Q. Let's then cover the final bullet point on DX-223 which refers to cost of delay. What do you mean by that?

A. One of the basic economic propositions is that time is money and that a delay creates -- delay loses value; that is to say, obtaining things earlier rather than later is more valuable, and this is why when you

7457

borrow money you have to pay more money back.

So one of the costs of changing JEDEC standards today is that, as we've already discussed, it wouldn't happen overnight, there would be substantial delay, and the delay is in itself inherently costly.

Q. In the items that are discussed on this slide -- well, actually strike that. Let me just ask one follow-up question on your last answer.

No. I think you covered it.

The items that are discussed on this slide relate to your testimony and economic conclusions relating to the difficulty and costs of changing JEDEC standards?

A. That's correct.

Q. And does that issue and do those conclusions factor into the conclusion that you discussed earlier that one of the indicia of Rambus' monopoly power is that in each relevant technology market Rambus' technologies today are the only commercially viable alternatives?

A. Yes, they --

MR. STONE: Objection, Your Honor. Leading and incorrectly states the witness' prior testimony.

JUDGE McGUIRE: Sustained.

7458

BY MR. ROYALL:

Q. Well, let's go back to DX-217.

We've been discussing your views relating to the first bullet point on DX-217 relating to the indicia of Rambus' monopoly power.

Do the factors that we've been discussing in connection with the slide we dealt with previously, DX-223, that is, the factors about costs of changing JEDEC standards today, do those factors relate to the conclusion that you state in the first bullet point on DX-217?

A. They do.

Q. And how do those factors relate to this conclusion?

A. What has caused the other commercially viable or ex ante commercially viable alternatives to fall away is the industry lock-in to the existing standard.

That is to say, the -- those alternatives that I identified yesterday as commercially viable were ex ante commercially viable. Once the standard is issued -- well, actually the issuing of the standard itself may not be enough to cause those alternatives to be commercial -- to cease to be commercially viable. That is, it may be possible to go back and revise the standard and include one of the

7459

alternatives if these complementary investments have not been made.

And the costs of changing the standard bear directly on what costs are there to switching to one of the alternatives, and so those costs are all relevant in the calculation of the commercial viability of the alternative technologies today.

Q. Let's go back to DX-187.

I believe this may be an animated slide.

Do you recall this slide, Professor McAfee?

A. I do.

Q. And DX-187 relates to what you've termed the latency technology market?

A. That's correct.

Q. And when we discussed this slide earlier, you explained which technologies you included in that market as part of your market definition analysis. Do you recall that?

A. That's correct. Yes.

Q. And which technologies did you include in the latency technology market as part of your market definition analysis?

A. Well, programmable CAS latency plus the first four bulleted technologies.

Q. Do you have -- do your views as to what

7460

technologies are in this market today differ from what is reflected in DX-187?

A. Yes, they are.

Q. And how do your views today differ from what you explained earlier when you described the process through which you defined the latency technology market?

A. All four of the first of the bulleted technologies that were included in that market have ceased to be technologies within that market.

Q. And why is that?

A. I would like to contrast it to the ex ante period. At the time that JEDEC first included programmable CAS latency in SDRAM or at the time that the standard was finalized in, say, 1993, the alternative of fixed CAS latency required a relatively modest amount of cost and actually offered performance benefits over programmable CAS latency.

At this point, in order to change the standard, you would now have to incur all of the other costs on the slide that we just looked at to deal with changing the deployment of an existing standard rather than -- which none of those costs would have been required to switch to fixed CAS latency ex ante.

So that is to say, in addition to whatever

7461

costs and benefits were associated with fixed CAS latency in the ex ante period, you now have all of the additional costs associated with lock-in required in order to change the standard.

Q. Does that summarize your views as to why the technologies with the red check marks by them in DX-187 although included in your initial market definition are no longer, in your view, commercially viable technologies in this market?

A. It does.

Q. Let's move to DX-194.

And again I believe this is an animated slide.

Do you recall this slide from our discussion yesterday, Professor McAfee?

A. I do.
Q. And this relates to the relevant technology market that you defined and that you identified as the burst length technology market?
A. It does.
Q. And when you defined that market, can you remind us what technologies in addition to programmable burst length you included within that market?
A. It is the first four bulleted technologies.
Q. All of which have red check marks by them?

7462

A. That's correct.
Q. Do your views differ today as to what technologies are included in this burst length technology market?
A. They do.
Q. And what technologies today would you include in that market?
A. Only programmable burst length.
Q. And why would you not include the other four technologies that are checked in DX-187?
A. Again, the cost --
Q. I'm sorry. I gave the wrong number. In DX-194.
A. As with programmable CAS latency, the economics of changing the technology from programmable burst length today to an alternative technology for setting burst length has -- the economics have changed dramatically because today you have a large installed base and all of the other factors listed on the slide that we had looked at a couple of slides ago are required to actually change the technology.
So that is to say, whereas ex ante you didn't have an installed base, installed base of products, today you have an installed base of products, you have all of the differences and challenges for reaching

7463

consensus and the other factors that we discussed as an impediment to changing the standard. All of those attach only to the technologies not selected; that is to say, they don't attach to programmable burst length, but they hobble the alternative technologies in such a way as to render them no longer commercially viable.
Q. Let's go to DX-200.
Do you recall discussing this slide yesterday, Professor McAfee?
A. I do.
Q. And this slide relates to the relevant market that you identified as the data acceleration technology market?
A. It does.
Q. And can you remind us which technologies in addition to dual-edged clock you included in that relevant market when you defined the market?
A. They're the technologies indicated with the check mark.
Q. And would you include or do you include those same technologies in the data acceleration technology market today?
A. I do not.
Q. Why not?
A. The reason is the same. That is, the

7464

technologies other than dual-edged clocking now have a significant impediment that did not exist at the time in the ex ante period because the act of replacing dual-edged clocking with any of these technologies requires strandings of large specific investments and also the challenges of reaching consensus and the other factors which we've discussed.
Q. Now, finally, let's go to DX-207.
Do you recall discussing this slide with us yesterday, Professor McAfee?
A. I do.
Q. And this slide relates to the relevant market that you've defined and that you've identified as the clock synchronization technology market?
A. It does.
Q. And can you remind us which technologies in addition to on-chip PLL/DLL you included in the clock synchronization technology market?
A. It's again indicated by the four technologies with check marks along with on-chip PLL/DLL.
Q. And which technologies would you include in the clock synchronization technology market today?
A. Only the on-chip PLL/DLL.
Q. And why would you not also include the other technologies that are identified here with red check

7465

marks?
A. As with the other markets, those items now have the impediment to their implementation of requiring challenges of reaching consensus, the loss of the specific investments into the existing technology, and that hobbles the technologies to a point at which they are no longer commercially viable.
Q. Let's go back to DX-217.
Now, we have just been discussing the first bullet point and your views relating to the first bullet point on DX-217 in which you state that in each relevant technology market Rambus' technologies today are the only commercially viable alternatives.
Let's move now to the second bullet point on this slide, which refers to substantial barriers to entry, and let me ask you first of all to define for us what you mean by the term "barriers to entry."
A. So a barrier to entry -- it's a piece of economic jargon that means exactly what it says. It's something that is an impediment to new entrants that is generally not faced by existing incumbents in a marketplace.
So a barrier to entry is something that prohibits new entry and hence permits existing incumbents, for example, to exercise monopoly pricing.

7466

Q. And do you discuss the issue of barriers to entry in the book that we saw yesterday?
A. I do.
Q. Let's go to the next slide.
A. But that's not what the next slide has.
Q. And do you recognize this slide quote?
A. Yes. This is a statement from an early Rambus business plan.
Q. Oh, I'm sorry. I went to the wrong slide.
A. There is no slide from my book.
Q. Okay. Here we go.
This slide entitled Barriers to Entry will be I believe DX-226.
What are you seeking to convey through this slide, Professor McAfee?
A. So there's a fairly long list of recognized barriers to entry within the economics literature. This actually takes a subset of those barriers to entry that are, in my judgment, applicable to the DRAM marketplace or DRAM technology marketplace.
And so this lists the barriers to entry that are relevant in assessing the DRAM technology marketplace.
Q. And where did this list of factors come from or

how did you develop this list of factors relating to barriers to entry?

A. Well, I did actually look at my book, at the list of factors listed in my book and take it from there, although I have to say the list of factors in my book is similar to what you'll find in most economics books, industrial organization books that discuss barriers to entry.

Q. Have you reached any conclusions as to which if any of these factors listed in DX-226 have application to this industry and this case?

A. Yes. In fact I only listed the applicable barriers to entry. The list of total -- there's a long list of barriers to entry in my book. This is only the list of applicable barriers to entry.

Q. And what reasons do you have for concluding that scale is a barrier to entry applicable in this case?

A. Well, let me say that scale is a well-recognized barrier to entry, and we discussed yesterday the presence of scale economies in this industry, and I should say the scale economies operate not just at the plant level -- in fact the plant-level scale economies are not really the relevant ones; it's the industry-level scale economies that create the barrier to entry in this case in the technology market.

Q. What about the next point, user switching costs? What conclusions have you reached with respect to whether that is an applicable barrier to entry in this case?

A. So "user switching costs" refers to a new entrant is -- has a disadvantage if no one is using the new entrant product just by the fact they're a new entrant, and if there are switching costs, that creates a barrier to entry because the new entrant has to in some sense subsidize customers to switch to them or bears an additional cost relative to existing incumbents, and so switch -- we've discussed switching costs at present in the DRAM and DRAM technology marketplace and that creates a barrier to entry.

Q. What about the next point, strong learning curve? What, if any, conclusions have you reached with respect to whether that concept is applicable to this case?

A. A learning curve is a barrier to entry because a firm that's already gone down the learning curve has an advantage obviously over a firm who has not, and so a new entrant, sort of again by definition, hasn't yet gone down the learning curve, so a strong learning curve means a new entrant has to be better in order to survive in the industry against the more seasoned incumbent.

And I believe there's a lot of testimony that justifies the conclusion that learning curves -- which, again, learning curves are economic concepts, but the application to this industry does rely on the facts, and I think there's a lot of testimony that justifies the conclusion of a learning curve in the economic notion to this industry.

Q. Referring to the next point, sunk costs, what, if any, economic conclusions have you reached with respect to whether sunk costs are a barrier to entry applicable in this case?

A. Sunk costs are nonrecoverable costs. They have the effect of discouraging entry -- actually that point is at least somewhat controversial, to be fair. But they have the effect of discouraging entry because an entrant has yet -- who has not yet sunk an investment faces a risk of the loss of investment that creates a barrier to entry for the -- because of the risk attached to sinking the costs.

Q. And finally you refer in DX-226 to patents.

What, if any, conclusions have you reached with respect to whether the patents are a barrier to entry applicable in this case?

A. So patents are a classic barrier to entry. They're a legal -- that is, legal, not illegal -- they're a legal barrier to entry created by the government intentionally to promote innovation. They create a classic barrier to entry because in this case the government enforces the prohibition against entry.

Q. Is standardization a barrier to entry in the DRAM marketplace?

A. Yes. Standardization by creating switching costs creates a barrier to entry in this industry. And we've discussed, in the costs of changing the standards, we've discussed the barrier to entry associated with standardization.

Q. Have you seen any evidence that the concept of standardization being a barrier to entry is something that's recognized by market participants in this industry?

A. Yes. And the slide which has already been flashed up is the -- is an example of that.

Q. This would be DX-227.

Let me just read the quote here on DX-227.

It states: "The DRAM industry's penchant for standardization combined with the Rambus marketing strategy of licensing all major vendors make it extremely unlikely that any potential competitor would be able to gain critical mass enough to challenge an already established and ubiquitous Rambus chip."

Do you see that language?

A. I do.

Q. And do you have an understanding of where that language comes from?

A. Well, I have an understanding of the economic meaning of this language.

Q. I'm just referring to the source.

Do you understand the source of where that language came from?

A. Yes. I understand this to be an early Rambus business plan.

Q. And the source is identified at the bottom of the slide as -- with the date June 1989.

Now, do you, from the standpoint of your economic analysis, do you attribute any significance to this statement?

A. Well, yes. This refers to -- now, it refers in the form of if Rambus becomes the dominant standard or, that is to say, if the Rambus technology or RDRAM I believe would be the actual chip, if Rambus becomes the established technology, it will be difficult to displace them.

And it's the -- standardization is given as one of the reasons that the Rambus technology would be hard to displace and it's because the competitor if they're not produced in volume, that is, they haven't gained -- the term here is critical mass -- they're not going to be able to challenge the existing standard.

Q. And is that consistent with the conclusions that you've reached as part of your economic analysis

of this marketplace?
A. Yes, it is. Only in this case it's actually the JEDEC standard rather than the Rambus technology that was the -- that gained the critical mass.
Q. And why is it extremely unlikely that potential competitors would be able to gain critical mass once a standard has already been established and has become ubiquitous in the marketplace?
A. Well, we've discussed a number of factors both today and yesterday in which the -- that tend to produce an economy of scale. That is, the larger the volume that is produced of a chip, the lower the cost per unit not just of the chip itself but also of the complementary goods. That is, the large investments made to produce complementary goods get amortized over a larger volume of product, which lowers their per-unit costs, which makes it even more attractive to the

7473

marketplace.
And so for the same reasons that there tends to be a dominant standard in this industry, it will tend to be difficult to displace an established standard.
Q. Let's go back to DX-217.
Your Honor, I'm about to go into an area that does involve use of at least one slide that has been given -- I believe Your Honor gave it provisional in camera status?
JUDGE McGUIRE: Do you want to do that now or could we maybe do that toward the end? I'm just trying to think of a way that would require me taking a break here shortly. I guess we maybe can do that now and let the audience take a break and we're done with it.
MR. ROYALL: What I was going to suggest, I do have a little while to go. It's going to take me a little more than two hours to complete this, but if we can cover this now, I don't think it would take very long, and then perhaps we can take our short break and I can come back and finish up.
JUDGE McGUIRE: Let's do that.
And again, I have to advise the audience that the testimony and the evidence we're about to hear is

7474

closed to the public, so I'm going to ask that at this time the public excuse themselves from the courtroom and you will be advised when it's I guess safe to come back in.
Again, I will ask counsel to certify to the court that everyone at their counsel table and everyone behind them is cleared to access this in camera evidence.
MR. STONE: Based on my understanding that this information is information that came from Rambus, all the persons on our side of the room are cleared to be present.
JUDGE McGUIRE: And complaint counsel?
MR. ROYALL: Yes, Your Honor. My understanding is that all of the persons on this side of the room are also cleared to be present.
JUDGE McGUIRE: Okay. Good.
Then let me advise the court reporter that we are now in in camera session.
(The in camera testimony continued in Volume 36, Part 2, Pages 7622 through 7631, then resumed as follows.)
JUDGE McGUIRE: Then you may proceed at this time, Mr. Royall.
MR. ROYALL: Thank you, Your Honor.

7475

BY MR. ROYALL:
Q. Professor McAfee, yesterday you identified your key economic questions, and the third question was whether Rambus acquired market or monopoly power through exclusionary conduct.
Have you reached a conclusion regarding that issue?
A. Yes, I have.
Q. Can you explain the reasons -- strike that.
What conclusion did you reach?
A. That Rambus did acquire its monopoly power through exclusionary conduct.
Q. And what reasons do you have for reaching that conclusion?
A. Well, I have a series of slides. We might want to start with what is exclusionary conduct.
Q. And how would you define or how do you define from the standpoint of economics the term "exclusionary conduct"?
And before you answer that, let's just go ahead and mark this as DX-229.
A. Unlike market power, there's --
(Interruption at the door.)
BY MR. ROYALL:
Q. How do you, Professor McAfee, define from the

7476

standpoint of economics the term "exclusionary conduct"?
A. Unlike market power, there's a consensus on the definition of exclusionary conduct within economics, and it would be conduct that tends to exclude an equal or superior product or competitor.
Q. You mentioned on this slide, DX-229, in the third bullet, "Effect is anticompetitive -- harms consumers."
What do you mean by that?
A. Well, the logic of the definition of exclusionary conduct is that conduct that would exclude an inferior competitor would not have any -- would probably not harm a marketplace. That is to say, it would either have no impact or an insignificant impact on a marketplace by excluding an inferior competitor.
On the other hand, conduct that eliminates equal or superior competitors is generally going to harm consumers by reducing their choice and eliminating competition in the marketplace, and so conduct that tends to exclude superior competitors or products is known as exclusionary conduct and that tends to be harmful to competition and reduce the efficiency of marketplaces.

7477

Q. What do you mean by the last bullet point on DX-229, which states "no valid efficiency rationale"?
A. So again the purpose of defining exclusionary conduct to be the exclusion of superior competitors or products is to ensure that exclusionary conduct is bad for the functioning of marketplaces and hence does not have a valid efficiency rationale.
Q. In assessing whether Rambus' challenged conduct was exclusionary conduct, did you make any assumptions regarding Rambus' conduct?
A. Yes. Indeed I made a lot of them and I have a slide to that effect.
Q. Is this the slide you're referring to?
A. It is.
Q. This will be DX-230.
Can you explain to us what you're seeking to convey through this slide?
A. These are the factual assumptions that I make

in order to reach the conclusion that Rambus engaged in exclusionary conduct.
Q. Let me ask you about these assumptions, starting with the first, Rambus possessed IP relevant to JEDEC standards/work. That's an assumption that you're making?
A. Yes, it is.

7478

In order to know whether this assumption is true or not, one has to actually have expertise in assessing whether patents or pending patents are relevant to JEDEC standards, and I do not have that expertise personally.
Q. Going to the next point, Rambus failed to disclose relevant IP as required by JEDEC rules/process, is that an assumption that you have made for purposes of analyzing Rambus' conduct?
A. It is. This is the assumption that Rambus actually did something that mattered, that is to say, that it had something -- that it failed to disclose the relevant IP that was listed in the first bullet and that it was required to by the JEDEC rules.
Q. The next point states, "Rambus engaged in other related misrepresentations while a member of JEDEC."
Is that an assumption that you've made for purposes of conducting an economic analysis of Rambus' challenged conduct?
A. Yes. Although that assumption may be subsumed by the second assumption; that is to say, that assumption is not, strictly speaking, necessary to reach the conclusion if the second assumption is true.
Q. The fourth bullet states, "After leaving JEDEC,

7479

Rambus continued to conceal its IP."
Is that an assumption you have made for purposes of conducting an economic analysis of Rambus' conduct?
A. It is. The importance of that -- again, that assumption is to some extent subsumed by the second assumption, although the overall effect of the conduct depends on that assumption. The magnitude of the effect depends on the assumption.
Q. The second to last point states, "Before, during and after JEDEC participation, Rambus planned to enforce JEDEC-related IP."
Is that an assumption you have made for purposes of conducting an economic analysis of Rambus' conduct?
A. It is. The difference between -- what that assumption says is the behavior was not inadvertent; it was intentional. And that is to say, they did not disclose and they intended to enforce as opposed to an inadvertent failure to disclose, and again, that's an assumption I've made.
Q. And finally, the last bullet point states, "Rambus was aware of legal risks associated with this conduct (i.e., equitable estoppel)."
Is that an assumption you have made for

7480

purposes of conducting an economic analysis of Rambus' challenged conduct?
A. It is. And that actually provides a second route -- that assumption provides a second or alternative route at reaching the same conclusion, so that assumption is not necessary for one of the chains of logic that I will explain, but it is necessary for the other.
Q. In addition to making these assumptions, did you do anything, Professor McAfee, to corroborate for your own purposes the reasonableness of the assumptions that you've made?
A. Yes. I did a great deal of factual investigation. Again, the findings for these assumptions, these are all factual matters themselves.
And as I testified earlier this morning, the quality of my conclusions is very much predicated on the quality of my factual hypotheses, and so in order to get the right answer -- being an academic, I like to get the right answer -- in order to get the right answer, I investigated these assumptions to assure myself that I wasn't wasting my time reasoning from them.
Q. And in the course of doing that factual investigation, did you identify evidence that caused

7481

you to alter or lose confidence in any of these assumptions?
A. No. And I will add that reading the trial transcript corroborated that as well.
Q. Now, having now explained the assumptions that you've made for purposes of conducting an economic analysis of Rambus' conduct and in determining whether that conduct meets your economic definition of exclusionary conduct, having now identified those assumptions, let me ask you about the reasons why I believe you've now explained you ultimately did conclude that Rambus' challenged conduct was exclusionary in an economic sense.
A. Yes. And I have a slide to illustrate the major findings or to list the major findings.
The first of these is that the -- so again, I have assumed a failure to disclose and other misrepresentations. These have the effect of distorting the JEDEC standard-setting process. That is, they provide JEDEC with inaccurate information or with the lack of accurate information, and that information concerning royalties is material to the JEDEC decision-making process.
And so that has the effect of actually causing JEDEC to make mistakes relative to the world that would

7482

exist when JEDEC had accurate information.
Q. Is there anything in economic theory that speaks to whether conduct of that sort is or tends to be exclusionary?
A. Yes. Misleading information tends to be exclusionary generally. And I have a slide that illustrates that.
Q. Let me -- before we go further, the prior slide I believe will be DX-231, and this slide that's now on the screen relating to misleading information will be DX-232.
Can you explain what you're seeking to convey through this slide, DX-232?
A. Yes. Going back to the definition of exclusionary conduct, generally competition works best when consumers are well-informed, and in fact that shows up in virtually every, if not every, principles of economics textbook, that one of the requirements of perfect competition is well-informed consumers.
Providing misleading information tends to prevent competition on the merits by distorting consumer choice away from their optimal choices. That is, when you make choices based on false or misleading information, you tend to make mistakes and you make mistakes more frequently. And the effect of that is

7483

that it will tend to benefit inferior products and harm equal or superior products when concealed information about merits or misleading information about merits is

present in the marketplace.
Now, what is essentially the same logic is that if you increase -- by providing information, say, that makes one alternative look better than it is, that has the effect of increasing the relative -- the perceived relative cost of the alternatives. That is, it makes them look more costly than they are, and that will tend to cause them not to be chosen and hence is exclusionary conduct because it harms equal or superior products.
Q. And is there anything in economic theory that speaks to whether conduct that has the effect of raising the cost of alternatives or the perceived relative cost of alternatives is exclusionary?
A. Pardon me? Can you ask me the question again?
Q. Is there anything in economic theory that speaks to whether conduct that has the effect of raising the cost of alternatives or the perceived relative cost of alternatives is exclusionary?
A. Yes. Well, that just meets the definition of exclusionary conduct in that it tends to harm equal or superior products in favor of inferior products and

7484
therefore would be -- it would tend to exclude equal or superior products.
Q. Let's go back to the prior slide, DX-231.
The second bullet point on DX-231 states, "Excluded alternative commercially viable DRAM technologies."
Do you see that?
A. Yes, I do.
Q. And how does that relate to your conclusion that Rambus' challenged conduct is exclusionary?
A. Well, that's at the heart of exclusionary conduct, is to exclude the relevant alternatives. And I've prepared a slide or a series of slides that go through that logic.
Q. Let me ask -- the next slide is DX-233.
Before we talk about the substance of that, let me ask, as part of your analysis of Rambus' challenged conduct, have you given consideration to what likely would have happened if Rambus had disclosed its relevant intellectual property to JEDEC?
A. Yes, I have.
Q. And why have you considered that issue, why is that important to your analysis?
A. Well, in order to reach the conclusion that commercially viable alternatives were excluded by

7485
Rambus' conduct as opposed to by the JEDEC standardization process, I needed to actually ask what would have happened had Rambus disclosed its intellectual property and not engaged in misrepresentation, that is, had not engaged in the assumed challenged behavior.
Q. And does this slide, DX-233, relate to that element of your analysis?
A. Yes. This introduces the standard economic methodology for doing this -- for performing such an analysis, which is known as the but-for world analysis or also known in economics as a counterfactual.
Q. Can you define for us precisely what you mean by the term "but-for world"?
A. Yes. In fact the first bullet does that.
The but-for world is to suppose as a hypothesis that Rambus had not engaged in the conduct at issue, so that is to say it's to assume, contrary to the actual facts, assume that the challenged conduct or the conduct at issue had not occurred and then ask what would have happened under those circumstances.
Q. And the last bullet point here on slide DX-233 refers to standard economic methodology.
Is this a standard economic methodology?

7486
A. Yes, it is. As I said, it's common in any exclusionary conduct case and even more generally as a tool of economics. And the methodology is to apply standard economic reasoning to the changed set of facts under the but-for world hypothesis.
Q. In other economic consulting matters that you've worked on either with the government or private parties, have you engaged in this type of but-for world analysis as part of your economic analysis?
A. Yes, I have.
Q. And in this case did you in fact define for purposes of your economic analysis one or more but-for scenarios or but-for worlds?
A. Yes, I did.
Q. And how did you go about defining such scenarios or but-for worlds?
A. The process is to say what would have happened -- suppose that Rambus had not engaged in the conduct and then ask what would have happened.
And immediately you run up against the question of whether or not Rambus would have issued a RAND letter, that is, whether Rambus would have offered to license its technology on reasonable and nondiscriminatory terms; so that is to say, in order to make a prediction of what would have happened in the

7487
but-for world, I have to know one way or the other whether Rambus would have issued a RAND letter.
Q. Let's go to the next slide. This will be DX-234.
Does this slide relate to your but-for world analysis?
A. Yes. This summarizes the situation that will prevail when Rambus doesn't issue a RAND letter, that is to say -- so to run through the logic, we've hypothesized that Rambus disclosed its IP and did not engage in any of the other challenged conduct. In addition, we're hypothesizing that Rambus does not issue a RAND letter.
Now, in this case the but-for world is very simple. I can jump to the last bullet before looking at the first four.
Without a RAND letter, JEDEC is prohibited by its own rules from including the intellectual property that's been disclosed into the standard. The effect of that is that without a RAND letter, the JEDEC standard will not have Rambus' intellectual property embedded in

it, and that – in this -- you can think about this as the branch of a tree. It's the no RAND letter branch of the tree.
In that event, the standard does not

7488
incorporate Rambus IP, and as a result, we can conclude that in this branch of the tree Rambus' failure to disclose actually caused the inclusion of the Rambus technology in the JEDEC standard. That is to say, we can conclude that there was -- that the misrepresentations mattered.
Q. And have you developed any opinions or conclusions as to whether in such a but-for world Rambus would have issued a RAND letter?
A. Well, I think it's more likely that they would not, but I'm -- I have not reached a level of certainty that allows me to testify that in my -- to my expert opinion they would not. That is to say, my

informed judgment is that more than likely they would not, but I'm not prepared to testify that they would not.

Q. And what basis do you have for saying that in your opinion Rambus more likely than not would not have issued a RAND letter in a but-for world in which it had disclosed relevant intellectual property to JEDEC?

MR. STONE: Your Honor, I object to the question. It misstates the witness' prior testimony, which was not his opinion but his informed judgment, and the choice of words by the witness I think should

7489

be honored in his following questions.

MR. ROYALL: I'm happy to restate.

JUDGE McGUIRE: Okay. Restate.

BY MR. ROYALL:

Q. And what basis do you have for saying that in your informed judgment Rambus more likely than not would not have issued a RAND letter in a but-for world in which it had disclosed relevant intellectual property to JEDEC?

A. Well, that is what the first four bullets of this slide set out, are the major bases for my judgment that more than likely Rambus would not have issued a RAND letter.

There are documents and e-mails that suggest that RAND is not consistent with the Rambus business model and that Rambus wanted the flexibility to charge different royalty rates, which would be prohibited by the -- or different royalty rates to different companies, which would be prohibited by a RAND letter.

In addition, not issuing a RAND letter insofar as it makes the standard harder to -- the JEDEC standard harder to design has the effect of encouraging the success of RDRAM, which was one of Rambus' important goals, and so the last bullet points 3 and 4 refer to the fact that not issuing a

7490

RAND letter could have provided some modest amount of assistance in establishing RDRAM as an industry standard.

With all that together, it seems to me that more than likely Rambus would not have issued a RAND letter, but that's not -- I can't draw that as a matter of expert opinion, as a conclusion from my expert opinion. It would be overclaimed.

Q. And when you speak to this issue and express your informed judgments about this issue, are you commenting upon what you understand, from your review of the evidence, to be the economic incentives that would influence such a determination by Rambus?

A. So the -- let me take them in order.

The first bullet point does not refer to economic incentives but refers to my review of the facts.

The second bullet point is a mix of those two; that is to say, it's -- I have an understanding of the value of charging different royalty rates to different companies and the value of that flexibility, but it also has a factual basis.

The bullet points 3 and 4, the success of RDRAM, refers to economic analysis; that is to say, my conclusion that by not issuing a RAND letter there is

7491

some help for RDRAM is actually an economic analysis.

Q. And understanding that you're not expressing conclusions on what JEDEC's rules do or do not provide, is it nonetheless your understanding or assumption that in a but-for world in which Rambus failed to provide a RAND letter, JEDEC, according to its rules, could not or would not use Rambus intellectual property in its standards?

A. Yes, that is my factual assumption.

Q. Did you also consider a but-for world scenario in which Rambus did issue or would issue a RAND letter?

A. Yes, I did.

Q. We now have another slide up, which will be DX-235.

And can you explain to us what you're seeking to convey through this slide?

A. In this case I find that most likely -- so this is again had Rambus disclosed its IP and not engaged in other misrepresentations and also then subsequently issues a RAND letter.

Even so, I find that JEDEC would most likely not have included the Rambus intellectual property in its standards, and the reason is that free and commercially viable alternatives.

7492

In addition, there's an incentive for JEDEC to avoid royalties primarily because of the price sensitivity of the customer and for other reasons that we've talked about. And I think it would be hard to get consensus to include this particular IP given the commercially viable alternatives that I understand to be freely available to this marketplace.

So the -- what the first blue bullet point refers to with its subpoints is more than likely, most likely JEDEC would not have included Rambus intellectual property in its standard.

Q. And have you nonetheless considered a scenario in which JEDEC would have considered or might have considered inclusion of Rambus technology in its standard, provided that Rambus had issued a RAND letter?

A. Yes. The RAND letter does not specify a royalty rate, and it is my understanding that JEDEC does not negotiate royalty rates ever under any circumstances. Again, that's a factual question.

And since a RAND letter doesn't specify a royalty rate, firms are at risk when they've incorporated patented technology that the royalty rates may turn out to be very large. The RAND letter does specify "reasonable," but to a great extent

7493

"reasonable" is in the eye of the beholder.

And as a consequence, the firms have an incentive for ex ante negotiation; that is to say, the firms that intend to practice the JEDEC standard have an incentive to say, Hey, what's this going to cost me? That is to say, to investigate what does the word "reasonable" mean in the RAND letter.

Now, it's my understanding that that would have to be a one-on-one negotiation, that is, it would not be done collectively, and there is some testimony in the trial record that supports a conclusion for an ex ante negotiation.

Q. What do you mean by the point at the bottom of this slide, 235, where you say, "Rambus had different incentives -- 'pure play' technology company"?

A. Many of the companies in this industry cross-license with each other; that is to say, they're manufacturers and they each own licenses that have bearing on the behavior of the other and they have cross-license agreements.

The effect of that is that if one of them tries to charge a lot for its patented technology, it has to fear that the others will respond with equal increased charges.

Rambus is not in that position in the sense that by virtue of not being a manufacturer, Rambus faces no such risk, no such symmetric risk. And the effect of that is to make it more likely -- from an economic perspective, it makes it more likely that the firms in the industry, that is, the manufacturing firms in the industry -- and actually I emphasize that includes not just DRAM manufacturers but the manufacturers of chipsets who would also pay royalties -- would have incentive to seek out and find out what Rambus had in mind when it agreed to charge reasonable royalties.

And it doesn't take everyone to do this. If a single firm does this and finds out that the royalties are expensive, the expected royalties are expensive, they then have the ability to report this is going to cost us a lot to go this route.

Q. You've explained your reasons for concluding that members of JEDEC in this but-for world in which Rambus issued a RAND letter would have incentives for ex ante negotiation.

Does that element or does that conclusion bear in any way on your conclusions about monopoly power?

A. Yes. Again, in the – oh, on monopoly power.

Yes, it does. The incentive for ex ante negotiation would be a limit on the monopoly power, on the exercise of monopoly power, because ex ante the firms have -- the users of the technology, because they have alternatives, have a great deal more bargaining power than they do after they've already deployed the technology and become locked in.

Q. Does that conclusion about incentives for ex ante negotiation have any bearing on your broader conclusions about the exclusionary nature of Rambus' conduct?

A. Yes. In fact, let me actually take both bullets on this slide.

In the first bullet, if JEDEC does not include the Rambus intellectual property, we have immediately a conclusion of exclusionary conduct -- or of -- yes, of exclusionary conduct because the conduct mattered.

In the second case it matters not so much to the actual incorporation of the technology but into the prices that are charged, and so again, the finding is that the conduct matters. It has -- that there is causation.

Q. Referring to the top set of bullet points on this slide, DX-235, in which you state that JEDEC likely would not have included Rambus IP in its standards even if Rambus had issued a RAND letter, do your views in that regard have anything to do with the issue of lock-in or the potential for lock-in?

A. Yes. JEDEC generally has -- it is my understanding as a factual matter that JEDEC generally has a preference not to avoid -- or not to incorporate intellectual property where alternatives exist. And my understanding, as an economist, of that preference is that that's a rational preference on JEDEC's part as a way of avoiding lock-in.

The incorporation of proprietary technology when commercially viable alternatives exist generally exposes the industry to the threat of hold-up.

Q. Before we leave this issue of the but-for world, do you have any slides that depict the concepts that you've been describing in connection with the but-for world scenarios that you've defined?

A. I do.

Q. Let's go to the next slide. This will be DX-2356.

And what does this – what are you seeking to depict through this slide?

A. So this is a comparison of the but-for world to the actual world. This will depict the actual world. Here R1 and R2 refer to programmable CAS latency and programmable burst length, B and C refer to commercially viable alternatives in that process, and the standard-setting for SDRAM is the first large funnel or the leftmost of the large funnels in this.

So the features of SDRAM are going to be determined by the furthest-left small funnels, which will feature the selection of R1 and R2.

Q. And then we've just seen a second view of this same slide and some animation. Can you explain what you mean to depict through that animation?

A. Yes. In fact it's what I just referred to, the selection of R1 and R2 in the process of defining the SDRAM standard. And as I mentioned, R1 and R2 refer to Rambus proprietary technology.

Q. And which Rambus technology specifically do the arrows R1 and R2 refer to?

A. Programmable CAS latency and programmable burst length.

Q. I think there may be another view on this slide?

A. Here, those two technologies have now been incorporated into the SDRAM standard which is issued and is deployed. At that point SDRAM becomes a platform for the development of a subsequent standard DDR. That is to say, the output of the SDRAM standard process as deployed becomes a basis, an evolutionary basis for the development of the DDR standard.

And this illustrates that by showing R1 and R2 being fed into what will become the DDR selection process.

Q. And then I think there may be one more view? What, in this view, what are you seeking to convey?

A. So this illustrates the selection of R3 and R4, which refer to on-chip DLL and dual-edged clocking, into the DDR standard, and they are selected over commercially viable alternatives D and E.

Q. And perhaps there's one more view? Yes.

A. And here --

Q. Go ahead.

A. Here -- and now, all four of those technologies are incorporated into the DDR standard. The first two R1 and R2 were inherited from the base on which DDR built. R3 and R4 are additions to that standard.

Q. And what you've just walked through, does that reflect -- in what's depicted in this slide, DX-236, does that reflect your understanding of what has occurred in the actual world in terms of Rambus' intellectual property being incorporated into JEDEC SDRAM and DDR SDRAM standards?

A. It does.

Q. Let's go to the next slide. This would be DX-237.

What does this slide depict?

A. This slide starts off with the same environment, but it's going to consider what happens in the but-for world. The actual case that I will consider here is the case either of no RAND letter or a RAND letter issued and JEDEC making the determination not to include the Rambus technology in the standards.

So again, the hypothesis of the but-for world is that Rambus has disclosed its conduct -- excuse me -- disclosed its intellectual property early in the process.
Q. Let's go to the next view.
A. And so as I said under the case of no RAND letter or when JEDEC decides not to include the intellectual property, SDRAM actually gets non-Rambus technologies B and C, which were two of the commercially viable alternatives.
Q. And then is there another view of this slide?
A. And here those two technologies have been incorporated in the standard and the two Rambus technologies were not.
Q. And then is there one more?
A. Then here in the process of defining DDR, DDR

7500
did not inherit the Rambus technologies, so those aren't part of the base of the DDR standard, and the other two Rambus technologies are also not selected.
Q. And I think this may be the final view?
A. And at this point the DDR standard comes out not involving any of the Rambus intellectual property.
Q. And to be clear before we leave this slide, what are you meaning to depict by the fact that in this slide, DX-237, the arrows coming out on the right-hand side of the SDRAM and DDR SDRAM funnels are blue as opposed to yellow?
A. It's that the DDR platform, the DDR technology, does not incorporate Rambus intellectual property.
And I should say that as this diagram illustrates, the DDR was built on the SDR and generally in evolutionary technology the next generation will be built on the previous generation and so in this case the subsequent technology would not be inherited Rambus technology.
Q. Could we go back to DX-231.
Now, DX-231, which we touched on earlier, relates to the reasons why you've concluded that Rambus' challenged conduct is exclusionary. We haven't yet covered the last bullet point on this slide, which states, "Entailed a conscious choice to

7501
jeopardize the enforceability of patented intellectual property."
Can I ask you to explain what you mean by that and how that relates to your conclusion that Rambus' challenged conduct is in an economic sense exclusionary?
A. Yes. Before I -- before I start with that, I want to go back to one of my assumptions, which is to say that Rambus was aware of the legal risks associated with its conduct, so that is to say that's an assumption on my part and not an economic finding or not an economic conclusion.
I have a slide that describes this third bullet point.
Q. Let's see if we can find that.
Is this the slide you're referring to?
A. It is.
Q. This will be DX-238.
A. Yes. And the first bullet point, again, because it refers to knowingly incurred a risk, is an assumption on my part.
Q. And having made that assumption, how have you reasoned, how with respect to this factor, how have you reasoned to the conclusion that Rambus' challenged conduct is exclusionary?

7502
A. Well, Rambus is a technology company. Its business is selling technology. And so to risk losing the enforceability of its patents for a technology company is an extremely serious risk. And the implication from an economist's perspective, that is, from an economic analysis perspective, is that there must have been an expected compensated benefit. That is, there must be a reason for undertaking such a risk.
And there's quite a parallel to predatory pricing. Predatory pricing, as I believe I testified yesterday, is pricing below cost, which is something that on its face appears to be irrational. You're losing money on each item you sell. But the economic explanation for predatory pricing is that if you succeed in monopolizing a market, predatory pricing can pay.
So that is to say, the future gains, the recoupment of the investment in monopolizing the market by way of running losses currently makes up for the losses in the near term. And so if you succeed in monopolizing a market, that actually provides a rational account of why a firm might engage in predatory pricing.
And there's an exact parallel here. The risk,

7503
which is a very serious risk, of having your patents found unenforceable might be compensated by the gain associated with actually ultimately monopolizing the markets.
Q. And have you seen any evidence in the record of this case that Rambus acknowledged that participation in JEDEC created substantial legal risks?
A. Yes. And I have a quote of the Rambus chairman.
Q. This will be DX-239. Let me read this and then I'll ask you about it.
The quote on DX-239, which the source at the bottom of the page indicates this is a quote from a deposition of Rambus' chairman, William Davidow, taken in this case in January of this year, and the quote says: "The only product that Rambus has about this is intellectual property. Doing anything as stupid as putting intellectual property in jeopardy by sitting in a meeting would have been -- passively sitting in a meeting, which is my understanding of what we did, would have been the stupidest management move that I could think of.
"And you know, there isn't -- there is no rational motivation that I can think of that you would

7504
jeopardize the value of your paints by participating in a process that might deprive you of the right to enforce those patents.
"I mean, it's -- there was very little to be gained and everything to be lost. I mean, that's not the kind of thing that you do with a rational manager."
Now, I've read the quote, Professor McAfee, and my question is: What, if any, significance do you attribute to this quote from the standpoint of your economic analysis?
A. Well, this quote definitely for me confirms that the risk that was taken was substantial. That is to say, the -- so as I said, the -- I'm sorry. I've got a little tongue-tied.
That there was a risk taken and that the -- that that was a substantial risk and would need a substantial benefit to recoup the extent of the risk.
Now, his explanation was, well, we couldn't have done it because it would have been too stupid to

have done that. That's my reading of this, although of course that's a factual matter of what he meant.

But the normal economist's perspective -- and to be fair, I do actually -- I have encountered firms making mistakes and in my classes I describe or I

7505

present situations in which firms make mistakes and I'm not -- I do not intend to testify that firms never make mistakes because of course on occasion they do.

But on the other hand, the normal economic analysis is to assume that firms aren't making mistakes, that is that they are being deliberate, and in this case if they were being deliberate, they had to have a purpose and essentially the only purpose, candidate purpose, of which I'm aware is to monopolize the market.

And that purpose has the advantage, like predatory pricing, of being sufficiently valuable to make a sizeable risk worthwhile.

Q. And the predatory pricing analogy that you've drawn to this case and to statements such as the one that's presented in DX-239, does that predatory pricing theory have a basis in the economic literature?

A. Oh, yes. That's quite a popular topic in the economics literature. It's been empirically tested and examined with a variety of companies and it appears in any industrial organization textbook I believe.

Q. And where that paradigm of conduct, the predatory pricing paradigm, exists and there is what

7506

appears to be a conscious decision to price below cost in the way that you've described, when that conduct paradigm exists, does it provide a basis for an economist to draw inferences about the exclusionary nature of the conduct?

A. Yes, it does. In fact, it's -- so my understanding of the requirement -- so that the economic analysis is if you meet two characteristics, you've priced below cost and you have a method of recouping the losses sustained while you were pricing below cost, then it is generally well-accepted that you can conclude that this was exclusionary conduct whose purpose was monopolization.

Now, I want to be clear actually in my answer that I'm giving the economic analysis version of that. I understand also that there's a parallel legal version, but I do not mean to speak to the law but only to the economic analysis side.

Q. And do you find that economic paradigm to be applicable in this case?

A. Well, with the exception that we are not -- the conduct that's being described was not predation, but yes, otherwise it is exactly parallel.

Q. And do your conclusions in this regard as to this element of your conclusion that Rambus' conduct is

7507

exclusionary in an economic sense, are these conclusions independent from the earlier bases that you described for concluding that Rambus' challenged conduct is exclusionary, by which I'm referring to the misrepresentation element of your analysis and the analysis related to exclusion of alternative technologies?

A. That was quite a question. But yes, it is.

As I testified when we went through the assumptions, the conclusion here is -- requires that they knowingly engaged in this behavior and that they knew the risks. That's a factual matter that was not used in the -- that assumption was not used in the earlier analysis and hence is independent.

And I see this as a corroboration of the earlier analysis; that is, it's an independent means of reaching the same conclusion.

MR. ROYALL: Your Honor, I would guess that I have about forty minutes to go, and the very next topic is one that has again two provisional in camera slides.

If you wanted to break for lunch, my proposal would be to cover that as soon as we get back and then finish up. And again, I would estimate thirty to forty minutes.

7508

JUDGE McGUIRE: Okay. Why don't we do that then.

It's 12:30. We will reconvene then at 1:45 after lunch.

Hearing in recess.

(Whereupon, at 12:28 p.m., a lunch recess was taken.)

7509

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

(1:46 p.m.)

JUDGE McGUIRE: This hearing is now in order and in in camera session.

Again, I'll ask counsel to certify to the court that everyone at their table and everyone behind them is cleared to hear this in camera testimony.

MR. STONE: On behalf of respondent I can, Your Honor.

MR. ROYALL: And on behalf of complaint counsel I can as well.

JUDGE McGUIRE: All right. Thank you.

(The in camera testimony continued in Volume 36, Part 2, Pages 7631 through 7663, then resumed as follows.)

JUDGE McGUIRE: Okay. Mr. Royall, you may proceed.

MR. ROYALL: Thank you, Your Honor.

BY MR. ROYALL:

Q. Professor McAfee, we have now arrived at the fifth and final key economic question that you identified earlier, namely the question: What remedy, if any, is needed to restore competition/alleviate the anticompetitive effects of Rambus' conduct?

Have you reached conclusions relating to that

7510

question?

A. I have.

Q. Before we get to the precise nature of your conclusions, let me ask you to explain if you could, as an economist, how do you go about assessing questions

about remedies or appropriate remedies in an antitrust case?
A. Well, what an economist would refer to as the first best, that is to say, the most desirable approach to remedies would be to restore the world to what it would have been absent the anticompetitive conduct.
So the general idea is that you just want to undo the effects of the monopolization -- actually undo the monopoly and by undoing the monopoly will undo the effects of the monopolization and thereby undo the effects of everything else. That would be the first best.
I actually have a slide to illustrate or to summarize this.

Q. Is this the slide you're referring to?
A. It is.
Q. This will be DX-245.
And the point you just made, is that the same point that's being referenced here in the first bullet

7511
of DX-245?
A. It is.
Q. What do you mean by the statement in the second bullet where you say, "As a practical matter, in this case the preferred remedy cannot be achieved"?
A. Well, in this case there have been, as we discussed, substantial investments and in fact almost a decade's worth of investments in these technologies and we discussed misdirection of investments in technologies.
A lot of things that are not going to be, as a practical matter, possible to reverse have been created by these specific investments, and that leads to the conclusion that the first best is not attainable, which I would say is actually the normal state of affairs, but there's no -- this case being no exception.
Q. When you say "the normal state of affairs," by that do you mean the normal state of affairs in an antitrust case?
A. In an antitrust case, yes.
Q. What do you mean when you say here in the first subbullet on DX-245 where you say, "Rambus' monopoly power is durable"? What do you mean by that and how does that relate to the issue of remedies?
A. Well, there's a sense in which that's

7512
redundance since monopoly power, as I've defined it, is always durable. But Rambus has achieved monopoly power
and that's durable. That's not going to go away because the JEDEC standards aren't going away, having been adopted by the marketplace.
Q. And how does that relate to your views on remedies?
A. That says it's not going to be possible to go back to 1992 and change the technologies that are embedded in SDRAM. And DDR SDRAM for that matter.
Q. Your next subbullet states, "The but-for world is now unattainable."
What do you mean by that and how does that relate to your conclusions on remedies?
A. The but-for world that we discussed, in particular the but-for world in which -- well, actually either of the two, when Rambus technology is not embedded in the JEDEC standards or when there is ex ante negotiation, neither of those worlds is available to us today, and there's no way to actually create those worlds at this time.
Q. Now, you mention in this second bullet in this slide, DX-245, you refer to some practical issues pertaining to remedies.
What, to be precise, what practical issues are

7513
you referring to in that regard?
A. Well, three main ones which are presented on the subsequent slide.
Q. Let's go to the next one.
Is this the slide you're referring to?
A. It is.
Q. This will be DX-246. And you have entitled this slide Practical Limitations.
What do you mean by "practical limitations" in this context?
A. These are aspects of the world that are relevant to the attempt to undo the monopolization of Rambus. That is to say, the existence of an installed base of SDRAM and DDR and the devices and complementary
devices have been developed, those already exist. Those investments have already been made. They're committed. There's no way to undo the existence of those investments today.

Q. You refer in the second bullet on this slide to DDR-II and you state that the DDR-II standard has been developed largely under the same assumptions as were used for SDRAM and DDR SDRAM.
First of all, let me ask you, what do you mean by that? What are you meaning to state by that?
A. So the DDR -- so that actually means two

7514
things. One is that DDR-II development started building on DDR and at a time when it wasn't known that Rambus had intellectual property covering DDR or at least wasn't widely known.
The second thing is that DDR-II was and was intended to be an evolutionary outgrowth of DDR and as a consequence DDR-II is building on a product that contains Rambus intellectual property.
Q. And how do those --
MR. STONE: May we just be clear that as with yesterday that the witness is testifying to his assumptions here as opposed to facts that he just stated?
JUDGE McGUIRE: Okay. Mr. Royall, can you inject that into your questioning?
MR. ROYALL: Yes, Your Honor.
BY MR. ROYALL:
Q. What you just described in answer to my earlier question, Professor McAfee, was this your understanding as to the timing of the development of the DDR-II standard by JEDEC?
A. Yes, it is.
Q. And are you making assumptions about the facts in that regard?
A. Yes, I am. I was not a witness to the or a

7515
participant in the development of DDR-II.
Q. Now, having made such assumptions, what, if any, economic conclusions do you make about the DDR-II standards development and implications of that for the question of remedies in this case?
A. Well, we've talked at some length about the economies associated with reusing existing technology in an evolutionary approach to the development of DRAM standards. And that evolutionary approach requires the DDR-II standard to build on the DDR standard, and that's just a restriction on any remedy in that if Rambus is allowed to assert its IP against DDR, then the DDR-II will have to build on some other foundation

in order to avoid Rambus IP.
Q. The final point that you make on this slide, DX-246, refers to technological development in alternatives to Rambus' claimed technologies has been forgone. What do you mean by that?
A. As we discussed, for example, with asynchronous alternatives, the investments that might have otherwise arisen in asynchronous DRAM technologies were not fully exploited because SDRAM appeared to be a better alternative than it was or than was understood to be.
Q. How --

7516

A. I think I said that exactly backward. Can I try again?
Q. Yes. If you would like to restate it.
A. To take, for example, asynchronous technologies, there were investments that would have otherwise occurred in asynchronous technologies that were not taken because SDRAM was believed to be a better alternative than it has proved to be because it was believed not to carry IP from Rambus.
Q. And how, if at all, does that point relate to your conclusions about remedies?
A. Well, that's water under the bridge. It's already been -- the time has already passed.
Q. In situations in which there are practical limitations of the sort that you've described, what, if anything, does economics teach in terms of the appropriate approach to remedies?
A. So there's a theory in economics known as the theory of the second best, and it suggests in this instance that the second best approach -- by the way, I have a slide for this as well.
Q. Is this the slide?
A. It is.
Q. This will be DX-247.
And let me just come back to what you were

7517

saying earlier.
You were referring to the theory of the second best in economics. Can I ask you to explain what that theory is?
A. Well, the theory of the second best generally is when the first best is not available for some reason, it's to do the best you can given the constraints that are ruling out the first best, the first best being in some sense a theoretical optimal solution.
And so the theory of the second best suggests in this instance that if you can't undo the conduct, you should try to minimize the effects of the conduct.
Q. What do you mean in the second bullet point in DX-247 when you state, "The appropriate remedy to Rambus' conduct thus involves minimizing the marketplace harm associated with the anticompetitive behavior"?
A. So what I mean is in order to minimize or undo the effects of the conduct, the natural approach is, given that you can't just undo the conduct itself, is to try to eliminate or minimize the effects that conduct has had on the marketplace, that is, minimize the harm associated with the conduct.
Q. And have you, Professor McAfee, reached any

7518

conclusions regarding what type of remedy or remedies, from the standpoint of economics, would be needed in order to achieve the remedies-related objective that you describe in this slide?
A. Yes, I have.
Q. And what conclusion have you reached in that regard?
A. I have actually a slide that summarizes the undoing of the effects.
Q. This would be DX-248.
Is this the slide you're referring to?
A. It is.
Q. And let me ask you if you could to explain your conclusions, and I would start with the first bullet where you state, "Rambus should be prohibited from enforcing against JEDEC-compliant DRAMs any patents filed (or based on filings) prior to June 18, 1996."
A. So let me say first that the June 18, 1996 is obviously a fact point and that what I'm referring to is that's part of an assumption that what should have been disclosed was patents or intellectual property that existed prior to that point, relevant intellectual property.
And the prohibition of enforcing is given that

7519

the intellectual property would be unlikely to have been adopted in the standard under the hypothesis of disclosure, that is, in the but-for world, a way of undoing the effects of the harm that occurred is to make the standard to be royalty-free as it would have been in the but-for world or would have likely have been in the but-for world.
Q. And when you use the term "JEDEC-compliant DRAMs" here, by that are you meaning to refer to both SDRAM and DDR SDRAM compliant products?
A. Yes. And also to successive generations. The successive generations build on the existing DRAM.
Q. Do you have any view or conclusion as to whether the appropriate remedy in this case from the standpoint of economics should extend to DDR-II?
A. Yes. That being a successive and evolutionary development on DDR.
Q. And what basis do you have or what has caused you to conclude from the standpoint of economics that the remedy should extend to encompass DDR-II as well as SDRAM and DDR?
A. So again, given the likely but-for world, in the likely but-for world the DDR would not contain Rambus IP. JEDEC would then be building a DDR-II in the but-for world on a product base that did not

7520

involve DDR.
If I can give an example, if the alternative that had been adopted over on-chip DLL were a vernier system or a "vernier" system, then JEDEC would be building on a base where they have learned about and fine-tuned and exploited the vernier system, and it's likely that the DDR-II would then incorporate the same vernier system and not on-chip DLL.
And so if the effect of undoing is to correct the same effect you need to enforce against -- you would need to prohibit the enforcement of the patents even against the successive generation.
I should say to be fair, at the point in which a revolutionary change, that is, a major redesign rather than an evolutionary step is taken, then it would be reasonable to in some sense start the clock over, although that's going to be a hard thing to define as a practical matter.
Q. When you use the term in the first bullet point of this slide "patents filed," by that are you meaning to refer to anything with respect to patent applications?
A. Yes. My understanding -- again, this is an assumption on my part, is that my understanding is that

the JEDEC members were supposed to reveal or disclose
7521
not just patents but patent applications, but that would be an assumption on my part.
I guess from an economic perspective the undoing of the content of the conduct would specify nonenforcement of any intellectual property that should have been disclosed, whatever that might be.
Q. The second bullet point states, "This remedy should extend both to U.S. and foreign patents."
A. Yes. This is a world market. The products which are produced using these technologies are a world market and the technologies themselves are a world market, and so to enforce the remedies selectively in one nation is not going to actually address the problem.
I should also state that it is my

understanding that the U.S. is a net importer of DRAMs, and so if the patent enforcement still occurs outside, there would actually be harm to U.S. consumers in the long run.
Q. Have you considered as part of your economic analysis whether a remedy of the sort that you described that was limited to U.S. patents and no patents beyond that would be sufficient to address the anticompetitive effects of Rambus' conduct?
A. I do not believe it would. As I said, the U.S.
7522
is a net importer and it's actually a relatively small -- it's a significant but small share of the entire world market, and so enforcement against the rest of the world would have a similar effect as enforcement against the entire world.
Q. In the final bullet point on this slide, DX-248, you state, "This remedy will restore competitive pricing in the relevant technology markets and mitigate other anticompetitive effects."
Could I ask you finally to explain what you mean by that statement.
A. Yes. This essentially puts right JEDEC's decision to incorporate this technology given that it had the belief -- that the members had the belief that there was no intellectual property attached to the standards.
And so in that sense it is an appropriate remedy in that it confirms the beliefs of the JEDEC members or the expectations of the JEDEC members that the standards they were defining were royalty-free.
MR. ROYALL: Your Honor, I have no further questions.
JUDGE McGUIRE: Just so I'm clear on this first point that you made here, sir, when you talk about any patents filed prior to June 18, I assume by that you
7523
mean patent applications; is that correct, as opposed to patents that have been issued?
THE WITNESS: Yes. Well, actually what I'd like to say is that it's whatever should have been disclosed should not be enforced.
So I've -- what I've written here is conditional on the assumption that what's found is that it's patents and patent applications prior to Rambus' departure, but in fact the actual nature of my conclusion is whatever should have been disclosed should not be enforced.
JUDGE McGUIRE: Again, but for my question, when you're talking about patents filed, you're referring to any patent application?
THE WITNESS: Yes, I am.
JUDGE McGUIRE: Okay.
THE WITNESS: But to be fair, that is an assumption on my part.
JUDGE McGUIRE: Okay. Right. I just want to clarify that for the record.
BY MR. ROYALL:
Q. And if I could just follow up on that, when you say "patents filed," are you referring only to patent applications or to patents as well as patent applications?
7524
A. Well, of course patents -- in order for patents to have issued prior to that date they must have been filed prior to that date, so it would include patents as well.
MR. ROYALL: Your Honor, I have no further questions at this time for Professor McAfee.
JUDGE McGUIRE: Thank you, Mr. Royall.
At this time we'll hear the cross-examination by respondent.
MR. STONE: Thank you, Your Honor.
CROSS-EXAMINATION
BY MR. STONE:
Q. Professor McAfee, how are you?
A. Good.
Q. Good.
Can we bring up DX-231.
This is a chart we looked at that you were shown by Mr. Royall earlier today; am I right?
A. It is.
Q. And one of the things you talk about in your first bullet point is that based on some factual assumptions you have made that Rambus' conduct, as you
understand it based on those assumptions, has distorted JEDEC's standard-setting process by concealing material information; correct?
7525
A. Yes.
Q. I want to ask you about the concealing part of that and the definition of exclusionary if I might.
It certainly is true, isn't it, that many companies and individuals conceal information?
A. It is true that many companies conceal information.
Q. A company, for example, that is very profitable might conceal the extent of its profits from others.
A. Well, I'm willing to reason with you that they might. Often companies are actually touting to the stock market that they're very profitable. In fact, what they tend to conceal is losses rather than profits.
Q. But a company, for example, that wants to discourage people from entering into the same line of

business and competing with it might not want to make public how profitable that line of business is; correct?
A. Again, as an argument, it's a sensible argument. It is not actually in accord with my understanding of many factual situations. Normally companies conceal losses and are actually running off to the stock market to say how big the gains are,
7526
although in principle what you say makes economic sense.
Q. And you're familiar with privately held as well as publicly held companies?
A. Yes, I am.
Q. And many privately held companies do not

report whether they're making profits or losses; correct?
A. Yes, that's correct.
Q. And one reason companies that are privately held don't disclose the fact that they're in a line of business that is particularly profitable is because they don't want to do anything to encourage other people to enter that line of business and compete with them; isn't that right?
A. That's -- I can think of an example of that.
Q. And so it's not -- and the fact that by not disclosing the profits in an effort to discourage other people from entering into competition with it doesn't mean that the conduct is exclusionary, as you use the term in an economic sense, is it?
A. That a company doesn't disclose the profits that they make?

Q. Yes.
A. Is not exclusionary.

7527

That -- I have to say I haven't really thought about this issue, but that appears to be a reasonable conclusion.
Q. The fact that a company may have made an invention which it thinks will have great value in the future but which it determines it wants to maintain as a trade secret and not disclose it to its competitors may discourage them from taking the preliminary steps necessary to build that product, but such conduct would not be exclusionary in an economic sense, would it?
A. I'm sorry. I had a little difficulty understanding that.
Q. Certainly. Let me step back.
Let's assume if we can as an economic question for you that a company has developed a new process of manufacturing that will allow it to produce product more cheaply than its competitors.
Can we assume that?
A. Yes.
Q. And let's further assume that that company would like to build a factory to employ that process and not let anybody know that it has a new factory using a cheaper process until they actually start producing product.

7528

Can we add that to the assumption?
A. So just to make sure I'm clear, the hypothesis is they've invented what's known as a process innovation and it lowers their cost of manufacturing and they haven't told anybody about the process innovation because they want to wait until they've actually built the factory.
Q. Yes.
And that would give them an economic advantage if they can be the first to utilize this process. Correct?
A. That's correct.
Q. And in that scenario, the fact that they don't reveal the information is not something that in an economic sense you would consider to be exclusionary, is it?
A. No, it is not something that I would consider to be exclusionary.
Q. Now, the fact that a company applies for a patent on the process and chooses not to reveal the fact of that patent application or its contents is also not exclusionary, is it?
A. Well, that's a -- I would describe that as a very incomplete hypothetical.
Q. Okay.

7529

A. So that is to say, I can think of circumstances where your hypothetical is true; that is to say, just concealing the existence of a patent is not by itself exclusionary.
Q. And in fact, the law recognizes that patent applications are to be kept confidential; correct?
MR. ROYALL: Objection, Your Honor. Calls for a legal conclusion.
MR. STONE: Let me withdraw it.
BY MR. STONE:
Q. As a matter of economics, you recognize that there are policy interests served in protecting patent applications from public disclosure, do you not?
A. Well, I'm aware that patent applications are generally kept secret in this country. I'm not actually aware of an academics debate on the value of keeping patent applications secret, and so I'm not as a matter of economic analysis aware of a conclusion of the kind that you described.
Q. As a matter of factual assumption or understanding on your part, isn't one of your assumptions or understandings that patent applications are kept secret?
A. It is my understanding, yes.
Q. So when you talk here about the conduct on

7530

Rambus' part that you have assumed distorting JEDEC's standard-setting process by concealing material information, you have implicit in that statement more than just the fact that they didn't reveal certain information; isn't that right?
A. Well, I considered that I was very explicit about the assumptions that I was making in this, and I agree that I'm assuming that there was a material -- that material information, relevant information, should have been revealed and was not and -- but that's an assumption on my part, not a finding.
Q. And I want to explore the "should have been revealed" portion of your assumption if I might.
The "should have been revealed" portion of your assumption comes from something other than economics; true?
Let me rephrase it.
You're not saying that as a matter of economics it should have been disclosed?
A. No. I -- I'm happy actually to turn to my assumption and tell you -- it was definitely not as a matter of economics. It was an assumption that to comply with the rules.
Q. And that's what I want to get to.
So your assumption that what made the failure

7531

to disclose exclusionary was that it was, based on your assumption, in violation of a rule?
A. Or a process, yes.
Q. Okay. And have you made any assumption one way or the other as to whether that rule or process is one that the antitrust laws should be employed to enforce?
MR. ROYALL: Objection, Your Honor. Calls for a legal conclusion.
MR. STONE: Let me rephrase.
JUDGE McGUIRE: Sustained.
BY MR. STONE:
Q. As a matter of economics, have you made any analysis one way or the other as to whether the underlying economic principles of antitrust law would be advanced by the particular rule that you have

assumed?
MR. ROYALL: I would object as vague and ambiguous. I'm not sure what he means by "rule."
JUDGE McGUIRE: Can you restate on that, Mr. Stone? It is somewhat vague.
MR. STONE: Sure.
BY MR. STONE:
Q. You've told us there was a rule or process that you have assumed; correct?

7532
A. I have.
Q. Okay. Is that rule or process that you have assumed something that as a matter of economic principles you feel advances the interest of antitrust?
A. Okay. So now I think I understand your question, and the -- I haven't done the kind of analysis that would let me answer that question fully.
I have some familiarity with the -- with -- while I have good familiarity with the standard-setting literature generally and the -- my understanding of the conclusions of that literature, which is not a literature I've personally contributed to, but I have some understanding -- I have a good understanding of I think -- is that standard-setting organizations generally walk a fine line in the antitrust world in the sense that there's a risk of -- there's a recognized risk of, what actually Adam Smith said, that when competitors get together it often ends in a conspiracy against the public.
So there's a fine line of the -- that these organizations walk.
On the other hand, there's a recognized --
JUDGE McGUIRE: All right, Mr. McAfee. I think you're getting somewhat far afield from the import of

7533
the question. I'm going to ask you to sort of isolate your answer to comport more closely with what he was asking you. And I'm sorry to interrupt you, but I just think you're getting way too far out of the scope of the question.
THE WITNESS: So can I finish my sentence and then ask for a restatement of the question?
JUDGE McGUIRE: Okay. Go ahead.
THE WITNESS: There's a recognized benefit to standard-setting organizations, so in that sense there's a balance. I have not done the analysis necessary to apply that to JEDEC itself.
BY MR. STONE:
Q. Do you want the question back? I think in the end you --
A. Yes, I did ask for the question to be read back.
MR. STONE: Could I ask, Your Honor, that we have the question read back.
JUDGE McGUIRE: Yes.
Could we read the question back.
(The record was read as follows:)
"QUESTION: Is that rule or process that you have assumed something that as a matter of economic principles you feel advances the interest of

7534
antitrust?"
THE WITNESS: Well, actually I thought I was being responsive to the question. That is, I was giving the --
JUDGE McGUIRE: You know, you might have been, but I just felt you were getting too far afield, so there's no point in arguing.
BY MR. STONE:
Q. Are you comfortable with the answer?

A. Yes.
Q. Okay. And similarly with respect to the portion of DX-231 and the first bullet that talks about misrepresenting, again, your conclusion that assumed conduct that you would say constitutes misrepresenting material information is exclusionary depends upon there being some independent duty not to engage in such a misrepresentation; is that correct?
A. I'm going to have to ask you to explain that.
Q. Certainly. Let me break it up.
You also have told us that based on assumptions you have made as to Rambus' conduct you concluded that there was some conduct which you would describe as misrepresentation which you concluded was exclusionary, as you defined that term; correct?
A. As I understand -- I think I assumed that there

7535
was other conduct that was misrepresentations. And then based on that assumption, I found that the conduct would be exclusionary.
Q. And all misrepresentations even if they lead to competitive impacts are not necessarily exclusionary as you've defined that term in an economic sense, are they?
A. All misrepresentations --

Q. Let me see --
A. -- are not exclusionary? Is that the question you asked me?
Q. No. Let me see if I can make it clearer for you. It's undoubtedly my fault, so let me try again.
A misrepresentation is not always something that even if it has an impact on competition would be classified by you as exclusionary; isn't that right?
A. As stated --
MR. ROYALL: Your Honor, I was going to object to the compound nature of the question.
I think it may help if you can break that down. If he can answer it, that's fine, but it seemed compound and confusing to me.
JUDGE McGUIRE: Overruled. I'll hear the question.
If you can answer it, go ahead,

7536
Professor McAfee.
THE WITNESS: Yes. It could be a misrepresentation could not be exclusionary, and I'd be happy to explain the circumstances under which a misrepresentation would not tend to be exclusionary.
BY MR. STONE:
Q. I think I'm fine where we are. Let me keep moving.
Let's go if we can to DX-232.
On the screen in front of you is DX-232, which is another chart you looked at this afternoon; correct?
A. That's correct.
Q. And in it you say, "Concealing or providing misleading information is exclusionary when equal or superior products are excluded."
I added the word "are" in there, but that's what you mean; correct?
A. Yes.
Q. And you told us earlier that if inferior products are excluded, that would not qualify as exclusionary conduct in an economic sense; correct?
A. That's correct.
Q. Okay. And when you say in the second bullet point that concealing or providing misleading

7537
information prevents competition on the merits, you again are referring to prevents competition between equal or superior products and the one in question; correct?
A. Well, I would have said that statement is more generally true even though in terms of concluding that it's exclusionary, the relevant case would be equal or superior products.
Q. So for purposes of determining whether it's exclusionary conduct as you have defined the term in an economic sense, we need to look for whether or not there's been an impact on equal or superior products or competitors?
A. That's correct.
Q. Okay. Earlier today you talked a bit about risk taken or that you assumed was taken by Rambus. Do you recall that testimony?
A. I do.
Q. And you -- correct me if I have this wrong or oversimplified, but you assumed that Rambus' conduct represented a conscious taking of a risk?
A. I did assume that.
Q. Okay. And the risk you assumed that was being taken was the risk of not disclosing information which under a rule or process should have been disclosed?
7538
A. Well, it's the consequences of that, so the risk is the consequences of that action.
Q. Okay. So let me see if I can restate it and see if I get it right.
So the risk that you assumed was that Rambus took the risk of losing the ability to enforce certain intellectual property as a result of not disclosing certain intellectual property in connection with certain rules and processes; is that right?
A. That's kind of a complicated question.
Q. Let me restate it.
You assumed that Rambus took a risk that it might lose the ability to enforce some patents; correct?
A. I did, yes.
Q. Okay. And you assumed, not making any factual conclusion yourself, you assumed that Rambus did that knowingly?
A. I did, yes.
Q. And you further -- then you concluded if those assumptions were correct that such conduct would be irrational, except if it was intended to achieve monopoly power; correct?
A. I think that actually overstates my testimony.
Q. Okay. You told us that the -- you referred to
7539
"the only candidate purpose of which I'm aware." Do you recall that phrase?
A. That sounds like a phrase I said.
Q. Okay. So what was the only candidate purpose that you were referring to as a candidate purpose for taking such a risk?
A. That was the monopolization.
Q. Okay. Did you consider other purposes that might lead someone to take such a risk?
A. I did. But the reason for my phrasing as it was was I didn't find that -- this could be a failure of imagination on my part. I didn't consider the other alternatives that I -- of which I was aware, but admitting the possibility using the phrase that I used that there might be some other explanation which you might give me now.
Q. No. No, no. The assumption you made was that Rambus took the risk of losing the ability to enforce patents; correct?
A. That's correct.
Q. And the way in which you assumed they did that was by not disclosing patents that they should have disclosed; correct?
A. And the other misrepresentations but generally the behavior, yes, I'm assuming that that behavior
7540
risked the patents so that they knew that.
Q. And they also would have known in your assumed scenario that the fact of nondisclosure was going to become known in the future; correct?
A. I don't know that I know that.
Q. Well, patents are public; correct?
A. Yes, patents are public.
Q. And you know that just as a matter of general common knowledge that you can go onto a Web site and find patents; correct?
A. I've done so.
Q. And so all the patents that issued ultimately to Rambus would be publicly available?
A. Eventually.
Q. And when they issued; correct?
A. Uh-huh.
Q. You need to answer audibly for the reporter.
A. Yes, they would become public when they issued.
Q. And that's not a -- that's information that you would assume people at Rambus also knew, that their patents when they issued would be publicly available; correct?
A. Yes, they would know that.
Q. And the patents that are involved in the
7541
litigation you talked about in the course of this trial, those patents are public; correct?
A. The patents that have issued, yes.
Q. And so consistent with the assumptions you've made, a rational risk taker would have assumed that, well, everybody is going to find out about my failure to disclose these patents because someday they're going to issue and be public; correct?
A. I think they would know -- so in particular, if at any point they were being enforced against the JEDEC standard, then they would certainly be known.
Q. But they're public even if they're not being enforced?
A. That's correct.
Q. So your assumption is that Rambus took a risk of losing the ability to enforce its patents by not disclosing patents that it knew would issue in the future and be publicly known; correct?
A. I knew the patents -- they knew the patents would issue in the future and become publicly known.
Q. Yes.
So they knew their failure to disclose, in your assumed set of facts, would be discovered?
A. No. I don't think that follows because -- and I'm happy to explain.
7542
Q. Well, let me ask it this way.
What you have assumed they should have done is disclosed information about their patents; correct?
A. Yes. And not misrepresent their intellectual property.
Q. I'm sorry. Did I interrupt you?
A. I don't know.
Q. Okay. And did you say and not misrepresent --
A. Their intellectual property.
Q. Okay. And the harm that you have told us in

the course of this proceeding flows from that failure to disclose occurs only if it turns out that Rambus has patents which would be infringed by JEDEC-compliant parts; correct?
A. I'm sorry. I have to ask you to restate that. I just spaced out a little bit.
Q. That's okay.
The harm that you have told us flows from a failure to disclose occurs only if the patents read on or would be infringed by JEDEC-compliant parts?
A. That seems right, yes.
Q. Okay. So if Rambus had patent applications which you say it should have disclosed and knew it should have disclosed and took a risk of not disclosing them, the harm arising from any assumed nondisclosure

7543

doesn't occur until the patents ultimately issue; correct?
A. Well, in fact the harm arises from the enforcement of the patents, so yes, it typically would not be until the patents issued.

Q. And the patents can't be enforced until they've issued; correct?
A. That's my understanding of patent law, but I'm not a patent attorney.
Q. So at the moment Rambus had an issued patent and sought to enforce it, it had to know that its previous failure to disclose, as you have assumed it, would be discovered?
A. No.
Q. Okay. Isn't it true that a patent shows on its cover when the patent was filed?
A. Yes, it is. Well, again, I am no expert in patents, but I have seen patents and they have dates on the cover for the application.
Q. Then I'm going to ask you to explain – you offered this earlier and I thought I could short-circuit; it shows that I couldn't -- go ahead and explain why it is in your view that it would not be obvious once the patent issued that if there had been a duty to disclose that previously Rambus had failed to

7544

comply with that duty.
A. Because my understanding of the duty to disclose is that it attaches to the JEDEC member, not to the organization as a whole, and so unless you can see Mr. Crisp's e-mails, you wouldn't discover the failure to disclose because you had to have knowledge that he was aware of the patents, that is, the member was aware of the patents rather than the company as a whole.
And there's a voluminous amount of the record associated with, for example, no requirement of patent searching. That is, it's not that you promise to give up your patents when you join the organization; it's that you have a good-faith duty to disclose your patents. That's my understanding of the rule.
And so just knowing that Rambus had intellectual property, you could never draw the conclusion that Rambus by itself -- from that fact you could never draw the conclusion of bad faith without knowing that the JEDEC member from Rambus was aware of

those patents.
Q. Okay. So in your assumptions -- and this includes your assumption as to the scope of the duty to disclose at JEDEC -- the mere issuance of a patent wouldn't put you on notice that somebody had failed to

7545

disclose it unless one of the named inventors on the patent was also the JEDEC representative?
A. That would certainly be -- is it possible that a named inventor forgot that they had invented something? I could conceive of that. Some of these people invent a lot of stuff. But otherwise, yes, you would expect a named inventor to be aware of the patent.

Q. Okay. And is it also your assumption that if the named inventor had in fact forgotten that the JEDEC rules would not require disclosure by that named inventor even if he was the JEDEC rep?
A. So again this is my understanding of the facts and the assumptions I've made. I haven't actually assumed anything about named inventors and haven't thought very extensively about that.
My understanding is – and again, it's a finding of fact is what's at issue, but my understanding is the requirement is requirement essentially of good faith; that is, if you are aware of something that's material and relevant, you're supposed to disclose it, and if you fail to do that, you violated the process.
Q. Okay. So let me carry this one step further.
Going back to your assumed risk-taking on the

7546

part of Rambus, should Rambus have known, as you've assumed the facts, that when their patents issued, which let's assume should have been disclosed, that at least people might be suspicious and curious as to whether or not Mr. Crisp knew about them?
MR. ROYALL: Your Honor, could I ask for some clarification of what patents are being referenced in these questions?
MR. STONE: Okay. That's fair.
BY MR. STONE:
Q. Have you made any factual assumption, Professor McAfee, as to what specific patents or applications Rambus should have disclosed to JEDEC?
A. I am assuming that it should have disclosed patents or patent applications with reference to all four of the technologies challenged in the case. If they shouldn't have disclosed on one of the technologies, then my finding of exclusionary conduct on that technology is no longer -- on that particular technology would no longer be reliable because I've assumed that they should have disclosed on that technology.
Q. Have you made any assumption as to the specific patent application numbers or identifiers for purposes of your work?

7547

A. No, I have not.
Q. As part of the risk-taking that you've referred to, would you expect Rambus to have, had they actually been knowingly taking this risk, to have concerned themselves with the possibility that once the patents that you believe should have been disclosed were issued that people might inquire whether Mr. Crisp had known of those patents?
A. As a -- as human nature, so sort of somewhat outside of my economic reasoning, although human nature is actually part of the domain of economics, but it would be consistent with my understanding of human nature that people would at least be curious not so much when the patents issued but at the point that Rambus started suing them.

Q. Okay. Now, as part of your factual assumptions, did you assume that Mr. Crisp disclosed

patents held by Rambus or the possibility of patents held by Rambus at a SyncLink meeting? Did you assume that occurred?
A. I'm aware of that as a factual matter. I don't -- I didn't assume it in any of my -- in any of the conclusions that you stated here today, but I am aware of that as a factual matter, that he disclosed the existence -- I must -- as I sit here today, I don't

7548
remember whether it was patents or just the existence of intellectual property.
Q. Was it -- and let me ask this.
Was it important to your analysis for purposes of the opinions you've expressed here today one way or the other whether you have assumed or understood whether Mr. Crisp had provided a letter to JEDEC in which he discussed the possibility of Rambus intellectual property relating to SyncLink?
A. I'm sorry.
Q. Sure. Let me do it again.
Is it important for purposes of the opinions you've expressed here today and yesterday that Mr. Crisp provided a letter to JEDEC that discussed intellectual property that Rambus might possess that might bear on SyncLink?
A. I would agree that it's in principle important if it rose to the level of revealing the intellectual property to JEDEC itself. And that is the relevant intellectual property on the four technology markets. Since SyncLink used some of that technology and other technologies, it in principle could have done that, but it's not my understanding of the facts that it did do that.
Q. For purposes of the discussion you and I have

7549
been having about the presumed risk, is it important to that discussion from your perspective forming opinions as to economic issues that Mr. Crisp would have been known by the other JEDEC participants to have made a statement about Rambus intellectual property?
A. Well, a statement about Rambus intellectual property is not very specific. If the -- if Mr. Crisp had revealed detailed knowledge of intellectual property which could then later be enforced against JEDEC members, that could actually reveal that they were in violation of the JEDEC process.
Q. Is it correct for purposes of the discussion we're having right now about risk that Mr. Crisp did reveal to JEDEC some level of knowledge about Rambus intellectual property by virtue of that letter, as you have assumed the facts?
MR. ROYALL: I was going to object, Your Honor. The question, although he threw in assumption at the end, he's asking the witness whether a certain factual proposition is correct.
MR. STONE: No, no. And I don't mean to. Let me rephrase it.
BY MR. STONE:
Q. I want you to assume that Mr. Crisp provided a

7550
letter to JEDEC in which he expressed some awareness of Rambus intellectual property.
Can you assume that?
A. I can, yes.
Q. For purposes of the discussion you and I have been having about risk-taking, would it matter, in terms of whether or not people would be more than curious should patents later issue and be enforced, that the JEDEC representative had expressed at least some level of knowledge about Rambus patents at a JEDEC

meeting?
A. I think "at some level of knowledge" is an inadequate description. I would describe this as being on a continuum. That is to say, if he revealed specific knowledge in a written document which could later be used against Rambus, that would actually enhance the risks very substantially.
On the other hand, vague generalities are not going to be much revelation at all. So I would describe this as on a continuum and it would matter the specific nature of the revelations.
Q. Okay. Let's pull up DX-239.
Now, you offered this --
A. Actually can I ask for a restroom break at the next -- I mean, it's not urgent. But the next

7551
convenient --
MR. STONE: This is fine.
JUDGE McGUIRE: Let's take a break right now then. We'll go off the record for ten minutes.
(Recess)
JUDGE McGUIRE: Mr. Stone, you may proceed with your examination.
MR. STONE: Thank you, Your Honor.
BY MR. STONE:
Q. Professor McAfee, right before we took the break I had asked to put up on the screen DX-239.
And this is a quotation from deposition testimony given by William Davidow that you referred to earlier today; correct?
A. That's correct.
Q. And you said a little bit about what this testimony, what he said, but is it correct that what Mr. Davidow said in his deposition as quoted here is that he could think of no rational motivation why Rambus or anyone else would jeopardize the value of their patents by participating in a process that might deprive them of the right to enforce those patents?
MR. ROYALL: Your Honor, I object to the question. Mr. Stone has just asked Professor McAfee for an interpretation of what Mr. Davidow meant by this

7552
deposition testimony as opposed to what, if any, economic conclusions he draws from it.
JUDGE McGUIRE: Mr. Stone?
MR. STONE: Let me just -- I'll rephrase, Your Honor.
BY MR. STONE:
Q. When you withdrew certain economic conclusions from this testimony, did you understand the testimony to be that Mr. Davidow said he could think of no rational motivation for someone to engage in a process that would lead to them being unable to enforce their patents?
A. That is what I understood him to say.
Q. And then you did not understand him to say that the only rational motivation for doing so would be in order to monopolize, did you?
A. I did not understand him to be talking about monopolization.
Q. Okay. We can take that down. Thank you.
You also talked today in connection with this same line of questioning by Mr. Royall about mistakes; correct?
A. That's correct.
Q. And as a matter of economics theory, you recognize that information is not perfect; correct?

7553
A. Generally information is imperfect.

Q. And so sometimes people not knowing full information may make mistakes?
A. I'm willing to allow that even people who have good information occasionally make mistakes. I consider that I cautioned my testimony on that matter with that caveat.
Q. Okay. And a mistake in this instance could be that someone didn't understand the rules in the same way you have assumed the rules?
A. That could be an example of a mistake.
Q. And it could be a mistake that you have assumed the rules incorrectly?
A. Well, it wouldn't be the same kind of mistake that we've been discussing. If it's my mistake as opposed to a mistake on the part of a Rambus employee.
Q. I don't disagree with that. But it could still be a mistake?
A. Well, I made an assumption. That assumption is either right or wrong. I don't -- in that sense I don't -- I mean, a mistaken assumption, as I testified, would lead to -- would generally lead to incorrect or conclusions that aren't applicable.
Q. Okay. And your assumption regarding a duty to disclose to JEDEC is different, is it not, than what

7554

you read in the Federal Circuit's opinion about the Infineon case as to a duty to disclose at JEDEC?
MR. ROYALL: Your Honor, I object that this seems to be asking for a legal conclusion or at least an interpretation of a legal opinion.
MR. STONE: I'll withdraw it.
JUDGE McGUIRE: Sustained.
BY MR. STONE:
Q. Let's bring up DX-176 if we could.
I want to switch subjects, Professor McAfee, and ask you about commercial viability. I just want to start off making sure that we're on the same page.
You relied on others to determine whether a particular technology was technically feasible; correct?
A. That's correct.
Q. And then based upon the identification by others of technically feasible alternatives, you undertook to make a determination of commercial viability; is that right?
A. That's correct.
Q. Okay. And did you limit yourself in looking at commercially viable technologies to those which were equal or superior technically?
A. I limited myself to those that would be in the

7555

marketplace. That could include technologies that were not exactly equal. And they in particular were slightly inferior.
Q. So when we talked earlier about exclusionary conduct, if exclusionary conduct resulted in eliminating from the marketplace or excluding from the marketplace certain inferior technologies, did you then use those for purposes of determining whether or not there had been any competitive injury?
A. When you say "inferior technologies," the commercial viability of the inferior -- inferiority of a technology depends on its price. It depends on what it costs. And so it's appropriate to include technologies which may be in some -- well, at the same price one might be inferior, but at a lower price it's actually superior. So it's in that sense that I included technologies which may at the same price be inferior.
Q. Okay. So for purposes of determining whether a technology is equal or superior, you have to do some analysis which combines both the technical feasibility and attributes of the technology along with its price; correct?
A. Well, it's a matter of constraining the price of a given technology, and so the alternative

7556

technologies -- actually I've been assuming that the alternative technologies were actually freely available, with the exception, as I mentioned, of the Kentron technology, which in any case is a later technology, but...
Q. Okay. And the way in which economists in the antitrust context often examine alternatives is to use what you referred to as the SSNIP test; correct?
A. That's correct.
Q. And that is, you look at a small but significant nontransitory increase in price and determine what the elasticity is?
A. Of the market substitution, yes.
Q. And is there a usual price increase that is utilized in terms of determining what is a small but significant nontransitory increase?
A. Well, for physical products 5 to 10 percent is a common price increase. But that actually assumes that the products are already traded in volume before such price increase could be used. I would say in technology markets, I'm familiar with no such common price increase.
Q. Have you developed a particular price increase to utilize for purposes of your analysis that you presented here over the past two days?

7557

A. I didn't because I didn't literally do a SSNIP test. I did a commercial viability test, which I described as being parallel. It's not literally an increase in price but rather a substitution question.
So it's parallel to that. But it's not exactly the same, so it doesn't have as a basis an increase in price.
Q. And in deciding how to compare technically inferior technologies with those that are superior, have you developed some formulation or quantification of how performance trades off with price or cost?
A. Well, I'm not really in a position to directly assess the cost/benefit of performance and costs associated with these technologies, so I have to rely, as it says on this slide, on others who have a better appreciation of the costs and benefits of those technologies, and so that's what I've relied on.
That is, I'm not in a position personally to evaluate the relative qualities of these technologies because they're very sophisticated technologies.
Q. And you're not qualified to comment on the cost or price of these technologies either, are you?
A. To comment on?
Q. Well, you've done no study of the cost or price of the various technologies, have you?

7558

A. I would say that I've -- the price, as I said, with the competition of the Rambus technology that I assumed -- understand to have royalties attached to it, I've looked at the other technologies as -- and the Kentron technology as I mentioned, I've looked at the other technologies as being freely available. That is, I was not aware of any intellectual property or royalties that attach to them.
Q. Okay.
A. And so that answers the pricing aspect.
And then on the cost, I've actually -- and I should say, the testimony of the witnesses in this

trial have very much spoken to the issues both of cost and performance of the technologies.
Q. Have you done any sort of an econometric analysis to determine the cost or price trade-offs for different levels of performance?
A. No. And nor do I think that econometric analysis is possible or appropriate in this circumstance.
Q. Let me ask about price.
May I get the chart, Your Honor?
JUDGE McGUIRE: Go ahead.
Actually, Mr. Stone, if you move that up a little more, I can see it better. That's fine.

7559

BY MR. STONE:
Q. Could we, Professor McAfee, talk for a moment then about the price of the Rambus technology, if we could.
That price is a certain percentage of the average selling price of a DRAM; is that right?
MR. ROYALL: Your Honor, could I ask for clarification as to what Mr. Stone is referring to by the term "Rambus technology."
JUDGE McGUIRE: Mr. Stone?
BY MR. STONE:
Q. Well, let's talk about the four technologies that were in the yellow arrows with Rs on them. Okay?
Does that make sense to you, Professor McAfee?
A. I'm familiar with those technologies.
Q. Those would be the Rambus technologies covered by Rambus patents that relate to the four technology markets you've told us you've defined; correct?
A. Okay.
Q. And in figuring out what the price of those technologies are, would you take a certain percentage of the average selling price of a DRAM that incorporated those?
A. So my understanding of the Rambus contracts is that that's one component of the charges but that's not

7560

the only component of the charges necessarily, but that's one component of the charges --
Q. Okay.
A. -- that Rambus assesses for its technologies.
Q. And the other component is sometimes there's a fixed fee or a flat fee or nonrecurring expenses paid?
A. There's some testimony of charges for various provision of other services, but -- but this is my understanding of the main charges, but there are other charges that have been referred to in the trial testimony.
Q. I'm trying to keep us from having to go back in camera, so if I am a bit vague and generalize, understand that's why. If we need to for your answer, we will.
A. Well, I was going to say alternatively you can ask me just to assume that those are the charges and I would be happy to do that as well.
Q. Let me just ask you, for our purposes, let me just ask you to assume that the price is a certain percentage of the price of the DRAM. Okay?
A. Okay.
Q. And without getting into specifics of what anybody pays for any particular DRAM under any particular license agreement, can we for the sake of

7561

argument simply use 5 percent of the average selling price of the DRAM --
A. If you want.
Q. -- as our hypothetical?
A. We can.
Q. Now, have you looked at all at what, for a particular DRAM used in an ordinary PC that any one of us might buy for home use, what this turns out to be in dollars? Can you give us a rough ballpark?
MR. ROYALL: I object to the question as vague as to what you're referring to. Are these Rambus technologies? It's just a vague question.
JUDGE McGUIRE: Sustained. Mr. Stone --
MR. STONE: Certainly.
THE WITNESS: Are you asking me --
BY MR. STONE:
Q. No. I'm going to ask you another question.
A. Okay.
Q. Give me a rough number for the amount of money that would be paid to utilize Rambus technologies in a DDR SDRAM.
A. At 5 percent? Are we assuming 5 percent?
Q. Use 5 percent.
A. So it varies year to year, but it would be on the order of a billion dollars.

7562

Q. No. Just for one. Just a DRAM. I'm going to have to sell my PC quick if that's what I'm paying.
A. I'm sorry. I thought you meant for the market as a whole.
Q. No. I'm trying to take us to -- what I'm trying to understand -- and let me not be convoluted about it, if I am being -- I just want to understand what the price impact is on a PC.
A. That's also something that actually there's been testimony on that in the trial and that's something that's varied pretty substantially over the last decade.
Q. Well, can you give us a ballpark, based on your work, of what the cost of the DRAM is that goes into an ordinary PC today?
A. A couple of hundred dollars -- well, it depends on what you mean by "an ordinary PC." I probably buy top-end PCs.
Q. Okay.
A. I think people -- so if you're buying a $200 PC, you're not spending more than, you know, $20 or $10 on DRAM. On the other hand, if you're buying a $2,000 PC, you're probably spending $200 or more on DRAM.
Q. A moment ago, Professor McAfee -- I just want

7563

to try to clear up something in the transcript -- you said, didn't you, that the price impact on a PC is something that has varied pretty substantially?
A. That's my understanding, yes.
Q. Okay. Let's take -- I'm not going to spend too much time on this. Let's take a $600 PC, and your understanding is a $600 PC would have DRAM that cost the OEM about how much?
A. Again, it depends on the time. I don't know what DRAM is selling for today. But it might be, say, $50.
Q. Okay.
A. A hundred dollars. Again, this is something that's varied pretty substantially over the last decade.
Q. So that the cost of the Rambus technology to Rambus is what Rambus has paid of that -- for that DRAM under this hypothetical set of numbers is going to range from $2.50 to $5.00; correct?
MR. ROYALL: Your Honor, I object to the question as vague. It may have been unintentional, but Mr. Stone referred to the cost of Rambus technology to

Rambus.
MR. STONE:
Q. I'm sorry. No, no. Let me rephrase it. Let
7564
me rephrase it.
A. Okay.
Q. The cost to the OEM of the inclusion of Rambus technology in this particular DRAM is between two and a half and five dollars using these hypothetical set of numbers; is that right?
A. Well, in fact I see two errors in that, one of which is mine. I gave you a price for what I understood to be the modules actually, but Rambus earns its money on the DRAM, but not the module. But on the other hand, Rambus also gets royalties on the controllers, which I didn't give you a price for and nor do I know what they cost and -- at least off the top of my head, and so there would be other charges to Rambus as well, and so the number is both too high and too low or that is it has positive and negative errors associated with the overstatement of the cost of the DRAM and the understatement because of the lack of a module.
Q. We talked earlier -- we talked yesterday about the impact, if any, on consumers of the expectation of Rambus that it be paid for the use of its technology; correct?
A. We talked about -- which consumers are you referring to?
7565
Q. The ultimate consumer, the user of the -- the purchaser of the PC.
A. We did talk -- yesterday or today?
Q. I think yesterday is when I objected, but maybe it was today.
A. Okay.
Q. One day or the other. Okay?
A. Uh-huh.
Q. And one of the issues that I wanted to ask you about was whether you have formed any opinion as an expert economist on whether there would be fewer PCs sold as the result of the payments to Rambus that we have assumed are at issue in this case.
MR. ROYALL: Is that a question, Your Honor?
MR. STONE: It is.
MR. ROYALL: It doesn't sound like it.
THE WITNESS: I think he said would there be
fewer PCs sold. That is a question.
As I testified today, I don't think that there's been an impact on the DRAM prices as of today, and as a result there's no way to trace that, these effects, through to the final consumers.
I haven't really considered the controller market and whether there's been an impact on the controller market, but I expect that the analysis would
7566
be similar, but I haven't actually personally done that analysis.
But with the respect to the DRAM itself, there's no mechanism by which such an impact would have been felt already. And as a result, I do not think that there would have been an effect on the final PC market as of today.
BY MR. STONE:
Q. Have you made any study of the elasticity of demand for PCs among consumers?
A. No.
Q. Have you made a study of the elasticity of demand for DRAM among OEMs?
A. I have not studied the elasticity of demand for OEMs.
Q. Could we bring back up DX-176.
I want to direct you to the bottom half of this chart where you say "serious consideration at JEDEC."
That was one of the factors you took into account, is it not, in your consideration of commercial viability?
A. It was.
Q. Now, the phrase "commercial viability," is that a phrase that you would find in the DOJ guidelines?
7567
A. I don't recall that phrase in the Department of Justice guidelines.
Q. Or in any of the FTC's guidelines?
A. I don't recall offhand, but not to my knowledge.
Q. Is there any established literature in your field of industrial economics that describes the use of a commercial viability test to determine market substitutability?
A. I don't recall offhand. Not to my knowledge.
Q. Have you written any papers or articles yourself on that subject?
A. Well, I've written about the -- I've written several papers about antitrust evaluations. I didn't use the phrase "commercial viability" in those -- in those -- I needed a name for the technologies, though, is the reason for this.
Q. When you talked about serious consideration at JEDEC, you gave us, for each of the four technologies in question, you gave us selected quotes in your charts to people's views.
Is that a fair summary of what some of the charts showed?
A. Yes. A small -- not very much, yes.
Q. Was it important for purposes of determining
7568
commercial viability that there be serious consideration given at JEDEC to a particular technology at a point in time where you had us, if you will, on the left side of the funnels, what I think is called ex ante?
A. That was certainly better -- the earlier or the more relevant the time period, the better the information is.
Q. Because one of the things you told us, isn't it, that when you go to a more recent point in time, people's knowledge about what was viable or feasible at earlier points in time might not be as good?
MR. ROYALL: Objection, Your Honor. I believe this misstates the witness' prior testimony.
THE WITNESS: My understanding --
JUDGE McGUIRE: Just a second. I've got to rule.
MR. STONE: Let me restate, Your Honor.
BY MR. STONE:
Q. Isn't it correct that in your view knowledge improves with time and it's hard to go back and remember exactly the state of knowledge at that earlier point in time?
MR. ROYALL: Objection. Vague.
JUDGE McGUIRE: Overruled. I'll hear the
7569
question.
THE WITNESS: Actually I don't think I was referring to memory at the time in the statement I made. It was, rather, that the -- as the technology advances, what is feasible -- I'll explain this better if I give an example that's quite responsive.
But for example, we know how to put a lot more

pins in today than we did in 1992, and as a result, adding pins seemed more feasible today than it probably would have in 1992. And so in that sense, yes, as the technology changes and we learn things, the comparisons change and that -- so the closer in time the consideration is that I can draw on to the relevant period, the better the data is.

Q. Okay. And for purposes of your economic analysis of commercial viability, you were looking, for the first two technology markets, at whether there was serious consideration at JEDEC in the 1992 time frame; is that right? And you told us yesterday 1992 meant 1991 to 1993.

A. Well, my attempt is to be relevant to the standard, and as I said, the lock-in is actually a continuum so that the time actually -- that is, lock-in is not something that happens at a particular day; it's something that happens in a continuous

7570

fashion.

And so yes, 1991 to 1993 for SDRAM strikes me as the relevant period, but that doesn't rule out 1994 and 1995 as being relevant. And now, unfortunately, I've forgotten your question.

Q. That's okay. Let me -- so have I, so let me ask another one.

Is it correct then that for purposes of your opinion if alternatives were commercially viable for SDRAM with respect to the technology markets that are involved in the years 1994 and 1995 that would be pertinent for your analysis?

A. Yes, it would be pertinent. It would be not necessarily perfect information, but it would certainly be relevant information.

Q. And would it be pertinent for purposes of your analysis if alternatives were commercially viable in 2000 with respect to the two technology markets that relate to SDRAM?

A. It would depend on the nature -- are we talking about SDRAMs still?

Q. Yes, we are.

A. It would depend on the nature -- that is, if they had not been commercially viable in 1999, just became because of the technological advance

7571

commercially viable in the year 2000, that would actually be a problem for the commercial viability during the relevant time period, so that if you found that they weren't commercially viable earlier than 2000, the fact that they became commercially viable in 2000 would not be much help.

Q. If they were given serious consideration by JEDEC in 2000, would that be evidence that they were thought to be commercially viable alternatives in 2000?

A. Well, it would certainly be evidence that they were thought to be commercially viable alternatives in 2000.

Q. Just as a matter of economics and understanding the costs of organizations operating, you wouldn't expect, consistent with economic principles, that JEDEC would spend a lot of time discussing technologies in the year 2000 if there was not a sense among at least some significant number of members that those technologies were commercially viable at that point in time?

A. Yes. I don't take it as a proof, but that actually is consistent with my understanding of JEDEC and of the market generally.

Q. Okay. With respect to DDR SDRAM, I want to

7572

focus a little more carefully on what you consider to be the pertinent date for purposes of your analysis.

Yesterday I think you told us 1995; is that correct?

A. My recollection is that's around when the standard issued.

Q. Around when the standard issued? I'm sorry. I'm on DDR.

A. On DDR. '97. I've forgotten -- I've actually -- I may forget when the DDR standard issued, but I have it in my --

Q. Go ahead. Take a look at your chart.

A. '99 is when the DDR standard issued.

Q. And what's the pertinent date with respect to the DDR SDRAM for looking at whether or not there were commercially viable alternatives for purposes of the analysis that you've done?

A. Well, in respect to DDR, the changes to DDR could have come -- I mean, even a disclosure in 1998 might have led to a change in DDR. But from the perspective of the lawsuit, that is to say, given the allegations or my understanding of the allegations, the relevant period is when the disclosure should have occurred, which is earlier, so it would have been 1995 time frame.

7573

Q. And have you -- what I'm trying to get to is: What have you assumed to be the date on which a disclosure should have been made as to DDR SDRAM?

A. Well, prior to 1996.

Q. And what have you based that on?

A. Well, it's my understanding of the alleged behavior; that is to say, it's my understanding of the allegations.

Q. Did you look at anything beyond the allegations in selecting that date for purposes of your analysis?

A. Well, there's certainly -- I've read a fair bit of information about -- that describes what patents and pending patents Rambus had and when it was applying for patents, and so on. Again, I'm not here to testify about what I read in those documents, but they don't undercut the hypothesis that Rambus had awareness of patents with respect to the two DDR technologies earlier than 1996.

Q. Let me see if I can rephrase. I don't think I'm being very clear. Let me ask it this way.

Have you made an assumption as to when JEDEC's work on DDR SDRAM officially began?

A. I don't know that I've explicitly made that assumption. It may be implicit in the assumption that

7574

there was a duty to disclose or that the misrepresentations mattered, so that is to say -- that's outside of my testimony. So that is to say, my understanding is that if there was no work on it, the duty may not have established, but that's not for me to say one way or the other.

Q. Let me then ask it hypothetically and see.

If there was no duty to disclose unless work had begun on the standard and if work did not officially begin on the DDR SDRAM standard until after June of 1996, would you agree that under your analysis Rambus' assumed conduct was not exclusionary with respect to DDR SDRAM?

A. Not necessarily, but maybe. In the incompleteness of the hypothetical you referred to whether there were other misrepresentations, but again, these are -- you're questioning me about -- you're changing my hypothesis in the way of my assumption and

trying to get me to reason about whether this change in this hypothesis leads to a violation of my assumption, and that's actually kind of outside of my general reasoning.

That is, I haven't concerned myself with the determination of did they have a duty to disclose other than I read a fair number of documents just so

7575

that I was comfortable that there was actually a reasonable assumption to be made. But that is still an assumption as opposed to a conclusion that I'm testifying to.

Q. I didn't mean to get you to reason sort of outside the realm of area in which you've been doing your work. I'm mostly just trying to understand your assumptions, so let me see if I can phrase it slightly differently.

You have assumed with respect to DDR SDRAM that to the extent that work on DDR SDRAM is relevant to whether there was a duty to disclose that that work had commenced while Rambus was still a member of JEDEC; correct?

A. If it -- if I understand your question, which I take to be if work had not yet commenced or -- and the absence -- and there was no duty to disclose absent work and there was no issue of misrepresentation absent work on the standard, then there would be no duty to disclose, that seems logical to me, but that doesn't -- that just seems like another way of saying my assumption that there was a duty to disclose or a violation of the process was incorrect, and if that's true, then the conclusions I drew from that assumption would certainly fall away.

7576

Q. Okay. With respect to commercial viability and determining whether or not a particular technology is treated as a good substitute, did you look for cost analyses, projected cost analyses of different technologies performed by market participants at any of the relevant time periods?

A. I didn't find any such cost analyses in the record. I did talk to participants in JEDEC who did not -- who sort of -- that wasn't the nature of the -- their description of what they did in their laboratories. That is, there weren't any spreadsheets for me to look at, and so that wasn't the kind of data that I understood to be available for my analysis.

Q. And did you look for whether there was any contemporaneous data that was -- I guess -- let me just be clear.

Did you review any contemporaneous data prepared at the time any alternative was considered where someone analyzed the relative cost and performance of one alternative versus another?

A. I didn't -- and there are statements in the JEDEC record that are qualitative about relative costs, but other than that, I'm not aware of any contemporaneous cost estimates.

Q. Let's look if we could at DX-129.

7577

I want to direct your attention here to the small bullet point that says, "Excluded equally efficient or superior alternative technologies," if I might.

A. Uh-huh. Yes.

Q. Earlier today or -- let me phrase it this way.

Earlier in your testimony, you identified certain alternative technologies that you felt were within the technology markets that you defined; correct?

A. The commercially viable technologies.

Q. Yes.

Did you consider each of those technologies to be equally efficient or superior to the Rambus technology that was included within that same market?

A. When you add royalties to the Rambus technology, yes.

Q. So in each instance you were able to do a comparison of those other technologies and conclude that the Rambus royalties were such as to make the other technologies equally efficient or superior?

A. I'm sorry. I meant to say that I found them to be price-constraining against the Rambus technology, which is not quite the same thing as you've said, although it's actually closely related.

7578

Q. What I want to ask about is this language and this has -- to an economist, the idea of equally efficient or superior alternative technologies has meaning; correct?

A. Yes.

Q. Because, as you discussed earlier today, if you exclude an inferior technology, that from the perspective of economics is -- does no harm; correct?

A. Well, generally is not harmful. It's not that there would never be circumstances under which it's harmful; it's that often it will not be harmful, but that's also the accepted definition of exclusionary.

Q. So what I want to ask about is, rather than the price-constraining technology market definition that we talked about earlier, whether you also made a determination as to which of the technologies included within each market were equally efficient or superior to the Rambus technology.

A. So my understanding of these technologies and also of the meaning of commercial viability is such that given intellectual property, the others -- one of the others, not -- I'm not sure I know which one -- but that one of the others would have been selected over the Rambus technology. I think we went through that logic today.

7579

And the implication of that was that for JEDEC, given the disclosure, the others were -- actually I need to say likely. I left out the word "likely" in that. At least one of them was -- of the excluded technologies was equally efficient or superior, but I don't know necessarily which one.

Q. And are you saying that it is likely that at least one of them would have been equally efficient or superior? Is that how you wanted to put the word "likely" into your answer?

A. I'm happy with that method of putting the word "likely" in.

Q. And the comparison, the royalty comparison you're making for the Rambus technology, is -- can we put a dollar figure on the price of that technology? Is it -- can we select an average price for a DRAM and multiply it by some percent to understand what this is in dollar terms?

MR. ROYALL: Again, Your Honor, I object to the question as vague in that it doesn't define what Mr. Stone is referring to by the term "Rambus technology."

MR. STONE: Let me rephrase it.

BY MR. STONE:

Q. I'm going to use "Rambus technologies" for the

7580

time being -- and I'll tell you if I change my definition -- to refer to the four Rambus technologies that were represented on a variety of your charts with

yellow arrows, one each of which is included within the four technology markets you've earlier defined. Is that okay? Is that acceptable to you?
A. So to be clear, until you tell me otherwise, you are not talking about RDRAM.
Q. Until I tell you otherwise, I am not talking about RDRAM.
A. Nor any other technologies that Rambus may or may not own other than the four technologies in the complaint.
Q. Specifically, I'm talking about programmable CAS latency, programmable burst length, DLL/PLL on-chip, and the use of dual-edged clocking.
A. Okay.
Q. Okay?
Can you put a dollar figure in some fashion on the differential, dollar differential for a particular DRAM that you have assumed is the royalty differential for purposes of your performance-cost comparison?
MR. ROYALL: Objection. Vague as to time frame and as to what is meant by "a particular DRAM."
BY MR. STONE:

7581
Q. Fine. Let's take, for example, a 128-meg DDR SDRAM. Can we do that?
A. Uh-huh.
Q. And that's a yes for the reporter?
A. Yes, it is. Sorry.
Q. Thank you.
For any point in time, when you were doing a comparison of alternative technologies and trying to decide if they were equally efficient or superior to the Rambus technologies, have you converted this royalty differential into dollars?
A. I have not.
Q. Okay. Look if you would at DX-177.
Here you talk about cost of the solution to DRAM manufacturers and others and performance benefits of the technology. Those are the middle two bullet points. Do you see those?
A. I do.
Q. Have you made any effort to quantify in any fashion, technically, economically, or in any other way, the performance benefits of the various technologies that you have been comparing to the Rambus technologies for purposes of determining whether they are equally efficient or superior?
A. I have created no such performance

7582
comparison -- well, cost comparisons. I have talked about the relative merits, as I understand them -- again, this is my reading of others' testimony, but I haven't quantified those comparisons.
Q. Okay. Let's take the highlighting off of that and let's go the second bullet point where it says "IP royalties."
With respect to the various technologies that you have compared to the Rambus technologies to determine if they are equally efficient or superior, have you considered whether any of those other technologies are covered by intellectual property beyond Kentron?
A. I'm aware of no other intellectual property. It's my understanding from my reading of the record that there was no other intellectual property attached to them. It would matter to my conclusions if there were such intellectual property.
Q. How would it matter to your conclusions if there were such other intellectual property?
A. It could render -- it could in principle render a technology not commercially viable if it had attached to it intellectual property.
Q. Why is that?
A. Well, it's my understanding of the JEDEC

7583
process that it has -- you can think of it as attaching a penalty. It's not an absolute bar, but it attaches a penalty to the presence of intellectual property.
And we spent a great amount of time during my direct testimony exploring my understanding of the reasons and economic motivations behind that preference. The short summary is that my understanding of the JEDEC process is that they would be leery and would need a -- I've forgotten now the exact phrase -- a well-justified reason before including technology that involved royalties and intellectual property, that is, patents, in the standard.
Q. As to -- let's assume that one of these other technologies is covered by a patent.
Can we assume that for purposes of these questions?
A. We can.
Q. If it is covered by a patent and JEDEC is aware that it's covered by the patent, have you for purposes of your analysis reached a conclusion as to whether or not JEDEC would include that technology among the alternatives it would consider?
MR. ROYALL: I object. It's an incomplete hypothetical.

7584
JUDGE McGUIRE: Overruled. He can answer if he understands the question.
THE WITNESS: I have not explored the commercial viability of any of the market technologies, other than the Kentron one, with a patent attached to them, and if a patent is attached to it, it could in principle upset my conclusion that they were commercially viable.
BY MR. STONE:
Q. Have you --
A. That particular technology was commercially viable.
Q. I'm sorry. I stepped on your answer and I apologize.
Have you concluded that the Kentron technology is commercially viable?
A. It appears to be commercially viable.
Q. And you --
A. But as I said, royalties are a problem with that technology.
Q. But even though there are royalties associated with that technology, you think it remains commercially viable?
A. So it remains -- it's my understanding it remains commercially viable against a technology with

7585
royalties. Against a technology without royalties, it may not be commercially viable. It is actually my understanding it hasn't been adopted by the market at this time.
Q. Many of the technologies that you have identified as commercially viable technologies have also not been adopted by the market; correct?
A. That's correct. Well, in this setting. I don't know one way or the other whether they've been adopted in some other setting. These technologies often apply to applications in specific integrated circuits and other places where one might apply the same technologies, but I haven't studied those

markets.
Q. For purposes of your analysis of commercial viability and among the considerations that you took into account, does it make a difference if a technology is covered by a patent but the holder of the patent has agreed to provide a RAND letter?
A. If the holder of the patent doesn't provide a RAND letter, my conclusion is that the technology is not commercially viable, so not only is it important, it's necessary.
Q. Have you assumed -- because I understand this may be a factual issue -- have you assumed for your

7586

purposes that JEDEC will not adopt technologies that are covered by patents where a RAND letter has not been provided?
A. I have assumed that.
Q. Have you also assumed that what JEDEC does is select the best performance-cost combination among the alternatives available to it for consideration?
A. This slide is supposed to set out the factors that I think -- the major factors which entered into that determination, and cost and performance are certainly present, but they are not the only two -- they are not the only factors I think that enter into the decision. And in particular, I would point to the final one, that every one of these technologies had problems to be solved, and so a perception of the magnitude of those problems would be relevant to the determination of which technologies should be selected, for example.
Q. And just so -- let me ask this hypothetically just so I'm understanding this.
For example, it might be that JEDEC was risk averse when it came to problems and they might choose a technology that might be a little bit inferior in terms of cost and performance if they thought there was less risk that the problems associated with that technology

7587

could not be solved?
A. Let me be at least slightly pedantic but also true to my economic profession by saying, once you've introduced risk, you need to talk about expected costs and benefits rather than cost and performance, rather than cost and performance as if they were known. From an economic perspective, such a risk aversion may well be efficient.
Q. And did you make any assumption as to JEDEC's weighing of the problems it saw associated with each technology?
MR. ROYALL: Objection. Vague.
THE WITNESS: Yes. I would actually --
JUDGE McGUIRE: Well, hold on. Hold on.

THE WITNESS: I'm sorry.
JUDGE McGUIRE: When an attorney stands up and objects, I've got to rule before you answer.
Overruled.
You can answer the question now.
THE WITNESS: I have an understanding about how the decision-making and the deliberation of JEDEC proceeds. The economic model I used to understand JEDEC is what's known as the median voter model. That may not be -- I think I would want to temper the median voter model because in my understanding JEDEC actually

7588

seeks more consensus than the median voter model requires; so that is to say, it is more of a consensus-driven organization than the median voter model.
In such a -- but starting with the median voter model, the -- actually I need to hear your question again now.
BY MR. STONE:
Q. My question is this: Have you assumed any particular way in which JEDEC dealt with addressing the problems of a particular technology?
A. Yes. So I have an understanding -- I would have to think a bit to trace through -- I've certainly assumed this consensus, that consensus is important to JEDEC. That's an answer to your question. Yes, I've assumed that JEDEC -- that consensus is important. It's not that JEDEC requires unanimity -- that is not my understanding -- but that it seeks -- it continues to deliver a -- when it is far from consensus.
Q. And in terms of the words I used earlier about risk averse, have you made any assumptions one way or the other about the level of risk aversion on the part of JEDEC given the model that you have used for thinking about that decision-making process?
A. So given the model that I've described, it

7589

actually doesn't make any sense to talk about the risk aversion level of the body as a whole. The individual members have risk averse -- risk aversion levels, and to some extent the decision-making of the whole of the committee was then affected by the levels of risk aversion of the individual members.
It is -- but it's not the case that you can represent the whole as a -- by a set of risk averse preferences, if you'll accept a little bit of jargon from me.
Q. In coming up with any of your determinations as to commercial viability, can you give us an example of how you took into account your last bullet point, every technology had problems to be solved?
A. Yes. For example, in finding that doubling the clock speed was a substitute for dual-edged clocking, so that is using one edge of the clock and doubling the clock speed, it was important that a substantial fraction of the JEDEC membership, as I understand it, of the manufacturers, had problems producing the symmetric duty cycle required for dual-edged clocking. Now, it's not absolutely symmetric what's required; it's just symmetric.
So that is to say, there was a general concern that it was difficult -- a challenge to manufacture a

7590

clock who has -- that is 50 percent up and 50 percent down or something close to that. It doesn't need to be exactly that. And that's a -- that -- so it's a challenge to manufacture such a clock.
It's also a challenge to deal with the electromagnetic interference associated with doubling the clock speed.
So the fact that both of those represented challenges that were considered at the time to be

actually pretty serious, not every -- remember IBM knew how to produce the symmetric duty cycle clock pretty easily; other members did not. It mattered to my opinion, though, that there was a substantial number of JEDEC members who were unsure about both, about how they were going to implement both alternatives. And that's what -- that was important to my finding that doubling the clock speed was an alternative to dual-edged clocking.
Q. Okay. Let's look if we can at DX-144.
I'm sorry. Let's look at DX-132 first.
This was your chart of the DRAM industry overview that we looked at yesterday I believe;

correct, Professor McAfee?
A. It appears to be, yes.
Q. And am I correct that technology providers,
7591
that is, people who develop technology that may be useful to the DRAM industry, also include DRAM manufacturers?
A. DRAM manufacturers do generate technology.
Q. So in that sense at least between technology providers and manufacturers, there's also some vertical integration of those two functions?
A. There are some -- well, actually it is my understanding that all of the DRAM manufacturers generate technology and so all of them would be vertically integrated to -- it's my understanding. There may be some of the smaller players who don't produce very much.
Q. And are there other technology providers other than DRAM manufacturers and those like Rambus and Jazio
that you've listed here?
A. Texas Instruments, for example.
Q. Okay.
A. They no longer manufacture DRAM, but they provide technology.
Q. And they would show up on this chart as well as a PC OEM and a server OEM, would they?
A. Texas Instruments? They certainly used to manufacture PCs, but I don't -- if they're manufacturing PCs today, I don't know about it.
7592
Q. Okay. So -- and do the manufacturers of DRAM-related logic also provide technology?
MR. ROYALL: Objection. Vague as to what type of technology the question concerns.
JUDGE McGUIRE: Sustained.
BY MR. STONE:
Q. With respect to what's shown on your chart here as technology providers, based on your understanding and the assumptions you've made, do some of the manufacturers of DRAM-related logic that are also shown on this chart, DX-132, fall within the oval identified as technology providers?
A. I don't specifically know. I would expect Intel is a technology provider, for example, and it's also a chipset manufacturer or -- also a chipset manufacturer, so I would expect they are, but I don't
actually know one way or the other for sure.
Q. Is it correct that a buyers cartel may arise in circumstances where you have a few large buyers, vertical integration and a high level of coordination?
A. This is a -- I'm going to ask you just to repeat the question so I make sure I have the question.
Q. Let me see if I can make it simpler.
In DX-132, there are people who are buying
7593
technology as you've drawn this description of the DRAM industry; correct?
A. Yes.
Q. And included among the buyers of technology are the DRAM manufacturers; correct?
A. Yes.
Q. And if the DRAM manufacturers for purposes of buying technology were to act like a cartel, you might look to see whether the circumstances of their industry is susceptible to cartel behavior, might you not?
A. I am perfectly capable of doing such an investigation.
Q. Okay. And among -- and you've written about buyer behavior in articles you've published; correct?
A. Yes.
Q. And you wrote an article in the Texas Law Review on buyer power?
A. Yes.
Q. And among the characteristics you look for in a buyer cartel are that there's a few large buyers -- that's one factor you would look for; correct?
A. Well, the Texas Law Review paper has nothing to do with cartels.
Q. No. It just has to do with buyer power;
7594
right?
A. It does have to do with buyer power but not with cartels.
Q. And now I'm jumping from --
A. I just wanted to make sure that you've changed the topic.
Q. I did.
A. I've also written on cartels, so -- but proceed.
JUDGE McGUIRE: Well, then you can answer this next question then.
BY MR. STONE:
Q. One of the factors you look for, if you're looking to see whether there might be a buyers cartel, is whether there are a few large buyers?
A. That certainly would be one of the ingredients to a buyer cartel.
Q. And it also is a factor that you would look for to see if they're vertically integrated; correct?
A. Vertical integration can contribute to -- vertical integration can make certain kinds of cartel behavior either more successful or more likely.
Q. And you also would look to see if there's a high level of coordination among the buyers; correct?
A. Now you've kind of switched gears on me.
7595
Precisely what do you mean by "coordination"?
Q. Well, for example, isn't it the case that industry associations or consortia are often thought to provide the mechanism for buyer cartels to coordinate on the price they will pay?
A. Industry associations are what are known as a facilitating device. They help -- they facilitate, they make it more likely that a cartel, whether buyer or supplier cartel, can operate.
Q. And in your book, the Competitive Solutions book that we saw the cover of or the dust cover of on the text the other day or on the screen the other day, you wrote about the use of industry associations as a possible mechanism for a buyer cartel to operate; correct?
MR. ROYALL: Your Honor, if Mr. Stone intends to ask Professor McAfee about his book, I'd ask that he be presented with a copy and that I also be presented with a copy. I don't have a copy of the book present.
JUDGE McGUIRE: Can we make a copy of whatever passage you're looking at, Mr. Stone, or at least give them an opportunity to view it before we go into this line of inquiry?
MR. STONE: Can I just put it on the ELMO?
7596
JUDGE McGUIRE: That would be fine. And then if they still want to examine it, I'll give them that opportunity.
MR. ROYALL: My only concern with this approach, Your Honor, is I don't know if Professor McAfee may need to look to other aspects of

the book.
JUDGE McGUIRE: If he does, he'll be given -- if he has any questions on that, I'll be sure -- I'm sure and confident that he'll raise them.
THE WITNESS: You know, I have a jitter in the screen here that makes it hard to read, and this is actually coming out both blurry and jittery. So this is actually making me somewhat nauseous.
MR. STONE: May I approach?
JUDGE McGUIRE: Yes, you may.
BY MR. STONE:
Q. Let's do it this way. I'm going to direct your attention to the paragraph under the heading Industry Associations.
Is that something that you wrote?
A. It is.
MR. ROYALL: Your Honor, I now object because I don't have a copy of it.
JUDGE McGUIRE: Okay. Let's take two minutes

7597

and you can both --
MR. STONE: I have a copy right here.
JUDGE McGUIRE: Oh, you have a copy.
MR. STONE: Of the page, not the book.
JUDGE McGUIRE: Okay. Let's still take two minutes so he can take a look at it and then the professor can take a look -- is it just that page you're going to inquire on?
MR. STONE: Just one paragraph.
JUDGE McGUIRE: Let's give them one minute to look through it and then you make your inquiry.
(Pause in the proceedings.)
Perhaps, if he hasn't already done so, at the end of the day he'll be happy to autograph that book for us.
MR. STONE: I will be certain to ask, Your Honor.
(Pause in the proceedings.)
JUDGE McGUIRE: Okay. Mr. Stone, you may proceed.
MR. STONE: Thank you.
BY MR. STONE:
Q. Mr. McAfee, directing your attention to page 138 of your book under the heading Industry Associations, is that a paragraph that you wrote?

7598

A. Yes, it is.
Q. And do you agree with the statements set forth in that paragraph?
A. In the context of the entire chapter, yes, I do.
Q. Okay. Could you read the paragraph into the record not too fast for us, if you would be so kind.
A. "An industry association is an example of what is known as a facilitating device, which helps a cartel or a tacit collusion function. Industry associations provide a reason for executives to get together and learn how to know and trust each other. Industry associations perform studies that may suggest mutually beneficial strategies and dire consequences of a failure to cooperate. An industry association can be a vehicle for cooperative, build-the-market kind of advertising, or it can sponsor research projects that benefit the industry as a whole. Finally, industry associations lobby for beneficial legislation. Much of the work of industry associations is beneficial to customers -- improving the market and eliminating costly, ineffective regulation -- but an industry association also forges links between competitors and thus can be a vehicle for softening or eliminating price competition in the guise of rationalizing the

7599

marketplace."
Q. Thank you.
In connection with the negotiations that you have presumed would occur either ex post or ex ante between Rambus on the one hand and DRAM manufacturers

on the other hand, you told us earlier today that you would expect each of those negotiations to be one on one; correct?
A. That's my understanding, yes.
Q. You would not expect, would you, that the DRAM manufacturers would get together either through an industry association or otherwise to talk about a collective strategy that they would pursue in negotiating with Rambus?
A. So my -- when I said I expected them one on one, I was speaking in the context of JEDEC; that is, I was saying my understanding of JEDEC, that JEDEC does not provide a vehicle for collective negotiation.
Now, as to whether there was another vehicle available for collective negotiation I haven't actually considered.
Q. There were other -- in the course of the work you have done, you became aware of other collective gatherings of DRAM manufacturers, did you not?
A. I'm aware of -- well, of DRAM manufacturers?

7600

Q. Let me ask it this way. Let me -- did you become aware of SyncLink?
A. I did become aware of SyncLink.
Q. Did you become aware of M9?
A. I didn't encounter M9 in my reading except from the trial testimony I think. That was the first -- that's the first time I recall encountering M9, is in the trial testimony.
Q. Did you become aware of ADT?
A. Yes.
Q. And did you become aware of AMI-2?
A. Yes.
Q. And in addition to M9, did you become aware of M11 and M14 through your reading of the trial testimony?
A. Yes. Sometime at the same points even.
Q. And you would not have expected, would you, for purposes of this hypothetical negotiation between Rambus and the DRAM manufacturers that through any of the groups we've just identified that the DRAM manufacturers would get together and agree on a joint strategy for dealing with Rambus in negotiations?
MR. ROYALL: I object to the question as vague inasmuch as I don't think it's clear what hypothetical negotiation he's referring to.

7601

MR. STONE: I'll back up.
JUDGE McGUIRE: Just restate as to that portion.
BY MR. STONE:
Q. With respect to the hypothetical negotiation --
A. Can I interrupt and ask --
Q. May I approach, Your Honor?
Do you want me to take it back off your hands?
A. If you're not going to ask me further questions about it.
Q. Not at the moment. I'll be back for the autograph.
Professor McAfee, with respect to a hypothetical negotiation between Rambus and DRAM manufacturers, either ex ante or ex post, as to what they would pay for the Rambus technology, have you

assumed that in advance of those negotiations there would be no meeting among the DRAM manufacturers and agreement upon a position they all should take in the negotiations?
A. I'm sorry. I was listening to the first part of your question, I started thinking, and now I've actually -- I missed part of the question.
Q. That's okay. Let me try it again.
I'm correct, am I not, that for portions of

7602
your opinions that you've expressed here over the last two days that you've assumed a hypothetical negotiation between Rambus and DRAM manufacturers to determine the price they would pay for Rambus technology?
A. Well, I concluded that if Rambus signed a RAND letter, so we're in the but-for world analysis, if Rambus signed a RAND letter, and if JEDEC determined the inclusion of the technology was well-justified or that the technology was well-justified, that individual manufacturers would contact Rambus to get a sense of what the royalties that Rambus expected were. I didn't actually consider one way or the other whether that would be done individually or collectively. I don't think it upsets my opinion if it's done collectively.
Now, my understanding of the antitrust laws is that may or may not be a violation of antitrust laws, but certainly some kinds of collective action on the part of companies is a violation of the antitrust laws, but I don't think it actually matters to my opinion that it's individual.
Q. I want to ask you about economics, not antitrust law, if I can.
From an economic point of view, if all of the

7603
purchasers, all of the buyers of a particular product or a technology agree on what they are willing to pay for it, they affect the negotiations as opposed to each of them negotiating individually and without

coordination, do they not, as a matter of economics?
A. You know, I think -- I guess I feel like it's an oversimplification of what is a rich cartel theory, and in fact I have presented a lot of information in my book on this exact topic and also in other published -- at least one other published paper, and so I don't quite subscribe to that. It's not -- it's oversimplification, is the right description of it. That is to say, it's not wrong in principle, it's rather -- it's oversimplified. It requires additional hypotheses.
Q. Okay. Let me see if I can invite some additional information from you without having you rewrite the chapter here in the courtroom.
MR. ROYALL: Objection, Your Honor. I don't think that statement was necessary.
MR. STONE: No, no, no. I meant it -- it was not meant to be critical.
JUDGE McGUIRE: And it's not and the court takes it as such. Go ahead.
BY MR. STONE:

7604
Q. Please, Professor McAfee, I meant no disrespect in that question.
Can you tell us, with as much as detail as you feel necessary to feel comfortable with the answer, what factors must be in place for you to agree with the statement that a buyers cartel acting cooperatively would have more market power in negotiating with a seller than if they each acted individually?
A. Well, it was actually the -- what's complicated in cartels is to get them to act cooperatively, and so if they -- if you want me to assume that they are acting cooperatively, then in fact I agree with the statement that they could affect the negotiations. But it's -- the challenge is actually to get a cartel to act cooperatively.
Q. Okay. And that's partly signaled by the heading on page 138 of your book that preceded this section I had you read which was Solutions to Tacit Cooperation Problems.
There are problems with tacit cooperation; correct?
A. In fact I think my recollection is I give 13 of them.
Q. Okay.

A. But I don't specifically remember the number.

7605
Q. But for these purposes if we simply assume that there was collective action by all of the buyers of a particular commodity or a technology, they would have increased market power in negotiations with the seller than if they each acted individually?
A. If you add in cooperation. Collective action may not be sufficient to get cooperation. OPEC is a classic example of a cartel that has collective action but little, often little cooperation.
Q. An agreement not to include patented technology in a standard without the provision of a RAND letter would be an example of cooperation among the members of that organization, would it not?
MR. ROYALL: Objection. Incomplete hypothetical.
JUDGE McGUIRE: Sustained.
BY MR. STONE:
Q. You have assumed for purposes of your analysis that the JEDEC members have agreed through their adoption of the rules that they will not include patented technology in a JEDEC standard without first being provided with a RAND letter; correct?
A. That is my understanding of the JEDEC rules.
Q. Bring up if we could DX-144.
Directing your attention to DX-144 that's on

7606
the screen before you, it lists three ways in which DRAM standards are set, through standard-setting organizations, private consortia and proprietary standards.
Do you see that?
A. I do.
Q. Are each of those what you would refer to as de jure standards?
A. I'm sorry. I'm blanking out on what the --

Q. Sure. Let me ask it differently.
A. No. But I should know the answer to this. I'm just blanking on what the -- it's the ones that aren't imposed by the government, is the -- all of them are the ones that aren't imposed by the government, but I don't remember if that's de jure or what the other one is.
JUDGE McGUIRE: De facto.
BY MR. STONE:
Q. Let me ask it differently.
A. I think these would all be de facto.
Q. Okay. It is also correct, is it not, that the marketplace itself by simply accepting a particular product can turn a product into a de facto standard?

A. That's correct.
Q. So in addition to standard-setting
7607
organizations, private consortia, proprietary standards, we also could have widespread market acceptance?
A. So no, that's not quite my understanding. My understanding is these are the three means by which standards are proposed to the market and then the market chooses the standard from that; so that is to say, all of these are subject to a market test.
So that is to say, yes, inside the standard-setting organization they set their standard and propose it to the market, but they can't impose it in the sense that, for example, the Federal Communications Commission imposes standards on cellular communications. They make it a law. None of these organizations have that kind of authority.
Q. If a company starts manufacturing a product and other companies start manufacturing it as well and it catches on in the marketplace and soon accounts for a substantial volume of market share, would you consider that product to have identified a standard?
A. Yes.
Q. And it could do that --
A. If it is a standardized product, that is, if we're talking about something that embodies a standard -- a standard has characteristics attached to
7608
it, but --
Q. When you use "proprietary standards" in your example on this demonstrative, could that also include within its ambit, as you use the term, a company that simply publishes a standard and says here's what we're going to make and anybody else who wants to make it can as well?
A. Yes. It would make the term "proprietary" somewhat of a misnomer. It would be a standard provided by a firm that was proprietary but offered on free terms, and so it's not exactly proprietary because it was given away free.
Q. Okay. When you referred to the RDRAM -- and I'm now using RDRAM distinct from Rambus technologies we've talked about earlier -- did you include it as the result of a proprietary standard?
A. Yes.
Q. And did you call it proprietary because it was a single company which developed the standard? That's part of the elements of proprietary?
A. And owned the rights to the practice of the standard.
Q. And let me go back then to slide DX-134.
With this background that we just covered, I'd like to talk for just a moment about your chart on the
7609
basic economics of the DRAM industry if I can.
The large capital requirements, which is your first bullet point, was important for purposes of your analysis, was it not?
A. It was significant, yes.
Q. Now, one of the things you showed us earlier was the cost of a fabricating plant or fab; correct?
A. Yes.
Q. Now, the cost of a fabricating plant is not a cost that when the plant is built is limited to producing DDR SDRAM, is it?
A. It is not.
Q. For purposes of your analysis, have you assumed that a fabricating plant can produce various different kinds of semiconductor devices?
A. I am, yes.
Q. Okay. And when you talk about economies of scale, are you assuming that as the volume of production goes up, the marginal cost of producing the next unit goes down?
A. That's the meaning of economies of scale. I should say, as I testified, there are two kinds of economies of scale in this industry. There's the fact that the minimum efficient scale of the plant is very large, but there's also a network economy. That is to
7610
say, as the industry gets larger, the average cost of production falls, and that's the related components as opposed to DRAM directly.
Q. I want to make sure I understand the network economies.
Tell us more about what you mean when you say "network economies."
A. So a network economy is anything where the -- it's a situation where increased use of a product either lowers its cost or enhances its value.
Q. So for example, in this case it's not a consideration that you took -- let me strike that.
I was concerned by the factors listed on this chart whether you were for purposes of your economic analysis assuming that DDR SDRAM in a computer was limited in terms of its ability to network with other computers. And you were not making that assumption, were you?
A. You mean in the sense of networking like routers and the like?
Q. Like networking to the Internet, like networking through a modem line.
A. No, no. That's a computer term. This is the economic term of a network externality.
Q. So the network externality here is that as
7611
DRAMs become used in different applications, the price would be driven down even more, or the cost driven down even more?
A. Well, the total delivered cost of the product, so if you have to produce chipsets, the fixed costs associated with the chipsets are amortized over a larger volume, so that's -- it's not necessarily the cost of the DRAMs that are driven down, that's the minimum efficient scale aspect of DRAM production, which has been growing but is, you know, still -- the minimum efficient scale is still well less than the industry size, which is generally the relevant condition for economic analysis of economies of scale.
But it's the other components, the amortizing of the costs of the other components over a larger volume.
Q. And for purposes of your network externalities, you're not assuming that products have to use a particular form of DRAM in order to interface in any fashion with other products?
A. No. I think actually -- yes. So I'm agreeing with you. I'm not assuming that they need a particular form of DRAM.
Q. Let me ask you then about interoperability.
Have you -- this is an issue on which you've
7612
made certain factual assumptions?
A. Yes.
Q. And have you assumed that different models of DRAM may require certain changes in the operating system -- certain changes in the rest of the system in order to operate?
A. To be useful, yes.

Q. Okay. And have you assumed that changes may be necessary in the motherboard, the chipset, the controller and the BIOS?
A. Yes.
Q. Have you assumed there's anything else in the chart that we looked at, DX-30, that would need to be changed as you changed versions of DRAM?
And we can bring up DX-30 if you want.
MR. ROYALL: That's what I was going to ask for the purposes of that question.
JUDGE McGUIRE: All right. Let's see it.
MR. STONE: DX-30. It was the hand-drawn chart. That's it. Perfect.
BY MR. STONE:
Q. Do you remember seeing this the other day?
A. I do.
Q. And you included a copy of it within your charts; correct?

7613

A. I did.
Q. Referring you to DX-30, is there anything that you have assumed needs to be changed as the version of DRAM changes other than the chipset, the motherboard, the memory controller and the BIOS?
A. Yes.
Q. What else?
A. In particular, hard drives have DRAMs in them. Moreover, fax machines, printers and other devices have DRAMs in them. And the -- in order to use those DRAMs in that device, you would have to change components that are not listed on this chart but are present in those other devices.
If you are restricting it to within the PC, the only thing that I see that would have to be changed that contains DRAM is the hard drive, but there may be other components that contain DRAMs that I'm forgetting as I sit here today.
Q. And the use of the -- have you assumed that the use of the DRAM in a hard drive is independent of the use of the DRAM as it interfaces to the Northbridge chip in the chipset?
A. It is. The hard drive is just a plug-in device. It's self-contained.
Q. Okay. You can take that down and let's go back

7614

to DX-134 if we could.
Let me ask you if I can about price sensitivity.
Is the factor that you've taken into account here in describing the basic economics of the DRAM industry that purchasers of DRAM are sensitive to the price of competing DRAM?
A. Yes.
Q. And when you refer to the price sensitivity on this chart, is that the nature in which you --
A. Can I clarify my previous answer? I answered too quickly.
Yes, although it's not all purchasers. It's a significant fraction, a substantial fraction of the purchasers.
Q. And are those the OEMs?
A. Oh, I was actually talking about the ultimate final consumer. The OEMs have -- inherit the preferences of the final consumer because that's their market, but it's the final consumer whose price sensitivity drives the price sensitivity of the OEMs.
Q. And have you done any quantitative studies to measure price sensitivity?
A. I have not quantified the price sensitivity of consumers.

7615

Q. And finally let me ask you about the commodity nature of DRAM.
You, I think when being asked about this demonstrative earlier, you talked about the concept of backward compatibility? Do you recall that yesterday?
A. I certainly talked about backward compatibility, although I don't recall talking about it in the context of this particular slide.
Q. Well, I may be incorrect on that, and if I am, I apologize. Let me just ask you about backward compatibility.
Is it necessary, as you understand it, for the economics of the DRAM industry that DRAMs be backward compatible in the sense that a newer version can be used in connection with a motherboard, chipset, controller and BIOS that was utilized with an earlier version?
A. No, it's not generally necessary. Clearly that would be a benefit if it were true, but it's not generally necessary. In fact, it's rare.
Q. And when you used the term "backward compatible" in your testimony, what did you mean by that use of that term?
A. I'm referring to the reuse of components; that is to say, it refers to pieces or modules, a module

7616

being a different use of the word "module" than is standard here, so let me not use that term -- pieces or subassemblies, components of the DRAM being the same in such a way that it actually reduces implementation costs and testing costs.
Q. So for example, if you could use the same core from one DRAM version to the next, that would be one of the examples of reusing prior components?
A. In principle, yes. I can't testify that that is an example, but in principle, certainly that's the kind of example I have in mind.
MR. STONE: Okay. Your Honor, if it was convenient with the court, now is a convenient time for me to break before I move to another subject, if you want to.
JUDGE McGUIRE: You mean break for the evening?
MR. STONE: Break for the evening.
JUDGE McGUIRE: Yes, that would be fine.
It's 5:00 then. We will take a break for the evening and I guess convene here -- it's already Friday -- tomorrow at 9:30 a.m.
MR. STONE: Thank you, Your Honor.
(Time noted: 5:00 p.m.)

7617

C E R T I F I C A T I O N O F R E P O R T E R

DOCKET NUMBER: 9302

CASE TITLE: RAMBUS, INC.
DATE: June 26, 2003

I HEREBY CERTIFY that the transcript contained herein is a full and accurate transcript of the notes taken by me at the hearing on the above cause before the FEDERAL TRADE COMMISSION to the best of my knowledge and belief.

DATED: June 27, 2003

JOSETT F. HALL, RMR-CRR

CERTIFICATION OF PROOFREADER

I HEREBY CERTIFY that I proofread the transcript for accuracy in spelling, hyphenation, punctuation and format.

DIANE QUADE

UNITED STATES OF AMERICA
FEDERAL TRADE COMMISSION

In the Matter of:)
Rambus, Inc.) Docket No. 9302
----------)

Friday, June 27, 2003
9:30 a.m.

TRIAL VOLUME 37
PART 1
PUBLIC RECORD

BEFORE THE HONORABLE STEPHEN J. McGUIRE
Chief Administrative Law Judge
Federal Trade Commission
600 Pennsylvania Avenue, N.W.
Washington, D.C.

Reported by: Susanne Bergling, RMR

APPEARANCES:

ON BEHALF OF THE FEDERAL TRADE COMMISSION:
M. SEAN ROYALL, Attorney
GEOFFREY OLIVER, Attorney
JOHN C. WEBER, Attorney
ROBERT DAVIS, Attorney
Federal Trade Commission
601 New Jersey Avenue, N.W.
Washington, D.C. 20580-0000
(202) 326-3663

ON BEHALF OF THE RESPONDENT:
GREGORY P. STONE, Attorney
STEVEN M. PERRY, Attorney
PETER A. DETRE, Attorney
SEAN GATES, Attorney
Munger, Tolles & Olson LLP
355 South Grand Avenue, 35th Floor
Los Angeles, California 90071-1560
(213) 683-9255

APPEARANCES:

ON BEHALF OF THE RESPONDENT:
A. DOUGLAS MELAMED, Attorney
Wilmer, Cutler & Pickering
2445 M Street, N.W.
Washington, D.C. 20037-1420
(202) 663-6090
and
JOHN GUARAGNA, Attorney
Gray Cary Ware & Friedenrich LLP
401 B Street, Suite 2000
San Diego, California 92101-4240
(619) 699-2848

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

JUDGE McGUIRE: This hearing is now in order. Are there any housekeeping items we need to pick up this morning?

MR. STONE: I don't believe so, Your Honor.

JUDGE McGUIRE: If not, you can continue with your cross examination, Mr. Stone.

MR. STONE: Thank you, Your Honor.

JUDGE McGUIRE: Good morning, Professor. How are you this morning?

THE WITNESS: Good, thank you.

MR. ROYALL: Could I ask for one moment? Our computer is having another malfunction.

(Pause in the proceedings.)

JUDGE McGUIRE: All right, Mr. Stone.

MR. STONE: Thank you, Your Honor.

CROSS EXAMINATION (cont.)

BY MR. STONE:

Q. Good morning again, Professor McAfee.

A. Good morning.

Q. Is it correct that you were not able to tell us based on the assumptions or understanding that you performed what specific claims of any patent applications or patents or what specific patent applications or patents in their entirety should have been disclosed according to your understanding and assumptions by Rambus to JEDEC?

A. That's correct.

Q. Is it also correct that you can't say as to a specific date when any particular disclosure should have been made by Rambus to JEDEC?

A. I think as I've already testified, I'm not in a

position to say what should have been done. In fact, that --

Q. Let me -- you are correct. Let me withdraw the question. Let me reframe it I think consistent with what I have heard you say.

Based on the assumptions you have made, you're not able to identify a specific date on which any particular disclosure should have been made by Rambus to JEDEC. Is that correct?

A. Well, I don't actually understand the difference in that question. Again, you seem to be calling for a legal conclusion or at least a -- for me to conclude what should have been done in terms of disclosure, which was --

Q. Right.

A. -- not my --

Q. I don't mean to ask you that. If I did, I

7671

wasn't clear enough. Let me try to reframe it again.

You have assumed certain things about Rambus' conduct that has led you to -- that has provided the basis for the opinions you've ultimately formed.

A. That's correct.

Q. I'm just going to ask you about your assumptions, not about any of the conclusions you've formed. I'm just asking you in the course of developing your assumptions, have you made assumptions as to specific dates on which disclosures should have been made by Rambus to JEDEC?

A. I have not.

Q. Okay. And have you assumed any particular triggering event would have caused Rambus to be obligated in some form or another to make a disclosure to JEDEC?

A. No, I haven't assumed anything in the way of -- other than the need -- other than there was a requirement or a violation of the process that formed the basis for them to have misled JEDEC or misrepresented their IP.

Q. Thank you.

Have you assumed in connection with the JEDEC process that when patents are disclosed to JEDEC, that it will then request a RAND assurance or a RAND letter

7672

be provided by the patent holder?

A. So, my understanding is -- what I've assumed is that in order to incorporate the disclosed intellectual property, the -- a RAND letter was necessary, but that -- I could conceive of circumstances where having heard there was intellectual property, the -- JEDEC decided not to pursue that avenue and didn't seek a RAND letter, just went a different direction. That would not make a difference to my opinion.

Q. Have you assumed that if JEDEC was advised of patented technology that was contemplated to be included in a standard, that they would not include that patented technology in the standard without first requesting a RAND assurance from the patent holder?

A. That's my expectation. There is one example in the record I believe or in the trial testimony of a company that was using the -- or at least as I understand it was using the need for a RAND letter as a way of slowing down the proceedings and that after some amount of deliberation, JEDEC decided that there wasn't any actual IP and that this was, in fact, an attempt to slow down the JEDEC deliberations, and so there is an instance where they did not seek a RAND letter in the end, but that was because they determined to their satisfaction that, in fact, there was no relevant IP.

7673

Q. And do you recall the name of that company?

A. Not offhand.

Q. If I suggested to you that it was Echelon, would that refresh your recollection at all?

A. That sounds right.

Q. Okay. And it was your understanding in that regard, was it not, that as a matter of economics, someone who provides information that might turn out to be incorrect could impose costs on the system?

MR. ROYALL: Objection, vague. I'm not sure what system is being referenced here.

JUDGE McGUIRE: Sustained.

BY MR. STONE:

Q. In regard to the testimony that you referred to a moment ago about Echelon, was it your understanding that some people thought that Echelon was giving notice that they had intellectual property that applied to certain technologies incorporated in a standard in an effort to slow the standard-setting process down?

A. That is a fair summary I think of my understanding.

Q. Okay. And would you agree that the conduct that was at least suggested by some of the testimony was the type of conduct that would impose a cost on the standard-setting process employed by JEDEC?

7674

A. It is my understanding that misrepresentations generally can harm the standard-setting process and that this is apparently -- again, I've done no further investigation beyond what I read in the trial record -- but this is apparently an example of that.

Q. So, is it consistent, then, with your understanding that if someone advises JEDEC that patented technology may be included in a standard and JEDEC determines that the technology is not, in fact, patented, that it would not be inconsistent with their procedures to then not request a RAND letter?

JUDGE McGUIRE: Now, there is two negatives there, Mr. Stone.

MR. STONE: Well, let me try to simplify it, because I was trying to keep count as I went, Your Honor, but I may have gotten turned around. So, let me try to simplify it.

BY MR. STONE:

Q. Let me back up.

Is it your assumption that when JEDEC decides to include patented technology in a standard where they have an expectation that the technology is, in fact, patented, that they will request a RAND letter or RAND assurance from the patent holder?

MR. ROYALL: Can I ask for clarification as to

7675

whose expectation is being referred to, JEDEC collectively or specific JEDEC members?

MR. STONE: Let me reframe.

BY MR. STONE:

Q. Is it -- have you assumed that when JEDEC is advised that certain technology that is proposed for incorporation into a standard is patented, that JEDEC will request a RAND letter or RAND assurance from the patent holder unless a determination is made that the technology is, in fact, not patented?

A. My understanding is that they -- if they are planning or considering incorporating intellectual property in -- patented intellectual property in a standard, that they won't do that without a RAND letter, and I think that answers your question.

Q. But I was trying to ask a question which also picked up the exception with regard to Echelon that we had talked about earlier, and can you give me a general

statement of the policy that you have assumed exists that includes the exception for Echelon?
MR. ROYALL: Again, can I ask for clarification as to what is meant by "exception for Echelon"? I don't think the record is clear on that.
JUDGE McGUIRE: Yeah, I don't think it is, Mr. Stone.

7676

MR. STONE: Sure.
BY MR. STONE:
Q. Let me ask it this way, Professor McAfee: Tell us, if you would, what you have assumed is JEDEC's policy or rules with respect to when they will request a RAND letter or RAND assurance be provided.
A. When they're planning to incorporate -- when JEDEC is planning or JEDEC members are planning to incorporate -- proposing to incorporate intellectual property into a standard, they will request -- my understanding is they will request a RAND letter or they won't incorporate the intellectual property without a RAND letter from the owner of that technology.
Now, my understanding is that in terms of Echelon, that because they didn't consider that Echelon had intellectual property in spite of it -- Echelon's statements, that that didn't violate their process, but again, these are -- my assumption is that they will not incorporate the technology that's patented or patent pending without a RAND letter. That's the nature of my assumption. And I don't believe Echelon violates that.
Q. Okay. Is it a correct statement, then, of your assumption that if JEDEC determines that the technology is not patented, even after someone having said that it

7677

is, that they may proceed without requesting a RAND letter or RAND assurance?
A. Well, I think they did exactly that in Echelon's case.
Q. Okay. Let me ask you now, if I might, about the but for world that was the subject of some testimony yesterday, and maybe we can bring up DX-233 as a point of reference.
You talk in Exhibit -- you testified with respect to DX-233, I believe, that -- let me rephrase it. I don't need to go back and repeat what you said.
In the but-for world, you started with the assumption of hypothetically, as you put it, that Rambus did not engage in the challenged conduct that you had described for us, correct?
A. I'm sorry, I was looking at the exhibit. Can I ask you to repeat?
Q. Certainly.
In setting up your construct of a but-for world, you assumed that Rambus had not engaged in the conduct that is challenged here.
A. That's correct.
Q. And you then took one of -- you took two paths as alternatives, that Rambus was asked for a RAND letter and provided it and that Rambus was asked for a

7678

RAND letter and did not provide it.
A. That's correct.
Q. If JEDEC had determined that the technology it sought to include was not patented, a third path could have been followed, which is that JEDEC would not have requested a RAND letter or RAND assurance, correct?
A. I think it's correct that that third path -- again, this is -- the assumptions about JEDEC are assumptions and not -- and not economic conclusions, but that at least seems plausible as a -- given my reading of the case, it seems possible -- that is, the possibility of that is plausible. That was a contorted sentence.
Q. If JEDEC did not -- let me start again.
If JEDEC concluded that Rambus would not ultimately be issued patents which would cover the technology that JEDEC sought to incorporate into the standard, it would be consistent with JEDEC's rules and practice that it not request a RAND letter or RAND assurance from Rambus as you have assumed those rules or practices. Isn't that correct?
MR. ROYALL: Your Honor, I would object to this line of questioning. Mr. Stone objected at the beginning of the direct examination to anything beyond very limited discussion of the nature of the

7679

assumptions that the witness has made, and now he is asking the witness to give what amounts to factual testimony interpreting JEDEC rules, which is something that your own order prohibits him from doing, and so I don't see the point in this entire line of questioning.
MR. STONE: Your Honor, if I might respond, I'm simply asking the witness questions about the assumptions he has made, and I'm asking him in a hypothetical way. I'm not asking him for any opinion as to these factual issues.
JUDGE McGUIRE: I'll entertain that line of inquiry, but let's keep that very much tied to the context of his objection.
MR. STONE: I will.
BY MR. STONE:
Q. Do you have the question in mind, Professor McAfee?
A. I do, but I -- given the objection, I think I misunderstood the question, because I understood you to be asking me about what was permitted within JEDEC's rules and not about, given a hypothetical, what are my economic conclusions --
JUDGE McGUIRE: Then if that is the inquiry, then that is I think sustained, but if you want to pose it as a hypothetical, then we'll do that.

7680

MR. STONE: I do, Your Honor. That's how I want to pose it.
JUDGE McGUIRE: All right, well, let's get to it then.
BY MR. STONE:
Q. Professor McAfee, for purposes -- what I'm trying to understand is the limits of the assumptions you have made or the parameters of the assumptions you have made, and I'm asking you hypothetically, would it be consistent with your understanding and your assumptions of JEDEC's practices and rules that if JEDEC determined that Rambus would not be issued any patents that covered the technology that JEDEC was seeking to incorporate into its standards, that JEDEC would not feel compelled to issue a request for a RAND letter or RAND assurance?
A. Okay, I think I understand that question. I'm going to give an answer in such a way that it either won't be responsive or, if I understood it correctly, it will.
My -- my hypothesis about the reaction of JEDEC to a disclosure is -- does not include the possibility that JEDEC or does not consider the possibility that JEDEC, having heard the disclosure, then says, well, we just don't believe it. We're going to incorporate it

7681

anyway, and we'll fight it out later if that -- if it turns out -- the disclosure turns out to be right. I did not consider that in constructing the but-for

world.
Q. As an economic matter, would it constitute in your opinion exclusionary conduct if JEDEC made a determination that it did not think patents would issue that covered the Rambus technology they sought to incorporate into the standard and for that reason did not request a RAND assurance or RAND letter?
MR. ROYALL: I'd ask for clarification. The question is vague as to "exclusionary conduct." On the part of who?
MR. STONE: I think --
JUDGE McGUIRE: We assume it's on behalf of Rambus. Is that correct?
MR. STONE: I think that's the whole reason we're here, Your Honor.
JUDGE McGUIRE: That seemed pretty clear to me, Mr. Royall.
MR. ROYALL: Okay, as long as that's -- as long as that's the question, then it's fine.
JUDGE McGUIRE: That's well established at this point.
THE WITNESS: Can I ask you to either read the

7682

question back or to restate it?
MR. STONE: Would it be possible to have it read back, Your Honor?
JUDGE McGUIRE: Go ahead.
(The record was read as follows:)
"QUESTION: As an economic matter, would it constitute in your opinion exclusionary conduct if JEDEC made a determination that it did not think patents would issue that covered the Rambus technology they sought to incorporate into the standard and for that reason did not request a RAND assurance or RAND letter?"
THE WITNESS: Okay, there's a missing hypothesis which I take to -- implicit but not explicit is the missing hypothesis that Rambus disclosed -- because in the but-for world, we're starting off with the hypothesis that Rambus disclosed, that is, they acted in good faith, they followed the process, whatever the legal -- again, I'm not here to testify about legal requirements, but they followed the legal requirements. JEDEC ignored their disclosure or did not act upon it and then incorporated the technology into the standard. In that case, Rambus would not have engaged in exclusionary conduct, as I understand it, given my -- the hypotheticals I have put forth.

7683

BY MR. STONE:
Q. Okay, and let me follow up on that.

If JEDEC knew of the Rambus intellectual property but was not advised of it by Rambus, and if it made the determination that the patents would not issue in such a way that they would cover the technology that they sought to incorporate, and if they then concluded not to request a RAND assurance or RAND letter, would Rambus have engaged in exclusionary conduct in an economic sense in your opinion as a result of having not disclosed that intellectual property to JEDEC?
MR. ROYALL: I'd object to the question as vague in that it doesn't define by the word "JEDEC" whether Mr. Stone is referring to all JEDEC members collectively or some subset of JEDEC's membership.
JUDGE McGUIRE: Sustained.
BY MR. STONE:
Q. You've talked to us yesterday about the JEDEC decision-making process and how it achieves consensus, correct?
A. I have.
Q. And you said it was somewhat like the model -- but I've forgotten the name that you applied to it. Can you remind me?
A. The median voter model.

7684

Q. Somewhat like the median voter model.
When I use "JEDEC," what I'm referring to is the collective body as you understand it and have tried to understand or model its behavior, if I might.
A. Okay.
Q. With that clarification, which I hope addresses the objection, let me see if I can pose the question this way:
If JEDEC was aware that Rambus had or potentially could have intellectual property that might be thought to potentially cover technology that JEDEC sought to incorporate into a standard, and if JEDEC decided that the intellectual property would not result in issued patents that covered the technology it sought to incorporate, and if it decided not to request a RAND letter or RAND assurance, in your opinion as a matter of economics, would Rambus' failure to disclose intellectual property to JEDEC in that instance have constituted exclusionary conduct?
A. The beginning part of your hypothetical was if JEDEC was aware. Now, it turns out that economists are -- especially game theorists, that is the branch of economics devoted to the study of games -- are acutely troubled by terms like "aware," and the reason is there are various levels of "aware."

7685

It's not -- it's one thing, for example, for the members of JEDEC to independently have knowledge but not be in a position to discuss it or not know that others have the same knowledge. It may or may not be possible through the deliberations of JEDEC for that -- for that awareness or that knowledge to reach consensus, and as a consequence, I can interpret your question many different ways, and unfortunately, in some of the ways I interpret it, the answer is yes, and in some of the ways I interpret it, the answer is no.
Q. Okay, let me try this: If a majority of the JEDEC members who voted on whether or not to incorporate the Rambus technology into the JEDEC standards knew that Rambus had potential patent claims over that technology and if they concluded -- that is, the majority who had this knowledge -- concluded that Rambus would not obtain issued patents which covered that technology, and if on that basis JEDEC did not request a RAND assurance or RAND letter from Rambus, would Rambus' assumed failure to disclose constitute in your opinion, as a matter of economics, exclusionary conduct?
MR. ROYALL: Your Honor, I would object to the question as vague. The term "majority" is not defined and the term "potential patent claims" is not defined.

7686

JUDGE McGUIRE: Overruled.
THE WITNESS: I know what "majority" means. So, again, that's -- remains an incomplete hypothetical. It probably wouldn't have been if I thought JEDEC was literally the median voter model, because a majority determines the outcome in a median voter model, but the process of JEDEC consensus means that the answer really still could go either way; that is, it could be exclusionary conduct, and it may not be depending on really the exact details. I haven't actually considered this in enough depth to even know exactly what it depends on.
BY MR. STONE:

Q. Okay, let me just ask it this way, then, and maybe I can simplify a bit.

There are situations in which JEDEC could become aware of Rambus' potential patents other than through Rambus' disclosure of that information to JEDEC such that Rambus' failure to disclose would not, as a matter of economics, in your opinion constitute exclusionary conduct. Isn't that right?

A. That's correct.

Q. If we could, let's bring up the DX-147 as context for my next line of questions.

The JEDEC process that you've testified about

7687

previously and that to some extent is summarized on DX-147 included the need for JEDEC to arrive at a consensus as to what features should be included in a particular standard, correct?

A. As it says, yes.

Q. And have you assumed that the decision to include the four Rambus technologies that we've referred to yesterday was the result of any action Rambus took to move JEDEC from other technologies to those?

A. Can I have the question read back?

Q. Yeah, it's a -- I haven't thought of a simple way to phrase this. Let me try a different way and see if I can get to my point.

I understand your opinion that -- your opinion/assumption that had JEDEC -- had Rambus disclosed to JEDEC, they would have moved from these technologies to others, and I'm not asking you to contradict that opinion.

Rather, I'm asking whether you have either assumed or have formed an opinion that anything Rambus did caused JEDEC in the first instance to select any one of the four technologies that we've identified as Rambus technologies.

A. I haven't made any assumptions in that regard,

7688

and moreover, my understanding of this question -- which maybe I didn't understand the question -- but my understanding is you're asking me as a matter -- this would -- strikes me to be something that's a matter of law; that is, it's not part of my economic conclusions.

Instead, it's was this a willful action or a positive statement, why don't you adopt this technology, versus a passive statement or passive actions, and that's something -- that's a distinction I haven't needed to make, and -- but as I understand it, it could be relevant as a matter of law, but that's not my expertise.

Q. Let me ask it differently. Maybe I can find another way.

Is it -- have you assumed that if Rambus had never joined JEDEC, that the four technologies at issue here would have been selected by JEDEC for inclusion within the standard?

A. I haven't assumed that, but it seems plausible.

Q. Is it consistent with the assumptions you have made that if Rambus had never joined JEDEC, that

JEDEC

would have selected the same four technologies that we -- that it did select?

A. Yes.

Q. Okay. And is it correct as a matter of your

7689

economic opinion that it's your opinion that if JEDEC had never -- strike that.

Is it correct that as a matter of your economic opinion, if Rambus had never joined JEDEC, there would not be exclusionary conduct on Rambus' part?

A. This is actually outside of my hypotheses, but that seems correct, although I have to say I haven't actually -- I'm afraid of saying "yes" unambiguously since I haven't really thought about this circumstance deeply; that is to say, certainly my reasoning falls apart if Rambus were not a member of JEDEC.

Q. Okay, let me ask again, if we can just for some context, bring up DX-145.

I want to direct your attention, if I might, to the second bullet point, which is, "Open availability of standard," if I might.

Have you for purposes of the opinions you have formed assumed when standards would be made available to the public; that is, JEDEC standards?

A. I can't think of any assumption about when other than prior to the deployment of the standard. Actually, no, that's not fair. It's before the deployment of the standard in the sense that manufacturers of DRAMs and the related components

need

access to the standard to experiment with it, to learn

7690

about it, to test manufacturing, define problems, so it would be prior to the deployment of the standard.

Other than that specifically, I haven't really considered the question of when the standard is available other than that it was openly available early in some sense.

Q. And let me just explore that.

There is, as a matter of economics, value in having access to the standard during the course of its development and before it becomes final, correct?

A. Yes.

Q. And manufacturers, you've assumed based on what you understand from the record, manufacturers make use of that preliminary information in work that they do.

A. That is correct.

Q. If the preliminary versions of the standard were made available only to JEDEC members and not to others, would that give an economic advantage to JEDEC members?

A. You didn't say who, but for -- that is, there are some companies that would have an economic advantage from being in JEDEC, but there would be other companies that would not.

Q. If -- let me just assume hypothetically, if a company was a manufacturer of chipsets, controllers or

7691

motherboards and was not a member of JEDEC and did

not

have access to preliminary versions of the standard, would its competitors who were members of JEDEC have

an

economic advantage by virtue of their JEDEC membership if that membership resulted in them having access to preliminary versions of the standard?

A. Potentially.

Q. Let me ask you about the fourth and fifth bullet points, implementation costs and manufacturing costs.

Is it correct that in your opinion, as a matter of economics, those costs should be considered together because ultimately it's the cost of the system that matters for purposes of your analysis?

A. Yes. To be fair, that -- I -- when I said that, I oversimplified slightly in that implementation costs, of course, vary with the implementation. Manufacturing costs vary with what's being

manufactured. When you mix that in with consensus, it wouldn't be that you just add the two necessarily, because it may be that reaching consensus requires weighing one or the other more heavily, but certainly at the overview level, it's approximately that you would add them together.

Q. Let me ask you about the final point,

7692

evolutionary versus revolutionary.

As you use that term, have you formed a view as to whether the switch or transition from EDO to SDRAM would be described as evolutionary or revolutionary?

A. I think evolutionary/revolutionary is a continuum. The switch from EDO to SDRAM was more revolutionary than it -- than a switch from EDO to burst EDO would have been, but less revolutionary than a switch from EDO to RDRAM. So, was it revolutionary or evolutionary? Well, it was more revolutionary than going to the burst EDO, but not as revolutionary as other alternatives available at the time.

And that is assumption on my part in that I'm not actually evaluating how difficult those transitions were. I'm relying on the expertise of people who testified at trial.

Q. As a matter of economics, am I correct that it's your opinion that if the performance is constant, evolution is preferred over revolution?

A. Yes; that is, other things equal, you would prefer an evolutionary approach.

Q. And that's because you can – among other things, you can re-use knowledge in that sense and you can lower your risk.

A. That's true.

7693

Q. Now, as a matter of economics, there are benefits perceived to result from innovation, correct?

A. Generally, yes.

Q. And as a matter of economics, we know that it's that desire to further innovation that led to the creation of the patent policy of the United States, correct?

MR. ROYALL: Objection, Your Honor, I think this calls for a legal conclusion.

MR. STONE: I don't mean to do that. Let me rephrase it.

BY MR. STONE:

Q. It is correct, is it not, that the patent system of the United States creates economic incentives that will in many instances encourage innovation?

A. That's certainly consistent with the economic understanding of patents; that is, the economic theory of the patent system.

Q. Okay. And is it also correct that economic benefit can often be realized from revolutionary ideas?

A. I only have trouble with the word "often."

Q. Okay, let me take that out.

Is it correct that economic benefit can be realized from revolutionary ideas?

A. Yes.

7694

Q. Okay. And is it also correct that you have concluded on prior occasions, such as in your book, that established manufacturers may sometimes prefer evolution to revolution?

A. So, now I'm only having trouble with "in your book," because I don't actually recall that passage, but I believe I testified here at trial that manufacturers may prefer evolution over revolution, other things equal.

Q. Okay. And it is correct, is it not, that sometimes in the context of economics, it has been concluded by economists such as yourself that outsiders who bring revolutionary ideas to an industry bring benefits that would not have necessarily been realized by the established industry's continued evolutionary progress?

A. Was the word "sometimes" in your question?

Q. Yes.

A. Yes, then the answer is yes.

Q. Okay. Is it consistent with your economic opinions that JEDEC would prefer evolution over revolution?

A. Again, you've left out "other things equal." A sufficiently large gain in performance is going to lead to a preference for revolutionary, and an inadequately

7695

large gain in performance would prefer evolutionary. So –

Q. Okay, thank you.

Let's pull up DX-132, if we could. I showed you this yesterday, Professor McAfee, and I just want to bring you back to it for a moment.

We talked about the sources of technology and I believe agreed that sometimes the technology can come from DRAM manufacturers, sometimes it could come from technology providers, such as Rambus, and it might on some occasions come from someone like Intel, correct?

A. I don't believe we restricted it to that set, but those were members of the set.

Q. Okay. And in the context where the technology is provided to the manufacturers by independent technology providers such as Rambus, they -- there's a price to be charged for that technology, correct?

A. Can I ask you to repeat your question or –

Q. Sure.

Just as a matter of economics, when a technology provider that is independent provides the technology to a company that is a manufacturer, you would expect there to be a price for providing that technology.

A. I would expect a price, yes.

7696

Q. Okay. And in the context of the work you have done in this case, it would be consistent that the price might be measured as a fixed fee plus a royalty, and it also might be measured in other ways.

A. That's correct.

Q. When the technology is provided internally -- that is, when a manufacturer develops technology and provides it to itself -- does the manufacturer in that case realize benefits from doing so even though it may not be actually paying a price?

A. Does it realize benefits from what?

Q. Developing the technology and making it available to itself.

A. Yes.

Q. And does the measure of those benefits depend in part on whether it can charge a price to others for the use of the technology?

A. If it is able to charge a price to others, it would benefit insofar as it collected revenue from others; that is, the company that had the technology would benefit insofar as it collected revenue from others.

Q. And can the company also realize the benefits of the technology it has developed through obtaining a lead in manufacturing; that is, getting a time

7697

advantage? Let me rephrase it. That seems to be not a well-framed question. Let me try again.

Are there ways in which a vertically integrated manufacturer can realize economic benefits from its internal development of technology other than by charging a price to other companies for the use of the technology?

A. Well, we've already spoken about they might use it in their own operations, and so, yes, they could have an advantage in using it in their own operations, but -- and -- but we had already spoken about that. Are you asking me about yet another kind of advantage?

Q. Let's start with just confirming that one way they could realize an economic advantage is by the use of the technology.

A. Yes.

Q. Could they also realize an economic advantage if they were able to patent the technology by using it in cross-licensing negotiations?

A. I expect that -- well, at least in principle -- I'm sure there are circumstances where companies have used technologies that they have developed to gain an advantage in cross-licensing arrangements in a way that was advantageous to the company. In fact, I think Mr. Appleton testified approximately to that in the case of

7698

Micron, if I understood the question properly, which I think I did, but --

Q. Okay. And I'm asking you simply as a matter of economics -- I'm not asking you to remember Mr. Appleton's testimony specifically or not or agree with it or not -- but just as a matter of economics, is there economic value in obtaining patents on internally developed technology because they give you benefits in licensing or cross-licensing negotiations?

A. Yes, and in fact, I think my book discusses examples of this as well.

Q. And are there also benefits to patenting internally developed technology in that you may thereby be able to prevent others from utilizing it?

A. Yes, in principle. Again, not -- it's not always the case, but in principle, that's correct.

Q. Okay. And are there economic advantages in being able to participate -- let me strike that.

Are you familiar as a matter of economics with patent pools?

A. Yes, but I've made no special study of them, but I'm at least somewhat cognizant of them.

Q. Okay. And is one of the benefits that may be realized by a company that internally develops technology and patents is that it is able to thereby

7699

gain admission, if you will, to a patent pool?

A. In principle.

JUDGE McGUIRE: All right, now, for the Court's own edification, I need some explanation as to what constitutes a "patent pool."

MR. STONE: Certainly.

BY MR. STONE:

Q. Professor McAfee, subject to the qualifications you provided us earlier, would you provide us a general description of a patent pool?

A. Companies may in some sense join together or agree not to -- to allow each other's intellectual property to be used by all the members of the pool, and that way they eliminate threats of lawsuits and the -- well, I want to charge you this for this, you charge me that for that and that sort of thing. That's my understanding of a patent pool, but this is not something I've made a specific study of.

JUDGE McGUIRE: That's all right, that's good enough. That gives the Court some context to the question.

MR. STONE: Thank you, Your Honor.

BY MR. STONE:

Q. Let's go back, if we can, to DX-147.

Again -- and I am going to ask you simply to

7700

confirm an assumption that I think we talked about yesterday -- you have assumed that JEDEC will not include patented technology in standards it adopts without, at a minimum, first being given a RAND letter or RAND assurance. Is that correct?

MR. ROYALL: Your Honor, I would object to this as asked and answered now several times. I don't see the point in going back over it.

JUDGE McGUIRE: Sustained.

BY MR. STONE:

Q. Let me just go to the next question, then, Professor McAfee.

Have you, for purposes of your economic opinions, considered whether a rule that prohibits the use of patented technology in a standard unless a RAND letter or assurance has first been given is illegal?

MR. ROYALL: Objection, Your Honor, calls for a legal conclusion.

MR. STONE: Does not, Your Honor.

MR. ROYALL: Well, the word "illegal" certainly suggests it does.

JUDGE McGUIRE: Just a second.

I am going to have to uphold that objection. It does call for a legal conclusion.

MR. STONE: Let me rephrase.

7701

BY MR. STONE:

Q. As a matter of economics, you have considered external restraints on behavior, correct?

A. The -- I don't know what -- the phrase "external constraints on behavior" means something to me, but I'm just concerned that it may mean something different to you, because it's just an odd choice of phrase. I mean, I think of things like budgets as being external constraints on behavior, and yes, we do consider the effects of that kind of external constraint on behavior.

Q. And -- and -- I'm sorry, did I interrupt you?

A. And laws, lots of things are external constraints on behavior. So, yes, we do consider them.

Q. Okay. And one of the things economists consider is that laws from time to time impose constraints on behavior, correct?

A. Yes, economists do consider that on occasion. In fact, there's an entire area of economics called law and economics which studies the interaction of the two.

Q. Okay. And have you for purposes of the opinions you've formed here considered whether there are any legal constraints that would prevent JEDEC from prohibiting the use of patented technology in standards unless a RAND letter or RAND assurance has been

7702

received?

A. I'm sorry, I need that read back.

JUDGE McGUIRE: Could the court reporter please read that question back?

(The record was read as follows:)

"QUESTION: And have you for purposes of the opinions you've formed here considered whether there are any legal constraints that would prevent JEDEC from prohibiting the use of patented technology in standards unless a RAND letter or RAND assurance has been received?"

THE WITNESS: I have not considered whether there are -- there's a legal prohibition. In fact, I

think I stated that I assumed JEDEC was requiring such a RAND letter, and so I did not consider whether there was a law that would have prohibited JEDEC from actually making that requirement.

BY MR. STONE:

Q. If there were a law that prohibited JEDEC from imposing such a requirement, would that impact your conclusion?

MR. ROYALL: Your Honor, I think this question does inherently ask for a legal conclusion.

MR. STONE: No, I --

JUDGE McGUIRE: Overruled. I don't think it

7703

does.

THE WITNESS: Well, it would -- as I understand the question, that is, there's a law prohibiting one of my assumptions. That would mean my assumption was violated, and hence, it could have an impact on my conclusion, because I had assumed that JEDEC would -- well, at least the conclusions that depend on JEDEC's requirement of the RAND letter, which in particular we use in exclusionary conduct conclusions, it would have an impact, yes.

BY MR. STONE:

Q. In the course of your work in connection with this case, you have been provided information by complaint counsel, correct?

A. Yes.

Q. Did they provide you with any information regarding a case that the FTC brought challenging a standard-setting organization's policy of refusing to include patented technology in their standards?

A. I don't recall any such evidence. I did review a very large volume of evidence, and there could have been something in there that I'm just not recalling as I sit here today, but I do not recall such evidence.

Q. Okay. One of the things you've told us that you have done in the course of your work is to try to

7704

check your assumptions to some extent, correct?

A. Yes.

Q. And I want to ask you about this assumption that JEDEC would not allow patented technology to be included in a standard without receiving a RAND letter or RAND assurance in terms of the factual checking you've done. That's the focus of my question.

If we could turn to Exhibit RX-1211, if we might, and Your Honor, may I approach and --

JUDGE McGUIRE: Yes.

BY MR. STONE:

Q. I'm directing your attention to what's been marked as RX-1211, which is a JEDEC publication, JEP21-H, and I want to ask you to turn, if you would, Professor McAfee, to the last page, page 20 of this document, and I'm going to direct your attention specifically to the third paragraph under the heading Notice.

You'll note here that it says -- and I really am focused just on the first sentence -- "JEDEC Standards are adopted without regard to whether or not their adoption may involve patents on," I think it should read instead of or, "articles, materials or processes."

Do you see that sentence?

7705

A. I do see that sentence.

Q. Is that sentence -- and I know I'm asking you to look at it alone -- but is that sentence consistent with the assumption you have made about JEDEC's prohibition on the inclusion of patented technology unless a RAND letter or RAND assurance has been provided?

A. I don't understand this sentence to be inconsistent. It certainly is not corroborative or supportive, but I don't understand it to be inconsistent in -- but it's not very specific, and so it's not corroborative of my understanding of the JEDEC rules.

Q. It makes no mention of any requirement of a RAND letter or RAND assurance before patented technology is included, does it?

A. It does not.

Q. Did you assume for purposes of your work in this case that when JEDEC did adopt the SDRAM standard

that we've talked about, that products manufactured in accordance with that standard would not infringe any patents?

A. As I understand your question, my assumption is actually that when products were manufactured would violate Rambus patents. So, yes, I did assume that

7706

they would violate patents, just not that that was generally known.

Q. Let me reframe it. Undoubtedly my fault again.

Did you assume that when JEDEC adopted the SDRAM standard, that JEDEC believed that products manufactured in accordance with that standard would not infringe any patents?

A. No. In fact, my understanding is there are basically semiconductor patents held by TI that -- in order to manufacture any kind of basic semiconductor device, and there may be other such patents that would apply essentially to any kind of semiconductor manufacture.

Q. Okay, let me see if I can take that into account in framing my question.

Did you assume for purposes of the opinions you have expressed in connection with this case that when JEDEC adopted the SDRAM standard, it believed that products manufactured in accordance with that standard would not infringe any patents that would apply to SDRAMs specifically but not to all semiconductors?

MR. ROYALL: Your Honor, could I ask for clarification in questions like this that when Mr. Stone is referring to JEDEC, he's referring to all members collectively or some kind of clarification so

7707

we know --

JUDGE McGUIRE: Could you clarify that, Mr. Stone?

MR. STONE: Certainly, Your Honor.

BY MR. STONE:

Q. Referring you back, Professor McAfee, to the discussion we had earlier today about the median voter model as modified to some extent to describe JEDEC's behavior --

A. Um-hum.

Q. -- that it is in that sense, the collective decision-making process of JEDEC, as you have modeled it, that I refer to when I say "JEDEC." Does that make sense to you?

A. Okay.

Q. Okay. With that clarification, do you need me to restate the question?

A. No.

Q. Okay.

A. I haven't assumed one way or the other about whether there were other patents that were picked up by

SDRAM. As I understand the question, I might have posed it as were the patents not involved in EDO, for example, that were involved in SDRAM, that's a -- I'm clarifying the question by posing it that way. I'm not

7708

aware of any such patents, but it was not important to my -- to my opinion.

Q. If there were patents that JEDEC was aware of that applied to SDRAM and not to EDO, and if JEDEC did not request RAND letters or RAND assurances with respect to those patents, would that have an impact on your opinions?

A. Well, it would certainly have an impact on the assumption that JEDEC requires a RAND letter, and tracing that through, it would then have an impact on the opinions that arose based on my understanding that JEDEC requires a RAND letter. So, potentially, although what you've described is actually something that was factual that I didn't assume one way or the other, but it would have an impact on my -- on the credibility that I place on one of my assumptions.

Q. Okay. And the assumption whose credibility it might cast doubt on would be the assumption that JEDEC would insist on a RAND letter or RAND assurance before it would include patented technology in a standard, correct?

A. As I -- I understood your question to ask me what if there were other patents that they didn't ask a RAND -- request a RAND letter for, yes, it would -- it would raise red flags on that hypothesis -- on that

7709

assumption.

Q. Did you consider as part of your factual assumptions that JEDEC was aware when it adopted the SDRAM standard that Motorola had a patent that applied to SDRAM?

A. As I sit here today, I vaguely recollect something about a Motorola patent, but I don't actually remember the details, and so I just don't recall.

Q. And did you as part of the assumptions you made assume that JEDEC was aware that Hitachi had a patent that applied to SDRAMs that was known to JEDEC at the time the SDRAM standard was adopted?

A. Again, I don't recall the specifics. I think I've already testified that I don't recall any patent -- I didn't recall any patents that applied to SDRAM and not to EDO, and I just don't -- I don't recall anything further about that.

Q. Let me just see if I might -- no, I won't do that.

Let's move to DX-154, if we could bring that up.

You used a power plant and a coal mine as an example of hold-up in your testimony I believe a couple days ago, correct?

A. Yes.

7710

Q. And you showed an example -- I think it's on DX-154 -- on how if a contract was signed after the plant had been built, the coal costs $20 a ton as contrasted with the example you showed on DX-155 -- if we can bring that up -- which was the contract being signed before the plant was built and the cost being $10 a ton, correct?

A. I recall that testimony.

Q. As a matter of economic theory, there is a certain increase in the price of coal that would cause the power plant to stop buying coal and shut down, correct?

A. That's correct.

Q. And in economic terms, how do you describe that price increase?

A. Well, one term for it is the choke price.

Q. And can you relate that to -- is that related to marginal costs, average costs?

A. The plant shuts down when its output prices reaches its average variable costs. As I sit here today, I'm not able to recollect the term of what input price causes the plant to shut down, but it shuts down when its output price reaches the average variable costs.

Q. So, if its average variable costs go up to

7711

where they hit the output price, that would shut it down?

A. That would shut it down, yes.

Q. And the solution -- one of the solutions you talked about in the context of the coal example was to enter into a long-term contract --

A. Pardon me, I need to amend my previous answer.

That's the Principles of Economics 101 version of the story; that is to say, a plant shuts down when the price reaches the average variable cost, but option values actually amend that answer and complicate it, so that is to say, if there -- if there are, say, for example, sunk costs associated with shutting down or costs associated with restarting the plant once it's shut down, then the decision won't be at that point, but yes, the first path of the decision is that point. I'm sorry to be pedantic about this, but this is something that I teach.

Q. That's all right, I just need a moment to read the answer again, if I can. Okay.

And one of the ways you testified that the scenario you've described as hold-up can be avoided is by signing a long-term contract before the plant is built.

A. That is correct.

7712

Q. And of course, there are inherent problems that you've written about and others have written about with long-term contracts.

A. That's correct.

Q. Which may impose costs on one party or the other that they didn't anticipate.

A. For example.

Q. Okay. And of course, in your hold-up example, one other constraint on the price that could be charged by the coal mine is the cost of transporting coal from a more distant mine to this location.

A. That's -- yes, that's correct.

Q. Okay. Now, directing you back to the technologies at issue here, DRAMs, you would expect as a matter of economics, wouldn't you, that DRAM manufacturers, in considering whether to develop processes to manufacture RDRAM or SDRAM or SLDRAM,

would make some assessment of the costs and potential revenues to be realized from each of those decisions?

A. I would.

Q. And as a matter of your understanding of the DRAM industry, you understand that some companies chose

to develop the capability to manufacture not just SDRAM, but also RDRAM.

A. I do understand that companies developed the

7713

capability not just for SDRAM and RDRAM, but explored even other technologies.

Q. Such as SLDRAM, for example?

A. For example.

Q. Okay. And you also would agree, would you not, that the DRAM industry has many examples of firms developing the processes to manufacture particular DRAM products that they don't ultimately then produce in high volume?
A. I'm sorry, I --
Q. Sure, let me just -- I'm trying to ask --
A. It's not the complexity. It could just be read back, I think.
JUDGE McGUIRE: All right, court reporter, could you please read that back?
(The record was read as follows:)
"QUESTION: And you also would agree, would you not, that the DRAM industry has many examples of firms developing the processes to manufacture particular DRAM products that they don't ultimately then produce in high volume?"
THE WITNESS: I don't know about many, but several certainly.
BY MR. STONE:
Q. Could we look at DX-160 for some context here.

7714

For purposes of your economic opinions that you've expressed in connection with this case, you made certain assumptions about the size of specific investments, correct?
A. Yes.
Q. And those would be the investments that would be specific to a particular choice of technology, correct?
A. That's correct.
Q. And they include things such as the design costs associated with that particular technology, correct?
A. They do.
Q. And the development of masks peculiar or unique to that technology?
A. That's correct.
Q. And any testing or qualification processes unique to that technology as well?
A. Those are included.
Q. Are there other categories of costs that you have included in these specific investments that are related to a choice of a particular DRAM technology?
A. Yes, there are costs -- the same kinds of costs associated with other components that work with the DRAM.

7715

Q. So, that would be costs associated with memory controllers, motherboards, chipsets and BIOS?
A. For example.
Q. And would you agree as a matter of your economic analysis that the costs we have just described as specific investments are incurred in either greater or lesser amounts, but the same category of costs are incurred when a change is made from SDRAM to DDR?
A. Well, so, my understanding is that when you go from SDRAM to DDR, minimizing those kinds of costs is part of the design problem faced in choosing DDR.
Q. But the same -- but the category of costs are still incurred. Is that correct?
A. The category are incurred, yes.
Q. Okay. And the category of costs, again, in greater or lesser amounts, also are incurred when you make transitions from, for example, PC100 SDRAM to PC266 SDRAM. Is that your understanding?
A. Yes, again, the category are incurred, although my understanding is that the size of those costs are -- are substantially less than, say, going from EDO to SDRAM.
Q. And in determining the size of the costs, what you have done is relied on information that you've been provided by others, either through the trial testimony,

7716

deposition testimony or your interviews or documents you've read. Is that correct?
A. Ultimately -- yes, I'm not the original source of any of the data.
Q. And have you taken the data that you've received from others and prepared any sort of quantification of the costs by category for different transitions from one technology to another?
A. I did not -- yes, I did not. Sorry.
Actually, when you reach a convenient stopping point, I would like to use the restroom.
Q. Now would be fine.
JUDGE McGUIRE: Well, I guess this is a good time. Let's take a ten-minute break.
(A brief recess was taken.)
JUDGE McGUIRE: Back on the record.
Mr. Stone, you may proceed.
MR. STONE: Thank you, Your Honor.
BY MR. STONE:
Q. Could we bring up DX-223? I guess I don't really need the DX for the purposes of this question, but maybe it's helpful to put it in context.
Did you assume one way or the other or not assume at all whether the costs the DRAM manufacturer incurs in changing from one process technology to

7717

another are greater than the costs that a DRAM manufacturer incurs in changing from one interface technology to another?
A. The costs of changing a DRAM standard -- I'm sorry, I am going to need that hear that again.
Q. Certainly. Let me try to back up a little bit.
One of the things you talked about as part of your opinion is that there would be costs that would be incurred if JEDEC chose to change its standards to eliminate the four Rambus technologies that you have talked about, correct?
A. That's correct.
Q. And in assessing those costs, you haven't, again, done any quantification of those, have you?
A. Well, I haven't added them up. I mean, I have seen -- I have certainly seen numbers in the record, but I haven't added them up.
Q. Okay. And have you, for purposes of forming your opinions, considered whether the difficulty of -- let me back up and start again.
Would you agree that the costs of removing those four technologies is equal to or less than the cost of changing from an interface technology such as SDRAM to an interface technology such as RDRAM? Is that one of the assumptions you've made?

7718

A. The cost of removing the four technologies -- the question is would the cost of removing the four technologies be less than switching from SDRAM to RDRAM? My understanding is that the answer to that is yes.
Q. And is it your understanding or have you made an assumption -- and if not, that's fine -- that the costs associated with changing from one process technology are greater than the costs of changing from one interface technology to another?
A. What's the -- what specifically do you mean by a "process technology"?
Q. All right, you are familiar with the manufacturing processes that are often referred to in terms of the number of microns?

A. Yes.
Q. Okay. Have you assumed one way or the other or not assumed at all that the costs of switching from one process technology to the next are greater than the costs incurred in switching from one interface technology to another?
A. So, my understanding is that the costs of changing an interface technology tend to be greater because they're -- at least their total costs, because they are industry-wide, they include all the other

7719

components, whereas the cost of a die shrink is pretty much within the manufacturer and does not spread out through the rest of the industry.
Q. Would it be inconsistent with the assumptions you have made if the facts turned out to be that the costs of changing from one process technology to another are greater than the costs of switching from one interface technology to another?
A. Well, the costs to whom, the total industry costs or the costs to the manufacturer?
Q. Fair point.
Would it be inconsistent with the assumptions you've made if the facts turned out to be that the costs to a DRAM manufacturer of switching process technologies were greater than the costs of switching interface technologies?
A. No, I've made no assumption about the costs of the process technology, so it wouldn't matter if that was more or less.
Q. In your understanding of the DRAM industry, how often are process technologies changed?
A. Eighteen months, two years, something in that neighborhood.
Q. If we could bring up 226.
One of the things you spoke about yesterday, I

7720

believe, were barriers to entry, and DX-226 was a demonstrative you used in connection with that, correct?
A. That's correct.
Q. Let me ask you about scale. Does the scale factor apply to a new entrant in the technology market?
A. You know, I don't know the answer to that. It's an interesting question, but I don't know the answer to it.
Q. Were the barriers to entry that you talked about yesterday --
A. Actually, can I add one more thing to my answer?
Q. Certainly.
A. There's certainly the cost of developing technologies that -- there are certainly some scale economies to developing technologies, so I think the answer to the question is actually yes, especially if you want to test the technology -- that is to say, you want to see how it implements -- and you would actually need to have some kind of silicon manufacturing facilities, and that would actually create quite a scale economy. The -- yes, so I think there was probably a scale economy in the technology markets.
Q. When you talked yesterday about barriers to

7721

entry and used DX-226 to help illustrate your testimony, were you referring then to barriers to entry in the DRAM manufacturing business?
A. When I used scale, I was referring to the DRAM manufacturing business.
Q. And when you used sunk costs, were you referring to the DRAM manufacturing business?
A. Yes.
Q. And when you used strong learning curve, were you referring to the DRAM manufacturing business and the manufacturing of related components?
A. Yes.
Q. Let's go to DX-160, if we could, again. Let me direct your attention to the fourth bullet point, the ease of reaching agreement.
One of the things you testified to was it's difficult for JEDEC to adopt standards which would eliminate the four Rambus technologies because 50 percent, roughly, of the manufacturing capacity is licensed and 50 percent is not, correct?
A. That's -- approximately, that's my understanding, yes.
Q. Hypothetically, I want you to assume that the entire industry had been offered a license on the same terms and that 50 percent of the industry accepted the

7722

license and 50 percent of the industry rejected the license, went ahead to manufacture the products, infringing the patents.
If that scenario occurred hypothetically, would you have the same difficulty in reaching agreement about a new standard that you testified to yesterday?
A. Yes.
Q. Don't all of the manufacturers have an interest in developing standards which will be less costly in terms of the payment of royalties?
A. If we're referring to the question of the ease of reaching agreement, so that this is something that is an ex ante/ex post question, there are issues in my mind, and your question doesn't specify that.
Q. Okay. Assume the situation where 50 percent of the market has taken a license and 50 percent has rejected the license, and an organization that includes all of them as members is confronted with the question of whether to adopt a standard which removes the infringing features. Can you assume that?
A. Yes.
Q. Wouldn't all of the manufacturers, those that are paying royalties and those that are in litigation, have an interest in seeing a standard developed that did not incorporate the patented technologies?

7723

A. The answer is not necessarily, and it depends on other unspecified hypotheses.
Q. Okay. And have you made a study in the circumstances of this case as to whether the interests of the 50 percent that are licensed and the 50 percent that are not licensed are all consistently in favor of adopting a standard that eliminates the patented technologies?
A. I have actually investigated this question, but I have not reached a conclusion on that question; however, that does not overturn my conclusion that it would nonetheless be a challenge given the differences.
Q. And that challenge -- let me strike that.
Let's pull up DX-158.
You've testified previously about various mechanisms that an organization might take to reduce the risk of hold-up ex ante, correct?
A. Yes.
Q. And you have testified to that as a matter of economics?
A. Yes.
Q. Let me ask you about it as a matter of economic theory, if I might.
The first bullet point on DX-158, IP disclosure commitments, as a matter of economics, you said if we

7724

can tell everyone who participates in the standard-setting process that they need to disclose whatever the pertinent intellectual property is to us, that would be one way to mitigate the risk.
A. Yes.
Q. And you mitigate the risk most completely if you tell every company that they have to tell you about all of the IP they have.
A. All of the relevant IP, yes.
Q. All of the relevant IP.
And the mitigation you achieve is less if you limit the disclosure obligation simply to the knowledge of the representative at the meeting.
A. That's correct.
Q. And if some companies are very large and have many employees, there might, as a matter of economics, be a lot of knowledge that is not held by the representative with respect to relevant IP.
A. That's correct.
Q. Similarly, if you're a company that does most of its research and development in another country and if your representative to the organization is not part of the same location or even in the same country where the research is done, they might have less knowledge than the company as a whole.

7725

A. I'm not sure I see what the other country has to do with it, but if the representative was not part of the research effort or not connected to the research effort of the company, the representative might not know as much as one of the researchers knew.
Q. Okay. It's also true, is it not, that this disclosure provision that might mitigate the risk would not extend to intellectual property held by persons who were not members.
A. That's correct, as I understand the question, which is to say does this protect you from intellectual property of non-members, no.
Q. So, there would be economic motivation for a standard-setting organization to search in some fashion for intellectual property that might bear on its standards that it otherwise would not expect to know about.
A. There would be a benefit to that.
Q. And as you testified earlier, there is a cost associated with being provided with incorrect information.
A. Generally, yes.
Q. And is it also correct that if the disclosure is expected at a very early stage of a standard-setting process, that there are costs associated with having to

7726

deal with a higher number of disclosures because there's more -- different technologies being considered? That's not clear. Let me see if I can draw a picture.
If we assume the funnel that you talked about yesterday, and if at the beginning of the process there are five technologies under consideration, and if as we go forward that narrows down to three and then to one, there are costs associated with requiring some disclosure of pertinent intellectual property at the point in time when there are five technologies proposed that are greater than the costs when there are just one, correct?
A. I'm not sure I agree with that proposition, and it depends on the nature of the winnowing process. It may be that if it's easy to project some of the alternatives just because someone says, well, there's IP on this particular alternative, you've actually had a net savings in the deliberation costs, and so I -- I'm not testifying that that's always the case. It's, rather, that it's not clear to me one way or the other which is the expedient way to do the winnowing process.
Q. I appreciate that answer. Let me see if I can clarify my point.
It could vary from organization to organization

7727

whether there was a net benefit in requiring disclosure early as opposed to waiting and imposing an obligation to disclose later.
A. Absolutely.
Q. Okay. Have you performed any analysis of which -- have you performed any analysis of JEDEC's actual costs and benefits in an effort to determine what would be the economically efficient disclosure standard for it to impose?
A. No.
Q. You recognize, don't you, that many standard-setting organizations have struggled with the various trade-offs that we have just talked about in brief?
MR. ROYALL: Your Honor, I would object to this question. Mr. Stone himself as objected a number of times that I'm aware of when any questions have been raised about other standard-setting organizations.
JUDGE McGUIRE: Sustained.
BY MR. STONE:
Q. In the course of forming your economic opinions, have you given any consideration to whether the assumptions you have made about JEDEC's policies regarding disclosure are the economically most efficient policies it could have selected?

7728

A. I have not investigated the efficiency of JEDEC's procedures and rules.
Q. Have you formed any opinion as a matter of economics one way or the other as to whether were an organization to require disclosure of patent applications, that procedure would be economically beneficial or not?
A. Well, I think as I testified, these have been – all of these disclosure requirements that were on the slide which is now off the projector, which could be done to various degrees, they have costs and benefits, and as I understand the question you've just asked me, yes, I'm aware of costs and benefits to these, and I haven't actually tried to -- attempted to perform any kind of cost-benefit analysis for JEDEC's -- the design of JEDEC's rules.
Q. Okay. Let me ask you about the testimony you gave yesterday, which I think was in your considered judgment, Rambus might have issued a RAND letter if it had been requested to do so. Is that a fair summary of that line of testimony?
A. It might have. I guess that's why I explored both branches of the tree, as to -- I didn't come to the conclusion that it would not have. That was actually what I judged to be more likely, but -- but it

7729

might have.
Q. I want to ask you about that. Bring up, if we could, DX-234.
You used DX-234 to illustrate some of your testimony about the reasons why your considered judgment was that it would be more likely that Rambus would not issue a RAND letter than that it would, correct?
A. That's correct.
Q. As a matter of economics, when the question was posed as to whether or not to provide a RAND letter,

you would assume, would you not, that whatever knowledge JEDEC had about alternatives to the use of the Rambus technology would also be known to Rambus?
A. Well, most of them. I don't know about all of them, but generally that would be my starting point.
Q. And one of the risks that Rambus would need to consider in deciding whether or not to issue a RAND letter is whether or not JEDEC would adopt a non-infringing alternative technology, correct?
A. That would be one of the things they would consider.
Q. And in that regard, as a matter of economics, do you assume that their calculation of that risk would be the same as what JEDEC's calculation of that risk

7730

would be?
A. I wouldn't assume it was the same, but I would probably assume what's known as an unbiased -- that it was unbiased, which is to say if it's different, it's not different in any particular direction. It's just there may be -- it may be different, but correct on average -- or it's the same on average rather than correct.
Q. If Rambus had been requested to provide a RAND letter or RAND assurance and if it had concluded that in the event it did not it would be likely that JEDEC would adopt competing or alternative technologies that were not infringing, there would be economic benefits to Rambus in giving a RAND letter, correct?
A. Well, there -- again, it -- there would be costs and benefits in giving a RAND letter, but you're now asking me about the heart of why I was unable to determine that it would not issue a RAND letter.
Q. And so let me just -- I'm asking you not about net benefit or net costs at the moment. I'm trying to identify that both exist.
At the time -- let's assume hypothetically, as you have, that Rambus was asked for a RAND letter, and if there was a risk that noninfringing alternatives might be adopted by JEDEC, there would be some benefits

7731

to Rambus in providing a RAND letter, correct?
A. Yes.
Q. And as a matter of economic theory, there might be costs to Rambus in providing a RAND letter, correct?
A. There might be costs.
Q. And the costs would be, in terms of categories, what?
A. Well, the costs of issuing a RAND letter are things that are listed on this slide, in particular that it -- not issuing a RAND letter might help RDRAM succeed by delaying the JEDEC standard-setting process. It would -- by not issuing a RAND letter, they would -- if the technology were still to be adopted, Rambus would then be able to charge what it wanted to discriminate and so forth. So, there would be these sorts of considerations.
Q. But as to the latter consideration, haven't you assumed that the technology would not be adopted if Rambus refused to provide a RAND letter?
A. I do not think the technology -- yes, I have assumed the technology would not be adopted, at least in this -- in this context.
Q. So, for purposes of your economic opinions here, the only cost to Rambus of issuing a RAND letter would be that they might not obtain some benefit for

7732

the future success of RDRAM.
A. Well, I guess the way I tend to think about this is I rarely think of anything as certain, and I think about this in terms of probability. So, when I say that JEDEC wouldn't include the IP, I mean it's -- that's their requirement. Is there no chance that there would be infringement? I don't make that -- I don't draw that conclusion, that is to say, particularly.
There might be another patent that's held by Rambus that is not one of the four technologies which is then infringed. This has also gone beyond my -- it's now -- it strikes me as it's going into facts rather than -- and legal opinions even, which I'm not trying to draw, but I guess the full answer to your question is is that I tend to think about these things as being probabilistic rather than certain, and that means there may be small advantages just on the -- on other branches of the tree that aren't actually listed on the slides.
Q. And I'm trying not to call for legal conclusions or even fact issues. I'm only trying to call for your economic opinions. I may not always succeed in asking the question that way, but that's my goal.

7733

As a matter of economic opinion, have you formed an opinion as to whether it would have been in Rambus' economic interest to issue a RAND letter if it had been requested to do so?
A. I'm not in a position actually to make that determination, and if I thought it was really in Rambus' interest to issue a RAND letter or fully -- that is to say, it was decidedly in their interest to issue a RAND letter, then I would have testified that I felt that were the likely outcome, but I -- I -- this involves a lot of trade-offs in the sense of what's the likelihood that RDRAM succeeds in being the dominant memory, what's the likelihood that JEDEC standards infringe. I'm not in a position to assess those probabilities as of the time that's relevant for this assessment, and so I can't say one way or the other.
Q. Once it became well known to JEDEC that Rambus claimed that it had patents which covered products manufactured in accordance with JEDEC's standards, was -- as you understand the policy and as you have assumed it -- JEDEC required to then request a RAND letter or RAND assurance from Rambus?
A. You mean in the year 2000?
Q. The year 2000 would be fine for purposes of that question.

7734

A. I don't know what JEDEC -- the JEDEC process or rules require. The testimony that I -- again, this is a fact issue, I think, that I haven't needed to rely on or needed to assume. The testimony, I think, said that -- well, once it was -- once there was litigation going on, we don't actually get involved, though that's a paraphrase, but I didn't need to assume one way or the other about what happens at that point in time. That was after the period that I was -- on which I was focusing.
Q. Your period ended in what year?
A. Well, I mean, my -- my --
Q. I'm sorry, let me be more clear in my question.
The period of time that is the subject of your expert opinions starts when and ends when?
A. Well, it depends on which issue we're discussing, but with respect to exclusionary conduct, which is this set of slides, the -- the period I was focusing on was prior to Rambus' departure from -- from JEDEC, so prior to 19 -- well, prior to June 1996.
Q. Let me --

A. I certainly wouldn't -- just to clarify, I certainly was not considering the issuing of a RAND letter much later, in a much later period, and what the consequences of that might have been.

7735

Q. Okay. The -- we talked yesterday about the dates for SDRAM and DDR SDRAM on which you would have expected a negotiation to occur, but I want to be clear about the DDR SDRAM ex ante negotiation, if I might.

Is it your -- is it part of your opinion that the hypothetical ex ante negotiation that would have occurred with respect to DDR SDRAM would have occurred before or after Rambus sent its formal letter of withdrawal to JEDEC in June of 1996?

A. My hypothetical is that at the time that the technology was being -- so, let me remind myself of the hypothetical. The hypothetical is Rambus has disclosed. At the time of the disclosure -- the disclosure occurs when they're discussing the relevant technology, so it's the dual edge clocking. At the time of the disclosure, when they're discussing dual edge clocking -- actually, so that's an interesting question.

I wouldn't have expected the disclosure -- the negotiation to occur until they reached a point where they were considering actually incorporating dual edge clocking into the standard, and that might have happened after Rambus had already left.

Q. Okay. In any event, any analysis we make today of how the negotiation would have occurred in the past

7736

is something that economists struggle with in various contexts from time to time, correct?

A. That's correct.

Q. And in the patent context, for example, economists often are called upon to express their opinion as to what a reasonable royalty would have been had a negotiation occurred at an earlier point in time.

MR. ROYALL: Objection, Your Honor, that he has any foundation to say what economists are asked to do in the patent context.

MR. STONE: Let me reframe.

JUDGE McGUIRE: Restate.

BY MR. STONE:

Q. Are you familiar with the economic methodology utilized in determining how patent licenses would be set at hypothetically earlier points in time than any actual negotiation occurred? Oh, that's a terrible question. I am going to withdraw that.

JUDGE McGUIRE: You know, I have heard worse from you, Mr. Stone.

MR. STONE: Well, I'll try not to let it happen again.

BY MR. STONE:

Q. Professor McAfee, let me ask it this way: You are familiar with the fact that patent litigation

7737

occurs.

A. I am familiar with that fact.

Q. And you are familiar with the fact that in the context of patent litigation, courts are often called upon to decide what a reasonable royalty would be.

A. Yes, but you're reaching the limit of my knowledge.

Q. Okay. Have you as an economist ever looked at the question of how you would determine what a reasonable royalty would be based upon a hypothetical negotiation that occurred at an earlier point in time?

A. The answer is yes, but I haven't -- it's quite recent, but I have not attempted to apply it to this case -- what I learned to this case.

Q. Okay, but you're familiar -- are you familiar that there's sort of an established methodology, sometimes referred to as the Georgia Pacific methodology, for making such a determination?

A. I have seen reference to that.

Q. Okay.

Your Honor, at this time I need to go to some of the in camera information, and I am going to work on my questions, as well.

JUDGE McGUIRE: Okay, and I'm just kidding.

MR. STONE: I understand.

7738

JUDGE McGUIRE: I have heard bad questions from both sides.

All right, again, to those in the audience, by prior court order, it's been determined that the evidence we are about to take on the testimony is confidential, and as a consequence, this part of the hearing will be closed to the public. So, I'll ask all of you in the audience that are not otherwise cleared to have access to this information to please vacate the courtroom, and I'll ensure that you're advised when we're done with this portion of the proceeding.

UNIDENTIFIED SPEAKER: Your Honor, I just wondered if you had any idea whether that would be before or after lunch.

JUDGE McGUIRE: I'm sorry, sir, what was your question?

UNIDENTIFIED SPEAKER: I was wondering whether the in camera session would go beyond the lunch hour.

MR. STONE: It will not.

JUDGE McGUIRE: Do you have some idea, Mr. Stone, how long that will last?

MR. STONE: I think 30 minutes will be a fairly accurate estimate. It could be a bit less.

(The in camera testimony continued in Volume 37, Part 2, Pages 7823 through 7848, then resumed as

7739

follows.)

MR. STONE: No further questions, Your Honor.

JUDGE McGUIRE: Okay, very good. It's ten until 12:00. I guess this would be a good time then to break, unless, Mr. Royall, you wanted to proceed with your questioning. I have no idea how much time you're going to be spending on this witness.

MR. ROYALL: I do think breaking now might help me to assess that. I don't think I'll need to go too long, but I could see it taking an hour and a half maybe.

JUDGE McGUIRE: Well, then --

MR. ROYALL: Please don't hold me to it. My estimates haven't been so accurate in the past.

JUDGE McGUIRE: It's ten to 12:00. Why don't we return back at quarter after 1:00. Hearing in recess.

(Whereupon, at 11:50 a.m., a lunch recess was taken.)

7740

AFTERNOON SESSION

(1:15 p.m.)

JUDGE McGUIRE: This hearing is now in order. Complaint counsel at this time may proceed with its

inquiry of the witness.
MR. ROYALL: Thank you, Your Honor, and my intention is -- I have just a few things to cover that are also in camera, and so my plan was to try to do that first, if that pleases the Court, for a few minutes and then open it up.
JUDGE McGUIRE: How much time do you anticipate that will take, Mr. Royall?
MR. ROYALL: I would think, at most, ten minutes.
JUDGE McGUIRE: Again, to the audience, we are about to hear in camera testimony, and if you can vacate the courtroom and I'll advise you about when you're free to come back.
(The in camera testimony continued in Volume 37, Part 2, Pages 7849 through 7869, then resumed as follows.)
REDIRECT EXAMINATION (cont.)
BY MR. ROYALL:
Q. Can we pull up DX-240?
Do you recall this slide, Professor McAfee,

7741

from your testimony earlier in the past few days?
A. Yes.
Q. And this slide relates to certain anticompetitive effects that in your economic -- that you have concluded from the standpoint of economics have either been caused or have been threatened by Rambus' conduct?
A. Yes.
Q. The third bullet refers to the threat of higher DRAM prices, and I'd like to ask you a couple of questions about that.
We have talked about the DDR royalties charged by Rambus, that's what we've been talking about just in the last few minutes, and what I'd like to ask is, have you seen -- in your review of the record, have you seen any evidence that corroborates your views or that you have concluded for purposes of your analysis corroborates or supports your views that, in fact, Rambus' DDR royalties do threaten to bring about higher DRAM prices?
A. Yes, I have.
MR. ROYALL: Your Honor, may I approach?
JUDGE McGUIRE: Yes.
BY MR. ROYALL:
Q. Professor McAfee, I've just handed you two

7742

documents. I'd like to take them one at a time, and let's start with what's -- the document that's marked CX-2558.
A. Um-hum, yes.
Q. Do you have that?
A. I do.
Q. Is this document one of the documents that you were referring to in response to my prior question when you said that you had seen evidence that corroborated your views about the threat of higher DRAM prices as a result of Rambus' DDR royalty?
A. Yes, it is.
MR. STONE: Objection, Your Honor.
JUDGE McGUIRE: Mr. Stone?
MR. STONE: Objection, leading, and secondly, this goes into the areas of factual testimony by this witness that Mr. Royall objected to. Every time I would go into an area about the underlying facts, he objected. I had objected yesterday. And he's now getting into areas that are not appropriate for this witness' testimony.
MR. ROYALL: May I respond, Your Honor?
JUDGE McGUIRE: Yeah, go ahead.
MR. ROYALL: First of all, I don't think it's a leading question at all. I asked whether this is one

7743

of the documents that he was referring to, and it either or isn't, and he can tell us, but --
JUDGE McGUIRE: He can answer the question to that extent only, is this one of the documents he was referring to.
MR. ROYALL: And I believe he's already answered that question before the objection.
JUDGE McGUIRE: Well, I don't care if he started an answer -- oh, he's already answered that part of the question?
MR. ROYALL: I believe he has answered, yes.
JUDGE McGUIRE: Then what's your next question?
MR. ROYALL: My next question relates to the substance of the document.
JUDGE McGUIRE: At that point we may hear again from opposing counsel, but go ahead and state your next question.
BY MR. ROYALL:
Q. How, if at all, Professor McAfee, does this document relate to your conclusions about the threatened effects of higher DRAM prices resulting from Rambus' DDR-related royalties?
MR. STONE: I do object, Your Honor, that this is an area of his interpretation of the facts for purposes of this testimony, is exactly the areas in

7744

which both my objections and Mr. Royall's objections have been sustained.
JUDGE McGUIRE: All right, he is not going to be able to testify as to the interpretation of the facts as stated in the objection, but I believe the question says, does this document relate to your conclusions, so to that extent, he can answer that question, and then if he gets beyond that where he is interpreting the facts, then I am going to uphold the objection.
MR. ROYALL: Yes, thank you, Your Honor.
BY MR. ROYALL:
Q. Do you have the question in mind?
A. I don't.
Q. The question was, how, if at all, does this document relate to your conclusions about the threatened effects of higher DRAM prices resulting from Rambus' DDR-related royalties?
A. As I testified, the -- I perceived a long run threat of higher prices associated with the royalties, and this document talks about -- this is my understanding, is that this document is corroborating that threat by suggesting a different positioning of DDR relative to what the -- let me say, a difference in business plans that would result in higher prices for

7745

DDR.
Q. Can you point us to the language that you're referring to in the document?
A. DRAM suppliers -- it's comments that DRAM suppliers have made that they do not want to produce DDR DRAMs if they have to pay this high royalty.
MR. STONE: Move to strike, Your Honor. That --
JUDGE McGUIRE: Just a second.
Mr. Stone?
MR. STONE: Move to strike on the grounds that that is now interpreting the document. Furthermore, his reliance on hearsay like that is an inappropriate basis for his testimony.
MR. ROYALL: May I respond, Your Honor?

JUDGE McGUIRE: Yes.
MR. ROYALL: First of all, Mr. Stone has asked this witness today in reference to his assumptions about a number of documents, and all I am doing is asking him further about documents in reference to understanding his assumptions, and so this is no different than what he's done, and in that regard, I would say it's highly -- it's entirely appropriate.
JUDGE McGUIRE: Mr. Stone, how is he interpreting this document? Because I'm not quite

7746

clear on how he's done that just based on his last answer.
MR. STONE: Well, clearly implicit in his answer is he is giving meaning to the words in order to say that they are support. I did not ask him to interpret any documents. I asked him to explain what his assumptions were in detail. I just tried to get more detail for his assumptions. I didn't show him documents and say, did these support your assumptions? I did ask him whether a statement in a document was consistent or inconsistent with his assumptions, but not whether it supported them or not.
MR. ROYALL: Your Honor, let me say --
JUDGE McGUIRE: One last comment.
MR. ROYALL: Well, this is a very significant issue, and it's significant for a number of reasons, but one is I have -- I'm only asking him about what evidence that he has relied on or considered in making his assumptions, and that is an absolutely critical thing for me to be able to draw out with this witness.
JUDGE McGUIRE: You can ask -- whether it's critical or not, that doesn't speak to his objection. His objection is whether his answer is attempting to interpret a document, and as I said earlier, he is not going to be allowed to do that. This last answer, it's

7747

not clear to me whether he's interpreting a document, but you can ask him again to what extent he factored in this document, but I don't want any testimony regarding what could be construed as interpretation of the language.
Now, maybe, again, this is going to have to come up again. It's not clear to me at this point to what extent he's interpreting the terms of the document. So, I am going to let you proceed, and then I'll hear again I'm sure from opposing counsel if it gets beyond where we are.
MR. ROYALL: Well, could I just put in context my response, because I can imagine this may come up again. I'm not asking this witness to interpret the document. This witness has made it extremely clear that he is not testifying as to what the facts are or are not. He has also made it clear that he's made assumptions and that he has conducted a factual investigation to corroborate those assumptions and that it's important --
JUDGE McGUIRE: In that context, that's fine. I think the problem opposing counsel is having was his answer appeared to be interpreting this document, even if he stated at an earlier point in this hearing that he's not attempting to do that. The answer could come

7748

out as if he were, and that was, as I understand the objection, the context under which that was noted.
So, I'm going to give you a chance to ask the question again in the proper context, and again, I'll admonish the witness to avoid any testimony that may be construed as interpreting any evidence in this case.
MR. ROYALL: Your Honor, I think the point I'm making is that in order for the witness to explain the facts that he considered in developing his assumptions, the factual assumptions that he made, he needs to comment on documents, and if every time --
JUDGE McGUIRE: I didn't say he couldn't comment on it. I just want to be sure his testimony does not appear to be interpreting the document, and as long as, again, we put it in the proper context, then we'll see if it doesn't clear the problems that opposing counsel is having.
MR. ROYALL: All right, let me try --
JUDGE McGUIRE: If I understand what he was saying, was that it was how the testimony was coming out that he had the problem with, so...
MR. ROYALL: Let me try to frame the questions with that input in mind.
BY MR. ROYALL:
Q. Professor McAfee, I'm not asking you to

7749

interpret for us what the facts are, the facts in this case do or do not prove, and I think you've made it clear that you have -- you understand that's not your role. On the other hand, you've made assumptions about facts, as you've testified, and based on those assumptions, you've conducted an economic analysis.
What I'm asking you is can you explain how this document, which you've identified as one that you viewed before, how this document -- how you took it into account in developing your factual assumptions in this case?
A. Let me do the reverse of what my reasoning is and start with my conclusions.
One of my conclusions was that there was a threat to long run DRAM prices, that is, a threat of increase of long run DRAM prices and a decreasing quantity, and I reached that conclusion because ordinarily it wouldn't be just a threat, it would be -- you would expect to see an actual harm, but this industry is unusual from an economist's perspective in that the other characteristics that we discussed lead to what's called a vertical supply or a perfectly inelastic supply.
That is to say, the DRAM manufacturers will continue to produce DRAM whether or not there's a

7750

significant increase in their input prices because the -- of the big fixed costs of their operations, and as a result, in this industry you wouldn't expect to see higher DRAM prices immediately, that is, you wouldn't expect to see, as in other industries, cost increases in the form of royalties passed on to final consumers right away.
What was significant to me about this document in crafting my assumptions was the suggestion that, well, perhaps DDR -- there would be a diversion of resources away from DDR immediately. That is, it suggested that the royalties might be passed on rapidly rather than -- rather than only over the long term.
Q. Now, let me ask you with respect to the second document that I handed you, CX-2561, is this a document that you considered in developing the factual assumptions that you have developed for purposes of your economic analysis?
A. Yes, it is, if you will give me a moment to review it. (Document review.) Okay.
Q. Have you had an opportunity to review it?
A. I have.
Q. Is there any aspect of this document that you considered in the course of developing your own assumptions about any issues that relate to your

7751

economic analysis?
A. Yes, there is.
Q. And can you point us to that, where in the document you see language that relates to your assumptions?
A. Well, in particular, with respect to the conclusion concerning effects on prices, in the numbered list, item 2, there's a statement that says, "Will also factor in impact of IP royalty."
Q. Can you -- oh, I see. Is this -- what's been highlighted on the screen, is this what you're referring to?
A. That's correct.
Q. And how does that relate to the assumptions that you have made for purposes of your economic analysis?
A. As I testified, my concern in examining downstream DRAM prices was pass-through, what economists call pass-through of costs, and this document, by using the language "will also factor in impact of IP royalty," suggests what the document says.
Q. By which you mean?
A. Oh, I will quote the document. "DDR volume, cost and pricing update."
Q. All right, let's move on to something else.

7752

Can we pull up DX-248?
MR. DAVIS: Our computer seems to have frozen up a little bit here.
JUDGE McGUIRE: Excuse me?
MR. ROYALL: The computer is frozen up.
JUDGE McGUIRE: Oh.
MR. ROYALL: Actually, we can -- I can ask this question without reference to the exhibit.
BY MR. ROYALL:
Q. Do you recall yesterday Mr. Stone asked you some questions about the time frame that would be relevant from your standpoint in terms of the disclosure of Rambus intellectual property to JEDEC?
A. Yes, he did.
Q. And do you recall that you gave an answer to the effect that the time period that was relevant for your purposes was the pre-1996 time period?
MR. STONE: Your Honor, I object to the mischaracterization of the testimony and to the leading nature of this. This is redirect, and --
JUDGE McGUIRE: All right, sustained.
MR. ROYALL: I'm simply trying to move things along, but I can ask --
JUDGE McGUIRE: I realize that, I realize that. You are just going to have to do it in a little clearer

7753

fashion, a little better fashion.
BY MR. ROYALL:
Q. And do you recall what time frame you indicated was relevant to your analysis?
A. I -- as the document says -- well, actually, I was asked to explain this on more than one occasion and to give the time period on more than one occasion, and I may have given short forms of the answer on some of those occasions.
Q. Let me try -- let me try it this way: Do you see in this slide, DX-248, you have listed in the first bullet point the date June 18, 1996?
A. I do.
Q. And what is your understanding of the significance of that date?
A. This is my understanding -- in fact, I believe, as I testified on direct, that this is the date that Rambus left JEDEC. That's an assumption on my part.
Q. And does that date have any significance from the standpoint of the timing of intellectual property disclosures within JEDEC that are relevant for purposes of your economic analysis?
A. Well, as I believe I clarified on the direct testimony and may have been confused again during the cross examination, my opinion as an economist -- I

7754

don't have an opinion about what should have been disclosed. That's -- that strikes me as being essentially a legal issue. My opinion as an economist that whatever should have been disclosed should not be enforced. That was my economic conclusion.
I sort of wish I hadn't used the date June 18th, 1996, but instead, to just refer to the economic conclusion, which relates what should have been disclosed, whatever that might be, to -- to nonenforcement, and so that is to say, rather than use the date June 18th, 1996, it's whatever is found to be what should have been disclosed should not be enforced.
Q. Do you recall -- do you recall that you were asked some questions by Mr. Stone relating to network issues?
A. Yes.
Q. And in that regard, I believe that you may have given some testimony as to what you understand the word "network" or "network effects" to mean as to how this relates to your analysis in this case?
A. I believe I may have garbled my answer, yes.
Q. Do you recall if that issue is discussed in your expert report?
A. It is.
Q. And do you have the expert report in front of

7755

you?
Let me ask you to turn to page 56 of your expert report, and I would focus your attention on paragraph 71.
MR. STONE: Your Honor, I object to the use of the expert -- the expert reports we've already determined -- the Court has ruled they are not admissible. If Mr. McAfee needs to supplement, correct or change his testimony, I think he should be asked to do that rather than rely on a document the Court has determined is inadmissible.
JUDGE McGUIRE: Sustained. I think you can ask the question without referring to his expert report.
BY MR. ROYALL:
Q. Are you familiar, Professor McAfee, with the term "direct network compatibility"?
A. Yes.
Q. And is that a term that's used in economics?
A. It is.
Q. And what do you understand that term to mean?
A. It's the requirement of devices to interact with each other, interoperate. It was originally used with local telephone networks, which weren't necessarily able to contact other telephone networks, and it was -- as we know, the value of a telephone is

7756

greater the more people you can call, and so that became known as a network effect or a direct network effect. So, this is the requirement of interoperability.
It's something that we have seen in this case with respect to an exhibit which I put up that had already been put up as well that showed the interaction or interoperability of DRAM with other components within a PC.
Q. Are you familiar also with the term "indirect network compatibility"?

A. Yes, I am.
Q. And what do you understand that term to mean?
A. So, an indirect network compatibility is -- or indirect network effect is a change in value that's associated not directly with the ability to interoperate, but with some -- with the provision of some sort of other component. The classic example would be video rentals. The more people that had a VHS VCR, the more VHS videos were available in the local rental store, and hence, the more valuable was the VHS VCR, and that's what eventually tipped the balance from the Sony Beta to the VHS.
We have seen the same sort of thing happen with DVDs recently; that is, the balance in the local video

7757
store has tipped away from VHS towards DVDs as more consumers have them -- have DVDs. That, of course, makes the DVD more valuable, and that's known as an indirect network effect.
Q. And do either of these concepts, direct network effects or indirect network effects, have applicability to your economic analysis in this case?
A. Both do.
Q. And can you explain how they relate?
A. Well, as I think I already mentioned, the direct -- we've seen direct network effects in the requirement that DRAM communicate with other devices within the system, and so those devices must be designed to be -- to interoperate, and that creates a requirement that the more of such components exist for DRAM, the more valuable will be the DRAM.
And we had a discussion of this with respect to things like fax machines and other devices, chipsets, all of which tend to increase the value of DRAM and are a source of lock-in as a consequence for DRAM design.
Indirect network effects are also present in that as a given DRAM becomes more popular, we see other

7758
devices designed to work with it, that is, third-party devices, which then tends to increase the value of that DRAM, thus locking the industry more into that particular design.
Q. I'm going to shift to another issue now.
A. Okay.
Q. Do you have an understanding as to whether any court has reached any final determination as to the validity and enforceability of Rambus' or any of Rambus' SDR or DDR SDRAM patents?
MR. STONE: Calls for a legal conclusion, Your Honor.
JUDGE McGUIRE: Sustained.
MR. ROYALL: Your Honor, the question -- may I be heard?
JUDGE McGUIRE: You may be heard.
MR. ROYALL: The question was not whether he had an understanding. It was whether there had been any such decision. I'm not asking him to interpret it or give any legal testimony at all, but as Mr. Stone asked the witness earlier about legal issues from the standpoint of an economic analysis, it's in the same context that I'm asking this question.
MR. STONE: Well, Your Honor, A, it's beyond the scope. I didn't ask him about any decision about validity. B, to the extent I wanted to ask him about the Federal Circuit and his understanding, Mr. Royall did make an objection that it called for a legal

7759
conclusion, which was sustained, and so no testimony on that was given.
JUDGE McGUIRE: It was beyond the scope in any event, so it is still sustained.
MR. ROYALL: What I had in mind was within the scope, and --
JUDGE McGUIRE: Mr. Royall, I have sustained the objection.
MR. ROYALL: I understand, Your Honor. What I had in mind was within the scope, and I can ask it in a different way and make that clear.
JUDGE McGUIRE: You can go on and ask your next question in any event.
BY MR. ROYALL:
Q. Do you recall being asked by Mr. Stone about whether you had made assumptions about whether Rambus
patents read on or covered either SDRAM or DDR?
A. I don't specifically recall those terms, but I was definitely asked about the -- whether the -- whether Rambus had patent coverage or something like that, the patents were relevant or something. I don't remember exactly what I was asked.
Q. And for purposes of your conclusions on monopoly power, do you make assumptions about the coverage of Rambus patents?

7760
A. Well, I think as I testified, I am not questioning that Rambus has IP that they can enforce against the standards.
Q. For purposes of your economic analysis and your conclusions about monopoly power, is it an essential assumption -- and I'm asking for your assumptions -- is it an essential assumption on your part that a court of proper jurisdiction has rendered a final conclusion as to the validity and enforceability of Rambus' patents?
A. No, it's not.
Q. Why not?
A. Well, to be fair, I'm not sure that I'm positioned to interpret the phrase "court --" I've forgot, a court of something jurisdiction, but the important thing from my perspective is Rambus' ability to enforce its patents; that is to say, if Rambus had no ability to enforce its patents, I think we could all go home, but the -- insofar as they have an ability to enforce their patents, whether that's a final determination or not I can't see would be relevant.
Q. And when you say "enforce patents," what are you referring to?
A. Against JEDEC-compliant standards, devices. Against the manufacturer of those devices.
Q. And does the existence of license agreements,

7761
actual license agreements, relate in any way to conclusions that you would draw about Rambus' -- let me restate that.
Have you made any assumptions about the ability of Rambus to enforce its SDRAM and DDR SDRAM-related patents?
A. I think, as I just testified, that I am assuming that they can do that, and I have seen, of course, evidence in the record, because companies don't sign license agreements unless they -- there's a threat of enforcement. That doesn't actually speak to the legal issue directly, nor do I need to assume anything about the legal issue.
And actually, from an economic perspective, it doesn't matter one way or the other whether they actually have the patent rights. If they can enforce them and charge for them, it's the charges that matter from an economic perspective.
Q. Can we pull up DX-229?
Do you recall this slide, Professor McAfee?

A. I do.
Q. And in this slide, do you -- you use the term "equal or superior products."
Do you see that?
A. I do see that.

7762

Q. And do you recall that Mr. Stone yesterday asked you some questions about those terms?
A. Yes, I do recall, but not specifically.
Q. And can you tell us, just so the record's clear, what you mean by use of those terms in the context of your economic analysis?
A. Well, these are products that -- the use I'm making of them is these are the products that the buyer -- that a -- that the buyers would -- would choose; that is to say, that are equal or superior from the perspective of substitution by buyers.
Q. When you use those terms, are you using them in the technical sense or in an economic sense?
A. I'm using them in an economic sense.
Q. Does your use of this terminology relate at all to your use of the term, which has come up in your testimony, of "commercially viable alternatives"?
A. It does.
Q. How are those two concepts related as they factor into your economic analysis?
A. So, commercially viable alternatives are price-constraining alternatives; that is to say, from the buyer's perspective, if the price of a given alternative is increased, if it's too high, the buyers can substitute one of the other alternatives, and so --

7763

I should say equal or superior from an economic perspective always includes prices. It's not -- you can't actually assess whether it's equal or superior without prices.
And so, the issue of equal or superior products -- excuse me, the relationship between the price-constraining alternatives and equal or superior products is that at reasonable prices or at nearly similar prices, similar prices, the commercially viable alternatives are equally -- equal or superior.
Q. And have you reached any conclusion as -- in terms of your own economic analysis as to whether Rambus' challenged conduct has resulted in the exclusion of equal or superior products as you define that term from the economic perspective?
A. Yes, as I testified, their conduct has -- given my assumptions, their conduct has excluded equal or superior products.
Q. And do you recall -- with reference to the term "commercial viability," do you recall that Mr. Stone asked you whether you're aware of that term appearing in any economic textbook?
A. I do.
Q. And do you recall that he asked you whether that term appeared in the DOJ-FTC Merger Guidelines?

7764

A. I do recall that question.
Q. And do you recall your answer to that question?
A. I didn't recall it -- I did not recall the term "commercial viability" appearing in the FTC-DOJ Guidelines.
Q. Does --
A. Those aren't actually exactly identical guidelines, by the way, but they are very similar.
Q. Does the term "commercial viability" as you have used the term for purposes of your economic analysis relate at all to the concept of price-constraining alternatives that you discussed earlier in your testimony?
A. That is my definition of commercial viability, is that it's a price-constraining alternative. So, yes, not only does it relate; it's the same concept.
Q. Are you familiar with or do you know whether the term "price-constraining alternative" appears anywhere in the economic literature?
A. Yes, it does.
Q. Do you know whether that term appears anywhere in either FTC or DOJ Guidelines?
A. It is my recollection that it appears in the -- in both.
MR. ROYALL: May I approach, Your Honor?

7765

JUDGE McGUIRE: Yes.
BY MR. ROYALL:
Q. Professor McAfee, I have just handed you a document that for the record I would mark as CX-3094.
(CX Exhibit Number 3094 was marked for identification.)
BY MR. ROYALL:
Q. Do you recognize this document?
A. Yes. This is -- appears to be the Federal Trade Commission version of the -- of the Horizontal Merger Guidelines.
Q. And could I ask you to turn to -- referring to the bottom left-hand corner, the numbers there, could I ask you to turn to page 6 of 26?
A. Yes.
Q. And roughly halfway down, in the middle of the page, do you see the paragraph beginning with the words, "In considering"?
A. I do.
Q. And that sentence states, "In considering the likely reaction of buyers to a price increase, the agency will take into account all relevant evidence, including but not limited to the following," and then there are four items listed under that sentence.
Do you see that?

7766

A. I do.
Q. And the first of those items refers to evidence that buyers have shifted or have considered shifting purchases between products, and I read only a portion of it, but do you see that language?
A. I do.
Q. I'm sorry, I didn't --
A. I do see that language, yes.
Q. Then the fourth item refers to the timing and costs of switching products.
Do you see that language?
A. I do see that.
Q. When you said earlier that you recalled the concept of price-constraining alternatives being discussed in the FTC and DOJ Guidelines, were you recalling this -- this language that I've pointed you to or something else?
A. No, strictly --
MR. STONE: Your Honor, Counsel is leading the witness. He should -- all he needs to ask is where in the document -- where in the document does it appear? He's leading him. If the witness can't find it, it is relevant evidence. To point him to it is to lead him.
Now, we all know that the Guidelines will be argued before Your Honor in any event, so my objection

7767

is that that sentence is probably a bit moot, but I do think counsel continues to lead the witness.
JUDGE McGUIRE: It is moot, but it is sustained as well, Mr. Royall.
BY MR. ROYALL:

Q. Well, without reference to necessarily the language that I read but by reference to the document -- and take your time to review the document -- but is there anything in this document that you've identified that relates to the concept of price-constraining alternatives that we identified a moment ago?
A. I think as I testified on direct, the -- my notion of price-constraining alternatives embodied in commercial viability is exactly parallel and analogous to the language of the Horizontal Merger Guidelines with which I'm quite familiar and have, in fact, published about; that is, I have written papers about the Horizontal Merger Guidelines, and the parts that I would point to is the evidence that buyers have shifted or considered shifting purchases between products in response to relative changes in price, so this is talking directly about buyer substitution, which I think was actually even on the slide that I presented in discussing price-constraining alternatives, and then

7768

the timing and costs of switching products as well.
These -- this conceptually is identical. I gave it a different name rather than a sniff test, partly because when I do a sniff test, I tend to actually have data about buyer purchases available to me. Here, I don't actually have the data available about buyer purchases. Instead, I'm having to rely on discussions with engineers and the published record from the time that would indicate the same kinds of concepts; that is, evidence that the buyers have shifted or have considered shifting their choices. But in that sense, I think the language is identical in meaning and intent from my definition.
MR. ROYALL: Your Honor, at this time I would move in evidence CX-3094.
JUDGE McGUIRE: Mr. Stone, objection?
MR. STONE: I do object, Your Honor. I think this is a document which is properly cited as authority, as we would cite a case to Your Honor. I don't think the Guidelines are themselves evidence. This is a legal document published by the FTC, and I think it's -- it can be cited for -- as an authority with respect to antitrust issues, but I don't think it's permissible as an exhibit. It's not evidence.
JUDGE McGUIRE: The Court will take notice of

7769

the document.
MR. STONE: I think that's appropriate, Your Honor.
JUDGE McGUIRE: But it will not be entered into the record.
MR. ROYALL: Thank you, Your Honor.
BY MR. ROYALL:
Q. Do you recall, Professor McAfee, that in his questions to you yesterday, Mr. Stone asked you about -- he asked you a hypothetical question about hypothetically what impact, if any, it would have on your assumptions -- let me restate that.
He asked you -- Mr. Stone asked you whether it would have any impact on your assumptions --
JUDGE McGUIRE: Excuse me, I want to make clear on my last comment that when I said the Court will take notice of the document, it's inferred that I mean judicial type notice other than just it's noted.
MR. STONE: Yes, Your Honor.
JUDGE McGUIRE: Are we clear on that?
MR. STONE: That was my understanding.
MR. ROYALL: Thank you, Your Honor. Let me start over again.
JUDGE McGUIRE: I'm sorry, Mr. Royall.
MR. ROYALL: No, no, I garbled the prior

7770

question.
BY MR. ROYALL:
Q. You were asked yesterday or do you recall being asked yesterday about what, if any, impact it would have on your assumptions if hypothetically Rambus had made disclosures to JEDEC relating to the relevance of its technologies to SyncLink.
A. I was asked something about SyncLink, disclosures to SyncLink and those being the same members as JEDEC or something to that effect. I don't recall specifically.
Q. And in the course of conducting the factual investigation that you have conducted in developing your assumptions and corroborating the reasonableness of your assumptions, have you reviewed any disclosures that were made by Rambus to JEDEC in reference to SyncLink?
A. Yes, I have.
Q. Let me --
Your Honor, may I approach?
JUDGE McGUIRE: Yes.
BY MR. ROYALL:
Q. Professor McAfee, I have just handed you a document that's been marked as CX-91A. Do you recognize this document?

7771

A. Well, I recognize it as JEDEC minutes.
Q. This document attaches a number of documents, and if I could point you to a particular attachment, which is on page 13 of the document, page 13 of CX-91A.
A. Attachment C, yes.
Q. Yes, Attachment C, and do you recognize that document?
A. Yeah, I -- I --
Q. And by that I mean do you recognize it as something that you have reviewed or considered in connection with your economic analysis in this case?
A. I have definitely reviewed it. I recognize it.
Q. And the document, as is clear from the record, is a September 11, 1995 letter on Rambus stationery, and do you recall the subject of this letter?
A. I'm sorry, I'm really having trouble reading this document. (Document review.) Yes, I remember this document. Do I recall the -- I recall my analysis and the reading of this document.
Q. I'm sorry, you said you recall?
A. Is there a question -- was I asked a question? I had asked for time just to actually read it, because I had --
Q. Well, I can repose the question.
Can we pull up DX-230?

7772

DX-230 is now on the screen. Do you recall that we discussed this slide as part of your testimony earlier?
A. Yes.
Q. And this relates to the principal assumptions that you have made relating to the nature of Rambus' challenged conduct?
A. Yes, I recall that.
Q. And the second bullet point here states, "Rambus failed to disclose relevant IP as required by JEDEC rules/process."
Do you see that?
A. Yes, I do.
Q. Now, then, referring back to the document that you have in your hand, Attachment C to CX-91A, can you explain whether in your view of that document you

reached any conclusion as to whether that document was consistent with or in any way inconsistent with the assumption that you made about Rambus' failure to disclose IP to JEDEC?

MR. STONE: Your Honor, I object that this is outside the scope of my cross examination. I asked the witness on pages 7549 and 7550 to assume for purposes of my questions that Mr. Crisp had advised JEDEC in the context of talking about SyncLink of Rambus patents so

7773

as to establish that he had a certain level of awareness of the patents in the context of the last bullet point on the demonstrative that Mr. Royall just referred to, namely, the risk-taking issue, and the use in this regard, that's not an assumption that we're now going through, that I questioned about.

It goes beyond the scope of my cross examination, and the use of this document in that context is also beyond the scope.

JUDGE McGUIRE: Mr. Royall?

MR. ROYALL: Your Honor, I don't believe it is beyond the scope when Mr. Stone asked the witness about

a hypothetical letter, and the witness did consider it an actual letter of the sort that he hypothesized, to then present the witness with that letter and ask him what, if any, conclusions he reached as to whether that affected his assumptions. It seems directly within the scope of his examination.

MR. STONE: Your Honor, and if this were asking about the appropriate issue, namely, the last bullet point on the demonstrative, not the second one, I would not be rising in objection to it, but it's beyond the scope of anything I did with that assumption about a letter.

JUDGE McGUIRE: Sustained.

7774

MR. ROYALL: One moment, Your Honor. Could I confer briefly with Mr. Stone?

JUDGE McGUIRE: You may.

(Counsel conferring.)

BY MR. ROYALL:

Q. Let me withdraw the question and the document for the moment, and let's go back to -- to DX-230.

We just talked about this slide, Professor McAfee, DX-230, and this relates to the assumptions -- principal assumptions that you've made for purposes of your analysis relating to Rambus' challenged conduct.

A. Is there a question?

Q. I just want to clarify that again for the – is that correct, that's your understanding?

A. That's correct, yes.

Q. And as was just noted on the record, Mr. Stone asked you about the last bullet on this page. Do you recall being asked questions about that bullet, which reads, "Rambus was aware of legal risk associated with this conduct (i.e., equitable estoppel)"?

A. I recall that series of questions.

Q. And do you recall that in the context of those questions or in the context of this bullet point, Mr. Stone asked you about the concept of mistake?

A. Yes, that had been part of my direct testimony,

7775

and he asked me more than one question about mistakes.

Q. And one of the questions he asked you related to the question of whether it's possible for corporations to make mistakes? Do you recall that?

A. He did ask that, and I agreed that it was.

Q. And in making the assumptions that you made about Rambus' conduct, did you consider the possibility that Rambus itself made mistakes as it relates to the issues in this case?

A. I certainly did consider that possibility.

Q. When you --

JUDGE McGUIRE: All right, I'm confused there. When you say "as it concerns the issues in this case," I'm not clear -- you are going to have to put it in a clearer context, if only for the Court.

MR. ROYALL: Well, I can do that, Your Honor.

JUDGE McGUIRE: All right.

BY MR. ROYALL:

Q. Specifically with reference to this bullet point, which I read into the record a moment ago, the last bullet point on DX-230, did you consider whether Rambus may have made mistakes relating to the potential legal risks associated with its conduct?

A. Yes, I did, especially in light of the quote to Mr. David that I actually put in my slides.

7776

Q. And as part of the work that you did to develop and corroborate your factual assumptions, did you review evidence relating to that subject?

A. I did.

Q. Did you see anything in the evidence that you reviewed that caused you to modify this assumption?

A. I saw -- I've considered that my assumption was corroborated by a substantial amount of evidence and that I felt comfortable in assuming that Rambus was aware of the legal risks and that this was not just an outcome of a mistake on Rambus' part.

MR. ROYALL: May I approach, Your Honor?

JUDGE McGUIRE: Yes.

BY MR. ROYALL:

Q. Professor McAfee, I've just handed you a document that's been marked for identification as CX-1942, and do you recognize this as a document that you reviewed in connection with your economic analysis in this case?

A. I do.

Q. And is this a document that relates to the issue that we've been discussing; that is, the work that you did to develop your factual assumptions and corroborate your factual assumptions with reference to the legal risks or the assumptions that you made with

7777

reference to the legal risks associated with Rambus' conduct?

A. It is. My understanding of this document is that these are notes –

MR. STONE: Object, Your Honor. The question as framed can be answered yes or no. I think the witness answered it when he said, "It is." I want to preserve, if I might, my ability to object to the interpretation of the document by this witness, which subject to the prior rulings, he may not be permitted to do so.

JUDGE McGUIRE: All right, that's sustained, and you can ask your next question.

BY MR. ROYALL:

Q. To be clear, Professor McAfee, I'm not asking you to offer an interpretation as to what this letter says in terms of the facts of this case or what may or may not be the facts in this case.

What I would like to ask you, however, is did your review of this document cause you to modify in any way the conclusions -- or rather, the assumptions that you made that we focused on a moment ago in the prior demonstrative, Exhibit DX-230; namely, the assumption that Rambus was aware of legal risks associated with its challenged conduct?

7778

A. I don't know whether I saw this document before I made that assumption or after I made that assumption. I just don't recall today, but it would not cause me to modify it. It may have actually informed my choice of assumption; that is to say, I may have seen it before I made the assumption rather than after. But -- but either way, it certainly does -- it certainly comforts me in my assumption, makes me more comfortable in my assumption.

Q. What is it about this document that -- from the standpoint of your own assumptions and developing and corroborating those assumptions -- causes you to have comfort in your assumption?

MR. STONE: Your Honor, I would object. This is an effort to have this witness testify to Rambus' state of mind. That's an area covered by Your Honor's in limine. We did not get into it on cross.

JUDGE McGUIRE: Right.

MR. STONE: The only thing that is permissible here, I believe, in light of Your Honor's in limine is for the witness to state his assumptions about Rambus' state of mind and then the finding of fact on those issues is directed to Your Honor's province, not the subject of expert testimony. So, this witness states his assumptions, and then ultimately you'll determine

7779

whether the facts support his assumptions or don't. Whatever evidence this witness relied on or didn't is irrelevant and really is an effort to testify directly to Rambus' state of mind in his opinion.

JUDGE McGUIRE: Mr. Royall, you can respond to that.

MR. ROYALL: Your Honor --

JUDGE McGUIRE: You do understand my prior holding on this issue, I'm sure.

MR. ROYALL: Yes, I clearly do, and I'm not asking this witness to testify as to the state of mind of Rambus or anyone else. On the other hand, he was questioned in cross examination about this very assumption and the potential that Rambus had made mistakes and whether that was something that he took into account in forming his assumptions, and I am simply probing that issue, and I -- I would note, and I could cite to the number of cases that were in our prior filings, but it is a perfectly appropriate thing to do --

JUDGE McGUIRE: I will entertain the question in the context of my prior rulings on the state of mind.

MR. ROYALL: Thank you, Your Honor.

BY MR. ROYALL:

7780

Q. Professor McAfee, understanding that I am not asking you to interpret the facts and am certainly not asking you to interpret anyone's state of mind, all I'm asking you about is the process that you went through in developing your assumptions and then corroborating those assumptions by review of information in the factual record.

The question I had for you, I posed for you, is whether there's anything in this document that caused you either to modify your assumptions or to reach any determination as to whether you were comfortable with the assumptions that you defined for purposes of conducting your economic analysis.

A. The answer is yes, that this document was useful in my evaluation of the assumptions. I understand the author of this document, I don't believe is on the record at the moment, to be Lester Vincent, who is an attorney employed by Rambus --

JUDGE McGUIRE: All right, hold on there, Mr. McAfee.

MR. STONE: Your Honor, this is the witness testifying to what the document means and what it is.

JUDGE McGUIRE: Sustained, and that last comment will be stricken from the record.

Now, we're not going to go into this too much

7781

further, Mr. Royall. If I have any more problems, I am just going to interject and you're off this subject.

MR. ROYALL: I understand, Your Honor, and I will -- if I can conclude this -- this --

JUDGE McGUIRE: Very delicately.

MR. ROYALL: May I have a moment to confer, Your Honor?

JUDGE McGUIRE: Go ahead.

(Counsel conferring.)

MR. ROYALL: Your Honor, with the understanding that your rulings today in terms of the ability to probe factual issues, even relating to assumptions, will extend to Rambus' experts as well, I have no further questions.

JUDGE McGUIRE: Well, and my rulings will be I guess whatever I determine them to be at the time, and I strive to be consistent. There may be instances where both sides feel I haven't always been able to achieve that, but your comment otherwise is noted.

Okay, Mr. Stone, any further recross?

MR. STONE: I have no questions at this time of Professor McAfee.

JUDGE McGUIRE: Okay, thank you.

Sir, we certainly appreciate your testimony, and you're excused from this proceeding.

7782

THE WITNESS: Thank you very much, Your Honor.

JUDGE McGUIRE: Thank you, Professor.

11186
UNITED STATES OF AMERICA
FEDERAL TRADE COMMISSION

In the Matter of:)
Rambus, Inc.) Docket No. 9302
----------)

Friday, August 1, 2003
9:32 a.m.

TRIAL VOLUME 54
PART 1
PUBLIC RECORD

BEFORE THE HONORABLE STEPHEN J. McGUIRE
Chief Administrative Law Judge
Federal Trade Commission
600 Pennsylvania Avenue, N.W.
Washington, D.C.

Reported by: Josett F. Hall, RMR-CRR

11187
APPEARANCES:

ON BEHALF OF THE FEDERAL TRADE COMMISSION:
M. SEAN ROYALL, Attorney
GEOFFREY OLIVER, Attorney
JOHN C. WEBER, Attorney
ROBERT DAVIS, Attorney
CHARLOTTE MANNING, Attorney
MALCOLM CATT, Attorney
Federal Trade Commission
601 New Jersey Avenue, N.W.
Washington, D.C. 20580-0000
(202) 326-3663

ON BEHALF OF THE RESPONDENT:
GREGORY P. STONE, Attorney
STEVEN M. PERRY, Attorney
PETER A. DETRE, Attorney
SEAN GATES, Attorney
Munger, Tolles & Olson LLP
355 South Grand Avenue, 35th Floor
Los Angeles, California 90071-1560
(213) 683-9255

11188
APPEARANCES:

ON BEHALF OF THE RESPONDENT:
A. DOUGLAS MELAMED, Attorney
Wilmer, Cutler & Pickering
2445 M Street, N.W.
Washington, D.C. 20037-1420
(202) 663-6090

11189
P R O C E E D I N G S
- - - - -

JUDGE McGUIRE: Counsel, good morning. Before we get started, any items that we need to take up this morning?

MR. PERRY: I have two housekeeping matters, Your Honor.

First, when the deposition of Jeffrey Mailloux was shown and read, there was a provisional in camera treatment afforded for it.

We have confirmed with Micron's counsel that there is nothing in that transcript that they feel should be in camera, and so that should come back into the public record, and we will inform the court reporting firm of that.

JUDGE McGUIRE: Okay. Very good.

MR. PERRY: The second thing is that you suggested yesterday that we talk this afternoon if there are any issues about the posttrial briefing order. We looked back at the order. We do have a few questions about it.

JUDGE McGUIRE: Well, I intend at the close of the testimony today to take some time and talk about that and answer any inquiries either side might have, and so we'll have time to do that.

11190

MR. PERRY: Great. Thank you.

JUDGE McGUIRE: Mr. Royall?

MR. ROYALL: Yes, Your Honor. There are a few additional things that we were planning to cover this afternoon after Professor McAfee testifies. I don't know if there's anything that Mr. Oliver has for this morning.

MR. OLIVER: Not for this morning, Your Honor.

JUDGE McGUIRE: Okay. Very good.

MR. ROYALL: And these other things relate I think mainly to some document issues.

JUDGE McGUIRE: Okay. We'll take that up.

Is there anything else that we need to discuss at this time?

MR. PERRY: It might be helpful if there's going to be any issues that we need to confer about this afternoon that we know what the issues are.

JUDGE McGUIRE: Well, I agree. Do you want to take some time and talk about that now or -- I would have hoped you would have conferred already so they'd have some idea as to what to anticipate.

MR. ROYALL: Some of these may be matters that happened as the subject of conferences earlier. I'm not sure.

MR. OLIVER: Can I have just a moment to...

11191

JUDGE McGUIRE: Sure.

(Pause in the proceedings.)

MR. ROYALL: Your Honor, just to preview the issues that we're talking about, there are some privileged-related issues that I think have been the subject of some back-and-forth between counsel that we are planning to raise just to resolve which documents or aspects of documents may or may not be privileged.

Another issue relates to there are public-record versions of various documents that have been created to avoid in camera, unnecessary in camera sessions, and what we were going to seek to do is to offer both the public versions of the in camera documents that have been already offered just so the record is clear to ease the briefing, to again avoid unnecessary in camera issues.

The third issue -- and this is something we can give respondent's counsel a list -- in the notice or, rather, our -- in our submission on the rebuttal case, you may recall in addition to rebuttal testimony there were a limited number of documents we planned to offer as rebuttal to rebut specific points that were raised by respondent's witnesses.

JUDGE McGUIRE: In whose testimony are you referring to? You mean today or the testimony we had

11192

yesterday?

MR. ROYALL: These are documents we were planning to offer -- and we can give respondent's counsel a list so they have the benefit of that -- a limited number of documents that the documents themselves we contend rebut points that were made in the testimony of respondent's witnesses.

JUDGE McGUIRE: But is that what you intend to do today?

MR. ROYALL: That's after Professor McAfee.

JUDGE McGUIRE: Okay. This is after the testimony. All right.

MR. ROYALL: And we can -- so they'll have the benefit of a list of that.

JUDGE McGUIRE: It would help if you could indicate to the opposing counsel what those are so they have a little preview and maybe we can save some time this afternoon.

MR. PERRY: Your Honor, I'm confused. If he's talking about the list that he was mentioning a few days ago that they were trying to get some documents into evidence that weren't in evidence, we would strongly oppose that. There's no basis for that.

I received the notice of rebuttal case, but I can't believe that's what he's talking about.

11193

JUDGE McGUIRE: I'm not quite sure what you're talking about either, Mr. Royall, and obviously this would be helpful to confer with opposing counsel so we're all clear as to what documents you're referring to.

MR. ROYALL: Yes.

JUDGE McGUIRE: If you want to do that now or, you know, during lunch, whatever.

MR. ROYALL: We can do that. I was just looking for my copy of that notice.

Thank you. Mr. Oliver just handed it to me.

I'm not referring to the issue that came up with respect to --

JUDGE McGUIRE: The counter-counter-designations.

MR. ROYALL: That we understand you've given us seven days to file something on that. That's a separate issue.

What I'm referring to is in our notice of --

JUDGE McGUIRE: Well, wait a minute. I'm not sure that's clear. I already have ruled on the counter-counter-designations that I would bar in this proceeding any of those that came in after the 12th of July that were the topic of that issue the other day.

But you indicated there were some other

11194

designations that you would offer this coming week, and that's the one I think I gave you seven days to -- okay. Just so we're clear.

MR. ROYALL: Well, other documents, I think other documents.

JUDGE McGUIRE: Other documents.

MR. ROYALL: Yes, Your Honor.

But just to go into -- Mr. Perry's point now is separate from that, and it relates to before the counter-counter-designation issue came up, we had submitted our notice of complaint counsel's anticipated rebuttal case in which we notified respondent's counsel that in addition to offering rebuttal testimony that we expected to offer into evidence, reading from the first page, a limited number of additional exhibits.

And that is what I was referencing earlier. We can give a list and confer at a break with respondent's counsel.

JUDGE McGUIRE: Right. Give it to them as soon as possible so that when this comes up this

afternoon, we're all on the same page at least as to what's being offered and it's not coming as a, you know, not as a surprise at least but at least so we won't have to spend so much time this afternoon on this.

MR. PERRY: We anticipate offering strong opposition to this, Your Honor. We can't cross-examine an exhibit.

JUDGE McGUIRE: I'll give you that opportunity.

Is there anything else?

MR. ROYALL: Not at this time, Your Honor.

JUDGE McGUIRE: Okay. Then at this time complaint counsel may call its next witness on rebuttal.

MR. ROYALL: Yes, Your Honor.

And we call as our next rebuttal witness R. Preston McAfee.

JUDGE McGUIRE: Then, professor, if you'll please approach and I'll caution you that you're still under oath from your prior testimony in this case, so if you'll have a seat.

- - - - -

Whereupon –

R. PRESTON McAFEE

a witness, called for examination, having been previously duly sworn, was examined and testified as follows:

- - - - -

DIRECT EXAMINATION

BY MR. ROYALL:

Q. Good morning, Professor McAfee.

A. Good morning.

Q. As you'll recall, when you testified in complaint counsel's case in chief, we discussed briefly the expert report that you submitted, the original expert report that you submitted in this case. Do you recall that?

A. I do.

Q. And that original expert report I believe was completed in December 2002; is that right?

A. That seems right.

Q. Did you thereafter submit an additional expert report in this matter?

A. I did.

MR. ROYALL: May I approach, Your Honor?

JUDGE McGUIRE: Yes.

BY MR. ROYALL:

Q. I've just presented you, Professor McAfee, with a document.

Do you recognize this document?

A. Yes. This appears to be my rebuttal report, second report I submitted.

Q. And without discussing for the moment the substance of what you have to say in this rebuttal expert report, can you tell us generally what the purpose of the report was?

A. Yes. It was to respond to reports of Dr. Rapp and Professor Teece, reports that they submitted.

Q. And when you testified earlier in the case, we discussed various materials that you reviewed and considered in conducting the work that led to the completion of your original expert report. Do you recall that?

A. I do.

Q. Did you review additional materials after the original report was completed in connection with the work that you did in preparing this rebuttal expert report?

A. Yes, I did.

Q. And if I could ask you to turn with me to appendix 1 of your rebuttal expert report?

A. I have it.

Q. Which is in the last few pages of the report.

And appendix 1 is titled Documents Considered in the Preparation of the Rebuttal Report of R. Preston McAfee.

Do you have that page?

A. I had gone on to the next page, but yes, I do have that page.

Q. And with reference to appendix 1, I'd like to ask you just a couple quick questions.

First of all, did you, in connection with the work that you did on your rebuttal expert report, review any business records produced in this case?

A. Yes, I did. And the first pages set those out.

Q. And are the listing of Bates-numbered documents on the first two, continuing to the very top of the third page of appendix 1, are those the materials that you reviewed, the business records that you reviewed in connection with this report?

A. That's correct. I and my staff. Generally I reviewed all of them, but there may be some that were reviewed, only a few, by my staff.

Q. And did you in connection with your rebuttal expert report review any deposition testimony?

A. Yes, I did.

Q. Do you recall how many depositions you read in connection with that report?

A. Well, the depositions are listed on this -- I can't actually read this on the screen.

Q. You don't need to -- you don't need to count them up, but the depositions that you read are listed on appendix 1?

A. That's correct.

Q. And did you in connection with your rebuttal expert report conduct any interviews, that is, aside from interviews that you conducted in connection with your original report?

A. Yes, I did.

Q. And again, are the individuals whom you interviewed in connection with this report identified on appendix 1?

A. They are.

Q. Generally speaking, without getting into details, what was your purpose in interviewing these individuals in connection with your rebuttal expert report?

A. Mr. Geilhufe -- actually I'm not sure how to pronounce his name -- "Geilhufe" -- "Geilhufe" --

JUDGE McGUIRE: That's good enough.

THE WITNESS: That's good enough.

Mr. Geilhufe provided numbers to Dr. Rapp on the costs of changing to various alternatives, and those numbers were not consistent with my understanding, and so I wanted to check whether knowledgeable industry participants viewed those numbers as accurate.

BY MR. ROYALL:

Q. And that was, generally speaking, that was your purpose in interviewing these individuals?

A. That's correct.

Q. Now, in the course of completing your rebuttal expert report, did you have available to you the

deposition testimony of either Dr. Rapp or Professor Teece?
A. I don't believe they had been deposed at that point.
Q. Did you at some point after completing your rebuttal report review their depositions?
A. I did.
Q. Have you reviewed the trial testimony of either Dr. Rapp or Professor Teece?
A. Both of them.
Q. Are there any aspects of the trial testimony of Dr. Rapp or Professor Teece that you disagree with?
A. Yes.
MR. STONE: I do object, Your Honor, to -- this is a line of questioning that I was not permitted to engage in with Professor Teece or Dr. Rapp, that is, namely to ask them to comment on and expressly disagree with testimony of Professor McAfee, with which they in fact do agree (sic). Rather, I was held

11201

to I want you to assume that this is -- there is this theory or this proposition, do you agree or disagree with it.
JUDGE McGUIRE: Then, Mr. Royall, I'll give you a chance to respond.
MR. ROYALL: Your Honor, there were instances in which he did ask questions in that way for assumptions, but I think the statement that he just made is not correct, and I could point you to areas in the record where both -- well, I know for Dr. Rapp that he commented on Professor Teece's -- Professor McAfee's testimony and there was one point where Professor Teece commented, I objected, you overruled the objection, you said that I could take it up in cross-examination or in our posttrial briefs.
And we're not intending --
JUDGE McGUIRE: All right. Let's do this. Let's cut here to the quick and just ask the question as to the area that you anticipate he does have disagreements with and we'll go from there.
I don't want this broad-based "is there any area that you disagree with." That's not going to be helpful, and I'm not sure that I ever have approved that type of inquiry, so let's go on that basis.
MR. STONE: And I did misspeak earlier,

11202

Your Honor. I did say with which they do disagree, referring to testimony by our experts, and I just wanted to correct my misstatement.
JUDGE McGUIRE: Well, even if that's the case, I think we can expedite this inquiry if we just cut to the chase here and just ask the questions, the appropriate questions.
MR. ROYALL: Yes. Thank you, Your Honor.
BY MR. ROYALL:
Q. Professor McAfee, have you prepared a slide that summarizes the focal point of your rebuttal expert testimony?
A. Yes. I have a slide that sets out my principal disagreements with what I understand to their testimony.
Q. Can we pull up DX-359.
Do you see the slide on the screen, DX-359?
A. Yes. That's the slide to which I referred.
Q. Now, is this a slide that you prepared to assist with your testimony here today?
A. Yes, it is.
Q. Can you explain to us, in general terms, what you're seeking to communicate or convey through this slide?
A. Well, this slide sets out my principal

11203

disagreements with what I understand to be the testimony of both Dr. Rapp and Professor Teece, the big -- the largest element of which is stated in the first section, that the challenged conduct failed -- that I understand them to testify that the challenged conduct failed to lead to market -- monopoly or market power for Rambus.
Q. And the various numbered subpoints on this slide, DX-359, what do those relate to?
A. So those refer to specific points that I understand to underlie their reasoning to the conclusion that monopoly power was not created by the challenged conduct.
MR. STONE: Your Honor, I do object to this

witness characterizing the testimony of others and stating his understanding as to what they testified to.
I think the way we've proceeded and I think the way we should proceed is for this witness to simply tell us what he thinks, not for him to tell us what he thinks other people said. He should just express his opinions, not to go into expressing an opinion as to what he understands others said. That is a province that is clearly one for the court to decide.

11204

MR. ROYALL: Your Honor, it is the very nature of rebuttal expert testimony to first identify what is being rebutted. Our scheduling order contemplates that. The expert report that Professor McAfee submitted is of that nature. And we're not asking for him to interpret; we're simply asking as a foundation to bring in his rebuttal testimony --
JUDGE McGUIRE: Then on that basis you can inquire, but I want you to keep in mind the tenor of his opposition and try to tighten up this questioning.
So overruled.
MR. ROYALL: Thank you, Your Honor.
BY MR. ROYALL:
Q. Now, if we could -- before we move on to other slides, if we can take quickly and in a summary fashion each of the numbered bullet points that you have on this slide.
The first point states, "DRAM standards can confer substantial market value on selected technologies."
Without going into detail, can you explain to us the basic point that you're seeking to convey through your rebuttal expert testimony on that subject?
A. Yes. This is actually my conclusion that the

11205

DRAM -- that the standards matter and that the standards do create, do lead to monopoly power in the relevant technology markets. And that's in contrast to what I understand the position of -- oh, I get to finish, yes -- that's in contrast to what I understand to be the position of Dr. Rapp.
MR. STONE: Your Honor, I do object that the question is eliciting answers where this witness is volunteering his understanding of the testimony of others. What the testimony of others is or is not is within the court's province to determine. It's not for this witness to interpret the testimony of others.
Secondly, the testimony he's just given is wholly cumulative of what he testified to in complaint counsel's case in chief. There's not a new statement

made there --
JUDGE McGUIRE: Okay. Mr. Royall, actually you weren't here on Thursday when these objections came up in the same form and to a great extent, unless your colleagues have advised you, I upheld those objections.
If these things are cumulative, they're not going to be entered and we're not going to inquire into them.
I'm going to uphold that objection and I'm

11206

going to ask you to confine your inquiry to questions that would speak to rebut or counteract those facts in evidence offered by the other side and not to purely go back and try to beef up whatever his testimony was in his -- in your case in chief.
So as I can ascertain that testimony is cumulative, it's not coming in today, so just so you understand that.
MR. ROYALL: Yes, I understand, Your Honor. And this testimony is not cumulative. It is rebuttal testimony and it is specifically rebuttal to the testimony of their experts.
The fact that his rebuttal testimony reinforces conclusions that he reached initially should not be a problem from the standpoint of rebuttal as long as it is rebuttal to their testimony.
And if Mr. Stone is going to object every time in rebutting one of their conclusions he says something that is consistent with what he said before, then that would completely turn on its head the nature of rebuttal testimony.
We're not asking him to give any cumulative testimony. We're not asking him to come in and say what he did on direct. We're asking him to rebut their experts and what they say, and that is the sole focus

11207

of the testimony that he plans to give.
And if Mr. Stone is going to object just because this conclusion, this rebuttal conclusion, is consistent with what he said, one would hope and expect that that would be true and that doesn't make it cumulative.
JUDGE McGUIRE: Mr. Stone, one last comment.
MR. STONE: Thank you, Your Honor.
Neither Dr. Rapp nor Professor Teece disputed the proposition that in some circumstances standards can confer market power. They didn't dispute that.
A statement which says standards can confer market value is not at all inconsistent or rebutting anything they said because they didn't disagree with that general statement.
The issue we're here to decide is whether there's been any market power conferred on Rambus, and that's not been addressed in this answer. They didn't dispute that as a general proposition from time to time standards can confer -- and we're just -- we're going back over, rehashing --
JUDGE McGUIRE: Mr. Royall, I want you to respond to that point. Is this still an issue?
MR. ROYALL: It is not an issue, Your Honor. And Mr. Stone was careful in his wording of what he

11208

just said. He said that neither Teece nor Rapp said that these standards could in some circumstances confer market power. The word here is, first of all, DRAM standards and substantial market power.
This does rebut Professor -- certainly Professor Rapp who says DRAM standards don't confer substantial market power --
JUDGE McGUIRE: Okay. Overruled. I'll hear the inquiry on that basis.
MR. ROYALL: Thank you, Your Honor.
BY MR. ROYALL:
Q. Now, if we could move on to the second point, Professor McAfee -- and again, I want to ask you to confine what you have to say to the rebuttal expert testimony that you're offering rebutting the contentions that you understand to have been made by respondent's experts, Professor Teece and Dr. Rapp.
Going to the second point on this slide where you say, "Commercially viable alternatives existed ex ante," can you tell us, without getting into detail, what you're seeking to convey through your rebuttal expert testimony on that subject?
A. Dr. Rapp provided an analysis that compared alternatives to the disputed technologies, and I find flaws in that analysis which lead me to continue to

11209

maintain that there were commercially viable alternatives ex ante.
Q. And then going to the third point, you say, "Ex post lock-in effects make switching to alternatives uneconomical."
Without going into detail, can you tell us what the basic point you're seeking to convey through your expert rebuttal testimony on that subject?
A. Dr. Rapp provided an analysis of switching costs that would permit him to assess ex post lock-in. I find significant flaws with that analysis that lead me to continue to maintain that ex post lock-in effects make alternatives uneconomical.
Q. And then moving to the fourth and final point, you say, "Most likely outcomes in but-for world: JEDEC standards avoid Rambus IP or Rambus IP licensed at lower royalty rates."
Again, without going into detail, can you tell us what is the basic point that you're seeking to convey through your rebuttal expert testimony on that subject?
A. Professor Teece provided an analysis that led him to the conclusion that the but-for world would have the same outcome as the actual world. I dispute several elements in that analysis --

11210

Q. And --
A. -- and find that either the standards would have avoided Rambus IP altogether or there would have been lower royalty rates than in the actual world.
Q. And are the points outlined here, that is, the four numbered subpoints on DX-359, are these the only points of disagreement that you have with Dr. Rapp and Professor Teece?
A. No. But these are the principal points.
Q. Coming back then to the first point, where you say, "DRAM standards can confer substantial market value on selected technologies," you covered this in a summary fashion, but now I would like to probe what is the nature of your rebuttal expert testimony on that issue.
Can you begin to discuss that?
A. Yes. And I've prepared a slide.
Q. Let's go to DX-360.
Is this the slide you're referring to?
A. Yes, it is.
Q. The first bullet point on this slide states, "Compatibility requirements in the DRAM industry are high."
Before we go any further, can I ask you to explain what you mean by the term "compatibility

11211

requirements" in the context in which you used that term here?
A. This is the requirement that DRAM products be compatible with other products that work with them, things like chipsets and the like, and what I mean by this statement is that those compatibility requirements are, in qualitative terms, high.
Q. And when you say that these compatibility requirements are high, what, if any, significance does that have to your own economic analysis?
A. Well, that has the effect of creating significant lock-in to existing standards or existing technologies, so it has the effect of leading to market power and monopoly power for technologies incorporated into the standards.
Q. In the first subbullet on DX-360 you refer to the term "parts compatibility." Can you tell us what you mean by use of that term in this context?
A. Yes. Parts compatibility refers to a requirement that parts inside a system work with each other but that from the final consumer perspective, the consumer doesn't look at the parts individually, they look at the parts as a system, at the system level.
And so Dr. Rapp gave in his report the example of tires and wheels. From a consumer perspective, they

11212

don't actually care about the diameter of their tire provided it works with their wheels.
Q. And can you explain to us what point you're making in the first subbullet on this page when you say, "Parts compatibility plus complementary products leads to network effects"?
A. Yes. I understand Dr. Rapp to conclude that parts compatibility leads to -- that parts compatibility means that compatibility requirements are automatically low. I dispute that conclusion.
Parts compatibility plus significant complementary products can lead to high compatibility requirements. And the case of VHS and Beta video systems is a classic case in the economic literature.
Q. And can you elaborate on this VHS/Beta example and how that relates to the points that you're making on DX-360?
A. Yes. Two separate systems, the Video Home System of JVC and Sony's Beta system vied for being the standard in videotapes. And for a substantial period of time both had roughly similar market shares in the sort of 40, 50, 60 percent range.
VHS got a slight edge, and the understanding of economists of this incident, of this historical incident, is the edge that VHS got caused more --

11213

caused Blockbuster and other video rental outlets to have more tapes for rent.
Now, that's the complementary product. That's not a product produced by either company but instead produced by a third party, video rental agencies.
Because of an edge in the complementary products, because there were more complementary products, that gave more value to consumers of the VHS system. The effect of that was to cause more consumers to switch to VHS, which of course caused the video rental companies to produce even more or to have even more tapes to rent for VHS. That edge in video rentals in the third party led ultimately to a hundred percent market share for the VHS system.
The parallel here is that DRAM has to work --
Q. Could I stop you there just to inject a question.
A. Sure.
Q. Break this up.
And before you go on to parallels, in the example that you've mentioned, VHS and Beta, as an economic matter, do you see any evidence of a network effect at work in that example?
A. Yes. This is a classic example of what economists call an indirect network effect.

11214

Q. And in your view, in the DRAM -- is the DRAM industry comparable in any respect to the situation that you described with VHS and Beta?
A. Yes, it is.
MR. STONE: Your Honor, I just want to be certain that Professor McAfee is going to testify to the assumptions that he made about that market and not testify here as a fact witness with respect to any aspects of the market.
JUDGE McGUIRE: Mr. Royall?
MR. ROYALL: Yes, Your Honor. I could ask a question to clarify that if you'd like.
JUDGE McGUIRE: If you would.
BY MR. ROYALL:
Q. Professor McAfee, can you clarify for the record that you're not here today to comment as a percipient witness of the precise facts that may or may not have occurred in the VHS/Beta industry but, rather, you're giving this testimony as an example of an economic concept based on assumptions that you have made relating to that industry?
A. Absolutely.
Q. And now, let me go back to my prior question.
How, if at all, in your view, is the DRAM industry comparable to the situation that you describe

11215

with VHS and Beta?
MR. STONE: And Your Honor, I wasn't really as concerned whether he wants to testify as a fact witness about VHS and Beta or not. My concern is that he not testify as a fact witness with respect to the DRAM industry where he should be stating what he has assumed facts to be, not stating them as facts.
JUDGE McGUIRE: Okay. Mr. Royall, I thought your follow-up, you know, addressed that point. Mr. Stone.
MR. STONE: No. It just asked him to confirm that he was testifying as to assumptions about the VHS/Beta system.
JUDGE McGUIRE: And not the DRAM industry.
MR. STONE: And said nothing about the DRAM industry.
JUDGE McGUIRE: Mr. Royall, can we --
MR. ROYALL: Your Honor, I haven't elicited any comments about the DRAM industry yet. I've just asked him how, if at all, does this concept relate to the DRAM industry. I think he can answer that without raising any objectionable testimony.
JUDGE McGUIRE: All right. Go ahead. If you do ask him any questions that pertaining to the DRAM industry, then you'll do it on the basis of his

11216

objection so we don't have to go through this again.
MR. ROYALL: Yes, Your Honor. I'll seek to do that.
BY MR. ROYALL:
Q. Coming back to the question, Professor McAfee, how, if at all, based on your understanding of the DRAM industry or any assumptions that you've made about the industry, how, if at all, is that industry comparable to the VHS and Beta situation which you've described?
A. So my understanding -- and it is an assumption

on my part -- is that there are significant complementary products to DRAM. I assume those include chipsets, hard drives, routers, all sorts of products that use DRAM, that have compatibility requirements with DRAM.

And the effect of that -- and moreover, I assume that the cost of those complementary products are quite significant so that when you change the DRAM significant costs have to be incurred by complementary products to match the new DRAM. And the effect of that is to create network effects.

Q. And what, if any, significance does this issue of network effects have to your economic conclusions in this case?

11217

A. Well, it has the effect that, in parallel to the VHS/Beta episode, that the choice of the technology by the marketplace or dominant share of the technology in the marketplace can lead to lock-in and hence confer market power on the technologies incorporated in the standard.

Q. And you mentioned that you have read Dr. Rapp's trial testimony. Without asking you to characterize or summarize it in any way, do you recall Dr. Rapp testifying about the issue of compatibility in the DRAM industry?

A. It's my recollection and it would also also be my recollection of my understanding of his testimony that he testified compatibility requirements are low.

Q. Did anything that -- again without asking you to summarize his testimony, but did anything that Dr. Rapp had to say on the subject of compatibility in his trial testimony cause you to modify your own conclusions with regard to whether compatibility requirements in the DRAM industry are high?

A. No, it did not.

Q. Now, turning to the second principal bullet point on DX-360, what do you mean when you say, "One technology standard tends to dominate DRAM industry"?

A. Generally there's one technology that is the

11218

technology of choice in most applications.

Q. And how is that relevant to your economic opinions and conclusions in this case?

A. It corroborates the first bullet point; that is, it suggests that compatibility requirements -- that is to say, implication of the statement that compatibility requirements are high is that there will typically be a dominant product standard, and so this is a consequence, an indirect corroboration of the high compatibility requirements.

Q. And what do you mean here by the use of the term "tipping phenomenon"?

A. There's been some discussion of the market shares of the leading technology and what those shares are, and my understanding of the economics that drives those is summarized with the term "tipping phenomenon."

You asked me what I meant by the term?

Q. Can you describe in slightly more detail what that term means to you?

A. Yes. "Tipping phenomenon" is originally a physics notion. If you stand a pencil on its point, it will tend to fall one way or the other, although actually generally we'd be unable to predict which direction it would fall, but we expect it to fall; that

11219

is, it's unstable if stood on its point. And that's what's known as a tipping phenomenon.

It's a situation where -- so if you had exactly 50/50 market shares for two technologies, for example, you wouldn't know which of those necessarily would come to dominate, but you'd expect one of them to come to dominate.

And so that's the parallel to the tipping phenomenon of we don't necessarily know which standard will win, but we expect one standard to win even when they're starting from equal positions.

Q. And how is that relevant, that concept relevant to your economic opinions and conclusions?

A. That's -- I see evidence of that in the historical record, that is, of standards tipping from one generation to the next.

Q. And what do you mean here when you say in the final point, "JEDEC standards have dominated throughout relevant period"?

A. For the last decade or so, the majority of the standards have all been JEDEC standardized technologies, that is, JEDEC standard DRAM designs; that is to say, even when there were two or more standards that were in large use, both of them were JEDEC standards.

11220

Q. And how is that relevant to your economic opinions and conclusions?

A. Well, it's an indication that the JEDEC standards -- so if I could go back to VHS and Beta, these were proprietary designs put forth by JVC and Sony that competed in the marketplace.

It could have been the case given the characteristics of the economics of the DRAM industry that standards came -- there were proprietary standards and a variety of other standards and that JEDEC was just one in a sea of alternative standards, but the empirical fact, which again is an assumption on my part, that it's JEDEC standards that have dominated the marketplace elevates the importance of those standards.

Q. Is it your view or are you seeking to convey through this slide, DX-360, that in the DRAM industry multiple standards simply cannot coexist in the market at the same time?

MR. STONE: Objection. Leading.

JUDGE McGUIRE: Sustained.

BY MR. ROYALL:

Q. I'll restate it.

Do you have a view, Professor McAfee, as to whether in the DRAM industry multiple standards can

11221

coexist in the market at the same time?

A. Well, I agree that multiple standards may exist at the same time, but that does not overturn my conclusion that one standard at any given moment tends to dominate.

And we do see -- we see passage from one dominant standard to a subsequent dominant standard, but what we don't tend to see is -- what we don't see and what I would not expect to see, given my understanding of the industry, is a long period of time where two standards both had large market shares.

Q. Can we pull up -- pull this slide down and pull up DX-141.

Do you recall this slide, Professor McAfee, from your direct testimony?

A. Yes, I do.

Q. Does this slide relate in any way to the points that you've been discussing in terms of the tipping phenomenon and the extent to which JEDEC standards have dominated in the relevant period?

MR. STONE: I object, Your Honor, on the grounds that this is cumulative. Neither Professor Teece nor Dr. Rapp addressed anything about this chart during their examination. We're simply rehashing testimony this witness has already given.

11222

MR. ROYALL: Your Honor, we -- may I?

He hasn't given the testimony, so how he could object to whether it's cumulative or not I'm not sure.

But this is obviously merely a pictorial graph, and I'm using it -- it's the only slide that I tend to go back to from his direct testimony. I'm using it for him to discuss and illustrate the concept that -- the rebuttal concepts that he's now describing. It's not cumulative in the mere fact that it's just a pictorial aid to the rebuttal testimony.

JUDGE McGUIRE: Overruled.

BY MR. ROYALL:

Q. Now, focusing obviously solely on your rebuttal testimony and the points that you're making in rebutting the testimony of respondent's experts, does this picture, DX-141, does it illustrate in any way the points that you've been discussing in terms of the tipping phenomenon or the dominance of JEDEC standards?

A. Yes, it does.

Q. And can you elaborate?

A. Well, to see the tipping phenomenon it might be useful to start with SDRAM, which is the area covered in blue.

And what you see in this is a period where,

11223

roughly 1996, 1997 and 1998, where there's relatively slow penetration of DRAM -- of the SDRAM in the marketplace, which then speeds up in 1997 so that in fact it goes from being a relatively small share to being the majority standard.

And there's actually -- so in other words, the growth rate increases in sales until it becomes a dominant standard, and then it has a period where it is the dominant standard and other products are trailing off or are still small market shares.

Q. And so that answer I take it was focused on the tipping phenomenon and the extent to which this illustrates the tipping phenomenon?

A. Yes. This illustrates the market tipping from EDO, which is in orange, to SDRAM, which is in blue.

Q. Does this slide in any way depict the point that you were making on DX-360 about JEDEC standards having dominated throughout the relevant period?

A. Yes, it did -- does. It's my understanding that the green, orange, blue and yellow all represent JEDEC standards, and so as a consequence, almost all of the area of this picture, that is, almost all of the market share throughout the entire relevant period is -- represents JEDEC standards.

Q. And from the standpoint of assessing the

11224

economic question that you identified I believe in the first slide as to whether the inclusion of Rambus' technologies in the SDRAM and DDR SDRAM standards, does the concept that you're referring to or does this graph relate in any way to those conclusions?

A. Yes. This suggests that incorporation in JEDEC standards is highly likely to lead to dominance of the marketplace or has led to -- actually what it suggests directly is that it has led to dominance in the marketplace.

MR. ROYALL: Your Honor, may I approach the easel?

JUDGE McGUIRE: Yes.

MR. ROYALL: Thank you.

BY MR. ROYALL:

Q. Now, Professor McAfee, I know you weren't actually present in the courtroom when Dr. Rapp testified, but I'll represent to you that this is a demonstrative exhibit, DX-328, that I created in the cross-examination of Dr. Rapp based on data presented in Dr. Rapp's expert report.

And do you recall reading the testimony relating to this demonstrative DX-328?

A. Yes, I do.

Q. And you'll see at the bottom of DX-328 a

11225

listing of market shares for the leading DRAM technologies for '94 through 2001 and then at the very bottom I wrote "average equals 71 percent."

Do you see that?

A. I do.

Q. Now, let me ask you to assume that that is a correct calculation of the average of the market share of the leading DRAM technology over the years that are reflected here, '94 to 2001.

Can you assume that?

A. I can assume that. In fact at some point I've calculated that myself, so...

Q. Well, then assuming that is a correct statistic, does that number have any significance to your economic opinions or conclusions?

MR. STONE: This is not contained in Professor McAfee's rebuttal report, Your Honor. I object on the grounds this is outside the scope of his rebuttal report.

JUDGE McGUIRE: Mr. Royall.

MR. ROYALL: Your Honor, this is rebutting testimony that was given by Dr. Rapp at trial, and in his rebuttal report Professor McAfee certainly did address the broader issue that we're discussing here, which is the extent to which standardization by JEDEC

11226

can confer substantial market power, which was the context in which this arose at trial.

MR. STONE: This is not rebutting testimony that was given by Dr. Rapp. This is testimony that was elicited by Mr. Royall on cross-examination. You can't ask questions on cross-examination to then create an opening for your expert to come back and say something that's not in his report. It's not in his report. But if he did calculations of this on his own, those calculations aren't in his report.

MR. ROYALL: Your Honor, I believe that proper rebuttal does extend to testimony that was elicited from a witness when the witness testified. It's not limited to what was elicited on direct.

JUDGE McGUIRE: Overruled. I'll hear the testimony.

BY MR. ROYALL:

Q. Now, referring again to the 71 percent statistic at the bottom of DX-328, does that number -- and we're assuming that it's an accurate average -- does that number have any significance to your economic opinions and conclusions?

A. I have to say that's kind of an odd way of phrasing the question for a rebuttal question. Could I ask you to rephrase the question.

11227

Q. Well, you understand that this is a slide that was used with Dr. Rapp in his testimony.

A. Yes, I do.

Q. And the average number at the bottom of the

page on this DX-328 is 71 percent.
Do you see that?
A. I see that number, yes.
Q. And do you recall that Dr. Rapp was asked about that statistic?
A. Yes, I do.
Q. And do you have -- do you attribute anything to that statistic from the standpoint of your own economic conclusions or opinions?
A. I see that statistic as representing a combination of dominant periods and transition periods.
So for example, in 1994 you see what is clearly a dominant period, fast page mode is at 97 percent, and then you also see transitions from fast page mode to EDO, from EDO to SDRAM, and in the latter part of the time period from SDRAM to DDR.
So as a consequence, 71 percent understates the extent to which there was a dominant standard in the marketplace because it averages the percentage associated with the dominant standard and the

11228

percentage associated with transitions.
Q. Putting aside what the historical data shows as to the market shares of the leading DRAM technologies over time, do you have a view from the standpoint of economic theory as to whether one would expect to see a single dominant standard in the DRAM marketplace?
A. As I've used the term "dominant," yes; that is to say, there is a design of which the majority, the vast majority even, of applications are built to.
Now, that's not to say that you don't have some legacy applications, and it's my understanding, it's an assumption on my part, that some legacy applications are as much as ten years old.
I believe it is my understanding that Mr. Bechtelsheim testified that Cisco has a ten-year time horizon on some of its products and as a result you would expect to see some legacy applications using old standards.
You also have some applications that require -- that value very highly much faster DRAM. Video has been the leading candidate or the leading example of that. And that gives you a small niche for even faster products than the majority product. But nonetheless that there's a product which is the majority product

11229

and it's a dominant -- it's correctly described as a dominant standard.
Q. Now, let's go back to DX-359.
We've been discussing the first numbered subpoint on DX-359. I'd like to now move to the second point, which states, "Commercially viable alternatives existed ex ante."
What is the nature of your rebuttal expert testimony as relates to that point on DX-359?
A. Dr. Rapp performed a study, an analysis of alternatives, and I find significant fault with that analysis. And I've actually prepared a slide which -- actually I've prepared a series of slides on that.
Q. And let's go to DX-361.
And while we're doing that, Your Honor, may I approach the easel and just pull this down?
JUDGE McGUIRE: Go ahead.
BY MR. ROYALL:
Q. We now have on the screen DX-361. Is this the slide you referred to a moment ago?
A. Yes, it is.
Q. And can you tell us, generally speaking, what are you seeking to convey or communicate through this slide?
A. Well, broadly speaking, there are two kinds of

11230

problems that I identify with Dr. Rapp's analysis. The first is the methodology, that is, the general approach taken, has problems.
Q. And you refer to the methodology in the first point and in the second point you refer to his underlying assumptions.
In terms of your rebuttal expert testimony, what do you have to say, again generally speaking, about the underlying assumptions of Dr. Rapp's analysis?
A. And so this point refers to even accepting the methodology, that is, ignoring the key to the methodology, the analysis is not robust to what I see -- this is a factual matter -- but what I see as relatively small changes in the assumptions and things -- changes that may even -- might even be found to be actually correct.
So again, this is if you change the assumptions, and it's a factual matter which assumptions are actually right, you get different answers; that is, it overturns his conclusion.
Q. And is that what you mean when you use the terminology that the analysis is not robust, or do you mean something different?
A. No. That is -- well, robustness generally

11231

refers to changing the assumptions but not necessarily to be in accord with the facts, whereas here I'm using it to mean changing the assumptions to be in accord with what I understand the facts to be or what may prove to be the facts.
Q. Now, putting aside your comments on assumptions, let's focus on the first bullet point.
What specifically do you mean when you say on DX-361 that Dr. Rapp's methodology is fundamentally flawed?
A. Well, I've prepared a series of slides, a series of two slides, discussing this. Methodology generally just means here's the general approach that he's taken and it's not -- without referring to the specifics of the approach, are there problems with the general approach.
Q. Let's go to the next slide, DX-362.
Is this one of the series of two slides on methodology that you were referring to?
A. Yes, it is.
MR. STONE: I do object to this slide, Your Honor. It contains a reference to an exhibit as support for a proposition which necessarily requires this witness to be interpreting the evidence, and I think it's now well-established that the experts are

11232

not supposed to be interpreting the evidence, and that's exactly what's happening here.
You'll recall that I wanted to show an exhibit to Professor Teece, namely, the Infineon trial exhibit, and Mr. Royall objected on the grounds it was not permitted, and that objection I think was sustained.
And I don't mean to make that argument for the purposes of saying you should treat it the same way in every instance. I think that's not a fair characterization of what I understand to be Your Honor's role.
But my point is this slide necessarily includes this witness' interpretation of an exhibit, and that's inappropriate.

MR. ROYALL: May I comment, Your Honor?
JUDGE McGUIRE: Go ahead.
MR. ROYALL: Your Honor, you asked directly at -- in the testimony -- in the testimony of -- preparing the rebuttal testimony of our experts that we be careful not to raise issues that would create objections, and we have been careful.
This slide is designed to address this issue in precisely the same way in which the slide that you now see on the screen addressed an issue with

11233

Dr. Rapp. And you'll see the reference to the RX number?
JUDGE McGUIRE: Yes.
MR. ROYALL: That's a document that is on respondent's exhibit list. We've done -- taken the same approach here.
Dr. Rapp was permitted to testify about his understanding of this document and about the assumptions that he made based on that, and I would direct Your Honor to page 10027 of the trial transcript.
JUDGE McGUIRE: All right. I'm going to cut this short.
I'm going to hear the question. If opposing counsel feels that it does speak to the interpretation of the evidence, that's something you can point out in your post-hearing brief and that's something that I'll give it its due weight and I'll give any answers to that point its due weight, if any.
MR. STONE: Thank you, Your Honor.
MR. ROYALL: Thank you, Your Honor.
BY MR. ROYALL:
Q. Now, if we could go back to DX-362.
You make a number of points on this slide, Professor McAfee. Let me start by asking you about the

11234

first point, which states, "Fails to replicate actual JEDEC decision-making behavior."
Can you explain to us what you mean by that?
A. So my understanding of Dr. Rapp's analysis is that he -- the general approach he's taken is to look at what he calls a rational DRAM manufacturer and asks how that rational DRAM manufacturer would select among alternatives.
That is not in accord with my understanding of JEDEC decision-making behavior, that is, the way JEDEC has behaved over the last decade or so, and so as a consequence, it doesn't -- his approach doesn't reflect important elements of the -- my understanding of the actual way in which these decisions are made.
Q. And in moving to the first subbullet where you say, "No accounting for time to market needs -- 'satisficing,'" with the word "satisficing" in quotes, can you explain what you mean by that?
A. Yes. The approach taken does not have -- let me say this.
The methodology must select a single product. That is, there's no ambiguity given the methodology. There's a single product that would be the outcome of the selection process modeled by Dr. Rapp because one product -- it's as if the technologies ran a horse race

11235

and one had to win of those.
And so there's no accounting in that methodology for what the term I've used, which is an common economic term, of satisficing or the time pressure that causes multiple products to be actually viewed as good substitutes for each other.
Q. Now, coming back to the point that you're making on that first bullet here, when you say, "Fails to replicate actual JEDEC decision-making behavior," in your view, is it important in an analysis of this sort to construct a model that seeks as best as possible to replicate actual JEDEC decision-making behavior?
A. Yes. If you want to actually understand how the marketplace decides, you have to understand how the decisions are made. That is, you have to understand the process by which decisions are actually made, and that is not accounted for in Dr. Rapp's approach.
Q. Coming back to the subject of satisficing, again without asking you to summarize the testimony, in the trial testimony of Dr. Rapp and Professor Teece, do you recall seeing any reference in their testimony to the concept of satisficing?
A. It's my recollection that they were critical of

11236

the -- at least the application of satisficing in this context.
Q. And did anything that either Dr. Rapp or Professor Teece said in their trial testimony cause you to alter or modify your own conclusions as to the applicability of that concept in this context?
A. No, it did not.
Q. Have you made any assumptions about whether JEDEC in the process of selecting DRAM standards behaves in a way that reflects the type of economic behavior that you referred to as satisficing?
A. Yes, I have assumed that JEDEC's behavior reflects satisficing.
Q. And what is the basis for that assumption?
A. I believe there's actually a substantial amount of evidence that makes me comfortable with that conclusion or that --
MR. STONE: I object, Your Honor, because if the witness is now going to state the basis for his assumptions, he's rehearsing the evidence, which was a basis on which we originally filed a motion in limine with respect to his testimony, and it was granted that he's not permitted to rehearse the evidence or go back in the evidence that he says may or may not support his assumptions because that is something that is clearly

11237

within the province of the court.
JUDGE McGUIRE: Sustained.
MR. ROYALL: May I comment?
JUDGE McGUIRE: You may comment, but I'm not going to change my own ruling there, so...
MR. ROYALL: We're not asking him to rehearse testimony. And again, I've been extremely careful in phrasing these questions to track precisely the type of questions that were asked by Mr. Stone and allowed, sometimes over my objections.
And in this case -- this relates back to page 10027 in the trial transcript relating to the slide that we pulled up with Dr. Rapp earlier which quoted a document that's on their exhibit list. He was permitted to ask and elicit how that document related to his assumptions, and that's all I'm seeking to do.
MR. STONE: Your Honor, if I -- I have two --
JUDGE McGUIRE: Go ahead, Mr. Stone.
MR. STONE: -- if I need to.
The question asked was different. The question was: What's the basis for your assumption?
And on a later point in the transcript from where Mr. Royall has just quoted, at 10412 through 13, Mr. Royall objected on the following grounds, that I

11238

was asking him a question, that I was asking the question: Is that a reasonable assumption? And then I'm saying, Mr. Royall said, As you read the facts of this case, do you think that's a reasonable assumption? That's the problem here, Mr. Royall said.

And Your Honor, that objection was upheld.

JUDGE McGUIRE: That is sustained and you're going to have to change the format of your inquiry, Mr. Royall.

MR. ROYALL: Yes. I'm happy to do that, Your Honor, but I did not ask -- I did not ask him whether this is a reasonable assumption.

JUDGE McGUIRE: Well, just restate and let's see where we go with it.

BY MR. ROYALL:

Q. You said that you've made an assumption, Professor McAfee, relating to this issue of satisficing and how that may relate to JEDEC's decision-making behavior.

Does any of the information that you've presented on this slide, DX-362, relate to the basis that you have for making such an assumption?

A. Yes, it does. There's a quote which increases my comfort level with respect to my assumptions.

MR. STONE: I object to this document. It's

11239

not in evidence. CX-2711 is not in evidence.

MR. ROYALL: No. And Your Honor --

MR. STONE: It could have been used with witnesses. It's a Micron document. It could have been used with Mr. Lee if they thought it was important. It could have been used with a whole bunch of witnesses they called.

JUDGE McGUIRE: Mr. Royall.

MR. ROYALL: Your Honor, there has been no limitation on asking experts only about documents that are in evidence. In fact, what I would like to do now is to offer this document in evidence, and this is CX-2711.

MR. STONE: I object. I object. We have no ability to cross-examine anybody about this document when they bring it in through their last witness who never saw it at the time it was prepared. I object to the document. It's improper. It's not within the scope of proper rebuttal.

MR. ROYALL: Your Honor, admitting documents through experts is something that has been done in this case. It's been done over our objections. It has been done by Mr. Stone.

And I'm referring specifically to an instance in which in the cross-examination of Mr. Nussbaum

11240

Mr. Stone offered and was able to admit a number of documents, a series of documents, some of which were in Japanese, and there was no foundation that the expert had ever seen the documents, no foundation that the expert could read in Japanese. And this is at trial transcript 1659 to 1660. The documents were admitted with an expert with no foundation over our objection.

JUDGE McGUIRE: Mr. Stone, response?

MR. STONE: And as Mr. Royall made the argument when I was doing Professor Teece and Dr. Rapp, cross-examination is different. You're permitted on cross-examination to show documents to experts that you're not on direct.

I was prohibited by the court's ruling and on Mr. Royall's objection from showing documents to Professor Teece and Dr. Rapp. Mr. Royall got up on cross-examination and showed them documents. I objected. Your Honor overruled my objection on the ground that there's a broader scope for cross-examination to challenge the basis for the opinions.

This is not cross-examination of Professor McAfee. You can't use an expert as a vehicle to just float in a bunch of documents that the expert

11241

can say I saw.

JUDGE McGUIRE: Mr. Royall, one more comment.

MR. ROYALL: One distinction is I was permitted to show documents to experts if there was a foundation that they had seen them before, and I can establish that foundation here.

Secondly, they have, over our objection, been permitted to do exactly what he said, which is to use an expert witness as a vehicle for admitting the document, and in that case these were documents that were in Japanese and there was no foundation that the expert had ever seen them. We had objected. The objections were overruled. The documents -- the Japanese documents were admitted. And I have copies of them.

JUDGE McGUIRE: I know which ones you're talking about.

MR. STONE: And it was in cross-examination to challenge the expert's opinion that nobody reading the '898 application --

JUDGE McGUIRE: I'm upholding the objection. I will not enter this piece of evidence.

BY MR. ROYALL:

Q. Moving, Professor McAfee, to the next bullet, you say here, "Royalties and manufacturing costs are

11242

not directly comparable."

Can you explain to us what you mean by that?

A. Yes. Another aspect of Dr. Rapp's methodology is a direct comparison of manufacturing costs translated into a percentage so that they're in the appropriate units to royalties. But there are two problems with making such a direct comparison. That is, this is not an apples-to-apples but it's an apples-to-oranges comparison.

Q. What do you mean by that?

A. It is inappropriate -- it is inappropriate to just compare -- well, let me say it a different way.

A rational manufacturer would not be indifferent between a manufacturing cost and a royalty that were the exact same percentage of their costs generally.

So that is to say, if I could manufacture it for .75 percent, just to take a specific number, or I could pay a royalty for .75 percent, I would not be generally indifferent between those two.

Q. You refer in the subbullet, first subbullet here, to manufacturing costs are subject to productivity gains. What do you mean by that?

A. Well, these subbullets set out the reason or the basis for my conclusion that royalties and

11243

manufacturing costs are not directly comparable. And one of them is I can -- with manufacturing costs I can seek ways to minimize -- to minimize those costs. That is, I can find ways to actually reduce my costs overall. And that's going to be not possible with a straight percentage royalty.

Q. And what do you mean by the next point, royalties are subject to hold-up? How does that relate to the point that you're making?

A. Manufacturing costs, they may be uncertain, but they don't have the feature that they're going to go up

with renegotiation.
Royalties, on the other hand, are subject to hold-up in the sense that if, for example, the contract, the license under which royalties are paid, expires prior to the time that the patents that underlie those royalties expire, you're going to have to renegotiate at some point, and at that point the royalties can be renegotiated upward; that is, the lock-in can be exploited.
Q. Now, with regard to the critiques of Dr. Rapp's methodology that you describe on this slide, what, if any, bearing do these points have on your views as to the reliability of Dr. Rapp's methodology?

11244

A. The first point, the first subbullet, leads to a conclusion just of unreliability, but it doesn't directly speak to a bias in any direction in his analysis, but it does lead to a conclusion that market -- commercially viable technologies may be excluded by his approach that in fact may not have been excluded by the JEDEC decision-making behavior.
The second one is in some sense more pernicious in that it speaks to a bias in Dr. Rapp's methodology in that it's going to understate the costs of royalties and overstate manufacturing costs. That is, it's going to induce a bias in the conclusion.
Q. Are these the only critiques that you have of Dr. Rapp's methodology in terms of his analysis of alternatives?
A. No. I have a second slide.
(Pause in the proceedings due to technical difficulty.)
JUDGE McGUIRE: All right. Mr. Royall, you may proceed.
BY MR. ROYALL:
Q. I think we now have DX-363 on the screen. Is this again a slide that relates to your critiques of Dr. Rapp's methodology?
A. Yes, it is.

11245

Q. Let me ask you about the first point that says, "Fails to account for potential impact of IP disclosures on evolution of DRAM technologies in but-for world."
Can you explain to us what you mean by that?
A. Yes. The approach that Dr. Rapp has taken, that is, the methodology, is to recreate the actual world in the -- using alternative technologies. That is to say, it's to recreate the complete functionality of the DRAM as we know it today in the alternative -- in the alternative world where an alternative technology was selected.
But that neglects the fact that had an alternative technology been selected, it is likely that the world would have evolved in a different way.
And so it neglects the impact that disclosures could have or in particular the choice of alternatives would have on the nature of the development of technology.
MR. STONE: Your Honor, I object to the last part of this witness' testimony on the grounds it's outside his area of expertise. He's not an expert in which way technology of DRAMs or other technologies would have gone and he has no basis as an economist to say that disclosure would have caused it to move in a

11246

different direction.
MR. ROYALL: Your Honor, I can clarify that with the follow-up question.
JUDGE McGUIRE: Go ahead.
I'm going to overrule the objection.
BY MR. ROYALL:
Q. Professor McAfee, when you comment on the DRAM industry or how the DRAM industry evolves or might evolve in a but-for world, are you intending to comment as an expert on DRAM technology?
A. No, I am not.
Q. Are you intending to comment as to what specific facts are as opposed to factual assumptions?
A. Well, I'm making factual assumptions, but I should say that the evolution of -- so how changes in the world affect choices that are made is actually a normal economic analysis point, and that changing, for example, the price of some technology, what will that do to demand for technology is right within the core of economic analysis.
Q. And is it in that context that you gave the previous answer?
A. Yes. That is what I intended to communicate.
Q. Now, you give a specific example in the first subbullet on DX-363 relating to DRAM applications and

11247

the number of latency and burst options. Do you see that?
A. Yes, I do.
Q. Can you explain what you're referring to there?
A. Yes. Under programmable CAS latency and programmable burst length I understand there to be and I understand Dr. Rapp to have assumed that there are twelve possibilities, and that's three CAS latencies times four burst lengths.
And so effectively that -- and so in assessing what would be the cost of going to fixed CAS latency and fixed burst length, Dr. Rapp has assumed that all twelve of the possible combinations would be offered by the marketplace.
Given my understanding of the DRAM marketplace and in particular the dominance of a single standard that we've referred to, I would be highly surprised if the outcome of the marketplace was for all twelve of those possibilities to actually be offered in fact.
Now, I wouldn't go as far as to say that only one of the twelve would be offered, although that's a possibility, and it's a possibility that was suggested to me by Desi Rhoden, but instead that not all twelve would be offered.

11248

Q. Now, referring to the first principal bullet point in the subpoints on this slide, DX-363, what, if any, effect do these errors, as you describe them, in Dr. Rapp's methodology have on the outcome of his analysis in your view?
A. Well, in the choice of -- to be specific, in the choice of fixed CAS latency and fixed burst length, Dr. Rapp has assumed that all twelve of the theoretical combinations would be offered. If instead only two of those combinations were actually offered by the marketplace, then in fact he's overstated the costs by a factor of six.
Q. Now, moving to the last bullet point on DX-363, there you state, "Ignores the potential for innovation of asynchronous alternatives in the but-for world."
Do you see that?
A. Yes, I do.
Q. And what do you mean by that?
A. Dr. Rapp has dismissed asynchronous alternatives entirely, it is my understanding; that is,

he's performed no analysis of asynchronous alternatives. And my understanding of JEDEC behavior is that the burst EDO is actually a serious contender to SDRAM as an alternative and burst EDO is an

11249

asynchronous alternative.

Had burst EDO been selected by the marketplace over SDRAM, the likely outcome from an economic perspective is that there would have been further investment in the asynchronous alternatives and that the marketplace might never have gone to synchronous DRAMs at all.

Q. Now, you told us earlier that your critique of Dr. Rapp's analysis relates both to his methodology and to his assumptions. We've been talking about methodology.

Let me ask you now, what, if anything, do you have to say in the nature of rebuttal expert testimony as relates to Dr. Rapp's assumptions?

A. Yes. I've prepared a slide that actually summarizes the assumptions that I find problematic.

Q. And we now have on the screen DX-364. Is this the slide you're referring to?

A. Yes, it is.

Q. You have two columns on this slide, one

titled Dr. Rapp'S Assumptions and one titled Alternative Assumptions.

Can you explain to us generally what you're meaning to convey with these two columns?

A. Yes. The left column sets out what I

11250

understand to be Dr. Rapp's assumptions in performing his analysis. The right column sets out alternative assumptions that -- now, these are factual assumptions -- they're not ones that I can testify to the truth or falsity of -- but these are factual assumptions which I've looked at what the effects of those assumptions would be on Dr. Rapp's analysis.

Q. And when you say you've looked at what the effect of the assumptions would be, are you referring to the effect of substituting the alternative assumptions that you identify here into Dr. Rapp's analysis?

A. Yes. That is to say, of altering one of Dr. Rapp's assumptions or one at a time and to be -- to one of the alternative assumptions and then performing the identical analysis, otherwise identical analysis.

Q. Now, the first point that you identify here under Dr. Rapp's Assumptions, you refer to alternatives Dr. Soderman claims to infringe Rambus patents should be ignored.

And are you referring there to what you -- an assumption that you understand Dr. Rapp to have made in his analysis?

A. Yes.

11251

Q. And then under Alternative Assumptions you say, "Supposedly infringing alternatives should be considered."

That's an alternative assumption that you're referring to?

A. That's correct.

Q. And have you explored what effect it would have on Dr. Rapp's analysis if you were to alter the analysis by substituting that alternative assumption in place of Dr. Rapp's assumption?

A. Yes. I should say that neither one or the other is correct. It's a matter of fact -- it's a factual question whether the alternatives that Dr. Rapp -- that Dr. Soderman said infringe do in fact infringe. And if they do infringe, then Dr. Rapp's assumptions are correct. If they don't infringe, then the alternative assumptions will be correct. And that's a matter of -- that's a factual question that I'm not able to ascertain.

Q. And putting aside what the facts or what the law may determine on that issue, have you nonetheless explored this alternative assumption that you identify in point 1 on DX-364?

A. Yes. And I've prepared a series of slides examining...

11252

Q. Let's go to DX-365.

In this slide, DX-365, on the first bullet point you say, "By excluding alternatives Dr. Soderman claims to infringe Rambus patents, Dr. Rapp eliminates least costly alternative to PCL," or I take it you're referring to programmable CAS latency?

A. That's correct.

Q. And then you say, "Second least costly alternative to PBL," and by that are you referring to programmable burst length?

A. That's correct.

Q. Now, what specifically do you mean when you make those statements in the first bullet point of DX-365?

A. So Dr. Rapp has performed an analysis examining various alternatives. He's excluded some alternatives from the analysis on the basis that Dr. Soderman said that they infringe or at least that I understand Dr. Rapp to say that Dr. Soderman said they infringe.

And in particular he's excluded what would have been the least costly alternative to programmable CAS latency; so that is, it would have of mattered significantly to his findings about what are the costs of alternatives had he included the -- these allegedly

11253

infringing technologies.

Q. Now, if we could pull up DX-307.

Do you see that on the screen, Professor McAfee?

A. Yes, I do.

Q. Do you recall this slide, DX-307, being -- having been used with Dr. Rapp's testimony?

A. Yes, I do.

Q. And you said that by -- you said earlier by excluding alternatives Dr. Soderman claims to have infringed Rambus patents Dr. Rapp eliminates the least costly alternative to programmable CAS latency.

Does this slide on the screen, DX-307, relate to the point you were making?

A. Yes, it does.

My understanding of the orange column, which has the subnote "covered by Rambus patent," is that that's to be excluded from the analysis because Dr. Soderman has testified that it's covered by Rambus patents and hence would not have been available to JEDEC as a free standard.

Q. And do you have some basis to refer to that excluded alternative as the least-cost alternative?

A. Yes, I do. If you look at the bottom row, which has the increased cost as a percentage of the

11254

average selling price or ASP, you see that least-cost alternative is in fact the one in the orange column at .21 percent.

Q. And if we could go to DX-309.

Do you recall this being another slide used by

Dr. Rapp in this case referring not to alternatives of programmable CAS latency but, rather, alternatives to programmable burst length?
A. Yes, I do.
Q. And you said earlier that by excluding alternatives Dr. Soderman claims to infringe Rambus patents Dr. Rapp eliminates the second least costly alternative to programmable burst length.
Is there information on this slide, DX-309, that relates to that?
A. Yes, there is. If you look again at the bottom row, increased cost as a percentage of average selling price, you see that the least costly is zero percent, comes from use burst terminate, but that the second least costly is .21 percent, which is explicitly identify in read command, and that is excluded by being covered by a Rambus patent.
Q. If we could now go to DX-311.
Do you recall this slide, DX-311, being used with Dr. Rapp's testimony?

11255

A. Yes, I do.
Q. And you'll see that there are two columns here, one referring to least costly and one to most costly.
Do you have an understanding of what those columns relate to?
A. Yes, I do. The Least Costly column refers to the combination of alternatives for both programmable CAS latency and programmable burst length that minimize the cost in that row, but it's also excluding the technologies that are allegedly covered by Rambus patents.
The Most Costly column refers to the technologies that in fact are the most expensive in that list, in those two lists.
Q. And do you have an understanding as to how Dr. Rapp's conclusions as to the least costly of alternatives to programmable CAS latency and programmable burst length would differ if he had included the alternatives that Dr. Soderman claims to infringe?
A. Yes, I do. And I prepared a slide that illustrates that change.
Q. Let's go to DX-366.
Is this the slide you're referring to?

11256

A. Yes, it does -- yes, it is.
Q. And can you explain to us what you're seeking to depict through this slide?
A. So this slide has substituted the programming in read command, which is an allegedly infringing technology, for programmable CAS latency. That was the least expensive technology according to Dr. -- well, I guess it's really according to Mr. Geilhufe, but according to Dr. Rapp's calculations of Mr. Geilhufe's numbers.
And that comes out as a total cost of .21 percent, which is substantially less than the Rambus -- the alleged -- the Rambus SDRAM royalty that Dr. Rapp used in his testimony.
As a result, the consequence is that the conclusion that Dr. Rapp had found is in fact overturned.
Q. And when you say "overturned," what do you mean by that?
A. I mean that a rational manufacturer would not have chosen the Rambus SDRAM royalty but instead would have chosen the alternative technologies.
Q. And by that do you mean that Dr. Rapp's own analysis with this substitution would lead to that conclusion?

11257

A. That's correct.
MR. STONE: Objection. That's leading, Your Honor.
JUDGE McGUIRE: Sustained.
BY MR. ROYALL:
Q. And do you have an understanding as to what conclusion Dr. Rapp's analysis would lead to if the change that you have made and reflected in DX-366 were to be made?
A. The only change I've made to Dr. Rapp's analysis is to eliminate the patent issue on one of the technologies; and so that is to say, the only change I've made is -- I have not changed any of his numbers otherwise. In fact, I've taken the numbers from Dr. Rapp's own slides.
And so the effect is that following exactly his methodology, if Mr. Soderman's analysis is incorrect and these are in fact public domain technologies, then Dr. Rapp's analysis changed to say that should be reversed.
Q. And is that what you're referring to in the box at the bottom of this slide?
A. Yes, it is.
Q. Now, in preparing this, these calculations on DX-366, did you substitute a different alternative for

11258

the programmable burst by comparison to what Dr. Rapp's analysis used?
A. I have not in this particular slide because the programmable -- the burst terminate alternative is in fact the least expensive and was judged to be noninfringing.
Q. If you were to substitute in place of burst terminate here the second least costly alternative to programmable burst length, which I believe you said earlier according to Mr. Geilhufe's numbers was explicitly identify in read command, if you were to substitute that alternative here, do you have an understanding of how that would affect the calculations or the conclusions of Dr. Rapp's analysis?
A. Yes. Explicitly identify in read command as an alternative to programmable burst length was also a penny, so the second row of numbers would go from being zero to one cent. The total costs would go to two cents. The cost as a percentage of the average selling price would go to .42 percent, which is still less than .75 percent, which is the number Dr. Rapp used for the Rambus SDRAM royalty.
Q. And do you have an understanding as to what, if those changes were made, what outcome Dr. Rapp's

11259

analysis would lead to?
A. Yes. It continues to lead to choosing the alternative because .42 percent is less expensive than the number Dr. Rapp used for the SDRAM royalty of .75 percent.
Q. Let's come back to DX-365.
Now, on DX-365, we've been discussing I believe the first bullet point and the two subpoints.
I want to go down to the second principal bullet point where you say, "An alternative to DEC" -- and by that are you referring to dual-edged clocking?
A. Yes, I am.
Q. You say, "An alternative to dual-edged clocking

that Dr. Soderman claims to be infringed, if considered by Dr. Rapp, would have been the least costly alternative."

Do you see that?

A. I do.

Q. And when you refer here to the least costly alternative to dual-edged clocking, specifically which alternative are you referring to?

A. So it's programming -- excuse me. It's dual banks on chip.

Q. Are you finished with your answer?

A. The least costly alternative, yes.

11260

Q. And do you have an understanding as to whether Dr. Rapp considered that alternative for purposes of the analysis that he presented at trial?

A. My understanding is he excluded that at trial and also excluded it in his expert report.

Q. Do you know of any reason why in an economic analysis of alternatives to dual-edged clocking this alternative should be excluded?

A. I'm not aware of any reason that this alternative should be excluded.

Q. Do you have an understanding of what effect it would have on Dr. Rapp's analysis if he had included the alternative to dual-edged clock that you've referred to, which I think is also sometimes referred to as the interleaving banks on chip alternative?

A. Yes. Yes, I do have an understanding of that, of the effects of that alternative. And I've prepared a slide that illustrates that.

Q. Now, before we get into your slide, let me ask you, when you say that it's your understanding that this is the least costly alternative, interleaving banks on chip, least costly as judged or determined by whom?

A. This is following Dr. Rapp's methodology using the numbers supplied by Mr. Geilhufe, so it's least

11261

costly as judged by Mr. Geilhufe, would be my understanding.

Q. Can we pull up DX-300.

Do you recognize this slide, Professor McAfee?

A. Yes. This seems to be -- appears to be a slide from Mr. Geilhufe's testimony.

Q. And when you said that you understood that the interleave banks on chip alternative was the least costly alternative to dual-edged clocking, is there information on this slide, DX-300, that relates to that?

A. Yes. The second substantial row, that is, the second colored row, refers to interleave memory banks on DIMM -- excuse me, but that's not the right one.

Oh, it's the first. I see. It's the first substantial row. I'm sorry. I have trouble reading this on the screen.

Interleave on-chip memory banks using two clocks, that's the relevant row, and the overall cost on a per-chip basis is estimated to be six cents.

Q. And when you're referring to six cents, are you referring to the far right column for that row under the heading Estimated Cost Increase or Decrease?

A. Yes. That's correct.

Q. Now, you mentioned that you had a slide that

11262

relates to your substitution of this least costly alternative into Dr. Rapp's analysis; is that right?

A. That's correct.

Q. Let's pull up DX-316.

I'm sorry. We've pulled up DX-316. Do you recognize this slide?

A. Yes, I do. This comes from Dr. Rapp's testimony.

Q. And again, as with an earlier slide, there's a reference to least costly and most costly, although in this context we're talking about alternatives to DDR SDRAM.

Do you have an understanding again of what the column Least Costly in this context refers to?

A. Yes. This refers to the technologies, again excluding those technologies not covered by Rambus patents, that are -- were the lowest cost given Mr. Geilhufe's cost estimates.

Q. And do you have an understanding based on this slide, DX-316, as to which alternative to dual-edged clocking Dr. Rapp used to calculate his -- the least costly pairing of alternatives to DDR?

A. Yes. My understanding is it's interleaving the banks on the module rather than on the chip.

Q. And do you have an understanding as to how

11263

Dr. Rapp's conclusions would be affected if in -- if you were to substitute into his analysis the other alternative that you have been discussing as the least costly, that is, the interleave banks on chip alternative?

A. Yes. The figure 25 -- I haven't actually prepared a slide that summarizes this, but the figure in -- in this figure itself, the figure of 25 percent would be replaced by 6 percent -- six cents -- 25 cents would be replaced by six cents.

Q. And the six cents that you're referring to, is that the number that you referred to in Mr. Geilhufe's slides earlier?

A. That's correct.

Q. So you're just saying if you substitute that number in here, this would -- is that what you're referring to, that substituting Mr. Geilhufe's number into this analysis?

A. Yes.

Q. Now, if we could go to DX-367.

Now, you said that you had a slide that relates to this portion of your rebuttal testimony. Is this the slide you're referring to?

A. Yes, it is.

Q. And can you explain to us what you're seeking

11264

to depict through this slide?

A. This slide is a summary of both of the effects we talked about so far, so this places the least costly alternative for programmable CAS latency, which is explicitly identify in read command, and it also puts the least costly alternative for dual-edged clocking, which is interleaving banks on chip, and comes out with a total cost on a per-chip basis of seven cents.

Now, that, using Dr. Rapp's calculations, comes out to be 1.36 percent of the average selling price, which is substantially less than the number he uses for the Rambus DDR royalty of 3.5 percent.

Q. And what do you mean by the statement in the box at the bottom of this slide, DX-365, when you say, "A rational manufacturer would have chosen the alternatives rather than incur a higher cost through a license from Rambus"?

A. So again, following exactly Dr. Rapp's logic, the finding is the opposite of the conclusion, so with this change in assumptions but otherwise following exactly Dr. Rapp's logic, the conclusion is the reverse of his conclusion, which is to say a rational manufacturer would prefer the alternatives rather than

the Rambus license.

11265

Q. And does the outcome of this analysis that you've done substituting different assumptions cause you to reach any conclusions as to the reliability of Dr. Rapp's methodology?

A. Well, ultimately it comes down to a factual question which I don't actually have any insight about, which is whether or not these alternative technologies infringe on Rambus patents.

This particular finding says if Mr. Soderman -- ultimately if Mr. Soderman is wrong, then the SDRAM alternatives were in fact cheaper than the Rambus technologies.

And so -- in addition, it is my understanding that Mr. Soderman did not testify at trial that interleaving banks on chip violated Rambus patents, which leaves me uncertain why that technology was excluded from this analysis.

If included, it means by itself, that is to say, you don't need to have to rely on Mr. Soderman being wrong, it would mean by itself that Dr. Rapp's conclusions are in fact incorrect.

Q. Now, putting aside what Dr. Soderman says may or may not infringe Rambus patents, just putting that issue to one side, are there other combinations of alternatives besides the combinations that you discuss

11266

in this slide that would increase the cost in terms of a percentage of average selling price by less than the assumed Rambus DDR royalty?

A. Yes. The toggle mode as an alternative for dual-edged clocking is sufficiently inexpensive at 12 cents that it would still leave the overall cost less than the assumed DDR royalty.

Alternatively, the alternative Dr. Rapp identified for programmable CAS latency would also still leave the overall cost less. Although not for the SDRAM. That is to say, if you exclude explicitly identify in read command as a technology, the DDR remains cheaper to use the alternatives, but the SDRAM would not.

Q. Let's go back to DX-364.

We've been discussing, Professor McAfee, the analysis that you've done to explore an alternative assumption relating to the first point reflected on this slide. Let's now move to the second point.

You say -- under the heading Dr. Rapp's Assumptions you refer to cost of alternatives is constant over time. Do you see that?

A. Yes.

Q. And is that your understanding of an assumption that Dr. Rapp has made for purposes of his

11267

analysis?

A. That is my understanding of his analysis, is that the cost stays constant throughout the relevant period.

Q. And then corresponding to that under the heading Alternative Assumptions, you say, "Cost of alternatives decreases over time due to productivity gains."

Do you see that?

A. Yes.

Q. And have you explored what effect it would have on Dr. Rapp's analysis if you were to substitute that alternative assumption in place of the assumption that you identify here on DX-364?

A. Yes, I have. And I've prepared a series of slides to summarize my view.

Q. Let's go to DX-368.

Is this one of the slides you're referring to?

A. That's correct.

Q. You state in the first bullet point, "Dr. Rapp relies on Mr. Geilhufe's cost estimates, which fail to fully account for productivity increases over time."

Do you see that?

A. I do.

Q. And what specifically do you mean by that?

11268

A. It's my understanding -- and I have to say it's somewhat of a challenge to read the testimony, but it's my understanding that Mr. Geilhufe has not incorporated effects of cost changes when densities increase so, that is, when you go from 64 megabyte to 128 megabyte.

And as a result, insofar as those changes would have effects on the overall costs and in fact could decrease the costs of these alternatives, productivity gains have not been accounted for in Dr. -- well, in Mr. Geilhufe's cost estimates and hence in Dr. Rapp's analysis.

Q. And have you read any portion of Mr. Geilhufe's trial testimony?

A. Yes, I have.

Q. Without asking you to characterize or summarize it, do you recall him addressing this issue of productivity in his testimony?

A. Yes. I believe he was asked about the issue of productivity.

Q. And did Mr. Geilhufe's testimony on that subject cause you to conclude that one way or the other whether there continued to be a problem with this aspect of his analysis?

MR. STONE: Objection, Your Honor. That's

11269

asking this witness to testify as to factual questions, as to whether there are or are not productivity gains to be realized and what factual impact Mr. Geilhufe's testimony. This witness has no expertise in the industry and cannot testify as to whether or not there are productivity gains that are realized that would be applicable here or not. Outside the scope of his expertise entirely.

MR. ROYALL: Your Honor, as with all my questions, I've tried to model them after the questions that have been asked by Mr. Stone. And I would refer Your Honor to page 9855 of the transcript where Mr. Stone asked Dr. Rapp about Professor Jacob's testimony and whether he took it into account and whether it caused him to modify his opinions or assumptions in any way. I'm simply trying to ask the same form of question.

MR. STONE: That may be what he was trying, but that's not what he did. What he asked him was do you still see problems, and any question about do you still see problems is asking him to express an opinion.

This witness has no opinion on productivity gains. He didn't express one. You cannot ask him does it cause you to change your opinion because he has no

11270

opinion to change.

JUDGE McGUIRE: Mr. Royall, can you address that comment?

MR. ROYALL: I think I can -- if that's all the objection goes to, I think I can restate.

JUDGE McGUIRE: All right. Restate and we'll hear the question.

BY MR. ROYALL:

Q. Now, we've referred to Mr. Geilhufe's

testimony and your review of it -- and again, I'm not asking you to summarize it -- but did reviewing that testimony cause you to change your opinions or conclusions as to whether the -- as to the point that you're making on this slide with respect to productivity gains?

MR. STONE: Your Honor, I think this question is very vague with respect to "as to the point that you're making."

JUDGE McGUIRE: Sustained.

BY MR. ROYALL:

Q. I can simply ask it this way perhaps.

Did your review of Mr. Geilhufe's testimony cause you to change any of your opinions or conclusions to the extent that you are evaluating Dr. Rapp's analysis?

11271

A. I guess the --

MR. STONE: Could we get just a yes or no to that, Your Honor. I think that's all it calls for.

JUDGE McGUIRE: You have to just answer that first yes or no, and then he'll follow up with appropriate questions.

THE WITNESS: I need to have the question read back then.

BY MR. ROYALL:

Q. All right. I can read it back.

Did your review of Mr. Geilhufe's testimony cause you to change any of your opinions or conclusions to the extent that you're evaluating Dr. Rapp's analysis?

A. No.

Q. Now, coming back to Dr. Rapp's analysis, what effect, if any, does this element of Dr. Rapp's assumptions, that is, the one that we've been focusing on relating to productivity gains, what effect, if any, does that element of his assumptions have on the outcome of his analysis in your view?

A. Productivity -- I find that productivity gains matter to the conclusions that Dr. Rapp reaches. That is to say, even granting his methodology and his other assumptions as being correct, if he is incorrect about

11272

no productivity gains, an assumption built into his analysis -- I need to say it matters by what extent there are productivity gains, and I don't know what, if any, productivity gains are the right factual assumption.

But I do find that productivity gains can matter if they're sufficiently large.

Q. When you say in the last bullet point on DX-368, "Substituting alternative cost figures that account for productivity gains reverses the outcome of Dr. Rapp's analysis" -- do you see that?

A. Yes, I do.

Q. And when you say that, are you referring to Dr. Rapp's analysis of alternatives to SDRAM or to some other set of alternatives?

A. To both SDRAM and DDR SDRAM.

Q. And have you specifically looked to see how alternative assumptions about productivity gains would affect the calculations made by Dr. Rapp as to -- let's start with SDRAM?

A. Yes. And I've prepared a slide that illustrates that.

Q. Let's go to DX-369.

Is this the slide you're referring to?

A. Yes, it is.

11273

Q. And can you explain to us what you're seeking to convey through this slide?

A. The first -- well, so the second, the middle row, refers to Dr. Rapp's numbers, so that is, it refers to no productivity increases.

So we see a number that we've already seen this morning under least costly of all alternatives, a number of .21, does not include or permits the allegedly infringing technologies.

We see Dr. Rapp's least costly of .83 in the second or the column that's one from the right or the next column, next position, and then finally he -- Dr. Rapp also listed the most costly technologies, and we have that technology listed as well.

So the .83 and the .166 (sic) come directly from Dr. Rapp's slide.

Q. And based on what you present in this slide, what, if any, conclusions have you reached?

A. Well, here what I've done is replicate his analysis but with a 30 percent productivity increase, annual 30 percent productivity increase, to examine what that would do to the -- to his results for SDRAM.

And as you can see, all three of them fall below Dr. Rapp's assumed .75 percent SDRAM royalty; that is to say, even the most costly alternative with a

11274

30 percent annual productivity increase winds up being cheaper than the Rambus alleged royalty.

Q. And without asking you to summarize any trial testimony, is there any trial testimony that you have taken into account in making this alternative assumption of 30 percent annual productivity increases?

MR. STONE: Your Honor, I do object. Your Honor, this is the witness trying to characterize, interpret or find support for an assumption on that issue. As to whether there's support in the record for that is one that's within the court's province, not expert witnesses.

MR. ROYALL: Your Honor, I am simply once again asking the same sorts of questions that were asked of Dr. Rapp who was, in response to Mr. Stone's questions, permitted to identify a number of witnesses without summarizing the testimony but just the witnesses whose testimony he took into account, and that was all the question asked.

JUDGE McGUIRE: I will hear the question, but Mr. Stone is right, ultimately it is the court's determination.

BY MR. ROYALL:

Q. I'm not asking you again, Professor McAfee, to

11275

summarize the substance of anything; I'm simply asking, is there trial testimony of any individual that you've taken into account in making this assumption of a 30 percent annual productivity increase?

A. Yes. Mr. Becker.

Q. Referring to Henry Becker?

A. That's correct.

Q. Now, the analysis that we've been discussing relates to SDRAM.

Have you done a similar analysis relating to DDR SDRAM?

A. I have. And I've prepared a slide that illustrates that.

Q. Let's go to DX-370.

Is this the slide you're referring to?

A. Yes, it is.

Q. And can you walk us through this slide briefly

or what you're seeking to depict through this slide?
A. Yes. This is the parallel slide to the previous slide but for DDR SDRAM, so the first column of numbers, which is the second column from the left, has the least costly of all alternatives, that is, not excluding technologies looked at by Mr. Geilhufe but excluded by Dr. Rapp.
The second column or the second from the right

11276

has Dr. Rapp's least costly alternatives, so those numbers -- the 4.84 is taken directly from his analysis. And then finally, his most expensive of 5.42.
And what it then does is subject that analysis to a 30 percent annual productivity increase and again finds that all three of those are now substantially below the -- I'm sorry -- I may have misspoken.
This isn't just -- this is not all four DDR technologies. This is only the two technologies that are in DDR that are not in SDRAM.
Q. And just so we're clear, what technologies are you referring to?
A. Dual-edged clocking and on-chip PLL/DLL, although for the latter Dr. Rapp did not put any cost of alternatives.
Q. And you refer in the bottom of this slide to an implied royalty of 2.75 percent. What is that in reference to?
A. Well, so taking the numbers that Dr. Rapp uses for DDR of 3.5 percent and of SDRAM for -- that is, for the other technologies of .75 percent, there's an implicit royalty on dual-edged clocking and on-chip PLL/DLL of 2.75 percent, that is, the difference between 3.5 percent and .75 percent.

11277

Q. And is the number 2.75, is that a number that you would compare to the numbers presented in this chart?
A. That's correct.
Q. And just to be clear -- and I was going to suggest a break, Your Honor -- just to be clear before we leave this, what is the purpose of comparing 2.75 to the numbers in this chart?
A. This is -- so again, Dr. Rapp's methodology is to say what would the costs of these alternatives be and to estimate the costs of the alternatives and compare those to the royalty and decide whether a manufacturer should prefer to pay the Rambus royalty or to use the alternative. And the comparison then says that subject to a 30 percent annual productivity increase, even the most costly alternative would actually be less expensive than the Rambus royalty.
And so as a result, all of the alternatives are

less expensive than the Rambus royalty.
MR. ROYALL: Your Honor, I'm at a convenient breaking point.
JUDGE McGUIRE: All right. Then let's take a ten-minute break and then we'll return.
MR. ROYALL: Thank you.
(Recess)

11278

JUDGE McGUIRE: At this time you may proceed, Mr. Royall.
MR. ROYALL: Thank you.
BY MR. ROYALL:
Q. Let's pull up DX-364.
Now, referring to the third point on DX-364, Professor McAfee, you refer there to the heading Dr. Rapp's Assumptions, you say, "Mr. Geilhufe's cost estimates are accurate."
Is that a reference to what -- an assumption that you understand Dr. Rapp to have made?
A. Yes.
Q. Then under Alternative Assumptions, you refer to lower cost estimates of DRAM industry participants are accurate.
And is that a reference to an alternative assumption that -- to the assumption that you understand Dr. Rapp to have made?
A. Yes. We saw tables of these costs. The costs are actually -- the costs Dr. Rapp uses are additions of various costs identified by Mr. Geilhufe. The accuracy of Dr. Rapp's conclusions is only as good as the underlying assumptions. And in particular, if the cost assumptions are changed, are lowered, then his conclusions would be reversed.

11279

Q. Now, coming back to -- just a moment, Your Honor.
If we can go back to DX-359. We've been discussing I believe the second numbered subpoint on DX-359 relating to commercial viability of alternatives. And have we now covered your various critiques of Dr. Rapp's analysis of alternatives either in terms of methodology or assumptions?
A. Yes, we have.
Q. And how, if at all, do your critiques of Dr. Rapp's analysis relate to your overall conclusions, that is, your own opinions and conclusions as to the commercial viability of alternatives?
A. Dr. Rapp's analysis of alternatives in which -- I find Dr. Rapp's analysis of alternatives to be unreliable reasonable perturbations of assumptions and overturn the conclusions -- or reasonable to some extent is a finding of fact or -- I find his methodology to be flawed and, as a result, I find his criticism of my conclusion that there are commercially viable alternatives to be unfounded and, as a result, I am not inclined to change my conclusion.
Q. And how, if at all, do those views relate to the first point that you make on this slide, DX-359, relating to market and monopoly power?

11280

A. As I understand Dr. Rapp's testimony, he's saying that there's no -- the challenged conduct doesn't result in additional market or monopoly power because there weren't any alternatives to begin with, that the Rambus technologies were superior.
And I find in contrast that that conclusion is unfounded and that --
MR. STONE: Your Honor, I move to strike. This witness is going out of his way to characterize the testimony of other witnesses when all he needs to do is state his opinions.
JUDGE McGUIRE: Sustained. I'm going to uphold that objection. That is exactly what I think. So you can -- so that last answer will be stricken.
MR. ROYALL: Your Honor, could I note something for the record?
JUDGE McGUIRE: Go ahead.
MR. ROYALL: That Professor Teece and Dr. Rapp were permitted at a variety of times to make comments about Professor McAfee's testimony, including -- and I can point you to the record -- including when they say that they agree or disagree with them and I was told to deal with it on cross.
JUDGE McGUIRE: You can re-ask it again, but that particular answer was beyond the scope.

11281

BY MR. ROYALL:

Q. Now, Professor McAfee, how do your conclusions on this subject that you've been discussing, commercial viability of alternatives, how do these relate to the point that you make in the first sentence of this slide, DX-359, as relates to market and monopoly power?

A. So commercially viable alternatives are critical to finding -- to my finding or my conclusion that Rambus' challenged conduct resulted in additional market power and in monopoly power for Rambus.

If there weren't any alternatives or any commercially viable alternatives ex ante, then Rambus' conduct wouldn't have led to the monopolization, simply the superiority of the technology would have led to the monopolization.

As a result, it's the finding of commercially viable alternatives that is critical to the conclusion that the challenged conduct led to market/monopoly power.

Q. Now, turning now to the third numbered subpoint on DX-359, you say there, "Ex post lock-in effects make switching to alternatives uneconomical."

Do you see that?

A. I do.

11282

Q. And what is the nature of your rebuttal expert testimony as relates to this?

A. Dr. Rapp has performed an analysis of switching costs which I find to be inaccurate.

Q. And do you have slides that relate to that portion of your testimony?

A. Yes, I do. I have a series of slides.

Q. Let's go to DX-371.

Is this one of those slides?

A. That's correct.

Q. And on DX-371, referring to Dr. Rapp's analysis, you say in the first bullet, "Substantially understates costs to DRAM makers of switching to alternative standards."

Can you explain what you mean by that?

A. Yes. Dr. Rapp actually -- he provides a list of some switching costs, which this is a factual matter, but I understand to be less than the actual switching costs, just for those specific items on his list.

Q. And turning to the next point, you say here, "Ignores costs to non-DRAM makers of switching to alternative standards."

What do you mean by that and why does that matter to an analysis of switching costs?

11283

A. Well, this is an entire category of costs that he has left out that are appropriate switching costs, and it's the costs incurred by the producers of complementary products and the users of DRAM.

All of those costs are going to be relevant to the question of lock-in and the switching costs because you can't get sellers to switch if you can't get the buyers to switch. And as a result, it's the total market switching costs, not just the DRAM makers' switching costs, that are relevant.

Q. And do you have a view regarding what, if any, effect Dr. Rapp's failure to account for switching costs to non-DRAM makers has on the overall results of his analysis?

A. Yes. He's -- by leaving out costs, he's understated the switching costs. That's true in both of the first two bullets. That is, by just leaving costs off of his list or understating the costs, he's made the costs appear to be lower than they actually are.

Q. Well --

MR. STONE: I object, Your Honor. This witness has no basis to testify to what the costs actually are, and he just said, he just compared what was done by Dr. Rapp to what he says the costs actually are. It's

11284

outside this witness' expertise, outside the scope of his rebuttal report.

JUDGE McGUIRE: Mr. Royall.

MR. ROYALL: Your Honor, Dr. Rapp and Professor McAfee from the standpoint of economics and economic analysis in making certain assumptions have indeed commented on the costs of switching. It is in his rebuttal report. It was addressed in Dr. Rapp's analysis. This is all within the context --

JUDGE McGUIRE: As to what the costs actually are?

MR. STONE: He's done no computation of what the costs actually are. That's my objection. He's making a statement which implicit in it is that he's done a calculation that says in his calculation the costs are higher.

JUDGE McGUIRE: Mr. Royall, you can re-ask the question and make it clear this time.

MR. STONE: Thank you, Your Honor.

MR. ROYALL: I can do that. Thank you, Your Honor. I can do that.

BY MR. ROYALL:

Q. Professor McAfee, do you have a view regarding what, if any, effect Dr. Rapp's failure to account for switching costs to non-DRAM makers has on the overall

11285

results of his analysis?

A. Yes. It would induce a bias in his analysis by omitting costs, and without saying what those costs -- the magnitude of those costs, I can say categories of costs. These are the costs incurred by users of DRAM, producers of complementary products of DRAM, and there has been testimony in trial concerning the magnitude of some of those costs.

Q. Now, you've referred to understating costs, your views as to the extent to which Dr. Rapp's analysis understates the lock-in or switching costs.

Specifically how, in your view, has Dr. Rapp's analysis understated the relevant switching costs?

A. I'm sorry. I need to have the question repeated. I just spaced out for a moment.

Q. You've referred to your views relating to the extent to which Dr. Rapp's analysis understates lock-in or switching costs.

Specifically how in your view has Dr. Rapp's analysis understated such costs?

A. I've prepared a slide that sets out qualitatively, describes the cost understatements.

Q. Let's go to DX-372.

Is this the slide you're referring to?

A. Yes, it is.

11286

Q. Now, you make a number of points here. Let me see if we can quickly walk through each of them.

First you say, "Dr. Rapp's analysis understates costs of new mask sets."

What are you referring to there?

A. One of the costs in his list is the cost of new masks, and I understand that, from my interviews with Mr. Becker, that the costs are actually substantially higher than Dr. Rapp asserts.

MR. STONE: Your Honor, I move to strike on the grounds this witness has not been proffered as an

expert or someone who within his reports or his prior testimony is in a position to say what the costs would be.

He can't rely -- if Mr. Becker testified to the costs of what masks are and if the court decides to give credit to Mr. Becker's testimony, you may conclude that Dr. Rapp's analysis needs to be adjusted or not.

But it's not within the scope of this witness' report or his expertise and certainly it's not his position to just come in and say, Well, Mr. Becker said that and now I'm now going to come up with a new calculation that was not previously disclosed.

JUDGE McGUIRE: Mr. Royall.

11287

MR. ROYALL: Your Honor, we're not coming up with any calculation. That's the last point.

He is permitted to testify as to anything that he's relied on in addressing this issue, and this issue was expressly addressed in his rebuttal expert report, that is, the cost of masks and those costs being higher than the costs identified by Dr. Rapp, and that's all he's testifying to.

JUDGE McGUIRE: Perhaps you can qualify that point in your next question, and on that basis I'll hear the question.

MR. ROYALL: Thank you.

BY MR. ROYALL:

Q. Have you, Professor McAfee, have you done an analysis to calculate the extent to which the requirement of new mask sets would add to the switching costs of specific DRAM makers who might work around Rambus patents?

A. I haven't done a quantitative analysis.

Q. Well, then putting aside any quantitative analysis, what do you mean here when you say "understates costs of new mask sets," when you say that on DX-372?

A. This summarizes my understanding -- it's ultimately a question of fact -- of what a mask set

11288

costs.

Q. And what is the basis for your understanding?

A. I interviewed Mr. Becker of Infineon and asked him that specific question.

Q. And if we can pull up DX-317.

JUDGE McGUIRE: Then, Mr. Stone, just to address that last point you made, it is certainly an area of inquiry you can go into on your cross-examination.

MR. STONE: And I think it's now clear the extent of what he did.

JUDGE McGUIRE: All right.

BY MR. ROYALL:

Q. And DX-317, do you recall this slide being used with Dr. Rapp's trial testimony?

A. Yes, I do.

Q. Do you have an understanding of what Dr. Rapp is referring to here by the term "phototooling costs"?

A. Yes, I do.

Q. What is your understanding?

A. So that would include -- it could include other items as well, but it would include the cost of new masks, which are plates that are used for photoetching or phototooling of the silicon.

Q. And when you said in the earlier slide that

11289

Dr. Rapp's analysis understates costs of new mask sets, was that in reference to what is referred to as phototooling costs here?

A. Yes. He has a -- doing the multiplication, he has a cost of 600,000 associated with the phototooling costs which I believe to understate the cost of masks.

Q. And do you have any understanding as to the order of magnitude by which this number understates the costs?

MR. STONE: I object, Your Honor. It's outside the scope of his report. He has no expertise to comment as to what the order of magnitude should be. He is not an expert in DRAM manufacturing.

JUDGE McGUIRE: Sustained.

MR. ROYALL: Well, Your Honor, could I just comment on the -- there's been a representation that this is not covered by the expert report. Can I confer?

(Pause in the proceedings.)

I'll withdraw the question, Your Honor.

JUDGE McGUIRE: Thank you.

BY MR. ROYALL:

Q. Now, coming back to DX-372, moving now to the second point, you state here, "Does not account for multiple densities/configurations."

11290

Can you explain to us what you mean by that?

A. So my understanding of the numbers that were provided by Dr. Rapp is that they would include the costs of switching one technology, so in particular multiple densities, that is to say, say 64 and 128 or 128 and 256, being run simultaneously in the same factory, you would need to incur those costs for each of the densities.

Moreover -- and this is a factual issue -- it's my understanding that you use multiple sets of masks, that is, you have in essence a parallel operation so that even if you're looking only at one density, at the 128-megabyte density, you may have multiple sets of masks and as a result have higher costs than are represented on Dr. Rapp's slide.

Q. Moving to the third point, you say there, "Does not account for the additional costs of abrupt transition from infringing to noninfringing parts."

What do you mean by that and how does that -- how is that relevant to the subject of switching costs?

A. Economists are generally concerned with the cost of speed. Changing any technologies, not just DRAM technologies, but changing any technologies rapidly tends to cost more. The more rapid the

11291

transition, the more the costs are going to be.

In this industry we actually see several years of experiment -- or more than a year, I guess is a more accurate statement, of experimentation, that is, of design, testing and retesting and redesign. There's been substantial testimony. And what I refer to here is that if you want to transition rapidly, that's going to cost more.

And so there's no even discussion of the -- by Dr. Rapp of how much it would cost to actually transition rapidly out of Rambus technologies.

Q. And moving then to the fourth point, does not account for switching costs borne by non-DRAM makers, can you explain to us what you mean by that?

A. Yes. I already believe I mentioned that from the previous slide.

The non-DRAM industry participants, so buyers and producers of complementary products, could easily have switching costs that are well in excess of the switching costs of the DRAM manufacturers, and those switching costs are relevant to an economic analysis of

the switching costs for this industry because you can't switch the industry -- you can't just switch the DRAM makers if you're going to switch -- you'd have to switch the buyers and the producers of complementary

11292

products.

Q. And in making the statement that you made a moment ago about the switching costs of non-DRAM makers could well exceed those of DRAM makers, without asking you to summarize any trial testimony, but is there trial testimony that you're familiar with in this case that relates to that point that you have made?

A. Yes. By Mr. Heye and Mr. Bechtelsheim.

Q. Now, focusing then on the final point, you say, "Does not account for the cost of diverting resources, including teams of engineers, from other valuable projects."

First of all, let me ask you, you refer in this bullet point to -- not to individual engineers but to teams of engineers. Is there a reason for that?

A. Yes, there is.

Q. Can you explain?

A. There's been discussion of opportunity costs, which is actually a term of art in economics but may or may not be used by the fact witnesses in the same way as economists use it.

But there's been discussion of opportunity costs and there's also been testimony by Dr. Rapp that

11293

the right measure of these costs are the wages of the engineers. And I would challenge that point. In fact, in my business strategy class, that's a topic of an entire week, is the value of teams and how the cost of teams is not measured by their wages.

Q. Well, as relates to the analysis that you're discussing on DX-372 of switching costs related to this case, how does this cost of teams of engineers factor in to such an analysis?

MR. STONE: Your Honor, now that I think I understand this point, this is a point that's outside the scope of the rebuttal report, namely, the value of teams that's apparently above and beyond the value of the people that make up the team.

MR. ROYALL: Your Honor, this is a point that is directly responsive to trial testimony by Dr. Rapp, and for that reason it could not have been anticipated. It was not dealt with in Dr. Rapp's report in the way that he dealt with it at trial. It's proper rebuttal for that reason. And they're --

JUDGE McGUIRE: Overruled. I'll hear it.

MR. ROYALL: Thank you.

BY MR. ROYALL:

Q. Going back to the question, how does this point that you've made about the costs of teams of engineers

11294

factor into switching cost analysis in this context, in your view?

A. The cost -- the cost of -- let me see how -- I'm trying to come up with the best way to answer this question.

The measure of the cost of switching, if I have to divert a team of engineers that might otherwise be doing a separate project or some other project for the company, is by, in economic terms, the forgone value of that project or that value of that project.

And so if I have to divert my team -- if I'm a company like Advanced Micro Devices, which I'm taking as just an example to make it concrete, and I have to divert teams of engineers from developing the next processor to instead making my existing processors work with a new kind of DRAM, I'm forgoing the value of the new processor.

Now, my recollection is that Dr. Rapp rather glibly responded to that kind of logic as, well, why don't they hire more engineers if they have all these valuable projects.

But in fact my understanding is that creating -- and this is something that I teach as well -- is that creating teams of engineers or teams of functioning employees generally is actually quite a

11295

management challenge and it's something that one -- that is often responsible for large portions of the profits of firms, is effectively functioning teams, and it's not something that you can hire from a temporary agency just to deal with this -- with an existing problem.

And so I understand that the notion of opportunity cost -- this is my economic understanding -- is that the notion of opportunity cost that's used in this industry refers to that kind of cost of forgone opportunities that teams, which are hard to produce and hard to put together and can't be put together temporarily, might create.

Q. Now, again without asking you to summarize anyone's testimony, in your view of the trial record, have you seen testimony from any individuals that relates to that understanding that you've just described about the -- about opportunity costs in the DRAM industry?

A. Mr. Heye and Mr. Appleton.

Q. Now, let's go back to DX-371.

The third bullet point on this slide says, "Fails to account for coordination costs/difficulties."

What specifically do you mean by that in the context of this slide, DX-371?

11296

A. Dr. Rapp's analysis has no listing for coordination costs whatsoever. It's not listed on his slide. And so as a consequence, he's failed to account for coordination costs, which I consider to be large.

Q. And do you have a view as to whether in this type of economic analysis of lock-in it is important to consider coordination costs?

A. Yes. I think in fact in this case it's critical to consider coordination costs.

Q. And why is that?

A. Well, I've actually prepared a slide that or a pair of slides that --

Q. Let's go to DX-373.

A. -- introduce this idea.

Q. Is this one of the slides you're referring to?

A. Yes, it is.

Q. And in this slide, DX-373, you refer in the title to coordination costs/difficulties. And I wanted to ask you about that.

Are the types of costs that you're referring to here, are they costs that can be quantified?

A. Well, in principle they could be quantified. It would be a massive challenge to actually characterize the quantity, the magnitude of these

11297

costs.

I mean, in principle you could say, well, what amount of money would it take to overcome the coordination costs, so in principle there's a quantification. It's just I don't know of any

practical way to actually answer that question.
Q. To the extent that these costs or difficulties cannot practically be quantified, does that make them less meaningful in an economic sense?
A. No, it does not.
MR. STONE: Objection. Leading.
JUDGE McGUIRE: Sustained.
BY MR. ROYALL:
Q. To the extent that these types of costs or difficulties cannot be quantified, does that have any bearing one way or the other on their significance from the standpoint of economics?
A. No, it does not.
Q. Now, going to the first bullet point on DX-373, you say, "Regardless of switching costs, no DRAM makers will switch absent assurance of willing purchasers of the new DRAM who demand multiple sources of supply" and in the second point you say "support of new DRAM by complementary component suppliers."
Do you see that language?

11298

MR. STONE: I object, Your Honor. This is cumulative of this witness' testimony during the case in chief and does not rebut any testimony of witnesses that we called during our case.
JUDGE McGUIRE: Okay. Mr. Royall, would you answer that objection.
MR. ROYALL: Yes. This is directly rebutting Dr. Rapp's testimony because, as the witness has already testified, Dr. Rapp did not consider coordination costs/difficulties as part of his analysis, and now Professor McAfee is explaining why that is important and hence why the failure to consider it is an important critique.
And so he's simply explaining that, and I think it's perfectly proper rebuttal directed to Dr. Rapp.
MR. STONE: And my point is he already explained this in his testimony in the case in chief, we know his views and there's nothing to rebut.
The fact somebody didn't address it isn't an opportunity –
JUDGE McGUIRE: Again, I agree with the import of the objection. Can we cut this short? You know, I'll give you an opportunity to go into this, Mr. Royall, but we don't have to go through this same

11299

testimony again.
You may ask him if his -- if the fact that Dr. Rapp did not go into this would in any way alter his earlier economic conclusions that have already been offered in this proceeding.
MR. ROYALL: Well, there's a presumption here that I don't think is correct, which is that all of the content that is here being focused on from the standpoint of rebuttal has already been covered. I don't think that's correct.
I can streamline it.
JUDGE McGUIRE: Let's just speak to those areas perhaps that have not been, but I don't want to go back to anything he's already testified to because it is cumulative.
So let's try to expedite this line.
MR. ROYALL: I can do that, Your Honor.
BY MR. ROYALL:
Q. Now, Professor McAfee, understanding that you have talked generally about coordination previously in your trial testimony, and I don't want to go back over that prior trial testimony, but I do want to have an understanding of why it is your view, as stated in this slide, that Dr. Rapp's analysis ignores coordination costs and difficulties and why to you that may or may

11300

not be important. And let's try to move through this quickly.
You refer in the first bullet point here to "Regardless of switching costs, no DRAM makers will switch absent assurance of" and then you list two things.
Do you see that?
A. Yes.
Q. Now, without covering general issues around coordination that you may have testified to before, can you tell us specifically what you mean by the point that you're making here as relates to your rebuttal to Dr. Rapp?
A. All right. So the point that this makes that I did not make in my direct testimony is that regardless of the switching costs, the financial switching costs, the coordination costs may still completely block the switching to a new standard.
So that is to say, independent of the -- even if the switching costs, the actual direct financial costs, are very, very low, it may still be difficult or impossible to switch the industry from an existing product to a potential alternative product.
And so the -- so an analysis that focuses only on the direct monetary switching costs and does not

11301

account for coordination costs may actually get the wrong answer.
Q. And when you say that even if the switching costs, the financial switching costs, were relatively low, it may be difficult to get the industry to switch, does that have anything to do with the point you referenced to willing purchasers in subpoint number 1?
A. Yes. This is the coordination problem, is the DRAM manufacturers won't switch without the makers, the buyers, willing to purchase, and the buyers won't be willing to purchase unless the complementary components suppliers are also providing the components, and so you need a consensus in order to get -- in order to get switching, that is, you need coordination.
Q. And when you talked about even if the financial switching costs were relatively low that it would be -- there may be practical difficulties in switching an industry to a new standard, did that have anything to do with the second point that you make here about supporting new DRAM by complementary component suppliers?
A. Yes. I already believe I testified to that in my previous answer. But in order to get buyers to be

11302

willing to switch, they need to expect the complementary components to be provided, which is what leads to the need for an industry-level consensus and coordination. And by "industry" I mean buyers and sellers, not just the manufacturers.
Q. And if we can go to DX-374.
You refer in the first bullet point here to disparate commitments to existing standards inhibit coordination ex post.
Do you see that?
A. Yes.
Q. Now, I don't want to ask you to go over anything that you've covered in your direct testimony, but let me ask you this.
Do you recall this subject being addressed in

the trial testimony of Dr. Rapp? I don't want you to summarize the testimony, but do you recall it coming up?
A. Yes, I do.
Q. And having reviewed Dr. Rapp's testimony on that subject, did his testimony cause you to change your opinions or conclusions in any way as to the relevance of this point to an analysis of switching costs?
A. No, it did not.

11303

Q. And you refer here in the second subbullet, you say, "DRAM customers/complementary component manufacturers less motivated to change."
What do you mean by that?
A. Because they have an existing product, under the hypothetical that an alternative to the existing SDRAM or DDR SDRAM is being designed, because they have an existing product, it's in some sense easier for them to stay with the existing product. That's generally not a problem when we don't have an existing product with similar performance on the table.
Q. And when you talk about relevant coordination costs and difficulties in the context of this slide, DX-374, are you referring to costs and difficulties associated with implementing a new standard or are you referring to something different?
A. No. I'm referring to costs beyond the financial costs of implementing a new standard. Those costs were discussed in an earlier slide.
These are the costs of, if I want these companies to go along with the new standard, they're going to expect to make some profits, and it's the inducements beyond just the actual costs that are going to be relevant in getting them to switch. Relevant as

11304

a coordination cost as opposed to just a direct switching cost.
Q. Now, if we could come back to DX-359.
Now, we've been discussing I believe the third numbered point on this slide relating to ex post lock-in effects.
Have we now covered the points that you intended to make in terms of critiquing Dr. Rapp's analysis of lock-in or are there other points that you had in mind in terms of your rebuttal testimony?
A. No. I believe we've covered the critique of Dr. Rapp's analysis of lock-in.
Q. And how, if at all, do your critiques of Dr. Rapp's analysis on the subject of lock-in relate to your own opinions and conclusions on that subject?
A. I find from Dr. Rapp's testimony no reason to change my conclusion that there is in fact substantial lock-in in this industry and as a result there is a potential for the creation of monopoly power by incorporating the technologies in the standard.
Q. Let's move to the fourth and final point on DX-359.
You state there, "Most likely outcomes in but-for world: JEDEC standards avoid Rambus IP or Rambus IP licensed at lower royalty rates."

11305

Do you see that?
A. Yes, I do.
Q. Now, does this relate to an aspect of Dr. Rapp's testimony that you're critiquing?
A. No, it does not.
Q. And whose testimony are you rebutting through this point on DX-359?
A. Professor Teece.
Q. And what aspect of Professor Teece's analysis are you directing your attention to here?
A. Professor Teece, as I understand it, concluded that the outcome in the but-for world would be the same as the outcome in the actual world, and it's the logic by which he reached that conclusion that I am critiquing.
Q. And let's go to DX-375.
And does this slide, DX-375, does this relate to your critique of Professor Teece's but-for world analysis?
A. Yes, it does.
Q. And you say here, "Professor Teece's but-for world analysis is flawed."
In what ways do you regard his analysis to be flawed?
A. Well, this slide sets out the ways in which I

11306

regard his analysis to be flawed.
Q. Now, could we pull up -- actually, may I approach the easel, Your Honor?
JUDGE McGUIRE: Sure.
BY MR. ROYALL:
Q. Now, do you see the exhibit that I've placed on the easel, Professor McAfee?
A. Yes, I do.
Q. And do you recognize this to be a copy of an exhibit that was used in connection with Professor Teece's analysis?
A. It appears to be.
JUDGE McGUIRE: Is that, what, DX what?
MR. ROYALL: Your Honor, I believe that this was when originally used was DX-332 and we may want to place a new DX number on this. We'll have to -- 377? For our purposes, if we could identify this --
JUDGE McGUIRE: Do we have to do that if it's already been marked as a DX exhibit?
MR. ROYALL: This relates to the possibility that I may mark on the exhibit, so I don't want to --
JUDGE McGUIRE: Okay. Go ahead.
MR. ROYALL: DX-377.
(DX Exhibit Number 377 was marked for identification.)

11307

BY MR. ROYALL:
Q. Now, as you see, the title of this exhibit is But-For World Decision Tree, and I'd like to walk you through some of the branches on this decision tree.
Starting with the branch at the very top of what's --
JUDGE McGUIRE: Now, again, Mr. Royall, if we can expedite this, we don't need to go through anything that he perhaps already has testified to in terms of just going through the tree. I mean, if we can streamline this, please, you're encouraged to do so.
MR. ROYALL: Yes, Your Honor. I think I can do that. And this is the last topic I intend to cover.
BY MR. ROYALL:
Q. Referring to the first branch of the tree -- and although an earlier version of this was marked as DX-332, for our purposes I'll be referring to it as DX-377.
So in the first branch of DX-377, in a but-for world in which Rambus makes disclosure to JEDEC, do you see that there's discussion here of a scenario in which JEDEC does not ask for a RAND letter?
A. Yes, I do.

11308
Q. And starting with that branch, is there any aspect of that part of Professor Teece's analysis that you believe to be flawed?
A. Yes. Professor Teece puts weight on that probability, weight on that alternative; that is, he says that has a significant likelihood. And it would -- it would then lead to the same outcome as the actual world.
I agree that it would lead to the same outcome as the actual world, but I don't agree that that's a significant possibility that JEDEC does not ask for a RAND letter. I find that to be inconsistent with JEDEC behavior.
Q. And so in terms of your own critique of Professor Teece's analysis, do you agree that it is a plausible scenario that JEDEC would not ask for a RAND letter leading to the same outcome as in the actual world?
A. No.
MR. STONE: Objection. Leading, Your Honor.
JUDGE McGUIRE: Sustained.
MR. ROYALL: I can restate it.
BY MR. ROYALL:
Q. And referring to that branch of Professor Teece's analysis, that is, a scenario in
11309
which JEDEC does not ask for a RAND letter, do you have any views one way or the other as to whether there is such a scenario that is plausible that would lead to the same outcome as in the actual world?
A. I'm sorry. I feel like there was a "not" in your question that I want to make sure. I need to hear the question again.
MR. STONE: I think it's also been asked and answered.
I mean, the witness said, "I agree it would lead to the same outcome in the actual world, but I don't agree that that's a significant possibility that JEDEC does not ask for a RAND letter." He said it, in his prior question and answer.
MR. ROYALL: I don't know that that was exactly the question I was asking him.
JUDGE McGUIRE: I'll give you a chance to figure out. If it has been asked and answered, let's move on.
BY MR. ROYALL:
Q. Referring to that branch of Professor Teece's analysis, that is, a scenario in which JEDEC does not ask for a RAND letter, do you have any views one way or the other as to whether there's such a scenario that is plausible that would lead to the same outcome as in the
11310
actual world?
A. I have to agree that that was asked and answered; that is, that is the answer I gave, which is no, there's no significant possibility.
JUDGE McGUIRE: You're dead on that one.
MR. ROYALL: I stand corrected.
BY MR. ROYALL:
Q. All right. So in that case would you agree that and consistent with your critique of Professor Teece's analysis -- well, that would have been a leading question.
In connection with your critique of Professor Teece's analysis, would -- let me just move on.
Do you see that I've placed an X on the same outcome box of that branch of Professor Teece's analysis?
A. I do see that X.
Q. Okay. And do you agree or disagree in terms of the critique of your -- your critique of Professor Teece's analysis with that, that outcome?
A. Yes, but I would like a vertical line drawn -- Professor Teece has used a vertical line to indicate outcomes that don't arise, and so we should put a vertical line like that one there, yes.
11311
Q. And so the record will reflect that in red ink I'm drawing a vertical line on that first branch of Professor Teece's decision tree.
Now, moving on then to the branch of Professor Teece's decision tree that presumes disclosure by Rambus to JEDEC but that JEDEC then asks for a RAND letter, now, referring to that branch of his analysis, do you find any flaws with that branch of Professor Teece's but-for world analysis?
A. Yes. He has ruled out Rambus refusing to issue a RAND letter.
In my understanding of Rambus' business strategy -- and I should say the business strategy that one uses in the but-for world should mimic the business strategy one sees in the actual world, and so the actual business strategy would be the relevant strategy -- I see not a certainty but a significant likelihood that Rambus would refuse to issue a RAND letter.
In fact, I think more likely than not they may refuse to issue a RAND letter, based on their business strategy.
Q. Let me write then on the branch that relates to whether they do or don't issue a RAND letter -- did you say it's more likely in your view that they do not
11312
issue a RAND letter?
A. That's correct.
Q. So then I'll write "more likely" on that branch of the tree.
Now, do you have an understanding, if Rambus had refused a RAND letter to JEDEC after being asked for one, do you have an understanding based on JEDEC behavior -- I'm not asking you to interpret the rules -- but based on JEDEC behavior as to whether the same outcome could have resulted as in the actual world?
A. My understanding is that the same outcome could not result, that JEDEC would have standardized a different design for SDRAM and DDR SDRAM.
Q. So are you saying that in this branch of the decision tree relating to Rambus refusing the RAND letter, it's your understanding that there would be a different outcome in the but-for world?
A. That's correct.
MR. STONE: Objection. It's leading and asked and answered.
JUDGE McGUIRE: Sustained.
BY MR. ROYALL:
Q. You'll see, Professor McAfee, that I've written "different outcome" at the conclusion of that tree of
11313
Professor Teece's but-for world analysis.
Is that consistent with the -- your understanding of -- or your critique of Professor Teece's but-for world analysis?
A. Yes. But to be consistent it should probably have a box around it.
Q. All right. Now, we've talked about the branch of Professor Teece's decision tree that relates to refusing a RAND letter to JEDEC. Now let's talk about the branch that relates to the scenario in which Rambus

gives a RAND letter to JEDEC, which you described as being less likely.

But focusing on that scenario, do you find any flaws in Professor Teece's analysis of that but-for world scenario?

A. Yes, I do.

Q. And can you explain?

A. Professor Teece has ruled out ex ante negotiations as not arising and I find that ex ante negotiations are a possibility. Now, I would not describe them as more likely than not as I did in the previous answer, but I think they are a distinct possibility.

Q. And if in a but-for world in which Rambus provided a RAND letter to JEDEC there had been ex ante

11314

negotiations between Rambus and JEDEC members, do you have any views as to what the likely outcome would be in such a but-for world scenario?

A. Yes, I do. There would be in particular a different outcome and the likely outcome would be lower royalties than those that prevail today.

Q. And again you're referring to the ex ante negotiation outcome?

A. That's correct.

Q. So I'll put a box that refers to "different outcome/lower royalties."

Now, then looking at the alternative scenario in which Rambus gives a RAND letter to JEDEC but JEDEC members do not engage in ex ante negotiations with Rambus, now, referring to that branch of Professor Teece's but-for world decision tree, do you find any flaws in Professor Teece's analysis?

A. Yes. In this -- he's ruled out -- Professor Teece has ruled out adopting alternative standards, and I would not rule out adopting alternative standards. In fact, I think that's what would in fact happen.

So that is, I would put no probability/weight on adopting the existing standards, but instead I would actually expect because of the existence of

11315

commercially viable alternatives that one of those alternatives is in fact adopted.

And so that is, I would put a box at "adopt alternative standards" with different outcome.

Q. So let the record reflect that I'm placing a box on the branch of the decision tree that relates to JEDEC adopting alternative standards if there were no ex ante negotiations and --

A. And then I would also place a line through the -- a vertical line through the other, adopting the existing standards.

Q. And by that do you mean to say anything with respect to whether the same outcome could be achieved in a but-for world scenario in which no ex ante negotiations occurred?

A. Well, I'm indicating that there – I don't place any probability on that outcome occurring. That's what I mean by the vertical bar. That's what I understand the vertical bar to mean in this diagram.

Q. And consistent with that, would you want me to or not to place an X on the "same outcome" box?

A. Yes, please place an X.

Now, I should also say in placing that X, as I testified earlier, I do agree with Professor Teece that if JEDEC did not ask for a RAND letter, then we might

11316

expect the same outcome. I'm not so sure one way or the other -- I haven't considered it fully -- whether if we get to this far lower right portion of the decision tree that I would expect the same outcome to arise, but I haven't had to make a determination because I don't think that we get to that box.

So the Xs may mean different things on those two boxes.

Q. Now, if we could pull up DX-376.

This slide is -- refers to a summary of your rebuttal conclusions. I'm not going to ask you to read over these and I'm not going to read them, but I do want to ask, have we now covered, Professor McAfee, the points that you had outlined to address through your rebuttal expert testimony in this case?

A. Yes. We've covered all of my principal objections.

MR. ROYALL: Your Honor, with that, I have no further questions at this time.

JUDGE McGUIRE: Okay. Thank you, Mr. Royall. Would an hour today be adequate for lunch?

MR. STONE: Yes, it would.

JUDGE McGUIRE: If you all are going to be conferring on that earlier issue.

All right. Very good.

11317

It's 12:30. We'll take a recess and then convene at 1:30.

(Whereupon, at 12:28 p.m., a lunch recess was taken.)

11318

AFTERNOON SESSION

(1:32 p.m.)

JUDGE McGUIRE: This hearing is now in order. At this time we'll entertain the cross-examination of the witness. Mr. Stone.

MR. STONE: Thank you, Your Honor.

CROSS-EXAMINATION

BY MR. STONE:

Q. Good afternoon, Professor McAfee.

A. Good afternoon.

Q. Let me ask you if I can about DX-377, complaint counsel's version with some handwritten marks on it of Professor Teece's decision tree.

Your opinions regarding whether or not JEDEC would have asked for a RAND letter are independent of the nature of whatever disclosure Rambus might have made, are they not?

A. Well, I was assuming that Rambus made a

disclosure that it had relevant intellectual property. Certainly there's some disclosures potentially that would change my opinion. If it was a disclosure that didn't have to do with the technology, for example, but I mean, is it completely independent, no.

Q. It's independent of when the disclosure is made, is it not?

11319

A. I guess I was assuming that it was made during the relevant time period, prior to Rambus' departure from JEDEC.

Q. And it's independent then of when within that time period the disclosure is made; correct?

A. Well, it would depend then whether we were talking about SDRAM or DDR SDRAM at least potentially whether or not it was completely independent in the time period. For DDR I would just agree with you. For SDRAM, that could depend on, you know, if it was in 1996 that they disclosed, it would – it might matter.

Q. Suppose it was 1995 and Rambus disclosed that they had filed a patent application that contained a claim that might read on programmable CAS latency or programmable burst length if the claim were to issue.

Would your opinion be the same if that disclosure were made in 1995 regarding that technology that JEDEC in your view likely would have asked for a RAND letter?

MR. ROYALL: Could I ask for clarification, Your Honor, on this question as to who the disclosure was made to. Was this made to all relevant JEDEC participants or –

JUDGE McGUIRE: Yes. Go ahead, Mr. Stone.

11320

BY MR. STONE:

Q. And I want you to assume that the disclosure was made to all relevant JEDEC participants.

A. I'm glad for that clarification because I had been so assuming.

So let me make sure I understand the question. So it's 1995, Rambus says they have a – they have filed a patent application that contains a claim that may read on programmable CAS latency – was that the question?

Q. Yes.

A. And would JEDEC have asked for a RAND letter.

My expectation is, yes, that JEDEC would have asked for a RAND letter.

Q. And if they made that disclosure in 1992, your expectation is they would have asked for a RAND letter?

A. Yes.

Q. And if they made that disclosure in June of 1996, is it your expectation that JEDEC would have asked for a RAND letter?

A. That is my expectation, yes, they would have asked for a RAND letter.

Q. So then even with respect to SDRAM, am I correct that your opinion is independent of time with

11321

respect to when the disclosure was made to JEDEC as long as it was made during the time period that Rambus was a member?

A. Actually I may have misspoken when I agreed to 1996. The SDRAM had long since been finalized in 1995 and 1996, and that might affect my opinion about whether they ask for a RAND letter.

Q. And you have not, for purposes of any of the opinions you've formed in this case, you have not assumed any specific disclosure that should have been made in any specific time, have you?

A. I guess I'm assuming good-faith disclosures; that is, they disclose at the point where they realize that the JEDEC discussions are overlapping their intellectual property or even likely overlapping their intellectual property. That's been the nature of my assumption.

Q. But if I were to ask you what do you assume specifically they should have disclosed and when do you assume they should have disclosed it, you can't answer that question, can you?

A. Well, I can't say they should have disclosed, no. I'm assuming things about their disclosure. I can't say what they should have disclosed at all.

Q. Maybe I misspoke.

11322

If I were to ask you to tell me what specific information you are assuming Rambus should have disclosed and on what specific date they should have disclosed it, you could not answer that question, could you?

A. Not without referring to materials and even then not with the sort of precision that your question implies.

Q. And I want you to assume that in 1992 Rambus disclosed to all relevant JEDEC participants that it had filed a patent application in 1990 that was its effort to cover all of the patentable features in RDRAM.

And I want you to further assume that they said, And we hope someday to get patents that cover all of those relevant features to whatever extent the patent office thinks we're entitled to them.

Do you have an opinion as to whether in that scenario JEDEC would have asked for a RAND letter?

MR. ROYALL: Objection. Incomplete hypothetical.

JUDGE McGUIRE: Overruled. He can answer it if he can.

THE WITNESS: In my study of JEDEC behavior I don't recall encountering a similar circumstance, and

11323

that's giving me pause as to answering this question.

My expectation in that circumstance is the response would be something on the order of, well, which features do you think are covered. But I don't -- by your intellectual property. But I don't recall anyone making that kind of we think we've got these features covered -- we filed a patent which we're hoping to push as hard as we can to cover a whole bunch of features without any specificity.

BY MR. STONE:

Q. In your study of JEDEC's behavior, Professor McAfee, on how many occasions did you find JEDEC requesting a RAND letter in response to a disclosure of a patent application?

A. Well, there were certainly some. I don't recall how many. Not very many.

Q. Could you identify one for us?

A. I don't actually as I sit here today recall one. My recollection is that Mr. Kellogg named one, but I don't -- I don't actually recall one as I sit here today.

Q. Well, you studied the JEDEC minutes, didn't you?

A. I read – I on the order of nine months ago looked through the JEDEC minutes, yes.

11324

Q. And one of the things you were looking for was evidence of JEDEC's behavior; am I right?

A. That's correct.

Q. So when you reviewed all those JEDEC minutes, did you find a single instance that you can identify for us today of JEDEC asking someone who had disclosed a patent application for a RAND letter?

MR. ROYALL: Your Honor, I think this question is asked and answered. And at this point it's just becoming argumentative.

JUDGE McGUIRE: You know, I honestly don't know if it's been already asked and answered, so I'll let him go ahead.

If you can answer that question, go ahead, Professor.

THE WITNESS: I don't recall the specific incident as I sit here today. There may have been -- it may -- it is quite possible that in the instances where patent applications were disclosed that in fact JEDEC didn't have to ask for a RAND letter because one was volunteered, but I don't actually specifically recall.

BY MR. STONE:

Q. Okay. Is it your opinion that JEDEC would have asked for a RAND letter if in January of 1995 Rambus

11325

had disclosed that they had claims in a patent application that might cover certain features related to dual-edged clocking and then later disclosed before the end of that year that they had abandoned those claims?

A. So at the time -- they disclosed that they had requested -- that they had filed claims and then abandoned -- and then they later disclosed that they abandoned the claims, and the question is would they have asked for a RAND letter after the second incident having not asked for a RAND letter after the first.

Q. No. If they had asked -- if they ask for a RAND letter after the first, would they withdraw their request after the second?

A. You know, I don't know a whole lot about patents. My impression is that abandoning claims in a particular filing doesn't necessarily mean you can't refile them.

I'd be surprised having issued a request that they would then just withdraw it unless -- but again, that would depend on the nature of what was said. If what was said was, well, we're pretty sure we don't have coverage of this concept, then you'd expect that the claim -- the request to be withdrawn.

Q. Let us assume that in 1992 Rambus had advised

11326

the relevant JEDEC participants that it had filed a patent application, that it hoped to get the broadest possible coverage that it could for its inventions, that it hoped to cover all of the patentable features in RDRAM, which included dual-edged clocking, the use of a PLL/DLL on the chip, the use of mode registers to store latency information and burst length. It didn't know if it would get it or not.

A. But it specifically listed those characteristics.

Q. Let's assume it listed those characteristics.

It's your opinion that JEDEC at that point might have asked for a RAND letter; correct?

MR. ROYALL: I believe that may misstate the witness' prior testimony. This is a new hypothetical.

JUDGE McGUIRE: I'm sorry, Mr. Royall. I didn't hear you.

MR. ROYALL: I was saying that I believe he's asking the question in a way in which he seems to be representing that this is the witness' prior testimony and now we're at a new hypothetical, so I'm objecting to that.

If he wants to ask him what his view is on this hypothetical, that's one thing, but --

JUDGE McGUIRE: All right. Sustained.

11327

BY MR. STONE:

Q. Do you have an opinion one way or the other?

A. I was going to ask for it to be read back because I had managed --

Q. I'll rephrase it.

Do you have an opinion one way or the other whether if in 1992 Rambus had disclosed to the relevant JEDEC participants, we filed a patent application in April of 1990, we hope that patent application will give us broad coverage for our inventions, we hope that patent application will cover all of the patentable features in the product we're developing, RDRAM, and we hope that the protection will include coverage for features such as dual-edged clocking, the use of a PLL/DLL on a chip, the use of a mode register to store latency information, and the use of a mode register to store burst length, in that scenario, is it your opinion one way or the other that JEDEC would have asked for a RAND letter?

A. So certainly some of those features were eventually incorporated -- were incorporated into SDRAM, not just into DDR SDRAM, and I believe in 1992 all of those features were being discussed, but I don't -- I don't have the timeline at the tip of my fingertip, so I can't specifically say that, but I

11328

would expect, yes, that a RAND letter would be sought on some if not all of the relevant features.

Q. And if Rambus refused to provide that RAND letter, what is your opinion as to JEDEC's response?

A. Well, if they just said no, we're not going to provide a RAND letter, that's this blue box or blue oval.

Q. That's what you've said is more likely, isn't it?

A. Yes.

Q. Okay. So let's take your more likely scenario, Rambus makes this disclosure. What does JEDEC do?

A. My expectation is that they would try to work around those technologies and use alternative technologies.

Q. So they'd work around any technology that was disclosed in the patent application; correct?

MR. ROYALL: That misstates the prior hypothetical. There were more assumptions built into the hypothetical.

MR. STONE: I haven't finished my question.

JUDGE McGUIRE: Go ahead then, Mr. Stone.

MR. ROYALL: Well, you said "correct?"

JUDGE McGUIRE: But keep that in mind.

11329

MR. STONE: I'll keep that in mind.

BY MR. STONE:

Q. It's your opinion, isn't it, Professor McAfee, that JEDEC would have tried to work around all of the features that might be patentable that were in RDRAM, all of the features that Rambus claimed to have invented as disclosed in its patent application, as well as the four features I've assumed that they gave specific disclosure on?

A. Well, it's my expectation if it's a good-faith disclosure that it's convincing that Rambus does in fact have coverage of that, which that's what I understand your hypothetical to be, that yes, they would try to work around all of the features.

Now, it may be -- I haven't actually studied any but the four technologies at issue in this case. It may be that the mode register technologies, for example, there's just no getting around it. I mean, I don't know one way or the other about that, and so your hypothetical by extending beyond the four technologies is asking me about something that it would just be pure speculation on my part about the technology.

Q. But the understanding you've applied as to what JEDEC would do is that with respect to any technology

11330

for which JEDEC requested a RAND letter and one was refused, they would not include that technology; correct?

A. My understanding is that they're not -- they're not supposed to incorporate technologies that -- without a RAND letter, that's correct. They're not supposed to standardize technologies in the absence of a RAND letter.

Q. So if someone can initiate the issuance of a RAND request by simply saying we believe that we may get a patent someday on a particular feature and then refuse to issue a RAND letter, they would be able to prevent JEDEC, consistent with its rules, from pursuing that technology, would they not?

A. Yes. And I believe the system has been gamed once in exactly that same way.

Q. And companies are often known to engage in such gaming, are they not?

A. Companies engage in gaming on occasion, yes.

Q. You've written an article about feinting, F-E-I-N-T-I-N-G, where you talk about that, haven't you?

A. That's correct.

Q. You talk about the possibility that someone might suggest they have patent coverage in a misleading

11331

way, for example, to cause people to change their conduct?

A. I don't recall that being in the article, but I don't disagree with the statement.

Q. So if JEDEC upon hearing from Rambus, We may have -- let me strike that.

If JEDEC, upon hearing from Rambus that it has filed a patent application that it hopes will give it broad coverage over its inventions and broad coverage over all of the features of the product it's developing, had thought that it was being gamed by Rambus and that Rambus really would not get such a patent, JEDEC might have decided, you know, we're not going to ask for a RAND letter, we're not going to set ourselves up for a refusal to give us one, we're just going to go ahead because we don't think they'll ultimately get a patent. Possible response?

A. I admit that that's a logical possibility.

Q. Not irrational for JEDEC to think that, is it?

A. It's not irrational for them to think that if they are so being gamed.

Q. And if someone tells them that, they won't know for certain if they're being gamed or not, will they?

A. They will not know for certain.

11332

Q. Let me move down the tree to the situation where Rambus gives a RAND letter and at that point we show two branches. There either is an ex ante negotiation or there's not; correct?

A. Uh-huh. Yes.

Q. Now, you are not in a position to express an opinion as to the likelihood -- may I approach, Your Honor?

JUDGE McGUIRE: Yes.

BY MR. STONE:

Q. You're not in a position to express an opinion as to the likelihood that we would get down to Rambus giving a RAND letter on the basis of applying economic principles to Rambus' decision; right?

Bad question. Let me rephrase it.

You based your testimony --

A. What is that noise?

Q. Let me withdraw it.

JUDGE McGUIRE: Go ahead, Mr. Stone.

MR. STONE: I think it was the noise that was troubling the witness in the background.

THE WITNESS: Yes.

BY MR. STONE:

Q. You based your opinion about whether Rambus would or would not give a RAND letter upon your

11333

analysis of the Rambus business model; correct?

A. That's correct.

Q. And you have not made an effort to determine as a matter of economic opinion whether or not it was in Rambus' economic interest to issue a RAND letter if it had been requested, have you?

A. I certainly have taken that into account. If I had only looked at their business plan, I would have concluded that they would have refused a RAND letter. But because they had an economic interest associated with issuing a RAND letter, as well as an economic interest in refusing a RAND letter, I was unable to more precisely say which was the more likely outcome, but yes, I have taken the economic incentives into account.

Q. Well, earlier in this trial you told us you were not able to determine as a matter of economic opinion whether or not it was in Rambus' economic interest to issue a RAND letter, didn't you?

A. Well, that's what it means by not saying one way or the other which way it goes.

Q. Okay. And you told me the same thing in your deposition; correct?

A. That's correct.

Q. Okay. Now, if we get to where a RAND letter is

11334

given and JEDEC has to decide whether or not to engage in ex ante negotiations, does your view as to the probability that there would or would not be ex ante negotiations depend upon what it is they would be negotiating about, that is, a hope that a patent may someday issue, a pending patent application or an issued patent?

A. I don't actually distinguish the hope that a patent will someday be issued from a patent application. That is, if we're talking about prior to the filing of any patents or patent applications -- well, in any case in this whole period that have -- the '898 heritage filing, and so I guess -- actually let me ask you to ask the question again.

Q. Certainly. Let me be more precise.

I want you to assume that at the time the RAND letter was given Rambus did not have a claim pending in an application that would have read on any of the four technologies at issue here.

Can you assume that?

A. Yes, I can.

Q. Would there have been an ex ante negotiation at that stage?

A. I would agree that that would affect the probability of ex ante negotiations. If nothing else,

11335
it makes it harder to describe precisely what's being negotiated about.
Q. And is the likelihood also affected if there is a claim in a patent application as opposed to a claim in an issued patent?
A. Yes.
Q. And if Rambus were to have been asked for a RAND letter just simply on the basis of its hope or belief that it could someday obtain patent coverage but it did not have a claim in an application that then covered any of the technologies, would that also affect the probability that there would be a negotiation?
A. I'm sorry. I lost the thread.
Q. That's okay.
A. If I could ask you, if you could just read it back I think.
JUDGE McGUIRE: Go ahead, court reporter.
(The record was read as follows:)
"QUESTION: And if Rambus were to have been asked for a RAND letter just simply on the basis of its hope or belief that it could someday obtain patent coverage but it did not have a claim in an application that then covered any of the technologies, would that also affect the probability that there would be a
11336
negotiation?"
THE WITNESS: Yes.
BY MR. STONE:
Q. And the less certainty there is about the exact scope of the claim and whether or not it would issue lowers the probability that there will be ex ante negotiations; is that right?
A. I think that's a fair summary of my view.
Q. If the potential licensees are of the view that a claim in a patent application is unlikely to issue and if it issues unlikely to be found valid, will that affect the probability that they will seek to initiate negotiations?
A. So if they -- the hypothetical is that they think that the patent either won't issue or is not going to be found valid, are they less likely to negotiate. If that's the question, then yes, I would agree with you on that.
Q. If JEDEC as a matter of policy simply didn't seek or encourage ex ante negotiations following receipt of a RAND letter, they might rationally do so because they might have concluded that the costs of ex ante negotiations exceed the benefits of engaging in ex ante versus ex post negotiations; correct?
A. You're asking me about JEDEC as opposed to the
11337
individual JEDEC members?
Q. Let me ask you about the individual JEDEC members.
Individual JEDEC members might rationally conclude that the costs of engaging in ex ante negotiations exceed the potential costs of waiting to negotiate ex post and therefore decline to engage in ex ante negotiations; is that right?
A. Those circumstances could arise.
Q. In the event that no ex parte negotiations have occurred, we then get to the final node of this chart, which is JEDEC either adopts alternative standards or adopts the existing standards; correct?
A. Actually I think you asked me about ex parte negotiations, but you probably intended ex ante negotiations.
Q. I always win the ex parte negotiations, too.
Let me rephrase it.
In the node where there are no ex ante negotiations, one alternative is that the four technologies in question are included in the standard and one alternative is that different technologies are included in the standard; correct?
A. Those are the two alternatives, yes.
Q. And if there are ex ante negotiations, your
11338
suggestion is that different technologies will be included in the standard or not?
A. No. That was not -- it was different levels of royalties. Potentially you could have different technologies depending on the outcome of those negotiations, but that isn't -- I'm not testifying that you would get the technologies.
Q. Okay. Your testimony in the event there are ex ante negotiations is that you would get the four technologies in the standards with lower royalties?
A. Or you could get different technologies depending on how the ex ante negotiations go, but in either event it would be a different outcome.
Q. And you base your conclusion that there would be lower royalties on your ultimate conclusion that the licensor has greater bargaining power ex post rather than ex ante; correct?
A. The licensor, yes.
Q. Now, going back to the last node where the negotiation ex ante has not occurred, and we're looking at the question of whether or not the same standards including the four technologies will be adopted or some other technologies will be included if we could.
We know that absent any consideration of the
11339
possibility of paying a royalty JEDEC selected the four technologies; correct?
A. Yes.
Q. And we also know that given whatever knowledge the pertinent -- I forgot the word I was supposed to use -- JEDEC members had about Rambus' intellectual property position, those four technologies were chosen?
A. I don't know about pertinent. Those four technologies were adopted even given the state of knowledge of the JEDEC members, if that's what you're asking me.
Q. Now, have you made any assumptions as to what considerations JEDEC would take into account in deciding whether to continue with the four technologies in question or whether to pursue alternative technologies?
A. I'm sorry. Can I get that read back again.
Q. Let me just rephrase it.
In your opinion, would JEDEC consider the costs of alternatives compared to the costs of royalties that might have to be paid in deciding whether to switch to alternative technologies?
A. In my opinion, JEDEC members would consider that on an individual basis. They might not all reach
11340
the same conclusions in that regard, and so I'm answering this way because when you're phrasing the question "would JEDEC" suggests that JEDEC acts with a single mind and I don't believe that it does.
Q. Okay. And I'm corrected as to what I do understand to be the way you've characterized this.
Would the individual JEDEC members take into account the performance of the alternatives in deciding whether to pursue alternative technologies or keep the four technologies in question in the

standard?
A. Yes.
Q. Would they consider the ultimate future flexibility or headroom of alternative technologies as opposed to the four technologies in question when JEDEC members were deciding which they prefer?
A. Yes.
Q. You have not made any effort to quantify the performance differences between the four technologies in question and the alternative technologies, have you?
A. I have not quantified the performance and cost differences.
Q. And you have made no effort to quantify the future flexibility or headroom of the alternatives

11341

versus the four technologies in question, have you?
A. No, I have not attempted to quantify the headroom.
Q. And the quantification that you have provided us with respect to the costs of alternatives uses as its starting point the data of Mr. Geilhufe and testimony of Dr. Rapp?
A. Yes. Although that was in the form of criticizing that analysis, but yes.
Q. Earlier today I think you told us that being incorporated in JEDEC standards is highly likely to lead to dominance in the industry. Do you recall testimony to that effect?
A. That has been in the last decade or so, yes.
Q. Did your study include the various technologies standardized by JEDEC that have not become dominant?
A. I'm aware of technologies that have not become dominant.
Q. Did you look at all of them?
A. All of JEDEC being beyond 42.3, for example, or do you mean all of JEDEC in the DRAM arena?
Q. Well, when you told us that being incorporated as a JEDEC standard was highly likely to lead to dominance in the industry, did you mean to limit that

11342

to just 42.3?
A. I did actually mean to limit that to the DRAM industry.
Q. Okay.
A. I don't – I mean, JEDEC standardizes many things and I don't know once beyond – I have not studied them all beyond DRAM.
Q. And so you looked you believe at all the different technologies standardized by JEDEC 42.3 in the past decade?
A. Yes. I believe I've examined -- now, it wasn't -- I should – I believe I have encountered, is probably a better word than studied, all of the technologies that they've standardized in the past decade.
Q. Which are the ones you conclude are dominant?
A. The ones that were listed on my slides, so that's fast page mode, EDO, SDRAM and DDR SDRAM.
Q. So we have four that are dominant?
A. That's correct.
Q. And in the past decade how many different technologies have been standardized by JEDEC 42.3?
A. I don't know the answer to that.
Q. Not even half of the technologies they've standardized have become dominant, have they?

11343

A. The only one I can think of offhand was burst EDO that was not adopted, but I suspect there are others. But yes, I would agree that there are technologies that were standardized that were not

adopted by the marketplace, DRAM technologies that were standardized that were not adopted by the marketplace.
Q. Could we bring up DX-141, please.
This is the chart you referred to earlier in your testimony about one dominant standard replacing the next, is it not?
A. It is.
Q. And in the course of this you talked about a transition period, if I recall correctly; is that right?
A. That's correct.

Q. When would you say on the basis of this chart was the transition period for EDO?
A. So EDO has a transition in and then out.
Q. And let's look at the transition in first if we can.
A. So I would say 1996 is the approximate time of the transition in.
Q. Okay. And then when is the transition in for SDRAM?

11344

A. Late 1997, 1998.
Q. And when is the transition in for DDR?
A. Well, I should say this -- according to this chart, this chart is a projection I believe from the year 2000, but it might have been -- yes, a projection from the year 2000. And in fact DDR had much faster penetration in 2002 than this chart indicates.
So I would say that DDR is probably 2001 to 2002.
Q. And the transition period is the first stage of one of these technologies becoming dominant?
A. No. I'm referring to transition as going from not the dominant standard to the dominant standard.
Q. Okay. And you told us earlier today that the tipping phenomenon plays a role in the creation of the dominant standard in this industry; correct?
A. It does play – well, it's an economic description -- it's an economic description of a phenomenon that I think is present in this industry.
Q. And you gave us as an example VHS and Beta; correct?
A. That's correct.
Q. And there's been a lot of literature written about VHS and Beta, hasn't there?
A. There has.

11345

Q. You have not written any of that literature, have you?
A. My book has a discussion, but it's in the form of summarizing what other people have written. I have not been an original contributor to that literature.
Q. And while I'm on that subject, am I also correct that you have never written a peer-reviewed paper on standard-setting or the economics of standard-setting?
A. I think that's correct.
Q. In fact you haven't written any papers peer-reviewed or otherwise on the economics of standard-setting, have you?
A. I don't believe I have.
Q. Have you ever been invited to speak on any panel or committee that was examining standard-setting issues?
A. Not that I recall.
Q. And were you invited to speak at any of the

joint FTC/DOJ hearings on standard-setting in intellectual property?
A. I was not.
Q. Are you familiar with Peter Grinley?
A. Say the name again.
Q. Peter Grinley.

11346

A. That name vaguely rings a bell, but I may not be familiar.
Q. Betamax was the first to be introduced, was it not?
A. I believe that's right.
Q. And it had a very high market share for at least a couple of years, did it not?
A. I don't specifically recall, but that's not inconsistent with my recollection.
Q. VHS had some features that were not present in Betamax, didn't it?
A. So there's a lot of dispute about the feature aspect of this. The VHS -- whether features even mattered. I know some industry commentators said that at least Super Beta was substantially higher quality.
JUDGE McGUIRE: All right. Let's try to, Professor, to confine your answer just to the question as asked, if you don't mind.
THE WITNESS: So as a practical matter, yes, they had distinct features.
JUDGE McGUIRE: Thank you.
BY MR. STONE:
Q. If we could bring back up DX-114.
Each of the products listed on DX-114 have distinct features compared to the other products on

11347

that chart, do they not?
A. Yes.
MR. ROYALL: Just for the record, I think this may be DX-141.
BY MR. STONE:
Q. I'm sorry. Referring you to DX-141, my mistake.
And it's true, isn't it, that EDO provided, as you understand it, and that's one of your assumptions, a higher level of performance than fast page mode?
A. Yes.
Q. And it's also your assumption that SDRAM provided a higher level of performance than those that went before it and DDR provided yet a higher level of performance?
A. Yes.
Q. And the fact that each of the products as you understand them or that you have assumed them to exist provide a higher level of performance is of significance in deciding which one will become dominant, is it not?
A. It is.
Q. You would not expect under economic theory that a product which offered the same level of performance would become dominant over one that was already a

11348

dominant product in the market at the same level of performance, would you?
A. As long as we can agree that we're talking about performance per dollar or some sort of cost-adjusted performance level, then yes.
Q. Okay. We can take that down and bring up if you would DX-362.
Let me direct you to the bottom point here where it says, "Royalties and manufacturing costs are not directly comparable."
Do you recall testifying about that point earlier today?
A. Yes.
Q. You said one of the things you're able to do is reduce manufacturing costs?
A. That's correct.
Q. You also said that manufacturing costs don't go up with renegotiation, didn't you?
A. That, I did testify, yes.
Q. Have you ever been involved in a labor negotiation?
A. Labor would be the exception that can go up.
Q. What about when your suppliers of materials tell you they've raised the prices? Is that another exception?

11349

A. That could be an exception if you have -- if you aren't facing competitive markets in materials.
Q. Well, even if you're facing markets in your materials, sometimes the costs of materials go up, don't they?
A. Yes, costs of materials can go up.
Q. The costs of manufacturing equipment that you use in your plant can go up, can't it?
A. Yes, the costs of materials in your plants can go up.
Q. Now, you also said -- you talked about a license that might expire before the patent was due. Do you recall that?
A. I gave that as an example, yes.
Q. If the license runs for the life of the patents, you wouldn't expect there to be a renegotiation that resulted in a higher royalty, would you?
A. Not on that specific patent, no.
Q. And it is possible to renegotiate a patent license to reduce the royalty, isn't it?
A. Well, it's certainly possible to renegotiate the patent license to reduce the royalty, although I don't see how that would be relevant to an analysis of this industry.

11350

Q. Don't licensees sometimes come to the licensor and say we want to renegotiate the royalty because, A, we're about to work around this patent and we'll stop paying you anything, or B, we now have some patents in our portfolio that you might want and we think we should make a deal that reduces the amount we'll pay you?
A. The renegotiation of the latter form strikes me as being logically different. That's we now have something that you should be paying us for, let's net it out. That strikes me as logically different.
Q. And the first one you would agree is consistent with my premise that royalties can be negotiated downward?
A. Yes.
Q. Let's look if we can at DX-363.
You are not here to testify to the technical feasibility of asynchronous technology, are you?
A. That's absolutely correct.
Q. And you're not here to tell us that if you invest enough money in a particular technology it is certain to succeed, are you?
A. I would agree with that, I would agree that you can't buy certainty.
Q. And in fact you would agree that some

11351

technologies no matter how much money you put into them simply may not work because of physics?
A. That's quite conceivable.
Q. In thinking about alternative technologies, did

you do anything to quantify the performance differences between the four technologies at issue in this case and any of the alternative technologies that you've considered?

A. I judged them qualitatively, not quantitatively.

Q. With respect to fixed latency as referenced on DX-363, based on what JEDEC actually adopted, you would agree, wouldn't you, that the JEDEC members acting in their own self-interest in coming to a collective decision felt that a number of fixed latencies and -- a number of latencies and a number of burst lengths were of value?

A. I think JEDEC behavior and JEDEC discussions reflected that some and perhaps even a majority of JEDEC members thought that multiple latencies and multiple burst lengths had value.

Q. Okay. And you made no effort to quantify how much value that had to any of the members, did you?

A. I'm unable to quantify how much value that had.

11352

Q. Let's look if we can at DX-364.

With respect to infringing alternatives, you are not expressing an opinion, are you, as to whether or not any particular alternative infringes or not?

A. I am not expressing any opinion about the infringing of alternatives, and I hope my testimony was clear on that point.

Q. Okay. Let's look if we can at DX-366.

A. Actually I would like to apologize for calling Dr. Soderman "Mr. Soderman" several times as well.

Q. I'll accept on his behalf sort of like the Emmys. And I'm sure he won't mind, Professor McAfee. I called Professor Teece "Professor McAfee" the other day and it was hard to tell --

JUDGE McGUIRE: Did he mind that?

MR. STONE: It was hard to tell whether he minded or he was flattered, so we just went on.

MR. ROYALL: To end the confessional, I did call Professor Teece "Mr. Teece" and I do apologize.

JUDGE McGUIRE: Okay. I hope we're all clear now.

BY MR. STONE:

Q. If we can, let me ask you a couple of questions about this one.

The chart, DX-366, has a read command with a

11353

cost of one cent. That is an alternative technology that you understand Dr. Rapp based on testimony from Dr. Soderman to have considered to be infringing; correct?

A. That's my understanding, yes.

Q. And the next one you have, the burst terminate, you do understand that there has been discussion as to whether or not it has performance problems; correct?

A. I do understand that.

Q. If we were to eliminate -- let me withdraw that.

Let me ask you to take a look at DX-213.

This is a chart you used when you testified in the case in chief; correct?

A. It is.

Q. And you put a check mark by those that you felt were commercially viable options as you've defined the term?

A. That I identified as commercially viable, yes.

Q. And you put an X by one that you concluded was not commercially viable?

A. From my reading of the record, yes.

Q. And as to the other three, you said you didn't have enough information to determine whether they were

11354

commercially viable or not?

A. That's correct.

Q. Now, you have today told us that the first one listed on this chart, DX-213, the use of two or more interleaved memory banks on chip, is commercially viable?

A. No.

Q. Okay. So you have not -- you did not mean to indicate that by your testimony earlier today if you said anything that might suggest it?

A. I did not mean to indicate that it is my opinion one way or the other. I'm still agnostic on whether interleaving memory banks on a chip is commercially viable.

Q. So if we look at DX-367, and we see where your fourth item down says "interleave banks on chip," that's one as to which you are agnostic as to whether or not it's commercially viable?

A. That's correct.

Q. And it is one as to which you understand it might infringe?

A. Well, the record there is somewhat interesting. My understanding of the record is that Dr. Soderman said in his report but not during his testimony that it infringes.

11355

Now, I haven't read Dr. Soderman's testimony in its entirety, so I'm relaying my understanding, but it is not -- it is my understanding that he did not testify in court that it was infringing, only -- but he did say in his report, which I did read, that it was infringing, yes.

Q. So there was some discussion that it's infringing and there's some discussion as to whether or not it's commercially viable even if it were not infringing; correct?

A. Some discussion?

Q. By you just now.

A. I thought I said I was still agnostic on the commercial viability.

Q. Let me rephrase.

As of today, you would agree that you remain agnostic as to whether or not interleaving the banks on the chip was commercially viable and you understand there has been some prior discussion to the effect that it may infringe; correct?

MR. ROYALL: I was going to object just as it's compound. He's putting two different things in there. Maybe if we could break it down, maybe it would be easier to answer.

JUDGE McGUIRE: Mr. Stone, can you do that?

11356

MR. STONE: Sure.

BY MR. STONE:

Q. Your testimony is that you're agnostic as to whether or not interleaving banks on the chip is commercially viable?

A. That's correct.

Q. And you understand there has been some prior discussion that interleaving banks on the chip may infringe patents held by Rambus?

A. As I said, that's my understanding of Dr. -- that Dr. Soderman said so in his report but not during his direct testimony.

Q. Are you also aware of performance problems associated with interleaving banks on the chip based on

your understanding?
A. I think there are issues associated with all of these technologies. We had had a discussion about this during the cross-examination of my direct testimony. I don't have any other performance issues beyond that discussion.
Q. Okay. Let me switch then to switching costs.
You have not performed any calculation quantification of what you believe to be the switching costs that should be considered here, have you?
A. No, I haven't attempted to add them up.

11357

Q. And you haven't done that with respect to switching from SDRAM to alternative technologies or from DDR to alternative technologies, have you?
A. That's correct.
Q. You would agree, wouldn't you, that there are switching costs incurred when you go from SDRAM to DDR?
A. I agree with that.
Q. And there are also switching costs incurred when you go from DDR to DDR-II?
A. I agree with that.
Q. And there would have been switching costs incurred if you went from SDRAM or from DDR to SLDRAM;
correct?
A. There would have been.
Q. There also are switching charges incurred when you go from a PC66 to a PC100 or a PC133, aren't there?
A. There are some switching -- you said charges, but there are some switching costs, would be the ordinary term.
Q. And there are switching costs incurred when you go from a 64-meg to a 128-meg to a 256-meg of any particular DRAM design?
A. There are certainly switching costs incurred in

11358

those transitions.
Q. The switching costs we've talked about between SDRAM to DDR, for example, and within various SDRAM and
DDR product generations are incurred with a frequency of more often than once a year, aren't they?
A. There are some kinds of switching costs that are incurred with a frequency more often than once a year.
Q. Now, in terms of calculating the switching costs of moving to an alternative technology, one thing you would do if you were a cost-conscious manufacturer is try to piggyback the switching costs of a new alternative technology onto a situation where you were already incurring switching costs because of an intergenerational or density move; correct?
A. If that's efficient. It's my understanding of this industry that that's not necessarily efficient. There's some cases where, when you're changing a few things, it's better to go ahead and change everything else that you want to change.
But my understanding of this industry is actually the broader the changes, the more changes you're making, actually the more complicated, the more costly the total cost of those changes, so that it may well be cheaper to make the change to do the changes in

11359

smaller steps rather than do them wholesale.
Q. And you would expect that whichever way it turned out to be the most efficient that's what the manufacturers would choose?
A. That is what I'd expect, yes.
Q. And you have not made an effort to quantify whether the switching costs you referred to in going to alternative technologies could or could not be reduced by incurring those switching costs in conjunction with other design changes, have you?
A. I have actually made an effort to understand to what extent these switching costs can be reduced by piggybacking them, as you've used the phrase you used earlier, on the costs of other changes, which is how I came to understand that in making wholesale changes often makes it more costly, not less costly.
Q. But my question was: You haven't done it, made any effort to quantify that, have you?
A. That's correct.
Q. Okay. Now, in terms of coordination costs, that's an issue you talked about earlier today; right?
A. That's correct.
Q. And you understand JEDEC to be a coordinating body, don't you?
A. I do.

11360

Q. One of its goals is to coordinate the interests of a variety of different players in an industry to help them reach a consensus?
A. That's one of its major functions.
Q. And there's a cost associated with it performing that function; correct?
A. There is.
Q. And it has incurred -- that cost has been incurred by its members and others in the industry at various transition stages in the past decade?
A. Those costs have been incurred, yes.
Q. And those costs are incurred at the same time switching costs are incurred, as we discussed earlier?
A. At the same time as the switching costs were incurred?
Q. By that I mean coordination costs are incurred when you switch from SDRAM to DDR to DDR-II, from PC66
to PC133, from a 64 meg to 128-meg?
A. Yeah. There have been coordination costs associated with those transitions.
Q. Let me ask you now about productivity gains.
May I get the board, Your Honor?
JUDGE McGUIRE: Yes.
MR. STONE: I believe this will be DX-378.

11361

(DX Exhibit Number 378 was marked for identification.)
JUDGE McGUIRE: Yes, I believe that's correct.
MR. STONE: I will write "DX-378" on the top.
BY MR. STONE:
Q. You testified to calculations that you performed using a 30 percent annual productivity gain; correct?
A. I did testify to such calculation -- or the outcomes of such calculations.
Q. And a 30 percent annual productivity gain means if you start in year one with a product that costs one dollar to make, in year two the costs will be 70 cents, in year three the costs will be 49 cents, and by the time we get down to year eight the costs will be somewhere around 8 cents; correct?
A. I don't know about year eight, but I'm happy to check it with a calculator if you'd like. It's certainly in the right ballpark.
Q. Okay. So what you did was you took the numbers that Mr. Geilhufe testified to and over a period of some years you reduced them 30 percent a

year; correct?
A. In that particular thought experiment, yes.
Q. And for SDRAM, over how many years did you do
11362
this 30-percent-a-year reduction?
A. Well, I did it over the relevant period. I've forgotten the exact number. But I've tried to follow Mr. -- or Dr. Rapp's numbers in this regard, so it's -- as I sit here today, I don't recall exactly, but it's over the period of the day.
Q. Could you estimate? Would it be around eight years?
A. Sure. In that neighborhood.
Q. Let me write "approximately eight years."
And for DDR for what period did you run your 30-percent-a-year reduction?
A. Again it's taking Dr. Rapp's numbers, his time period, so again it could be on the order of eight years.
Q. Okay.
A. I don't remember as I sit here today.
Q. Now, what you assumed for purposes of this 30 percent annual production gain, you assumed that costs were going down 30 percent a year per bit?
A. Well, that's my understanding of the source of the 30 percent number, is that the costs go down 30 percent per bit. For DRAMs generally.
Q. Let me go to DX-379, my next chart. Let's make sure we understand that.
11363
(DX Exhibit Number 379 was marked for identification.)
BY MR. STONE:
Q. If I have a 64-meg product that costs five dollars and the next year I bring out a 128-meg product that I'm able to sell for five dollars, you would understand that for purposes of this productivity analysis to be a 50 percent reduction in cost per bit?
A. Yes. That's correct.
Q. And the 30 percent figure you used is one that you understand sort of applies across the industry?
A. On a -- yes. I'm not saying that it directly applies to each individual technology.
Q. Right. Okay. And that's what I want to explore to make sure we understand the limitations of that analysis.
For example, if my $5.00 product is consumed of five parts, my $5.00 cost is consumed of one dollar -- I'll make plus signs -- one dollar, one dollar, one dollar and one dollar, so we have five components each costing a dollar; is that fair?
A. Okay.
Q. I could get to a reduction in price of 50 percent by either moving them all to 50 cents all
11364
the way across or by moving some to 25, some to 75, and one to 50; right?
A. That's correct.
Q. It's sort of simple arithmetic that I can add up a bunch of numbers in a variety of different ways and still come to the same total?
A. That's correct.
Q. Now, Mr. Geilhufe's numbers you understand were described by him to be mature product costs; right?
A. You could describe them as mature product costs, although I have to say I personally find the testimony on this point somewhat confusing, so I gave those numbers as an illustration, but I've -- it's -- it would be a challenge to know exactly what the facts are.
Q. Okay. And I understand you're not here to testify as to the facts anyway and I don't mean to draw you into that. Let me just ask it this way.
You do understand that -- this would be DX-380, I believe.
(DX Exhibit Number 380 was marked for identification.)
BY MR. STONE:
Q. You do understand that Geilhufe's costs include
11365
costs of pins; correct?
A. That's one of the costs, yes.
Q. Costs of packaging; correct?
A. That's -- yes.
Q. Inventory costs; correct?
A. Correct.
Q. Now, for a particular product, a particular DRAM, you don't really think, do you, that the costs of the pins for that product are going to go down 30 percent a year every year for eight years?
A. I actually have looked up what the cost of pins to have been and it has not fallen by 30 percent a year. It has fallen, however.
Q. And you wouldn't expect the costs of packaging to go down 30 percent a year, would you?
A. That's my understanding, packaging has not gone down 30 percent a year.
Q. And you wouldn't expect inventory costs to go down 30 percent a year either, would you?
A. I would be surprised if they did.
Q. Because each of these costs are calculated on a per-product basis and are unaffected by any changes that might occur per bit; correct?
A. Well, so on the inventory costs I agree with that statement entirely. On the others, it's because
11366
they're a different kind of technology, they're not on the per-bit basis, I guess it's on a per-chip basis, if that's what you mean by "per-product," yes. Although that doesn't say that the costs would fall; it just says they are unrelated to the per-bit costs.
Q. Okay. So we need -- if we go back to the record to look at the testimony about historic cost reductions in this industry, you would agree, wouldn't you, that we need to be sensitive as to whether that testimony refers to a cost reduction on a per-bit basis or a cost reduction on a per-DRAM basis?
A. So if you want to do this aspect of Dr. Rapp's study right, what you'd like to do is actually adjust for the decrease in costs for each category of costs, some of which fall faster than 30 percent and some of which fall slower than 30 percent. I agree with that. If that's what I understand you to be asking me, then I agree with that statement.
Q. But the costs I put up on DX-380, costs of pins, costs of packaging, costs of inventory, are costs that are computed on a per-DRAM or per-product basis; correct?
A. Yeah, per -- yes, per chip.
Q. And they're unaffected by density increases that might allow a reduction in the per-bit price
11367
simply by going from 64 to 128 to 256, and so on; correct?
A. Yeah, although -- I'll say yes and no. My understanding of that 30 percent number is that's for the product coming out the door.
In other words, the competition is on the DRAM, the packaged DRAM, and that it's the packaged DRAM that

is actually falling at 30 percent. Even though that's measured on a per-bit basis, it's still the actual packaged product.

Now, that's a factual question and I may be wrong about that, but that is my understanding, and as a result, when I go to do this comparison, it's not and just because it's on a per-bit basis that its costs aren't falling.

Q. Let me just make sure we understand. I'm not sure whether we --

A. I'm not sure either.

Q. -- are disagreeing or not. Let me go back a minute.

If a product that is a 64-meg is then -- with the same package, same number of pins and same inventory costs but with an increased density is now a 128-meg product sold for the same price, that would be a 50 cent -- 50 percent reduction in the costs per bit?

11368

A. That's correct.

Q. And it would be zero percent reduction in the cost per DRAM or product?

A. That would be correct.

Q. So one of the things we need to be sensitive to when we look at the facts in this record, you would agree, is whether the cost reduction is being measured on a per-bit basis, which could result from density increases, or whether it's being measured on a per-product basis?

A. I agree that that's a relevant consideration in getting the correct answer.

Q. Okay. Relevant to understand the data?

A. Yes.

MR. STONE: Thank you very much, Professor McAfee. I have no further questions.

JUDGE McGUIRE: All right. Thank you.

Then, Mr. Royall, any further redirect?

MR. ROYALL: Could we have just a moment to confer?

JUDGE McGUIRE: Go ahead.

(Pause in the proceedings.)

MR. ROYALL: I'm ready, Your Honor.

JUDGE McGUIRE: All right. Go ahead, Mr. Royall.

11369

MR. ROYALL: Just a few questions.

REDIRECT EXAMINATION

BY MR. ROYALL:

Q. Professor McAfee, you were asked some questions about the but-for world and about scenarios involving gaming of JEDEC. Do you recall that?

A. I do, yes.

Q. Now, have -- in your review of the factual record, have you seen any evidence that has caused you to make assumptions or to draw conclusions about whether Rambus was -- in the but-for world should be viewed as having gamed JEDEC in the sense that you've used that term?

MR. STONE: Your Honor, that would require this witness to comment and interpret the evidence, which I avoided in framing my questions simply as assumptions and a question about economic principles.

MR. ROYALL: I'm asking about assumptions, whether he's made any assumptions.

JUDGE McGUIRE: You're asking him to --

MR. STONE: That's not how the question is framed.

JUDGE McGUIRE: If you can clarify on that basis, I'll allow the question.

11370

BY MR. ROYALL:

Q. Have you made any assumptions as to whether in the but-for world Rambus would be gaming JEDEC, in the sense that you used that term?

A. I was assuming that the disclosures were good-faith disclosures and hence were not involved in gaming JEDEC; that is, Rambus was not involved in gaming JEDEC in the but-for world.

Q. Now, you said in response to one of Mr. Stone's questions I believe, and I don't want to misstate it, but what I wrote down is that you said that in this industry, the DRAM industry, you did not think it was relevant to consider the possibility that renegotiations of patents could result in lower royalties?

A. Yeah, I didn't -- I don't think that was relevant.

Q. Can you explain why you don't think that's relevant in this industry?

A. Absolutely. As I've testified before, I think lock-in is a major feature of this industry, and as a consequence, the bargaining power of the licensor grows over time and it's more difficult, not less difficult, to get out from under patents as time goes by.

And so as a consequence, I would not expect to

11371

see the royalty rates renegotiated downward. So while that's a hypothetical possibility, it is not in accord with my study of this industry.

Q. You were -- switching to another topic -- you were asked some questions about the interleave memory banks on-chip alternative to dual-edged clocking. Do you recall that?

A. I do.

Q. And this is something that came up in your rebuttal testimony in the context of your critique of Dr. Rapp's analysis; is that correct?

A. That's correct.

Q. And you were asked on cross-examination about your own views as to the commercial viability of that alternative, interleave memory banks on chip. Do you recall that?

A. That's correct.

Q. And I believe the term as you used in describing your own views is that you're agnostic as to whether that's commercially viable?

A. I used that term.

Q. Now, does that view that you've described, your own view that you're agnostic about whether that's commercially viable, does the fact that you hold that view in your mind undermine in any way the

11372

critiques that you were making of Dr. Rapp's methodology?

A. It does not.

Q. And why not?

A. The critique of Dr. Rapp -- I don't accept -- I have problems with a number of aspects of Dr. Rapp's methodology. In this case I was following -- so I was, I guess the legal term is arguendo, I was following his approach, and in following his approach I would allow for the technologies that he's -- that have been put on the table and then follow his approach and see where it leads.

Now, I disagree with that approach, with his approach generally, and that's why if I agreed with his approach, then I would have to find that interleaving banks on chip was commercially viable, but since I disagree with his approach, I don't -- I can't use his approach to find that it is in fact commercially

viable.
Q. And just so we're clear, when you say if you agreed with Dr. Rapp's methodology or approach you'd have to find that the interleave banks on chip alternative was commercially viable, why is that?
A. Well, because the outcome was -- came up with a cost significantly less than the Rambus royalty

11373

level.
Q. Now, moving on now to another topic, switching costs, do you recall that you were asked not what the magnitude of the costs would be, but you were asked if you acknowledge that there might be switching costs in switching, for instance, from PC100 to PC133? Do you recall that?
A. Yes.
Q. And you were also asked about other switching -- switching that occurs in the industry on a somewhat routine or potentially annual basis. Do you recall that?
A. That's correct.
Q. Now, do you have any views as to whether the types of switching costs associated with those types of switches or how the types of switching costs associated with those types of switches would compare with the types of switching costs that have -- are relevant in this case, namely, switching costs associated with working around the Rambus patents?
MR. STONE: I do object, Your Honor, to counsel's characterization of certain costs as relevant. I think the question of what costs are relevant or not is not one that is properly introduced by counsel in the question and it's a question for the

11374

court. In that sense, the question is argumentative and I'll asked that it be rephrased.
JUDGE McGUIRE: On that basis, I'll uphold the objection and ask that it be rephrased.

BY MR. ROYALL:
Q. Just to be clear, when you look at switching costs in the context of this case, what costs do you consider to be, generally speaking, to be relevant to the type of economic analysis in this case?
A. So these are the costs of redesigning the product to avoid the intellectual property of Rambus, the four challenged technologies, the costs of redesigning not just DRAMs but all of the other products, the costs of getting consensus to redesign those products and the -- and all of the complementary products, and the costs of transitioning from a previous DRAM type to the new DRAM type.
Q. Now, do you have any views as to how those types of costs that you've just described, those types of switching costs, compare to the types of switching costs that Mr. Stone was asking you about, such as the costs of switching from PC100 to PC133?
MR. STONE: Your Honor, if this is an effort to obtain quantification of the costs, I do object. It's beyond the scope. It's inconsistent with the testimony

11375

he gave and it's not included in the report.
JUDGE McGUIRE: Mr. Royall.
MR. ROYALL: Your Honor, I didn't ask him to quantify. What I asked him is -- and the question was very clear -- is do you have any views as to how those types of costs compare to these other types of costs.

I'm not asking for a quantification. I'm just asking for whether he has any views on that from the standpoint of economics. He was just asked about this very subject. I'm just trying to complete the subject on the same subject which he was asked about.
JUDGE McGUIRE: I'll hear the question.
BY MR. ROYALL:
Q. Do you have the question in mind?
A. Yes.
So there are some categories of costs that aren't present in the routine switching. There's certainly some that are present in the routine switching, but there are some categories of costs and some of the discussion we've had of costs associated with coordination when you have disparate incentives, as an example, are not either present in the routine switching costs that Mr. Stone asked me about.
Q. And from the standpoint of economics or your economic analysis, do you have any expectation as to

11376

how, in terms of orders of magnitude -- I'm not asking for precise quantification but just in terms of orders of magnitude -- how the types of switching costs associated with a move, for instance, from PC100 to PC133 would compare to the types of switching costs that you've focused on as being relevant in this case?
MR. STONE: Well, as a once-upon-a-time science student, Your Honor, I don't think there's any difference between orders of magnitude and quantification, and to say "orders of magnitude" simply means give me an estimate of the quantification if you can't give it to me precisely because there's no way to answer --
JUDGE McGUIRE: All right, Mr. Royall, you've got your question in once, but that's it. That's the extent of it. I'm going to uphold his objection at this point.
BY MR. ROYALL:
Q. On the subject of productivity gains -- strike that.
I'm not asking you about quantification or orders of magnitude, but is the difference that you described in your answer to my earlier question, is that relevant to your conclusions about switching costs in this case?

11377

A. I'm sorry. I'm going to have to have that read back.
Q. I can restate it.
JUDGE McGUIRE: Can you rephrase?
BY MR. ROYALL:
Q. I had asked you an earlier question about the comparison between the types of switching costs that you were describing as relevant and switching costs associated with, for instance, a move from PC100 to PC133. I'm not asking you to quantify or comment on orders of magnitude.
But is the difference that you've described in your earlier answer, is that something that has any bearing on the conclusions that you have reached about lock-in and switching costs in this case?
A. Yes. There are some categories of costs that aren't present in the orderly or routine switching and those categories, there's been some testimony that suggests that they could be -- they could create an additional impediment to create lock-in.
Q. Now, the final thing I have to ask about relates to DX-369.
Do you recall this slide from earlier today?
A. Yes, I do.
Q. And Mr. Stone asked you some questions about

11378

this 30 percent annual productivity increase

assumption that you refer to in this slide. Do you recall that?
A. I do.
Q. Now, when you use that assumption 30 percent annual productivity increase, are you suggesting that based on your assumptions that this is in fact the accurate assumption that must be applied in the context of an analysis of this sort?
A. No. It was just for illustrative purposes to show that productivity increases could actually make a substantial difference and that as a result Dr. Rapp's analysis is not robust to productivity -- to some productivity gains or to sufficiently large, I believe was the phrased phrase I used in my direct testimony, productivity gains.
Q. And the effect of using this alternative assumption 30 percent annual productivity increase, the effect of using that in Dr. Rapp's analysis would be what, according to your own calculations?
A. It reverses his conclusions.
Q. And based on the calculations that you've done, would you need to use a 30 percent or assume something as high as a 30 percent annual productivity increase to reverse Dr. Rapp's conclusions?

11379

A. No, you would not.
Q. And by that do you mean a lower number could end in the same result?
A. Yes. In my rebuttal report I actually also computed 10 percent and that -- my recollection is that makes the least costly -- Dr. Rapp's least costly alternative less than .75 percent, but it did not make his most costly alternative less than .75 percent.
MR. ROYALL: Thank you, Your Honor. I have no further questions.
JUDGE McGUIRE: Mr. Stone, any further recross?
MR. STONE: Thank you, Your Honor.

RECROSS-EXAMINATION

BY MR. STONE:
Q. And if you use 10 percent for DDR, the results would be just as Dr. Rapp testified, wouldn't they?
A. Right. That's my recollection. I'm not -- actually I don't recall either way. But that's not inconsistent with my recollection.
Q. Okay. Could we look at DX-312.
This is a chart that was used by Dr. Rapp in his testimony to list the alternative technologies that he considered with respect to DDR SDRAM, isn't it?

11380

A. That looks familiar, yes.
Q. And you know that he did not consider as an alternative interleaving the banks on the chip, did he?
A. That's not listed and he did not consider it here, nor did he consider it in his report as I recall.
Q. And he testified, didn't he, that he didn't consider it because you had not included it in your set of commercially viable alternatives?
A. That was my understanding of his testimony.
MR. STONE: Okay. I have no further questions. Thank you, Your Honor.
JUDGE McGUIRE: Okay. Thank you very much. And, Professor, that concludes your testimony. You're excused from this proceeding. Thank you very much.
THE WITNESS: Thank you very much.
JUDGE McGUIRE: As I understand it then, that concludes the presentation of complaint counsel's case in rebuttal?
MR. ROYALL: Certainly as to testimony, yes, Your Honor.