FEDERAL TRADE COMMISSION

I N D E X (PUBLIC RECORD)

UNITED STATES OF AMERICA

FEDERAL TRADE COMMISSION

In the Matter of:	)
Rambus, Inc.	) Docket No. 9302
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Tuesday, July 22, 2003

9:32 a.m.

TRIAL VOLUME 47

PART 1

PUBLIC RECORD

BEFORE THE HONORABLE STEPHEN J. McGUIRE

Chief Administrative Law Judge

Federal Trade Commission

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Washington, D.C.

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P R O C E E D I N G S

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JUDGE McGUIRE: This hearing is now in order. It's certainly good to have you back, Mr. Royall. I hope you're feeling well.

MR. ROYALL: Thank you, Judge. I appreciate that very much.

JUDGE McGUIRE: Any housekeeping tasks here this morning before we begin?

MR. STONE: Not on our side, Your Honor.

JUDGE McGUIRE: Anything from complaint counsel?

MR. ROYALL: Well, there's one thing that I understand came up yesterday when Mr. Oliver was here relating to the subject of our rebuttal case.

JUDGE McGUIRE: Yes.

MR. ROYALL: And I did have a couple comments, if I could comment on that now.

JUDGE McGUIRE: Go ahead.

MR. ROYALL: First of all, Mr. Oliver and I have spoken about this, and to the extent we put on a rebuttal case, we would envision it on the order of, on the outside, two to three days, barring something unforeseen. And if respondent were to rest on Tuesday, we would envision completing our -- subject to some

unforeseen scheduling problem, completing the rebuttal case by Friday.

JUDGE McGUIRE: Very good.

MR. ROYALL: And the other thing is that with reference to what I understand was Your Honor's order yesterday, about going -- pointing out matters in the transcript, we wanted to ask for clarification on that, that order, as it pertains or might pertain to experts.

And on the subject of experts, I want to make just a couple of points. One is that, as you may know -- and I have copies here if you want to see it -- but the scheduling order that was agreed to by the parties in this case and approved or initially by Judge Timony provided for original expert reports by complaint counsel, then respondent's expert reports and then rebuttal expert reports, and that was the schedule that was agreed to and it was the schedule that was followed.

JUDGE McGUIRE: I'm glad you pointed that out to me. I wasn't otherwise cognizant of that. It's been a while since I've seen that scheduling order.

MR. ROYALL: So we've operated under the assumption -- for instance, what I have here is Professor McAfee's expert rebuttal report, so we didn't

go into any of this because we assumed it would be objected to if we'd seek to rebut their expert testimony before he testified.

So for our rebuttal case we would envision Professor McAfee on the order of a half a day and possibly Professor Jacob, but we're still analyzing that, and if he were to testify, it would be on the order of a half a day, and then all that would remain would be some possible factual rebuttal that would be limited, and we're still assessing that, both the need for it and the availability of witnesses. But if all of that, all told, we would envision not taking more than two, two and a half days.

JUDGE McGUIRE: So what is that Friday? I know the 29th is Tuesday.

MR. STONE: I believe that's the 1st.

JUDGE McGUIRE: Okay. Well, we tried to keep it out of August, but I guess we slipped in a little bit.

Mr. Stone, do you have any comment with what's being proposed here?

MR. STONE: No. I think the contemplation of two, two-and-a-half-day rebuttal with it principally focused on their experts is consistent with what I think we had understood they might do. And I think the

scope of those, the expert testimony, will, I think as Your Honor has indicated, be limited to what's proper rebuttal, but I do think it's not -- it doesn't come as a surprise to us that it might be Professor McAfee and/or Dr. Jacob.

JUDGE McGUIRE: Then let's proceed on that basis and we'll keep that in mind.

I had indicated that I'd asked complaint counsel to file with the court a motion by Thursday depicting which -- you know, whom you would have back on and the testimony that they sought to rebut. Is that going to be a problem?

MR. ROYALL: Well, one thing is in terms of experts, we are hoping that you would clarify that we wouldn't need to do that type of exercise for experts. In part for the economists it would be difficult because they haven't -- their economist hasn't even yet testified.

JUDGE McGUIRE: Mr. Stone, do you have any opposition to the expert request on that point?

MR. STONE: I do think that since our expert case is coming, we have tried to limit it somewhat from the reports, that it would be appropriate for a general description at least -- it would be hard for complaint counsel to do page and line of the transcript -- but at

least a general description of what their experts would do, and then complying with I think Your Honor's order with respect to the other specific witnesses would be appropriate.

JUDGE McGUIRE: Then that's what we'll do. I won't require the page and line citation for your experts, but I'm going to ask you to confer with the other side and, you know, apprise them of exactly what you intend to offer as well as in the motion that you're going to file on Thursday for your other witnesses. Okay? Is that clear?

MR. ROYALL: I'd like to ask Mr. Oliver to see if he has any additional comments.

JUDGE McGUIRE: Okay. Mr. Oliver?

MR. OLIVER: I think that will be fine, Your Honor.

JUDGE McGUIRE: Okay. Good.

Is there anything else?

MR. OLIVER: If I could point out, that's subject to the proviso that because apparently Mr. Teece won't be concluding until Friday, we may need to augment what we do on our motion on Thursday.

JUDGE McGUIRE: We'll keep that in mind. Let's hope we don't get to that point, but I won't hold you to that. But we'll see as we cross that

bridge.

The other thing I want to point out, I have an engagement today at 12:30, which should only take an hour, and I wanted to incorporate that with our break today, so I'm going to ask whoever has the floor at that time that we go on to about 12:20 to 12:25 and then we can break for lunch and then I should be able to do what I need to do in that hour time and then it won't cause any overlap. Okay?

If that's all there is at this time, respondent may call its next witness.

MR. STONE: Thank you, Your Honor.

MR. ROYALL: Actually there was another thing, Your Honor.

Just very briefly. I apologize for not alerting you to this. But this relates to Dr. Rapp's testimony.

As you I'm sure recall, when our economist testified, Professor McAfee, there were a number of objections. There were objections to any purported testimony about facts as opposed to assumptions, testimony about assumptions about facts. There were objections to any efforts on direct to summarize the record, to interpret documents, to interpret the state of mind of witnesses.

I don't know whether this is going to come up or not or how frequently it may come up today, but from looking at the slides, the demonstrative slides that were shared with us yesterday in connection with Dr. Rapp, there is one slide that would appear on its face to be objectionable along the lines of those objections.

And I don't know -- I don't have copies for Your Honor of these slides.

MR. STONE: I have a set for Your Honor.

MR. ROYALL: But the one I'm referring to is slide number 4.

Do you have a copy we could share?

MR. STONE: Yes.

Your Honor, could I hand this up?

JUDGE McGUIRE: Certainly.

MR. ROYALL: Why don't we just do this by paper.

JUDGE McGUIRE: Slide number 4?

MR. ROYALL: Yes, it's slide number 4.

And again, obviously Mr. Stone can respond, but this slide does seem to run afoul of the ground rules that were established with Professor McAfee in that it appears that it is summarizing factual information not by way of assumptions and in fact is summarizing what

documents say, and this does not appear to be confined to a statement of assumptions along the lines of what -- the limitations that were placed on Professor McAfee, so that was our concern.

JUDGE McGUIRE: Let's see if we can get some clarity on that, Mr. Stone.

MR. STONE: I think what we'll see when Dr. Rapp testifies is this will simply be a statement of his understanding of the factual information necessary for him to form his opinions and it's simply a basis for his opinions. I don't intend -- I'm very cognizant of --

JUDGE McGUIRE: Is it his assumption?

MR. STONE: It is going to be his assumption.

JUDGE McGUIRE: So if you make that clear in the record, would that resolve your objection, Mr. Royall?

MR. ROYALL: Well, the concern I have for one thing is that this is quoting from a document and presenting a document here, which is something that was objected to when questions of this sort were asked of Professor McAfee.

JUDGE McGUIRE: Are you talking about bullet point 2 here?

MR. ROYALL: Yes.

So if these are assumptions, if they could, the assumptions could be stated without use of this slide, I would have no objection to that, but it's the use of this slide that seems to run afoul of the ground rules that were established previously with Professor McAfee.

JUDGE McGUIRE: Mr. Stone, I think he's got a good point there. How can we address this issue?

MR. STONE: I think what we see here, Your Honor, is exactly similar to what Professor McAfee did when he quoted from a Rambus business plan in one of his slides or when he quoted from the testimony of Mr. Davidow at deposition and he put that up on one of his slides.

I think quoting from documents or testimony to explain the basis for their opinions is what Professor McAfee did, and as long as it was made clear it was his understanding and it wasn't -- he wasn't professing a view as to whether that evidence would ultimately be consistent with Your Honor's conclusions, it was appropriate.

I do have some copies of Professor McAfee's slides that do this if we need to show them for the comparison, but I did try and I do think the use of this slide and this reference is consistent with what

was permitted, and in fact without objection, with Professor McAfee.

JUDGE McGUIRE: Well, that's what I want to do here, is be consistent with our prior determination, so is there any way the two of you can iron this out, or do you want me to rule --

MR. ROYALL: Your Honor, I think it's correct that there was one slide that I'm aware of with Professor McAfee in which he did quote from a deposition, and as long as it's couched in these terms with -- that it's clearly an assumption, it's not a summary of the record, and as long as the testimony doesn't go beyond that, I'll withdraw the objection at this point.

JUDGE McGUIRE: All right. You'll stipulate to that then; right? Correct, Mr. Stone?

MR. STONE: Yes. His factual -- his reliance on the facts is something that his understanding is ultimately subject to Your Honor's ruling of what the facts ultimately are.

JUDGE McGUIRE: Then with that understanding, I'll go ahead, and they can present this slide, and then if you have any further opposition, I'm sure we'll hear from you at that time, Mr. Royall.

MR. ROYALL: Yes. Thank you.

JUDGE McGUIRE: Mr. Stone, you may call your next witness.

MR. STONE: At this time we call Richard Rapp.

JUDGE McGUIRE: Mr. Rapp, would you please approach the bench and you'll be sworn in by the court reporter.

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Whereupon --

RICHARD T. RAPP

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

DIRECT EXAMINATION

BY MR. STONE:

Q. Good morning.

A. Good morning.

Q. Would you state for us your full name, please.

A. It's Richard T. Rapp.

Q. Dr. Rapp, how are you currently employed?

A. I'm an economist and I'm the president of NERA, which is N-E-R-A, which stands for National Economic Research Associates, Incorporated.

Q. Are you an economist?

A. Yes.

Q. In what field of economics do you specialize?

A. I specialize in antitrust and intellectual

property economics, which is a branch of industrial economics.

Q. Would you please give us a brief description of NERA, the company for which you work.

A. NERA is an economic consulting firm. It operates around the world. It specializes not in the kind of economics that you hear on CNBC or something like that. It's the economics of competition, regulation and finance, which includes industrial economics, antitrust, intellectual property, securities, and the like.

So as far as the -- I'm sorry.

Q. No. How long have you been with NERA?

A. I've been with NERA since 1977.

Q. What's your current position?

A. I'm the president.

Q. And how long have you been the president?

A. I've been the president since 1988, so just about 15 years.

Q. And you said that NERA had offices throughout the world?

A. It does. It has about 15 offices, 500 employees.

Q. What are your responsibilities at NERA as its president?

A. I am the chairman of its board and management committee and I have ultimate responsibility for all aspects of the firm's management, which means the financial performance, risk management, recruiting, and so forth.

But I should add that NERA is a part of a larger firm. It is a subsidiary of a consulting group called Mercer or Mercer, Incorporated, and that in turn is a subsidiary of Marsh & McClennan Companies.

Q. Do you perform services at NERA other than those of management responsibility that you've just described?

A. Yes. I spend about half or two-thirds of my time -- it varies -- on management, but another third to one-half of my time I spend doing economic research, the likes of which I did since I joined the firm.

Q. And would that be generally described as consulting, economic consulting work?

A. Yes.

Q. And how long have you been doing that?

A. Again, since 1977.

Q. Let me take you back a little bit further than that even and ask you if you would share with us briefly your educational background.

A. Sure. I have a BA in economics from Brooklyn College which I received in 1965 and an MA and a Ph.D. degree in economic history from the University of Pennsylvania, and the dates are 1966 and 1970 for those.

Q. And what is economic history?

A. Economic history is a branch of economics and has to do with application of economic theory to historical statistical data.

Q. Did you start full-time employment sometime after receiving your Ph.D.?

A. Yes. At once after receiving my Ph.D.

Q. What was your first job?

A. My first job was as an assistant professor and then later a tenured associate professor at the State University of New York at Stony Brook.

Q. In what department were you there?

A. I was there in the department of history and taught in both history and economics.

Q. And what courses did you teach that were related to economic issues?

A. Well, I taught economic history, which was the field of my training, and I taught macroeconomics, microeconomics, quantitative methods, and then a variety of other subjects as well.

Q. How long did you stay at the State University of New York at Stony Brook?

A. Until 1977. I just had those two jobs.

Q. What was the nature of your research when you were a university professor?

A. I was interested in the subject of anticompetitive behavior and economic decline, so the -- when I speak of anticompetitive behavior in this context I'm talking about the nation rather than the firm as a unit of competition, so my particular interest was in international trade rivalry, predatory trade tactics and the relationship between that and how national economies rise and decline.

Q. And did you write articles or books in that area while you were a professor?

A. Yes. I wrote a book about the subject -- and these had to do with past centuries. The book was about the 17th century, articles about the 17th and 19th and 20th century examples of these things.

Q. Have you engaged in any research and writing since you joined NERA in 1977?

A. Yes.

Q. Can you tell us briefly what you've done that would be pertinent at least to the testimony you anticipate to give here?

A. Sure. The thread -- virtually the only common thread in what I did then and what I did since 1977 had to do with the subject of anticompetitive behavior but now with the firm as the unit of competition.

In the 1980s, a great deal of the work, consulting work, that I did had to do with the subject of predatory pricing, so I wrote, among other things, articles on that subject.

For example, there was one called Predatory and Exclusionary Tactics: The Economics of Akzo, A-K-Z-O, which was a case in the European Community; another called Predatory Pricing of Practical Synthesis. Those were published in law journals, in the European Competition Law Journal and in the Antitrust Law Journal in the United States.

Q. You're not a lawyer; correct?

A. I'm not a lawyer.

Q. Why is it that you publish articles in law journals?

A. It is a way for antitrust economists to make their opinions both known and useful in the community of lawyers that and economists that uses them.

Q. Have you done research and writing while at NERA in connection with other fields of study as well?

A. Yes. Several.

Q. Could you tell us what those are.

A. I've done work in healthcare financing, particularly in Japan of all things.

I've worked and written on intellectual property economics, and that too was keyed -- some of it was keyed to lawyers. Some other of it was just for the general -- just general scholarship on the costs and benefits of intellectual property protection in developing countries.

Q. Have you written on innovation or high technology types of areas?

A. Yes. In the 1990s, the focus of my consulting shifted mainly to high-technology areas and my writing did also.

So that, for example, in the mid-'90s, when the FTC/DOJ Intellectual Property Guidelines came out, I wrote an article, also published in the Antitrust Law Journal, entitled The Misapplication of the Innovation Market Concept to Mergers, or something like that.

Q. Okay. Could you, in addition to your publications, describe which of your work experiences since you've been at NERA is most directly relevant to your testimony that you anticipate giving today.

A. Yes. As I say, a good deal of my work in the

past, say, fifteen or even not quite twenty years has been in the area of high-technology antitrust and intellectual properties, and so to narrow it down further -- but this is by no means all of it -- I have done consulting work typically in connection with litigation projects with antitrust cases in the computer and semiconductor industries.

And my clients at one time or another have included many major computer and semiconductor firms, which I could name for you if you care to hear it.

Q. Well, let me ask you this: Has any of your work focused on standard-setting?

A. Yes, some of it has. And some of it actually goes a long way back.

More than twenty years ago, I was called upon to testify as an expert in a case called Hydrolevel versus the American Society of Mechanical Engineers, and the role that I played was as a damage expert after the case had been remanded to the District Court from the Supreme Court. There was a damage issue to be resolved and I testified in that case.

Q. More recently, have you been involved in anything to do with standard-setting?

A. Yes. I have -- well, let's turn to activities in the community of antitrust.

About five years or so ago, I proposed to the antitrust section of the American Bar Association that it would be sensible to have a session on standard-setting, and I helped to organize that and gave a paper on the economics of standard-setting as the background.

And then I guess about a year ago in the spring, there were joint hearings of the Federal Trade Commission and the Department of Justice on intellectual property and antitrust and the knowledge-based economy. I'm not sure I have the title exactly right. And I participated in those hearings and wrote a paper about standard-setting and market power.

I ought to add that I have been retained by Rambus not only in this current matter but in earlier matters as well, so I've been working on standard-setting related to issues similar to the ones about which I will testify for about three years.

Q. Okay. Have you testified in other hearings or trials as an antitrust economics expert?

A. Yes. Over the -- since the early 1980s, on average perhaps about once a year.

Q. And have you written and provided any testimony with respect to intellectual property

issues?

A. Yes. The same is true. I have testified probably about five or six times as an expert in intellectual property, particularly patent infringement cases, and my subject matter there is typically the valuation of patents or patent infringement damages.

And I have written on that subject as well, again, both on intellectual property economics in the larger sense and about -- and on damage calculations --

JUDGE McGUIRE: Can I interject and just expand on that last inquiry?

You say you've testified as an expert in patent infringement cases?

THE WITNESS: Yes.

JUDGE McGUIRE: And on IP-type --

THE WITNESS: Correct.

JUDGE McGUIRE: I'm curious what training you've had in those areas to qualify you as an expert in your mind.

THE WITNESS: Sure. It is only the economics, but the only area in which I testify in those cases -- there are really only two. One has to do with commercial success, and in fact that's a very rare assignment, which I understand is part of the test for

the nonobviousness of a patent. But for the most part my work is in patent infringement damages.

JUDGE McGUIRE: I got you.

THE WITNESS: Okay.

JUDGE McGUIRE: All right, Mr. Stone. I understand.

BY MR. STONE:

Q. You mentioned you were first retained by Rambus about three years ago?

A. Yes.

Q. What case was that in connection with?

A. It was in connection with the Infineon case.

Q. And were you designated as a testifying expert in that case?

A. Well, let me say that I was about to become one. Whether the court -- I never stood up in court to testify, so "designated" may not be the right word, but that was my intention at the time.

Q. And why did you not testify in the Infineon case?

A. I was present in court and about to testify, but the judge -- I'm not sure what the right word was -- but ruled out the antitrust claims for the antitrust counts in that case, so my testimony became superfluous and I didn't testify.

Q. And in that case who had been asserting antitrust claims?

A. It was Infineon.

Q. And so you were prepared to testify as to Infineon's antitrust counterclaims when the judge took them out of the case?

A. Yes.

MR. STONE: Okay. Your Honor, at this time we'd like to tender Dr. Rapp as an expert in antitrust and intellectual property economics.

JUDGE McGUIRE: Any opposition?

MR. ROYALL: Your Honor, I don't think I have opposition to that as long as I have an understanding of what is meant by "intellectual property economics."

JUDGE McGUIRE: Can you clarify that, Mr. Stone?

MR. STONE: I think the economics of the valuation of intellectual property and its economic role in a general sense within both standard-setting organizations and society is the issue, certainly not the technical side of intellectual property. We're not tendering Dr. Rapp as a technical expert on engineering.

MR. ROYALL: Okay. With that understanding, I have no objection.

JUDGE McGUIRE: All right. Then he shall be qualified as offered.

MR. STONE: Thank you, Your Honor.

BY MR. STONE:

Q. Now, did you in advance of today, Dr. Rapp, prepare some demonstratives to help explicate or explain your testimony today?

A. Yes, I did.

Q. And did you prepare one that would help summarize the subjects on which you've been asked to testify?

A. Yes.

Q. If we could, bring up the first one, which will be DX-302. And I've prenumbered these. Hopefully I'll keep them in the right order, Your Honor.

And with this demonstrative on the screen for us to follow along, Dr. Rapp, could you tell us in a brief and summary sense what you've been asked to testify about today.

JUDGE McGUIRE: And just so we're clear -- oh, you've already had that marked as DX-302. I'm sorry, Mr. Stone. Go ahead.

MR. STONE: Is that okay, Your Honor?

JUDGE McGUIRE: It's in the transcript. I just didn't hear you say that.

MR. STONE: Okay.

THE WITNESS: Just as the slide says, I have three basic subjects.

The first is whether Rambus' actions in JEDEC created market power for Rambus. And by "Rambus' actions" what I am assuming is a reference to the alleged failure to disclose intellectual property interests that complaint counsel believes should have been disclosed.

BY MR. STONE:

Q. And let me interrupt you for a moment so we're clear on the scope of the testimony in that regard.

You haven't formed an opinion as to whether there was or was not a duty to disclose on Rambus' part to JEDEC; is that right?

A. Correct.

Q. And you've just assumed that there was such a duty and that Rambus did not disclose some things that either Professor McAfee or complaint counsel have argued they should have disclosed; right?

A. Right. And again, I don't claim familiarity with the specifics of what disclosures are required or alleged to be required.

Q. Okay. And then if you would, continue on with I think what would be the second topic on which you've

been asked to testify.

A. The second is whether manufacturers were at any time locked into the Rambus technology at issue in this case, which also goes to the question of market power.

Q. And let me interrupt you on that one if I can.

When you say "the Rambus technologies," what do you refer to?

A. I'm referring to the four technologies that I understand are at issue in this case: programmable CAS latency, programmable burst length, the use of a PLL/DLL on a chip, and dual-edged clocking.

Q. Then what's the third subject on which you've been asked to testify?

A. I have been asked to testify about whether Rambus' actions in JEDEC can be called predatory or exclusionary according to the usages and tests that economists employ.

Q. And in regard to that particular subject of testimony, have you again assumed for purposes of your analysis that whatever complaint counsel or Professor McAfee have contended Rambus should have done and didn't do, you've assumed that to be the case for that analysis?

A. Yes.

Q. Okay. If you would -- and I think we can probably take that demonstrative down for a moment.

If you would, describe for us briefly the nature of the work you have done in connection with this case to prepare to testify on those three areas.

A. Sure. There was an initial study of data on DRAM industry shipments and prices and other aspects of the industry more broadly with which I was familiar but bringing myself up-to-date.

There was a review of documents that were relevant to these subject matters, depositions as they were taken during the course of the case, a review of trade press, securities analyst reports and other research materials that economists typically use. And at some point the trial transcript and the trial record became available to me.

There were also literatures that I reviewed particularly on the economics of standard-setting. And I was -- as I said, I reviewed the trial transcript, and I also was present in court for the testimony of Dr. Soderman, Mr. Geilhufe and Professor McAfee.

Q. And did you review any materials related to JEDEC meetings or standards?

A. I did. I would say later in the game, at the time the trial transcript and materials became

available, not early in my studies.

Q. Okay. And have you prepared a summary of the conclusions of your opinions?

A. Yes. It's the second slide.

Q. Okay. If we could bring up DX-303, please.

And is this a chart you prepared to summarize your conclusions?

A. It is.

Q. Could you briefly explain to us the first conclusion set forth, which reads, "There were no good economic substitutes for the four Rambus technologies."

A. That is my conclusion, that there were no good economic substitutes for the four Rambus technologies.

In other words, briefly, in cost-performance terms, the alternatives that I have analyzed, which are basically the alternatives that were proposed by Professor McAfee and complaint counsel as commercially viable alternatives, relying on the expert reports initially and then the testimony of Mr. Geilhufe and Dr. Soderman, my conclusion is that those alternatives were poor economic substitutes and that as a result of that, moving to the next conclusion --

JUDGE McGUIRE: Now, before you get there, let me just ask you to explain for my edification what you

mean by "economic substitute."

THE WITNESS: An economic substitute is a -- an alternative to which consumers would readily turn -- "consumers" in this case means DRAM manufacturers, and it's technology because we're in a technology market rather than a goods market -- to which they would readily return in response to, let's say, excessive pricing, whether it's a price increase or a price above the norm. A readily available default.

JUDGE McGUIRE: Okay. Proceed.

BY MR. STONE:

Q. I think that probably leads into your second conclusion, if you would summarize that for us.

A. Right. My second conclusion is that Rambus gained no market power from its actions in JEDEC, the actions that I spoke of earlier. And as I hope to explain, the connection there is simply that if there are no good economic substitutes to begin with that the act of formal standardization does not convey additional market power.

I'll just add that this conclusion is different -- is not to say that Rambus has no market power. It is to say that standard-setting, formal standard-setting by JEDEC, created no additional market power for Rambus.

Q. And what then is your third conclusion, Dr. Rapp?

A. The third conclusion is actually subsidiary to the others. It is that DRAM manufacturers were not locked into the four Rambus technologies.

And the way to say that a little more expansively is to say that if the economic substitutes -- if the alternatives that we are discussing were, contrary to my conclusions, close economic substitutes, then manufacturers would have been able to shift to those substitutes if they -- if there was -- if the price of the Rambus technology were too high. Let's put it that way.

Q. Okay. Have you analyzed in regard to that whether there's been any impact on competition or any anticompetitive effect from the conduct that Rambus is alleged to have engaged in?

A. Yes. It's an additional conclusion to these. It's really part of the same story, but it follows from my earlier conclusions, but it stands alone that I will offer the opinion and I am offering the opinion that Rambus' actions were not exclusionary according to -- or predatory, according to the economic tests.

Again, I'm not here to reach a final answer on that subject but to supply the economic analysis.

Q. And your final one on the chart, Rambus' actions in JEDEC were not predatory --

A. Sorry. I was staring at that. I've given you the answer to exclusion -- the question that you asked me was about impact; is that --

Q. Yes. Is there any anticompetitive impact from it?

A. Yes. That is a conclusion of mine also, that without the creation of market power in standard-setting and without lock-in that Rambus' actions in JEDEC had no adverse economic impact on competition.

Q. Okay.

A. Sorry about that.

Q. No. That's okay.

Let me ask you then, as a little further background to some of your analysis, whether or not there is economic literature that you've been able to refer to that addresses the economics of standard-setting.

A. Yes. There is an extensive literature on standard-setting, on the economics of standard-setting.

Q. And are you acquainted with that literature?

A. Yes.

Q. According to that literature, what is a standard? What does the economic literature consider a standard to be?

A. A standard is a specification of a product design intended to achieve engineering compatibility, intended to accomplish a means by which either parts will fit into products or systems or components of a network will work together seamlessly. The term for compatibility that's sometimes used in that setting is interoperability.

Q. Does the economic literature and do economists recognize a certain set of circumstances in which there's a need for standard-setting?

A. Yes. Absolutely.

Q. And what's that, if you could describe for us that set of circumstances?

A. That set of circumstances is when compatibility requirements is high and when either products or systems or networks will fail unless compatibility, engineering compatibility, is maintained at a high level.

Q. We've heard in this case from time to time reference to complementary products or complementarity?

A. "Complementarity."

Q. Could you explain what that means.

A. That is an economic concept that is closely allied to the issue of compatibility. Complementary goods are goods that go together in an economic sense.

We tend to -- economists tend to think about the relationship between prices and quantities. But basically what -- so in that context, the complementary good is one whose -- if there are two goods that are closely complementary and the price of one of those goods goes up, then the quantity of the other one will go down, and that's because the price on one going up will discourage the purchase -- if the price of good A goes up, it will discourage the use of good A, and since good A and good B fit together, it will cause a decline in quantity of good B.

That's the economics of it, but the way to think about it in normal terms is goods that go -- that fit together closely where you can't use one without the other.

And the example that always comes to mind for me is the first case that I worked on that had this quality was photocopiers, so the complementary goods were photocopiers, toner that you put in photocopiers -- that's specific to a kind of photocopier; you can't just use it interchangeably --

and drums and things like that.

Q. Does standard-setting, again from an economics point of view, does it include specifying every detail of, for example, the products, the toner and the copiers that you mentioned or other products?

A. From an economic point of view, the answer to that question is no. The standard-setting works best in the economy when it achieves the purpose that it's intended to achieve, that is to say, parts compatibility, system compatibility, but doesn't overdetermine a product's characteristics.

I'll give you an example if it would be helpful.

Q. I think it would.

A. The example that comes to mind when I think about this is tires. And of course there are standards when you buy a tire -- I forget how the numbering works, but you know, there's a grade for the -- whether it's a high-speed tire and it's X70-something by 18 -- where you know when you're buying a certain tire that it's going to fit on the wheel, that it's going to be appropriate to the kind of driving that you're going to do, and so forth, but the product design goes much beyond that.

So the standard assures you that the -- of

something about the tread and the size and fit of the tire, but as we all know, advertising about tires conveys a lot of additional information about whether it's good in the wet or the tread life is long or things don't -- things that are fortunately nonstandard.

Products that have compatibility requirements, we hope that they will also be differentiated so that consumers can pick and choose among the ones they want.

Q. Have you looked, in the course of your study of this literature, at how standards are set in the United States?

A. Yes. Sure.

MR. ROYALL: Your Honor, I object to this line of questioning to the extent this is going to go into what other standards organizations do.

MR. STONE: And I will not, Your Honor. This will be very limited to just lay background I think for the rest of his testimony. And I can frame it so that it's clear that it doesn't go into that.

MR. ROYALL: Well, I would also ask for clarification. I haven't objected yet, but this line of questioning with -- Mr. Stone is asking about what do you understand about standard-setting in the

economic sense, and then this is eliciting factual testimony, so I don't know whether we're talking about facts now or economic theory, and I would ask that that be clarified.

JUDGE McGUIRE: Mr. Stone?

MR. STONE: Certainly.

BY MR. STONE:

Q. Is the testimony you've just given about standard-setting, Dr. Rapp, is the testimony you've given consistent with the economic theory of standard-setting?

A. It is the background. It is the way economists think about standard-setting. I don't claim that we all think uniformly and we all have the same opinion, but what I am focusing on, and it's my opinion that I'm offering not with recourse to any facts, is where standard-setting -- about where standard-setting fits into the economic scheme of things.

The economic scheme of things in this country is that we have highly differentiated products, for example, and yet we have standards that to some degree act on those. Those are economic opinions.

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

MR. ROYALL: For now, I think so.

JUDGE McGUIRE: Okay.

MR. ROYALL: I'll just be observant.

JUDGE McGUIRE: I'm sure we'll hear from you again if it doesn't.

Go ahead, Mr. Stone.

MR. STONE: Thank you, Your Honor.

BY MR. STONE:

Q. Let me see if I can approach the question this way, Dr. Rapp.

Have you prepared a slide that simply identifies two different types of standards that are established in the United States?

A. Yes. And it's common nomenclature. It's not peculiar to economics. I think the terms have been used by lay witnesses in the course of the trial.

Q. Okay. Let me bring up if we could DX-304 and ask you, if you would, to just explain to us two distinct ways in which standards are set.

A. Yes.

Standards, just as a matter of nomenclature or terminology that economists use and I believe others do, too, standards are set first in a formal way, and that's sometimes called de jure. And there what we're talking about is a standard-setting agency like the IEEE or JEDEC, a committee process or a government.

And the example that I listed on this slide is that some of us have cell phones that use GSM technology and that technology was developed by a committee in Europe, it so happens, a good example of formal standard-setting.

The contrast --

Q. What's the alternative?

A. The contrast to that is what is I believe widely called de facto standard-setting, which is also known as market-based standard-setting because there's no committee that does it and yet it is standard-setting because a standard emerges.

And the classic example that everybody refers to in this connection is the standards war that was fought over the videocassette between the Betamax technology and the VHS.

Another example is that the PCs that all of us use, except for those of us who are Apple users, was a -- emerged as an IBM product in 1982 but eventually throughout the 1980s became a standard or a series of standards, not all of which were set by committee but just emerged in the market over a period of resolving incompatibilities.

If you remember, in those days people used to talk about IBM-compatible computers and there was a

period when you would worry about how compatible it really was, and eventually the market, with some help from standard-setting bodies to be sure, but the market resolved that so that we all understand what a PC is now.

JUDGE McGUIRE: If I may interject, Mr. Stone.

MR. STONE: Yes, Your Honor, whenever you would like.

JUDGE McGUIRE: With these two types of I guess standards that you've just testified exist in most industries and markets, are you able to determine on average, you know, what percentage of the standards in any given market may be de facto as opposed to de jure? Or is that just such a broad question you couldn't possibly answer?

THE WITNESS: I don't have the answer to that question and I don't know that there is anything in the literature about it. It's something that for an individual industry I think could be knowable, but the trouble is that a lot of de facto standard-setting just happens; it's not obvious.

JUDGE McGUIRE: Okay.

THE WITNESS: I don't have a good answer.

JUDGE McGUIRE: I just thought I'd ask.

Go ahead, Mr. Stone.

BY MR. STONE:

Q. Is it possible, Dr. Rapp, for there to be multiple standards for a particular product?

A. The answer is sure.

Q. Are there certain conditions or circumstances under which multiple standards can coexist?

A. The circumstances in which multiple standards -- it has to do with these compatibility requirements. Where compatibility requirements are exceedingly high, where there is a requirement for absolute precision, then -- and complementarity is also high, then the likelihood is that the market -- either the market or formal standard-setting will allow only one standard to prevail.

I think the alternative case, which may be the more common, is that the compatibility requirements are less than that, high, less than extreme, and in those circumstances multiple standards can coexist.

For example, when I spoke of cell phones before, we live with a certain amount of inconvenience in the fact that there are multiple standards. Not everybody has a GSM phone. The way that manifests itself is we can all talk to one another on our cell phones, but we don't get the kind of coverage that we might, and we live with that in order to have a

variety.

Q. Okay. And let me ask you, when you talked about that we can all talk with each other, there's a concept that we've heard about in the course of this trial, network externalities?

A. Yes.

Q. Is that related to the issue of whether there can be multiple standards and what you just described about cell phones?

A. Yes.

Q. Would you explain that to us.

A. Network effects or network externalities are a special kind of compatibility requirement and a special kind of complementarity, and it has to do with systems being able to talk to one another, or another way of looking at it is it has to do with a set of circumstances in which the quality and value of my product depends upon how many other people are using it.

In other words, the typical example of a network in a network effect is the fax machine. My fax machine would be worthless if nobody else had one. The more people that have them, the more valuable my fax machine was. At one time it was true of the -- when we talked about the telephone in those terms. Someday the

fax machine will be an historical example, too, but that's the essence of network effects.

And the important thing about that, the reason that it ought to come up in this circumstance, is that those are a very powerful sort of compatibility requirement. It is -- if my telephone -- if my computer couldn't talk to your telephone -- to your computer, the Internet couldn't function smoothly, and so forth, so that aspect of it is -- that is a powerful source of compatibility requirements.

Q. Have you looked, for purposes of your testimony in this case, at the compatibility requirements for DRAM?

A. Yes.

Q. And what have you concluded in that regard?

A. I have concluded that the compatibility requirements for DRAM are not high in the sense that I have been using the word.

I have to give you more than just a brief answer to that because in one sense they are high, in the sense that my computer wants a certain kind of DRAM in it and there may be some flexibility about that, but if I put the wrong DRAM or if there were an offbrand of DRAM that was not compatible with my Pentium III microprocessor, the computer wouldn't

function. And there's no argument about whether that's so.

But there are none of these network -- I shouldn't say none of -- the network effects associated with DRAM are weak, and consequently, my computer doesn't care what your computer -- what DRAM you have in your computer.

And if I may, just to explain why I'm attaching importance to that, that gets you to the question of whether multiple standards can coexist in the DRAM industry. And the weakness of the network externalities, the network effects, simply means what I've just said, that different DRAMs, different flavors or different generations of DRAM can coexist in the market.

Q. Are there examples of that that you can point to?

A. Well, the example is the coexistence in the market now of both different generations of DRAMs and different alternative types of DRAM, RDRAM, SDRAM, DDR, all unable to -- you can't plug them interchangeably into a computer and that they all coexist in the market.

JUDGE McGUIRE: Does that comport with the testimony we've heard in this proceeding regarding

what's called backward compatibility?

THE WITNESS: Backward compatibility -- let me fit that into context, and the way I keep on thinking about these things is my computer versus your computer.

Backward compatibility means that if I have a computer that runs on SDRAM, which my current laptop does, the generation before SDRAM was EDO, and I can't put -- I think this is right, but I'm -- this is an example and not testimony for the engineering of it. Backward compatibility means I can't put the previous generation on my -- of my -- of DRAM into my computer.

It doesn't mean, however, that if you've got an old computer that runs on EDO and I've got a newer computer that runs on SDRAM that there's any problem with the two of them talking to one another.

BY MR. STONE:

Q. Okay. As part of your background, for purposes of the opinions in this case, have you made some factual assumptions with respect to whether or not all of the different DRAM architectures have been adopted as formal standards?

A. It is my understanding, which is the way I'll try and be scrupulous about what's fact, opinion or just an assumption -- so when I say "understanding," I

mean assumption -- it is my understanding that RDRAM, for example, was never formally standardized by JEDEC, so that's an example of a nonstandardized DRAM that's out in the market now.

Q. And did you, for purposes of your assumptions, did you consider that or assume that to be the only one, or are there others?

A. No. There has been I think testimony to that effect, and I'm forgetting whether it is Mr. Kelley or some -- I won't name who it is, but there's been testimony that there are nonstandard DRAMs, certainly DRAMs that -- well, I'll stop there.

Q. Okay. And have you, for purposes of forming the understanding you have to allow you to express the opinions that you've summarized for us already, have you formed any understanding as to whether all of the SDRAMs and DDR SDRAMs have been built to formal standards?

A. My understanding is that they haven't.

Q. And could we look at the chart that we talked about earlier at the beginning of the session before I called you to the stand, which is DX-305.

And this is a chart you prepared, Dr. Rapp?

A. Yes.

Q. And what did you prepare this chart to help

convey in terms of your understanding?

A. I wanted to describe the fact that although JEDEC sets the standard for DRAM, that inside that context that there are powerful forces that in a de facto sense rather than a de jure sense affect the standard, cause the standard to change and in some sense are standard-setting themselves, and the principal influence is Intel.

We spoke about complementarity and compatibility. The principal issue I understand in DRAM and computer technology is the compatibility between the microprocessor, and Intel is a major manufacturer of microprocessors, and DRAM. That's my understanding.

So when Intel decides that either the DRAM manufacturers or JEDEC haven't got the current generation of DRAM quite right, they behave, Intel behaves, in place of a standard-setting body and creates a specification or a specification addendum, and that in some sense overrides or modifies the standard.

The standard may then catch up with it, but the point is that Intel, and possibly not only Intel, is capable of creating flavors, is the sort of funny way that people sometimes talk about it in this

industry.

Q. Let me see if I can ask you if you would to explain whether or not the understanding you have just described for us is relevant to the question of whether a formal standard creates market power for a particular technology that is the subject of that standard.

A. Well, it establishes that formal standard-setting is not the only way in which a generation, or I don't want to say a generation, but an iteration of some DRAM can become prominent. It also allows for the possibility, as I say -- and this is under -- this is based upon the underlying economics of compatibility in this industry -- that there can be more than one standard that coexists, not to -- well, I'll stop there.

JUDGE McGUIRE: I'm not sure that answers your question, though.

MR. STONE: I'm going to try to restate my question, Your Honor.

BY MR. STONE:

Q. Is it sometimes the case that being chosen as a standard, as a formal standard, creates market power?

MR. ROYALL: I'll -- I'll let it go.

THE WITNESS: It is sometimes -- yes, it is sometimes the case that being chosen as a formal standard creates market power, but not always.

BY MR. STONE:

Q. And from an economist's perspective, what are the circumstances or situations in which being selected as a formal standard will create market power for a particular technology?

A. The circumstances in which the formal standard-setting creates market power is when you -- when the standard-setting body is faced with several more or less equivalent technologies, equivalent in cost-performance terms, and one of those technologies -- and standard-setting elevates one of those technologies above the other.

In other words, there's nothing special about any of them in cost-performance terms, then one of them is judged to be the standard, and what that does in market power terms is it suddenly makes all of the other alternatives that were yesterday equivalent, it makes all of them now inferior because they're off-standard and only one of them is the standard. If you start from that premise, then that is the setting in which your standard-setting creates market power.

Q. And what's the role of compatibility in that

context, if there is a role for it?

A. The degree to which compatibility requirements are exceedingly high as a result of network externalities or things like that, then that single standard, because there can only be one standard in that circumstance, then that market power is enduring.

If you have the same situation that I described, a lot of -- not a lot but several equivalent technologies in cost-performance terms, one of them becomes anointed the standard, the others become inferior alternatives because they're not the standard, but now wait a minute, you can have more than one standard because the compatibility requirements are not high, it may be that that will diminish the market power that might have been created by the standard-setting.

So it depends upon high compatibility.

Q. Okay. Are there, by contrast, are there circumstances in which formal standard-setting creates little or no market power for a technology that is the subject of a standard?

A. Yes.

Q. And what are those circumstances, if you could describe those?

A. If you have an array of technologies where one

of the technologies is superior to the others, then that technology, if the market had been allowed to operate, would become the standard anyway, would be a de facto standard, and as a result, the fact of formal standard-setting doesn't add anything to its market power.

In a certain sense it started with that market power because that market power is the additional, in price terms -- that market power in price terms is the additional amount that one can charge for the superiority relative to the next best alternative.

Q. Are there situations in which technologies may be adopted as formal standards and yet not turn out to be valuable for any reason?

A. Yes. That can happen and it has happened in the history of the DRAM industry. I think burst EDO was designated a JEDEC standard, but it failed in the marketplace. Just because the standard is designated, that doesn't guarantee success.

MR. STONE: Your Honor, Mr. Royall and I are consulting on breaks, if we might, and could we have a short break at this point?

JUDGE McGUIRE: Sure. Go ahead. Oh, you want to take a short break?

MR. STONE: Yes.

JUDGE McGUIRE: All right. Let's go ahead and take a short break.

(Recess)

JUDGE McGUIRE: Mr. Stone, you may proceed with your inquiry.

MR. STONE: Thank you, Your Honor.

BY MR. STONE:

Q. Dr. Rapp, let me direct your attention now to Rambus and JEDEC, if I might.

Have you formed an opinion as an economist as to whether Rambus' alleged failure to disclose at JEDEC additional information about its intellectual property interests when complaint counsel say it should have disclosed, have you formed an opinion as to whether that resulted in an increase in market power for any of the four technologies that are at issue here?

A. Yes.

Q. And what is your view in that regard?

A. My opinion is that those alleged actions or nondisclosures by Rambus did not create market power in any of the four Rambus technologies at issue here.

Q. And why is that?

A. That is for the reason I gave in general terms before the break, because Rambus' -- because those four

technologies were superior to the alternatives that were available and thus the fact of formal standard-setting did not enhance their market power or the market power of the patents or Rambus' market power.

Q. Could you explain to us the basis of that conclusion and how you've reached it.

A. Well, I think the place to start is with the way that -- is observing the choices that the manufacturers and JEDEC made and that when confronted over time with opportunities to change the -- any one of those technologies, they did not do so. In a certain sense what I'm saying is by looking at what they did and the fact that they remained with those technologies not over a short period of time but over generational changes in DRAM.

Q. Is that something that is meaningful to economists, that kind of analysis of decisions actually made?

A. Yes. Economists -- something that is very basic and fundamental in economics is that we cannot observe preferences. We have to look at the choices that people actually make. And the equipment of economics that enables us to draw inferences about people's preferences from their choices is called the

theory of revealed preference.

Q. What does that theory mean or how does it apply in the context of the opinions that you are expressing here today?

A. It's actually quite complex, but it's very simple and straightforward in its origins. What it means is that you can learn about people's preferences by observing their choices.

The example is that if I go into the supermarket and spend $70 on a basketful of or a shopping cart full of groceries, you can learn from that that there isn't a combination of goods in that supermarket, forgetting about whether -- assuming that I'm looking at all the shelves equally -- that's worth less than $70 that I would prefer to that $70 item.

In other words, there is no combination of goods for $69 that's as good to me as that $70 bundle of goods, so I've got a lot of information about a lot of -- about my preferences for a lot of goods just embodied in the decisions that are on the register tape.

Q. Are there particular decisions that you've looked at in connection with this case where the theory of revealed preference has applicability?

A. Yes. It is the decisions that have happened

inside JEDEC or outside but that have dictated the course of DRAM design with respect to the features at issue of this case across periods of time when changes were possible. And the fact that changes did not happen, by inference, using this theory but also I think common sense, is that the manufacturers deemed these technologies to be superior in cost-performance terms, which is what counts, to the alternatives that were available.

Q. Are you familiar with testimony that Professor McAfee gave earlier in this proceeding to the effect that the theory of revealed preference is not applicable here?

A. I think I heard that.

Q. Do you agree with that conclusion?

A. I don't agree with that conclusion. It's true that the theory of revealed preference has its complexities and that there are things about this market that are special, but I think that the reason that I just gave you is the right way to look at this issue. That's my opinion.

Q. As I recall, Professor McAfee mentioned the concept called satisficing in his testimony?

A. Yes.

Q. Do you recall that?

A. Yes. And it's hard for me to know precisely what he meant by that. I have a view of what satisficing behavior means. It's a term in economics that, as he pointed out and rightly, has a long history, but it's a term with a certain amount of wiggle room in it, and we may differ in our opinions about it.

But if -- and I'm putting that conditionally -- if what he meant was that the theory of revealed preference doesn't work well here because manufacturers weren't particularly interested in finding the best solution in cost-performance terms, I guess I don't understand that. And the reason that I don't understand that is that it seems to me that that's what manufacturers are up to in the normal course of business generally, and we see decisions in JEDEC which point to, you know, in the balloting process and so forth, that point to the attempts to find the right cost-performance solution, the best cost-performance solution.

Q. Let me ask you to take a look if you would at one of Professor McAfee's slides, if we could bring up DX-177.

Do you recall this slide on commercial viability considerations, the first bullet point of

which says, "Time to market critical for JEDEC DRAM standards -- 'satisfice'"?

A. Right. I understand what he means there.

Q. In that regard, is there some -- let me see if I can frame it this way.

What conclusions do you draw from the testimony that Professor McAfee gave that time to market is critical for JEDEC DRAM standards in terms of the applicability of this concept of satisficing?

A. Well, if I may, I'll start by offering my opinion about what I think he -- what I recall him saying or my interpretation of that.

Q. Let me ask you to do this. Why don't you just tell us your understanding so we know what it is you're addressing as opposed to --

JUDGE McGUIRE: Mr. Royall?

MR. ROYALL: I do object to this line of questioning because it does seem that this witness is being asked not to offer expert conclusions of his own but to interpret the testimony that was given by another expert economist, and I think that's improper and it runs afoul of the ground rules that have been established here.

JUDGE McGUIRE: That appears to be what's going on, Mr. Stone.

MR. STONE: And I think what I'm trying to do, Your Honor, is -- the witness, who has opinions that certainly are from time to time different than the opinions of Professor McAfee, is certainly entitled to present his testimony as to his different opinions. What I'm trying to elicit is for him to explain his understanding of the opinion with which he disagrees so the record is clear as to the opinion with which he is disagreeing.

So in that sense I'm not asking him -- Professor McAfee's testimony will stand on its counts --

JUDGE McGUIRE: It will speak for itself, and you perhaps could ask him what his opinion is, and that will clarify the distinction, and it will be up to the court to determine any differences in the testimony.

MR. STONE: That's fine.

JUDGE McGUIRE: All right.

MR. ROYALL: That's what I was going to suggest. I don't see the need -- obviously he can say what --

JUDGE McGUIRE: I sustain the objection.

MR. ROYALL: Thank you.

BY MR. STONE:

Q. Let me ask it this way.

If the time to market is in fact a critical factor for purposes of JEDEC making its determination as to what DRAM standard to adopt, would that be consistent with an interpretation of satisficing that said that JEDEC was content to settle for something other than the best technology?

A. Not necessarily.

Q. Why not?

A. Because it -- product choices or technology choices have different dimensions. Time to market is certainly one of the dimensions that ought to be taken into account and I'm certain that manufacturers do take into account because of the nature of the industry. But it doesn't follow from that, in my opinion, that there is a less than complete desire to try and find the best technical solution in terms of cost-performance, taking time to market into account.

Q. Would taking time to market into account be consistent with the theory of revealed preference that you've described for us earlier?

A. Entirely consistent with it.

Q. Okay. You earlier expressed a view about the superiority of the four technologies at issue in this case to alternatives. Do you recall that?

A. Yes.

Q. And did you do that based on reliance on work done by others?

A. Yes.

Q. Which others did you rely on?

A. I relied principally on the conclusions of Dr. Soderman and Mr. Geilhufe. There were additional things on which I relied, pieces of trial testimony, but mainly those of Mr. Geilhufe and Dr. Soderman.

Q. And did you prepare a chart prior to today that summarized the different alternative technologies that you considered?

A. I did.

Q. Let's bring up if we can DX-306.

Does this slide summarize alternatives that you considered to the use of the two features present in SDRAM that are at issue here, programmable CAS latency and programmable burst length?

A. Yes.

Q. And could you tell us first how you selected which alternatives to include on this chart.

A. Yes. These are the alternatives for each of those two Rambus technologies in SDRAM that were deemed by Professor McAfee to be commercially viable.

Q. And so what are the alternative technologies that you considered as alternatives to programmable CAS

latency?

A. The alternatives to programmable CAS latency that I considered are fixed CAS latency, to explicitly identify latency in the read command, to program a latency value with fuses, and to use pins.

Q. To set the latency?

A. To set the latency.

Q. And what alternative technologies did you consider to the technology of programmable or variable burst length?

A. The alternatives that I considered were a fixed -- use of a fixed burst length, to explicitly identify burst length in a read command, to use burst terminate commands, and to use pins to fix the burst length.

Q. And did you also create a chart that sets out the cost data on which you relied for purposes of your comparison?

A. Several charts, yes.

Q. Let's turn if we could to DX-307.

Is this one of the charts that you've prepared for purposes of your analysis?

A. Yes.

Q. And could you tell us just in a general sense what's shown on this chart.

A. This chart shows across the column headings the alternatives, the four alternatives that I just named to programmable CAS latency, and in the row headings are elements of Mr. Geilhufe's cost analysis, and in the cells in the body of the table are nothing other than Mr. Geilhufe's cost numbers picked up from his tables into this table.

Q. Okay. So that we are clear that this is all explained in the record as well as on the chart, could you confirm that you have for each of the four alternatives to programmable CAS latency that you earlier identified, fixed CAS latency, explicitly identifying the latency in the read command, programming with fuses or using pins, that you analyzed the various costs for each of those four alternatives.

Can you confirm that that's what you've done?

A. Yes.

Q. Okay.

A. That answer is yes.

Q. And along the left-hand side under the heading Variable Cost Element, you list costs for wafer sort, good die yield, packaging, final test and good unit yield, circuit board area, board complexity and inventory; is that right?

A. Yes.

Q. And where do you get those costs from?

A. From Mr. Geilhufe's tables.

Q. And are there any differences in some of the numbers -- have you selected certain numbers presented by Mr. Geilhufe to use here as opposed to other numbers that he presented?

A. Only the numbers that apply in each of these areas, in other words, for each of the technologies. If you see blank spaces there, it's because for a particular technological alternative in Mr. Geilhufe's table there is an empty space.

Q. And did you make use of just what Mr. Geilhufe described as variable costs?

A. That's what I did. I have treated what he calls fixed costs elsewhere. What I'm interested in here in the cost elements -- sorry -- the cost elements on the left are labeled "variable cost elements." That's right. And that is because I am interested in finding the incremental cost of using each of these alternatives.

Q. And what did you find, using his numbers as you've organized the data here, what did you find to be the incremental cost of using fixed CAS latency as opposed to programmable CAS latency?

A. The incremental costs for using fixed CAS latency are as follows.

There is actually a benefit rather than a cost that Mr. Geilhufe related that has to do with reduced testing at the wafer sort level, so there is a negative cost or a benefit of a penny. There is a cost of three cents in the good die yield cost element, and there is a cost, an incremental cost of two cents -- an increment cost of two cents in the inventory cost element.

Those sum to four cents, which represented the unit cost savings from not selecting this alternative but using the Rambus technology instead.

Q. And just to make sure we're all clear, the four cents would be the cost in addition to the costs of a unit that used programmable CAS latency?

A. Yes.

Q. And maybe we can just focus on the line that says "unit cost savings from licensing."

Did you conclude whether there was an additional cost associated with the explicitly identifying latency in the read command as compared to programmable CAS latency?

A. Yes.

Q. What did you conclude?

A. That is that in Mr. Geilhufe's table that there is a cost of a penny associated with packaging in this respect. He actually said negligible or a penny, and I've dropped the penny down to the total there and no other additional costs.

Q. And did you find there to be additional costs associated with setting the CAS latency with fuses as opposed to programmable CAS latency?

A. Yes. Again, relying entirely on Mr. Geilhufe, there is a penny that his tables show in the wafer sort cost element, there is a three-cent additional cost -- all of these costs are additional or incremental -- in the good die yield and two cents additional in inventory, in the inventory cost element, for a total of six cents.

Q. And did you find total additional costs of four cents associated with using pins to set latency as opposed to the use of programmable CAS latency?

A. Yes. And those are -- arise as a result of increased packaging costs.

Q. The last line on your chart, the last row is labeled "increased cost as percentage of ASP."

Do you see that?

A. Yes.

Q. Could you tell us what that refers to.

A. ASP is the average selling price, and what I am intending to do by that line is to represent these incremental costs of using this alternative as a percentage of selling price. For SDRAM, that average selling price is $4.87, and it is an average across the expected life of the generation of chip.

Q. How did you determine an average selling price? What data or other information did you rely on?

A. It calls for two kinds of data. It calls for price data, and that is both actual and forecast price data, that for SDRAM runs from 1996 to 2006, so obviously forecast into the future. These data, by the way, come from InStat, which is a widely used and I believe industry -- I don't want to say industry standard but an industry source that's well-known.

Q. Now, what did you calculate for fixed CAS latency to be the percentage of the average selling price that is associated with the additional costs you attributed to that feature as compared to programmable CAS latency?

A. Could I -- I paused in my answer and didn't give a complete one. I'm sorry. If I could just finish that.

Q. I apologize for interrupting.

A. It's my fault. I was breathing there for a while.

Q. That's a good thing to do.

A. The prices alone aren't enough. Shipment data is required too, because what you want is a weighted average price, and suffice it to say that the actual or forecast price for each year across this product life cycle for SDRAM is weighted by the shipments and the average is $4.87.

Q. Okay. Could you indicate to us what you concluded then, based on your computations that you've just described, were the increased costs as a percentage of average selling price associated with the use of fixed CAS latency as compared to programmable CAS latency.

A. As a percentage of average selling price, that four cents is about .82 percent of selling price.

Q. And what is the increased cost as a percentage of average selling price for the additional costs associated with explicitly identifying latency in the read command as opposed to programmable CAS latency?

A. .21 percent.

Q. And with respect to programmable latency with fuses, what did you conclude was the increased cost as a percentage of average selling price as compared to

programmable CAS latency?

A. 1.23 percent.

Q. And finally, with respect to using pins to establish the latency, what did you conclude was the increased cost of that method of setting latency as opposed to programmable CAS latency as a percentage of average selling price?

A. .82 percent.

Q. Now, I notice on this chart that you have highlighted in orange the option of explicitly identifying latency in the read command. Can you explain to us why you did that?

A. Yes. I have colored that in to indicate that according to Dr. Soderman upon whom I rely that this is a technology, although it is one of the ones that is listed among Professor McAfee's commercially viable alternatives, that according to Dr. Soderman is covered by Rambus patents.

Q. So you've indicated that with orange?

A. Yes.

Q. Okay. Have you, for purposes of your analysis of the relative costs of these four alternatives to programmable CAS latency, relied just on the testimony of Mr. Geilhufe and Dr. Soderman or have you looked at other sources of information as well?

A. No. I have looked at other sources of information, and I have in mind particularly trial testimony, which if I can mention it I'll do in general. I won't mention the witnesses.

In other words, there were witnesses who explained that there were advantages to programmable CAS latency in its flexibility, and that created reduced cost. If I'm permitted to name somebody in that connection, I will. If not --

Q. I don't think I want you to sort of restate their testimony, but if there's witnesses whose testimony you rely on for that, why don't you identify their names.

A. I think it was Mr. Kelley principally.

Q. Let me ask you if you would then to -- let's pull up DX-308.

And directing your attention to DX-308, can you at the outset tell us what you are trying to convey with this particular chart?

A. I've been using the term "cost-performance," which has in mind the fact that both the cost of an alternative and the performance of the alternative, whether there is a benefit or a penalty to using the alternative, both figure in the decisions that a manufacturer or that JEDEC would make.

Dr. Soderman testified about the performance side of the story, and I have summarized his opinions on the right-most column -- well -- sorry. That's not a good description.

The general purpose of this is to capture both information about cost, about whether or not the product, in Dr. Soderman's opinion, or the technology alternative is covered by a Rambus patent and whether or not there were performance penalties, those three things.

Q. So this chart summarizes your understanding of each of those?

A. Correct.

Q. And in part, it summarizes your computations?

A. Yes.

Q. With respect to fixed latency, you indicate the four-cent-per-unit additional cost that you mentioned earlier?

A. Yes.

Q. And then in the far right-hand side for fixed latency you've written on this chart "Multiple latency values are required."

What do you understand in that regard to be the issue and what do you mean as to your understanding when you say "Multiple latency values are required"?

A. I understand that -- I understand, relying principally on Dr. Soderman, that different latency values are used by different chip makers and those who produce microprocessors and others, and the implication of that is so long as multiple latency values are valuable or useful in the market, it would require multiple chips to satisfy that need if fixed latency were the alternative.

Q. Okay. Let me ask you about the second item down, which says "use pins." And first I would note you've put an asterisk next to "pins" and then footnoted that to a statement: "Other alternatives using pins covered by Rambus patents."

Do you see that reference there?

A. Yes.

Q. Can you explain to us why you did that?

A. Yes. It comes from listening to Dr. Soderman state his opinion, and I'm doing nothing more than just relating my understanding of his opinion, that other ways of using pins would be covered by Rambus patents, so that the one that I list is the one that in his opinion would not be infringing, for example, if it were implemented.

Q. And you've listed there in the far right column three different bullet points. Can you explain

to us your understanding as to those or why you listed those?

A. Again, this is a recounting of the testimony of Dr. Soderman upon which I based my understanding of the cost-performance hierarchy of alternatives or what is preferable and what is not in cost-performance terms.

And what those three bullet points say is, first, not practical to use more than two voltage levels on a pin, which I understand to be Dr. Soderman's opinion. A consequence of that is that multiple pins are required, and that is the second bullet point. And the third bullet point is that the use of pins reduces flexibility.

Q. Finally, with respect to blowing fuses on the DRAM to set latency, in the far right column you have two bullet points. Could you explain what your understanding is as it underlies those two bullet points.

A. Yes. My understanding is that Dr. Soderman's opinion is that using blowing -- blowing fuses on the DRAM as a means for fixing CAS latency produces in the end a fixed latency part, and what that means is that if it can -- if blowing pins is impractical for OEMs, that is to say, for buyers or users of the part, that

it leaves you back where you started, with a manufacturer having to create fixed parts either by -- well, by blowing fuses, period.

Q. And the final one, number 4, where you've listed explicitly identify the latency in the read command, is the description in the far right column a description of your understanding as to why Dr. Soderman concluded that that particular feature would be covered by a Rambus patent?

A. Yes. What it reads is: "Need a register" -- maybe that should be "needs a register" -- "similar to mode register to store latency information." And I gather that Dr. Soderman's opinion is that that would infringe if it were implemented.

Q. Have you performed a similar analysis to the analysis you've just described with respect to programmable CAS latency for the feature of programmable burst length?

A. Yes.

Q. Let's bring up if we could -- and as I continue, I'll search for a way, Your Honor, to make sure we get this in the record as succinctly as we can. I know it's a little tedious. I apologize.

Did we bring up DX-209?

Can you describe for us, Dr. Rapp, what is

shown in a general sense on DX-309?

A. It is the cost calculation similar to the one that I did for programmable CAS latency associated with the alternatives to programmable burst length that are under consideration.

Q. And these are the four alternatives that you described earlier and were shown on an earlier chart?

A. Yes.

Q. Are the variable cost elements that you've considered for programmable burst length the same as the ones you considered for programmable CAS latency?

A. You require me to have a look.

Q. Okay.

A. It will just take a second.

Q. Sure.

(Pause in the proceedings.)

A. Yes.

Q. Okay. Let me see if I can ask it this way.

With respect to the alternative of fixed burst length as compared to the programmable burst length feature, did you conclude that there was an additional cost of using fixed burst length?

A. Yes.

Q. And what did you conclude that additional cost to be?

A. That additional cost is two cents and it consists of a benefit, rather than a cost, of a penny associated with testing at the wafer sort stage and a three-cent cost penalty associated with inventory in fixed burst length parts.

Q. And did you then convert that two-cent additional cost into a percentage of the average selling price?

A. Yes.

Q. And what percentage of average selling price did you calculate that to be?

A. .41 percent.

Q. Thank you.

With respect to the alternative of explicitly identifying the burst length in the read command, did you compute an additional cost as compared to programmable burst length?

A. Yes.

Q. And what did you compute that to be?

A. I noted that in Mr. Geilhufe's table he recorded that packaging costs in his opinion would increase by somewhere from a negligible amount to a penny a chip, and I used a penny a chip, and that is the total -- the incremental cost for use of the read command.

Q. And did you compute what percentage of the average selling price that additional cost would be with respect to using the read command to set the burst length as opposed to the use of programmable burst length?

A. .21 percent.

Q. Did you also look at an alternative to set burst length using a burst terminate command as compared to programmable burst length?

A. Yes.

Q. And what did you conclude in terms of any additional costs there?

A. That there was none.

Q. And did you also look at the use of pins to set burst length as opposed to the use of programmable burst length?

A. Yes.

Q. And what did you conclude there with respect to whether there are any additional costs?

A. I relied on Mr. Geilhufe who concluded that there would be a two-cent incremental packaging cost and that represents the total.

Q. And as a percentage of average selling price, what did you conclude that to be?

A. .41 percent.

Q. And of the alternatives to programmable burst length that you have considered and have just testified about, did you form an understanding as to whether any of those were covered by Rambus patents?

A. It is an understanding based on Dr. Soderman's opinion that to explicitly identify burst length in the read command would be covered by Rambus patents and the use of pins would be covered by Rambus patents.

Q. Okay. Did you, with respect to programmable burst length, rely on any testimony or information in the record other than the cost data and other testimony from Mr. Geilhufe and Dr. Soderman that you've just talked about?

A. Again, I believe there was trial testimony that recounted the cost advantage of flexibility in burst length.

Q. Not to have you go into any of the specifics, but among the witnesses whose testimony you reviewed did you consider that of Mr. Polzin and Mr. Kellogg?

A. Yes.

Q. Let me ask you if you also prepared sort of an overall assessment of the alternatives to programmable burst length and certain of their disadvantages as you have done with programmable CAS latency.

A. Yes.

Q. Could we bring up DX-310.

Is this a chart that you prepared to show disadvantages to proposed alternatives to programmable burst length?

A. Yes.

Q. Does this list the same four alternatives that we just spoke to?

A. Yes.

Q. Directing you first to one at the top of the list, the use of burst terminate command, you have in the right-hand side a notation which says "causes problems with pipelining."

What is your understanding in that regard and what did you mean by that?

A. This is I think disproportionately significant. I understand from Dr. Soderman's testimony that the use of a burst terminate command would reduce the performance, the on-the-fly performance of computers using this alternative to programmable burst length.

Pipelining refers to, I believe or I understand, efficiency of movement of information in the bus between the memory controller and the memory, the core memory array. And I understood, if I recall

correctly from Dr. Jacob's testimony, that the use of a burst terminate command carries with it a significant performance penalty, something on the order of 10 percent.

Q. As to the second alternative, fixed burst length, your notation there is: "Multiple burst lengths are required."

Can you explain what your understanding is in that regard?

A. It is simply that as long as more than one burst length is required by DRAM technology, the use of fixed burst length would call for multiple chips to be manufactured, more than one flavor of DRAM chip with respect to burst length to be manufactured.

Q. And finally with respect to the fourth alternative on this chart, DX-310, which is the use of pins to set burst length -- is that right, it's the use of pins?

A. Yes.

Q. Your notation there says, "Similar concerns regarding using pins for CAS latency."

Can you tell us what your understanding is in that regard?

A. Yeah. It's recorded in that way because that is the way Dr. Soderman expressed it, and referring

back, without actually doing so, to the use of pins in CAS latency, he refers to the fact that it reduces flexibility and that there was some concern about which way the pins could be used without infringing, multiple voltages not being a functional alternative.

Q. Let me ask you then, Dr. Rapp, whether you -- without regard to the performance disadvantages you've described but just focusing on sort of the dollars and cents side of it, did you try to compare the costs of the various alternatives that were proposed for programmable CAS latency and programmable burst length with the costs of using those two features in an SDRAM?

A. Forgive me. I'm just -- I just lost track of the question.

Q. The question was about as long as I could make it, so let me see if I can do it differently.

Did you sum up the costs, the increased costs or additional costs of the various alternatives that you have discussed, to determine an overall increased cost for employing alternatives in an SDRAM to the two features at issue here?

A. Yes.

Q. Okay. Could we bring up DX-311.

What does this particular demonstrative,

DX-311, convey?

A. It is for SDRAM what you said in the question, but it is also the answer to another question. What this does is it adds up the additional costs of using alternatives, in the plural, for fixed -- I'm sorry -- for the two Rambus technologies in SDRAM, and it in addition compares those additional costs with the royalty that I understand Rambus would charge for an SDRAM license.

Q. Okay. You have a column labeled "Least Costly" and a column labeled "Most Costly."

How did you compute those two or why do you have those two columns?

A. They represent the range among these alternatives, the ones that are not covered by Rambus patents I should add, from the least costly alternative to the most for each of those two technologies as listed in the previous tables.

Q. And for the least costly, what are the alternative features that you included as opposed to programmable CAS latency and programmable burst length?

A. Fixed latency and the use of a burst terminate command to fix the burst length.

Q. What did you compute to be the total additional

cost of using those two alternatives as opposed to the two features at issue here?

A. The sum of four cents for the fixed latency additional cost and zero for the burst terminate approach for a total of four cents additional cost.

Q. And as a percentage of average selling price, what did you compute that to be?

A. .82 percent.

Q. And did you compare that then to a Rambus royalty rate for SDRAMs?

A. Yes, I did.

Q. And for that you used what rate?

A. .75 percent.

Q. And what were the alternatives you considered for the Most Costly column?

A. The use of fuses to fix the latency and a fixed burst length. Those two being the more expensive of the alternatives.

Q. And what did that give you as the total additional cost of those alternatives over the use of the two features at issue here?

A. It give me six cents for the fuses plus two cents for the fixed burst length additional cost for a total additional cost of eight cents or 1.64 percent of average selling price.

Q. What are the implications of the results you've shown us on DX-311 for manufacturers and consumers of SDRAM?

A. The implication is that a rational manufacturer or a rational collection of manufacturers in JEDEC that saw its job to find the superior technology in cost-performance terms would have chosen to take a license from Rambus at .75 percent rather than incur a higher cost by using the alternatives without regard to the performance aspects of the issue, only on the basis of costs.

Q. And if they had taken the performance issues into account as you have earlier described them, which way would those performance considerations have cut?

A. That would have reinforced the decision to license rather than to substitute alternatives that performed less well.

Q. Is your conclusion valid even in the event that use of the two features in question would require paying a royalty to Rambus of .75 percent?

A. Yes. That's what the calculation discloses or reveals.

Q. Okay. We can take that one down I think.

Let me ask you at this point to go back for a moment to the concept we talked about earlier known as

satisficing. Can we do that?

A. Sure.

Q. And what I want you to do is consider -- I just want you to assume that Professor McAfee testified that because JEDEC was only satisficing, and assuming that JEDEC had known that Rambus had patent interests in these two features but did not know precisely what Rambus' royalties would be, JEDEC would have chosen some other technology that did not involve use of any technology covered by Rambus patents. Can you make that assumption?

A. Sure.

Q. Do you agree with that assumption?

A. I'm just going to ask that it be read back.

Q. Certainly. Let me just rephrase it.

I just want you to assume that Professor McAfee expressed that opinion. I'm trying to avoid asking you for your understanding of Professor McAfee's testimony. I just want you to assume that.

MR. ROYALL: Your Honor, if I could object belatedly, I think it's improper to ask a hypothetical question to the witness for him to assume what Professor McAfee said. I think he doesn't need to include Professor McAfee's name in this whatsoever. He can simply ask, Can I ask you if you agree with this

proposition, and I think doing it in a way --

JUDGE McGUIRE: Sustained.

MR. ROYALL: Thank you.

BY MR. STONE:

Q. Let me ask you this way.

Do you agree with the following proposition, that JEDEC didn't distinguish among -- let me see how to frame this.

Do you agree that JEDEC would have chosen some other technology than the two technologies it did choose that are at issue here with respect to SDRAM if it had assumed that Rambus had some patent interests on those two technologies, if it did not know precisely what Rambus' royalties would be, and if it was interested in satisficing?

MR. ROYALL: Your Honor, I object to this question as, for one, it lacks foundation that the witness has any basis to opine on what JEDEC would have done.

JUDGE McGUIRE: Sustained.

MR. STONE: Your Honor, may I be heard on that?

JUDGE McGUIRE: Go ahead.

MR. STONE: The only way we can get to the but-for world is to ask these witnesses to assume

certain things about the but-for world.

JUDGE McGUIRE: Well, the "but-for" is one area where I've allowed some speculation in this regard and I think I've tried to do that with each side, Mr. Royall, so if you want to expand on your objection in that context, you can do so.

MR. ROYALL: Well, I don't mind a hypothetical question being asked about the but-for world from the standpoint of eliciting his economic testimony, but to ask a question of what JEDEC would have done, I'm not sure that there's any foundation that he has any basis even in terms of economic testimony to opine on what JEDEC would have done.

JUDGE McGUIRE: Mr. Stone, do you want to respond to that objection?

MR. STONE: Well, I think this is exactly the testimony that we heard from Professor McAfee, his opining as to what JEDEC would have done in certain situations, with exactly the same foundation as to knowledge of JEDEC.

So I think I'm simply trying to elicit from this witness his views on the very same circumstances that Professor McAfee testified to.

MR. ROYALL: Well, I beg to differ with that. The foundation with Professor McAfee --

Professor McAfee was making specific assumptions about what JEDEC's rules provided, what the process provided and how the process worked. They were assumptions, but he was making assumptions nonetheless.

This witness has testified that he has not familiarized himself with the process and he has made no assumptions about how the process works, so I don't think there is a foundation for that testimony.

JUDGE McGUIRE: All right. Sustained. I'm going to uphold that objection, Mr. Stone.

MR. STONE: Okay.

BY MR. STONE:

Q. I want you to -- you were here for Professor McAfee's testimony; correct?

A. Yes.

Q. Professor McAfee told us that he didn't know what JEDEC's rules were, didn't he?

MR. ROYALL: Your Honor, I object to that question.

JUDGE McGUIRE: Sustained.

BY MR. STONE:

Q. I want you to make the same assumptions that Professor McAfee made about JEDEC. Can you do that?

MR. ROYALL: Your Honor, I object to that.

And one of the things I would say in this

regard is this is an attempt to broaden this witness' testimony beyond the scope of what's in his expert report, and it's very clear in his expert report and in his deposition testimony that he has given no consideration to the procedures and the process of JEDEC, and I can point that out if you'd like.

JUDGE McGUIRE: Mr. Stone, if it's not in his expert report, I don't want to go into it.

MR. STONE: I'm going to cover what's in his expert report, Your Honor.

BY MR. STONE:

Q. Let me phrase it this way.

I want you to assume that a rational standard-developing organization was trying to decide which technologies to include in the SDRAM, and I want you to further assume that it knew that Rambus had patent interests in two of those technologies, programmable burst length and programmable CAS latency, and that the rational standard-developing organization did not know precisely what Rambus' royalties for the use of those two technologies would be.

Can you make those assumptions up to that point?

A. Yes. Uh-huh. Yes.

Q. Okay. And given the cost analysis that you

have done so far, in your economic opinion, would a rational standard-developing organization have selected the two Rambus technologies at issue here or would they have selected one of the alternatives?

A. They would have selected the programmable technologies, programmable CAS latency and programmable burst length.

Q. And is your conclusion in that regard in any way inconsistent with applying the theory of satisficing to the decision-making process of this rational standard-developing organization?

A. This has to do with the ambiguity of that word "satisficing."

A rational standard-setting body has good reason to choose the preferred -- the best technology in cost-performance terms. It would need -- satisficing in some sense doesn't come -- if satisficing behavior means that small cost differences are overlooked, that it doesn't have to maximize, that it can just satisfice, then the answer is that it would be indifferent between a technology whose -- that is slightly more or less -- that is slightly better or worse in cost-performance terms, but then it would also be indifferent to paying a royalty or not, and so satisficing doesn't contribute anything to the analysis

of that situation.

Q. Okay. Let me ask you now to turn to the consideration of DDR SDRAM if I might.

Do you have an understanding, for purposes of the opinions that you are expressing here today, as to which of the four features or technologies at issue here are used in DDR SDRAM?

A. Yes.

Q. And what are they?

A. My understanding is that the two technologies we have just discussed, programmable CAS latency and programmable burst, are used in DDR SDRAM. And in addition, the use of a PLL/DLL on the chip and dual-edged clocking are used, so four Rambus technologies are used.

Q. And have you considered alternatives to each of those four?

A. Yes.

Q. Could we bring up DX-312, please.

Does this demonstrative, Dr. Rapp, list the various alternatives you have considered for purposes of your analysis to each of the four technologies at issue in this case?

A. Yes.

Q. And with respect to alternatives for

programmable CAS latency and programmable burst length, have you included the same alternatives that you testified about earlier this morning?

A. Yes.

Q. And with respect to dual-edged clocking, can you tell us, if you will, what alternatives you have considered?

A. Again, the set of alternatives that I considered are the ones that Professor McAfee identified in his testimony as being commercially viable and excluded others that have been discussed but were not regarded by Professor McAfee as being commercially viable.

What that left is three alternatives for dual edge clocking, interleaving banks on the module, doubling the clock frequency and the use of toggle mode, which I identified on the demonstrative as an asynchronous technology.

Shall I go on?

Q. No.

Let me then ask you, what technologies did you consider as alternatives to the use of on-chip PLL/DLL?

A. Four.

Q. What were they?

A. The use of a vernier mechanism, the movement of the DLL onto the controller, movement of the DLL onto the DIMM or memory module, and reliance on DQS strobe.

Q. With respect to the alternatives for each of these four technologies, did you perform a cost analysis as you described earlier in connection with the SDRAM?

A. Yes.

Q. And if I can try to summarize it in this fashion, did your cost analysis with respect to the alternatives to programmable CAS latency and programmable burst length lead you to the same computations for those two features as it did in the context of SDRAM?

A. Yes. The tables that I produced are parallel to the ones that I did for SDRAM.

Q. And were the other disadvantages that you described with respect to alternatives for those two features in the context of SDRAM the same disadvantages that you identified if those two features were needed and alternatives were employed in connection with DDR SDRAM?

A. I'm sorry. I didn't understand.

Q. That's fine.

You had a couple of charts earlier that listed some disadvantages in a performance or feasibility sense?

A. Yes.

Q. And did you find those same disadvantages applicable for those alternatives if they were used in DDR SDRAM as you concluded they were present for SDRAM?

A. Yes. For -- speaking now just of CAS latency and burst length alternatives.

Q. Yes, sir.

A. The answer is yes. There's nothing that changes about Dr. Soderman's opinions upon which I rely concerning the performance characteristics of those two technologies when they're picked up into DDR DRAM.

Q. Then I'm not going to repeat the early testimony as to those features. And instead, let me ask you -- I'm going to pull up, if we could, DX-313.

And can you describe for us generally what is shown on this chart?

A. These are the alternatives for dual-edge clocking for which I have cost numbers.

Q. And you do not include on this particular chart the toggle mode or the asynchronous technology that you

mentioned earlier; is that right?

A. Right.

Q. And will you talk about that later?

A. Yes.

Q. So with respect to the two alternatives then to dual-edge clocking that are listed on this chart, interleaving the banks on the module and doubling the clock frequency, did you calculate what additional costs there would be, if any, in using those technologies as opposed to dual-edge clocking?

A. Yes.

Q. And was that based on testimony from Mr. Geilhufe?

A. Yes.

Q. What conclusion did you reach with respect to additional costs associated with interleaving the banks on the module as compared to dual-edge clocking?

A. Relying on Mr. Geilhufe's estimate that there would be a 25-cent additional cost in board complexity to that technology, that's what I used -- and no other additional cost, that was the additional cost for interleaving banks on the module.

Q. And did you compute that to be a percentage of the average selling price?

A. Yes. Here the average selling price is $5.13,

and a 25-cent cost, extra cost associated with interleaving banks on the module, equals 4.88 percent of the average selling price.

Q. Did you calculate an average selling price for DDR SDRAM following the same methodology as you described for us earlier?

Let me ask it this way.

Tell us if you can how you computed the average selling price for DDR SDRAM --

A. Oh, I'm sorry.

Q. -- that you used in your computations.

A. Sure. I used the same methodology. The dates are different. It begins -- production began in the year 2000, so it's from there going forward, fewer years of data, mostly estimate, $5.13, same methodology.

Q. Okay. And did you, using that computation as to the average selling price and the data provided by Mr. Geilhufe, did you also compute any additional costs associated with the use of doubling the clock frequency as opposed to using dual-edged clocking?

A. Yes.

Q. And what are your computations -- what do your computations show in that regard?

A. They -- relying on Mr. Geilhufe, they show

4 cents additional cost for final test and good unit yield and 24 cents for a circuit board area penalty, for a total of 28 cents or 5.46 percent of average selling price.

Q. Okay. Did you also assess, based on the testimony of other witnesses, disadvantages associated with the use of these alternatives to dual-edged clocking?

A. I do not recall.

Q. Let me just show you DX-314 if I can.

Directing your attention to this particular demonstrative, can you just tell us what you were conveying through this demonstrative?

A. This again is a summary of both cost and performance and also coverage by Rambus patents. The only thing that is additional to what I've already testified to about these two technologies is the opinions of Dr. Soderman that are listed in the right-most part of the chart.

Q. And as to the alternative of interleaving banks on the module, directing your attention to the right-hand column, what was your understanding as to the disadvantages associated with that alternative based on the testimony you heard?

A. That that technology, that alternative,

requires an addition of high-speed switches and other hardware to the module and that there is a less -- there is less flexibility in the way that memory can be mounted, and for those applications that don't use modules, the technique doesn't work.

I'm paraphrasing. If you'd like me to state them exactly as they are here, that would be fine.

Q. Your paraphrasing is quite fine. I have no problem.

If you would look at the second alternative, the doubling the clock frequency, and again I'll direct you to the right-hand column, if you could just explain your understanding for purposes of the analysis you performed of disadvantages associated with that alternative as compared to dual-edged clocking.

A. According to Dr. Soderman, there are clock distribution problems, it is difficult to operate internal circuitry twice as fast, and there is increased electromagnetic radiation arising from the higher clock frequency.

Q. Okay. Did you, Dr. Rapp, perform a similar analysis for various alternatives to the use of on-chip PLL/DLL?

A. Yes. In the respect of having produced a table

like this.

Q. Did you do a cost analysis with respect to alternatives for on-chip PLL/DLL?

A. I was not able to, except with one of the, however many, four alternatives and it seemed sensible, rather than to present that paucity, that essentially lack of information, for me to simply assume there would be no cost penalty for purposes of my subsequent calculations, so you won't find the table for on-chip PLL/DLL like the cost tables that I've done for the other three technologies.

Q. And is, in your mind, is assuming the cost of the alternatives to the use of on-chip PLL/DLL to be zero, is making that assumption one that you think is reasonable in these circumstances?

A. Yes. I think it's sure to be an understatement of what the actual costs are, the actual additional costs are.

Q. Well, let me show you if we can what we've marked as DX-315, if we could bring that chart up.

And can you just tell us in a general sense what is conveyed by this chart?

A. It is really a synopsis of Dr. Soderman's opinions upon which I'm relying for my opinions on the cost-performance characteristics of these

alternatives. For the four alternatives to on-chip PLL/DLL.

Q. Okay. Let me ask you with respect to the first one, moving the DLL onto the DIMM or the module, what is your understanding, as summarized in the right-hand column, of disadvantages associated with that alternative?

A. I understand that a single DLL would not address timing differences between DRAMs and that an additional chip would be required.

Q. And with respect to the use of a vernier mechanism as opposed to the use of on-chip PLL/DLL, what's your understanding as to disadvantages associated with that alternative?

A. My understanding is that according to Dr. Soderman, that static delay will not account for temperature and voltage variations on the DRAM and that recalibration of the vernier is not sufficiently precise and consumes bandwidth.

Q. With respect to the third alternative, moving the DLL onto the controller, what's your understanding, as summarized in the right-hand column of DX-315, of disadvantages associated with that alternative?

A. I understand that it's Dr. Soderman's opinion

that a single DLL would not address timing differences between DRAM and that an additional chip would be required.

Q. Finally, as to the fourth alternative, relying on the DQS data strobe as opposed to the use of on-chip PLL/DLL, what's your understanding as to any disadvantages associated with that alternative?

A. I understand from Dr. Soderman that using a DQS without a DLL is not sufficient for high-speed performance and that DDR SDRAMs use both a DQS data strobe and a DLL anyway.

Q. Okay. Now, did you perform a cost calculation independent of any consideration of the disadvantages where you considered additional costs of these alternatives to the use of the four features in a DDR SDRAM?

A. Yes.

Q. And let's bring up if we could DX-316.

Does DX-316 summarize the cost computation you did for the use of alternatives in a DDR SDRAM?

A. Yes.

Q. And this is independent of any consideration to disadvantages in performance?

A. Correct.

Q. Again, did you pick a least costly alternative

for each of the four features and a most costly alternative?

A. Yes.

Q. And for the first two features, CAS latency and burst length, did you select the same alternatives at the same costs as you did in your earlier testimony about SDRAM?

A. Yes. They're identical.

Q. Okay. And if I might just summarize so it's clear on the record, does that show for the least costly alternative four cents due to the use of fixed latency for CAS latency and no additional costs for the use of burst terminate?

A. Yes.

Q. And then for the most costly alternative, which is the use of fuses for latency and fixed burst, do you come up with six cents for the first and two cents for the second?

A. Yes.

Q. And continuing on down there, for alternatives for on-chip PLL/DLL what did you do for purposes of this cost table?

A. For purposes of the cost data, it is -- I have assumed it to be zero. The reason there are dashed lines there rather than zero is that the zero that you

see for burst terminate is Dr. Soderman's actual estimate of the cost. Here I'm just leaving a place, but obviously there's no cost associated with it.

Q. And for alternatives to dual-edged clocking, what did you do for purposes of your cost computation?

A. I assumed that interleave -- sorry. I read in Mr. Geilhufe's cost numbers that interleaving banks on the module, summing his costs to my total, is the least costly alternative and that I recorded it as 25 cents as appears on the previous table, and for the most costly alternative it is doubling the clock frequency and my cost number is 28 cents.

Q. And then did you compute a total cost, total additional cost, for the least costly alternatives to the use of the four features at issue here?

A. Yes. Just by summing the four -- actually three numbers, 24 plus 25 is the least costly. The sum of the additional costs for the least costly alternative to these four technologies.

Q. And that's 29 cents?

A. 29 cents.

And the most costly alternatives to these four technologies adds up to 36 cents.

Q. And then did you calculate the percentage of average selling price for DDR SDRAM that would be

reflected by additional costs in each of these amounts?

A. Yes.

Q. And what's the percentage of average selling price for the costs associated with your least costly set of alternatives?

A. As a percentage of average selling price, the 29-cent additional cost equals 5.65 percent of average selling price.

Q. And what is the percentage of average selling price for the costs associated with the most costly alternative?

A. 7.02 percent.

Q. And then did you compare this to a particular Rambus royalty rate?

A. Yes. I assumed a royalty rate of 3.5 percent.

Q. And what did this comparison lead you to conclude?

A. The comparison shows that there are sizeable differences in those two numbers, the Rambus royalty rate being the low-cost solution to the set of technologies, the low-cost technology.

Q. So even using the least costly set of alternatives, paying the royalty to Rambus would still be cheaper?

A. By a substantial margin.

Q. Dr. Rapp, I want to ask you a few more questions about some of these cost numbers before we leave them, and let me ask you first whether you have an understanding as to whether DRAM manufacturing costs are in general constant over the life of a particular architecture or specification.

A. They are not.

Q. What is your understanding in that regard?

A. My understanding is that the DRAM manufacturing costs decline steeply over a product life cycle of a particular DRAM architecture.

Q. Does your understanding in that regard cause you to question at all the usefulness, for purposes of your analysis, of Mr. Geilhufe's cost estimates?

A. No.

Q. Why not?

A. Because Mr. Geilhufe was specific about the fact that he produced his cost estimates on the basis of a mature product. That means one that in his terms and in the terms of the industry has gone down the learning curve and experienced cost reductions.

Q. And is it your understanding that all of the different costs in question here would be ones that would be reduced over time or are some ones that do not

experience that change?

A. No. That's a second reason for not being concerned about these life-cycle cost declines. Things like inventory costs, for example, aren't subject to those declines. Those declines come from yield improvement and things -- and improvement in manufacturing technology.

Q. Dr. Rapp, were you in court to hear the testimony of Dr. Jacob on various alternatives?

A. Yes.

Q. And did you take his testimony into account in forming your opinions?

A. Yes.

Q. Did his testimony on any of these issues that we've -- the issue of alternatives that we've been talking about today cause you to modify in any way your analysis of the relative costs of alternatives?

A. No, they did not. The way that Dr. Jacob's testimony influenced my opinion most directly had to do with his testimony on the burst terminate command which I've mentioned in other respects. He didn't have -- I guess he spoke in vague terms about cost. I don't mean to characterize it, but I mean that there were no cost numbers in his testimony. He didn't -- he wasn't speaking to costs in ways that are susceptible to

arithmetic.

Q. In your opinion, can you make useful statements about cost comparisons without doing some sort of a numerical calculation or comparison?

A. No.

Q. Let me take you back to an issue we had left earlier.

All of the alternatives that you have talked about so far today in detail in terms of the cost sense have been the synchronous alternatives; correct?

A. Yes.

Q. And earlier you mentioned that there was an asynchronous alternative, toggle mode, to the dual-edged clocking. Do you recall that?

A. Yes.

Q. Have you formed an understanding as to whether or not the use of an asynchronous architecture would be a plausible alternative to the use of the four technologies at issue here?

A. I have. It is an understanding. It's an assumption. It's not a technology conclusion on my part. But I did read testimony that relates to the -- that -- that I could summarize by saying that asynchronous technology, as I understand it, would not be useful above certain clock speeds, that there is

insufficient headroom once you get above about 200 megahertz, according to the witnesses that I recall reading.

Q. Okay. Is that an understanding that has been useful to you in deciding whether and to what extent to consider asynchronous technologies as alternatives?

A. I've rejected it on those grounds.

Q. And did you try to confirm your understanding by reviewing various of the trial testimony in evidence in this case?

A. Yes. It is from that testimony that my understanding arrives.

Q. In light of the testimony you've just given us and the calculations and computations you have done, have you formed a conclusion about whether Rambus' actions at JEDEC resulted in an increase in the value or the market power of Rambus' patents?

A. Yes.

Q. And what's your conclusion in that regard?

A. My conclusion is that Rambus' actions in JEDEC did not do so.

Q. Why is that?

A. That is because the -- my calculations and the -- and consideration of performance as well as cost lead me to the opinion that Rambus' -- well, lead

me to the understanding that Rambus' technology was a superior technology to the others, both -- with respect to all four of the particular features at issue in this case, and consequently, formal standard-setting did not elevate Rambus above equivalent cost-performance alternatives. On the contrary, Rambus technology was already the superior alternative, and formal standard-setting ratified what only what the market otherwise would have chosen of its own.

Q. Have you formed an opinion as to what a rational standard-developing organization would have done had additional disclosures regarding intellectual property been made as complaint counsel contend they should have been made to that organization with respect to the features at issue in this case?

A. Yes. My opinion, based upon my understanding about the relative merits of the technologies, is that a rational standard-setting body would have elected to adopt the four Rambus technologies in preference to any of the alternatives.

Q. Have you as an economist considered whether manufacturers and consumers are better off than they -- by selecting the four features at issue here that you refer to as Rambus technologies than by selecting any

of the alternatives?

A. Yes. The -- in choices of technology, just like choices of inputs to manufacturing, the best solution in cost-performance terms for manufacturers is going to produce the lowest-cost and best products down the line and consumers will benefit from that as well as manufacturers.

Q. Let me ask you in this regard, Dr. Rapp, to take a look at one of Professor McAfee's demonstratives if we might.

If we could bring up DX-176.

Do you recall seeing this demonstrative entitled Commercial Viability before?

A. Yes.

Q. Have you taken into account in the opinions that you've expressed already today the various alternatives that are described by Professor McAfee as being commercially viable?

A. Those are the technologies that I analyzed.

Q. Okay. Now, with respect to the commercially viable technologies as he describes them on this demonstrative, technologies that constrain the price of chosen technology, do you see that reference?

A. Yes.

Q. Is that definition one that is useful to you

and appropriate in your view in considering alternatives for purposes of calculating whether or not there's increases in market power?

A. No. It --

Q. Tell us why or why not.

A. It is a definition that doesn't get you there. To speak solely of commercial viability or of constraining prices -- let me put it this way.

I disagree with Professor McAfee and with this slide about the usefulness of those terms. He speaks of it as parallel to a SSNIP test, which is a small but significant price increase test.

I find that "commercial viability" is a vague term. I mean, we understand what it means, but it's not a very clear one. And "constraining prices" is also vague in the sense that even weak substitutes can be said to constrain the price of a good whose market power is in question.

Q. Earlier today both I asked you some questions and the court I think asked you a question or two about the concept of a substitute. Did you recall that?

A. Yes.

Q. And for purposes of your analysis, have you analyzed and made informed opinions about whether there

are substitutes to the four technologies in question here?

A. The answer is that I have not addressed that question in a formal economic way associated with market definition. I've been talking about the term "alternatives" and perhaps used the term "substitute" in that regard, and I've been -- I've been speaking without reference to formal relevant market definition.

Q. And have you used -- have you considered the concept of whether alternatives are close substitutes for purposes of assessing their viability?

Let me take out the "for purposes of assessing their viability," which probably doesn't mean much as I phrased it, and let me ask you this way.

Have you considered alternatives as to whether or not they are close substitutes?

A. I haven't made a particular judgment about whether the four -- about whether the technologies that Professor McAfee identifies as commercially viable are in fact close substitutes.

Indeed, the conclusion that I draw -- maybe this is the way to answer your question -- the conclusion that I draw carries with it the implication that they are not close substitutes, that in

cost-performance terms, while they might in some sense be price-constraining -- and I would be hard-pressed to -- well, I could answer how, if need be -- that the cost-performance distance between those alternatives that have been proposed and Rambus technologies means that they are not close substitutes. That's a conclusion I can draw, yes.

Q. Let me ask you about the time aspect of any comparison that is made.

Have you made a comparison for purposes of the opinions you've expressed earlier as to whether these cost and performance comparisons would be made at a particular point in time, either before a standard, after a standard, for example, or some other point in time?

A. Well, at the relevant time, in other words, I have assumed that decisions -- that cost comparisons get made at the time of decisions, and what that means is either before a standard is chosen or within the time frame that would enable a revision, a change -- a redesign, and that doesn't necessarily mean a new standard. The time frame that I think about in that regard is 18 months or less, somewhere between 6 and 18 months. And that's based upon -- that is an understanding of mine based upon the testimony of

others.

Q. I want you to assume that, for purposes of this question, that if Rambus had never been a member of JEDEC, JEDEC still would have selected the same four technologies with respect to the four features in question. Can you make that assumption?

A. Yes.

Q. Does that assumed fact have significance with respect to your opinions?

A. It does. It's a consequence of the opinions that I've already given that if JEDEC were a rational manufacturer, it would have selected these technologies anyway. And the consequence of that for my opinion is that it ratifies the proposition that standardization doesn't add market power because the actual and the but-for world are the same.

JUDGE McGUIRE: Is that opinion -- does it take into account the time frame that all this would have occurred in JEDEC, that is, incorporate those four technologies?

THE WITNESS: I think so, if I understand your question. Sorry.

JUDGE McGUIRE: Well, what you've just testified to is that you feel that at some point JEDEC would have incorporated these four technologies as

standards.

THE WITNESS: Yes.

JUDGE McGUIRE: I guess what I'm asking you is: In coming to that conclusion, have you determined a time frame under which that would have occurred?

THE WITNESS: Yes. In other words, the particular circumstance for that time frame is before 1993 in the case of SDRAM and before 1999 in the -- 1996 in the case of DDR.

And I ought to -- but I have to say it goes a little beyond that. It has to do with the fact that if at some intermediate point in time there was -- it became desirable to make the change, I'm assuming also that a change could have been made within a standard during the course of the redesign.

JUDGE McGUIRE: Would there have been any impact on the market in the interim, you know, before they adopted these four technologies, in your mind?

I mean, I'm trying to -- what I'm trying to understand is how does the time that they disclose or they haven't disclosed affect the ultimate impact on the market. I'm trying -- and I know that question is not real clear.

THE WITNESS: No.

JUDGE McGUIRE: I'm trying to understand what

is the importance of the time frame if under your testimony JEDEC would have ultimately incorporated these four technologies, is there any impact there on the time frame under which that would have occurred to the market.

THE WITNESS: If I understand your question, Your Honor, I think the answer is no. My view of this -- I try to solve problems like this by looking at two states of the world, actual and but-for. The actual world, JEDEC standardizes SDRAM at one point and DDR in another.

What my testimony speaks to is the proposition that if they had the disclosure at their disposal that the time frame -- I have no reason to think the time frame would be different. I think the outcome would have been the same in the same time frame.

JUDGE McGUIRE: So it would have been the same whether it took them, you know, eight months to incorporate these technologies or four or five years?

I mean, it seems to me there ought to be some kind of an economic impact somewhere depending on the time that JEDEC ultimately incorporates these four technologies, and I don't know how much time that would have taken them, but is there some kind of an economic impact to the market depending on the time frame it

would have taken JEDEC to incorporate these four technologies?

THE WITNESS: Let me tell you what your question raises in my mind and see if it's helpful at all.

A reason that I can think of why the timing would be different if the disclosures had taken place is if there were some discussions that happened or a negotiation, but I don't think that's plausible. I think that what happens when there is a disclosure is not something that's very time-consuming -- it's just based on understanding -- a request for a RAND letter, and so forth.

I don't -- there are no lags that are built into my analysis about what would have happened. The timing of events in the actual world and the but-for world with disclosures is the same.

JUDGE McGUIRE: Well, that may answer my question.

Go ahead, Mr. Royall.

MR. ROYALL: Your Honor, I obviously appreciate your interest in asking questions. The last answer, though, I would object to and move to strike in that it -- the witness referenced his understanding of internal procedures in JEDEC,

including RAND letters.

And again, I'm happy to point this out, but the record makes it very clear that this witness has given no consideration in forming the opinions that are set forth in his expert report to the internal procedures of JEDEC, including whether or not there is any requirement of a RAND letter. That's not something he's considered at all in forming his opinions that are set forth in his expert report.

JUDGE McGUIRE: That, I'll take note of that point, but I'm going to overrule the objection.

MR. ROYALL: Thank you, Your Honor.

JUDGE McGUIRE: So when I go back through this transcript, I'll keep that in mind, but I'm clearly aware through prior testimony that that's part of the internal processes at JEDEC.

MR. ROYALL: I understand. Thank you.

JUDGE McGUIRE: All right, Mr. Stone.

MR. STONE: Thank you, Your Honor.

BY MR. STONE:

Q. Dr. Rapp, let me see if I can follow up on these questions.

Have you assumed that the -- for purposes of your opinions, have you assumed that whatever complaint counsel contends Rambus should have

disclosed was disclosed at the earliest point in time that it's been contended that they should have disclosed?

A. Sure.

Q. And with that assumption as to facts, have you formed a view as to whether a rational standard-developing organization would still have adopted the four technologies in issue here that are covered by Rambus patents?

A. Yes.

Q. And what's your conclusion if the disclosure had been made at that earliest possible time?

A. The same. That they would have.

Q. And if disclosure had been made at later points in time, does that cause you to think that this rational standard-developing organization would have changed its opinions as to which technologies to use?

A. I don't believe so. I think that the cost-performance hierarchy remains the same.

MR. STONE: Your Honor, I'm about to switch to a new topic, if you wanted to break now. I know it's a few minutes earlier than you'd indicated, but --

JUDGE McGUIRE: It's up to you, Mr. Stone. We could go another ten minutes, but if you would prefer to break, I don't know how much time this next topic is

going to take.

MR. STONE: It will take more than the ten minutes.

JUDGE McGUIRE: Then why don't we go ahead and break and we'll adjourn to 1:45. Okay?

MR. STONE: Thank you, Your Honor.

JUDGE McGUIRE: Hearing in recess.

(Whereupon, at 12:15 p.m., a lunch recess was taken.)

A F T E R N O O N S E S S I O N

(1:48 p.m.)

JUDGE McGUIRE: Mr. Royall?

MR. ROYALL: Before we continue, just one thing.

Earlier this morning, Mr. Stone asked Dr. Rapp if he was familiar with the testimony that Professor McAfee had given on the theory of revealed preference, and there was some back and forth on that.

We searched the trial record and we saw no reference to the theory of revealed preference in Professor McAfee's testimony. It's possible that we missed it, but I'm concerned that the way the record stands -- we can double-check this, but the way the record stands, that if our search is correct, that the questioning of Dr. Rapp today may have misrepresented that Professor McAfee testified to something in trial that he in fact didn't testify to.

But again, I don't want to suggest that I'm entirely confident. I'm certainly not suggesting to you that anything intentional happened here.

JUDGE McGUIRE: Right.

MR. ROYALL: But I would ask that respondent's counsel look into that, because I wouldn't -- if I'm right about that, I would want that clarified for the

record.

JUDGE McGUIRE: Mr. Stone, maybe you can do that.

MR. STONE: Yeah, we'll certainly look into it, and I think I should clarify it perhaps with the witness as well so that the record is clear because I don't want the witness to have been put by me in an awkward position with respect to that. And we will look into that.

JUDGE McGUIRE: Why don't you take that up and we'll talk about this in the morning. Does that offer you enough time?

MR. STONE: That's fine.

JUDGE McGUIRE: And if complaint counsel will take this up again with us in the morning before we start, we'll get that resolved.

MR. ROYALL: Okay.

MR. STONE: Okay.

JUDGE McGUIRE: All right. Mr. Stone, you may proceed.

MR. STONE: Thank you.

BY MR. STONE:

Q. With respect to the colloquy, Dr. Rapp, that you just heard, let me just say, would your testimony with respect to the theory of revealed preference that

you gave earlier today have been any different whether that testimony was directly in response to something Professor McAfee said or whether it was based on a general understanding and set of questions?

A. The latter. It was based on my general opinion about the theory of revealed preference and its application in this setting.

Q. Okay. Thank you.

Right before we took the lunch break we were talking about your opinions as to what a rational standard-developing organization would have done if Rambus had made disclosure at various points in time. Do you recall that?

A. Yes.

Q. And I believe you expressed the opinion that a rational standard-developing organization would have stuck with, stayed with the four technologies regardless of what point in time disclosure had been made?

A. Yes.

Q. What I want to ask you to assume, though, is that let's suppose that rational standard-developing organization wanted to switch at some point from the four technologies to alternative technologies. Can you assume that?

A. Sure.

Q. Is there a concept of lock-in that you would take into account in deciding whether such an organization could switch?

A. Yes.

Q. Okay. Let me ask you about that.

Is that a term, "lock-in," a term of art in economics?

A. It is. It's a term that is frequently used in economics when studying the economics of different industries.

Q. Can you explain what it means?

A. Well, it means -- this is one of those cases where the economic jargon and everyday meaning of the word are the same, which means you can switch.

JUDGE McGUIRE: How refreshing.

THE WITNESS: It's amazing, I know.

It means you can switch. And so the crucial concept that goes with the notion of lock-in is switching costs.

BY MR. STONE:

Q. And what are switching costs?

A. Switching costs, again, are the costs of switching. There's no magic about this one either.

Q. And what's the relationship then, just so we're

clear -- it's probably obvious -- but what is the relationship between switching costs and lock-in?

A. If switching costs are high, then buyers or consumers can be said to be locked in. And I can explain easier by example if that's all right.

Q. If you would.

A. I referred earlier to photocopiers as my favorite lock-in -- or an example of something actually. That may not have been in reference to lock-in. But it is a good example for that.

People buy certain models of -- by release certain models of photocopiers. Toner is specific to most models. It's not interchangeable. And the notion is that if a manufacturer wanted to, subject to a certain set of conditions and assumptions, if the manufacturer had a large installed base of users of a particular model who are all dependent upon its toner, then conceivably it could raise the price of the toner, exploit those consumers, and thus switching costs might be high, because in order to get around it, according to this example, you'd have to buy a new photocopier, an expensive piece of hardware.

That's what we mean by "switching costs," the costs of moving from one set of circumstances -- from one technology to another.

Q. Okay. And it's those switching costs that I want to ask you about for a moment.

Have you heard the phrase "specific investments" referred to in the context of this trial?

A. Yes.

Q. And is there a correlation between what you have heard and understood to be specific investments and switching costs?

A. Yes. But it's a -- it is an incomplete, imperfect relationship. It is not simple and straightforward.

And if I may, I'll shift the example to one that we heard earlier in the courtroom. Let me know whether this is in or out of bounds. I'd like to talk about coal plants at the mining mouth.

Q. I think that's within bounds.

A. Okay. An example of a specific investment is a coal plant that is built at a mine mouth, a coal-fired electricity plant that is built at a mine mouth to take advantage of nearness of the power source, of the coal, and then the notion is if the mine operator was able because of imperfect contracting to raise the price of coal, the story goes, there would be -- it would be a case of hold-up because the plant owner, having situated an expensive plant there, let's say a

$100 million plant, would be locked into that location and to that coal.

That's the story of specific investments and lock-in. What I wish to say about that, the reason that I say that that's an imperfect story is because it doesn't really focus on what's important. It's got all the preconditions right, but it doesn't focus on what's important.

What's important are not the sunk investments, not the plant that's sitting there on the ground. That's a piece of history. What's important is what it would take to get around that contract, that high-priced coal.

If the answer is that you have to build a new plant, by the way, abandon the old plant, but the more important fact is build a new plant somewhere else and that new plant costs a hundred million dollars, then it's fair to say that the switching costs are a hundred million dollars, and that's my definition of very high.

But there are other stories that go with that example. Imagine for sake of argument that there is a gas pipeline that runs nearby and that for $5 million it's possible to run a line to the electricity plant that's still sitting at that mine mouth and imagine

another $5 million will buy you a conversion. I'm making all this up. I don't even know whether it's possible technologically, but imagine another $5 million will turn your coal-fired plant into a gas fired plant. Okay?

In that case the specific investment is exactly the same. It's that original $100 million plant, but it's neither here nor there. What matters is the forward-looking switching costs, $5 million for a pipeline, $5 million for a conversion cost, the switching costs. The real switching costs are $10 million, and to the extent that anybody is locked into that coal price, it is only to the tune of that $10 million in the second example.

Q. And let me bring you now from that example if I might, Dr. Rapp, to an issue in this case.

The cost of fabricating plants you would agree is quite high?

A. Yes.

Q. Are the costs of constructing and equipping a fabricating plant switching costs?

A. My understanding is that they are not. Well, let me say that my conclusion, my opinion, is they are not based upon an understanding of the way in which changes in technology may happen without having to

build a new fabrication plant.

Q. Let me ask you, have you formed an opinion in this case as to whether in 1993 -- and assume that that's when the SDRAM standard was adopted and assume that manufacturers had begun to make some specific investments in SDRAM -- were DRAM manufacturers at that point in time locked into using the four features at issue in this case?

A. No.

Q. Have you formed an opinion as to whether the manufacturers of DRAMs were locked into using the four features at any subsequent time?

A. I have.

Q. What's that opinion?

A. And my opinion is that they were not locked in.

Q. And what's the basis for your opinion?

A. The basis for my opinion is that the switching costs associated with shifting to alternative technologies if those alternative technologies were worth switching to were relatively low by comparison to the expenses associated with manufacturing DRAMs in general, so they could have switched at any point.

Q. Have you in forming this opinion taken into account testimony by Professor Jacob on the costs of

what he referred to I think as a redesign today?

A. Yes. That is what -- it is the redesign that I have in mind as among the opportunities for -- that present themselves for switching from one technology to another without having to rebuild the plant or anything like that because circuits get redesigned periodically and within those opportunities shifts to alternative technology are possible, not at no cost but at low cost.

Q. Have you also taken into account testimony by Professor McAfee on this same subject?

A. Yes.

Q. Have either -- have you seen any quantification of switching costs that was presented in the testimony of either of those individuals?

A. I have not. There were no -- again, speaking of costs, costs require numbers, as far as I'm concerned, to make meaningful statements about them, and I have not seen numbers associated with testimony about switching costs until this point.

Q. I want you to assume in this regard that the DRAM industry might be characterized as having high fixed costs and low marginal costs. Can you assume that?

A. I can assume that, and I agree with the

assumption.

Q. Okay. And if you make that assumption, does that allow you to form any conclusions about what switching costs would be?

A. No, not of itself. The fact of high fixed costs and low marginal costs doesn't say anything about switching costs.

Q. Well, let me ask you to address specifically an argument that it would be difficult for manufacturers to switch from the four technologies at issue here and to substitute alternate technologies because there are high fixed costs and low marginal costs in the DRAM industry.

Can you address that argument and tell us whether you agree or disagree with it?

A. The second part of the argument doesn't follow from the first.

Q. Why is that?

A. Well, because you can have high fixed costs and low marginal costs and there is nothing about that set of circumstances that prevents switching at low cost, unless what you're saying is that those fixed costs need to be replicated in their entirety every time a switch of some particular technology is made, which we know is not true.

Q. Have you, in assessing those questions that I just posed to you, have you taken into account testimony of witnesses such as Mr. Becker from Infineon who testified here?

A. Yes. I remember the -- again, this is just a recollection and in the nature of a basis for my opinion -- that Mr. Becker spoke of the frequency of redesigns at the Infineon Richmond plant.

Q. Let me see if I can ask it this way so as to be consistent with rulings we've had.

Have you formed an understanding in that regard about the frequency of redesigns of DRAMs?

A. Yes.

Q. And what is your understanding in that regard?

A. My understanding is that redesigns of one sort or another occur, generally speaking, in this industry with a frequency of about 12 to 18 months.

Q. In your opinion, Dr. Rapp, is it possible for an economist to make a sound economic judgment about switching costs being sufficiently large to create lock-in without doing some sort of quantification of those costs?

A. It is not.

Q. Do you have an understanding -- and again, I'm asking you for an understanding, not your opinion -- as

to whether there have been changes in the technology of SDRAMs that would have made it easier or harder for the manufacturers to switch away from the four technologies at issue here?

A. Yes. I have an opinion that there have been changes in the technology, and it is not the specific technology that is the basis for my opinion but simply the fact that changes in the speed of DRAMs within generations and the need for periodic design creates an opportunity for changing the circuitry of DRAM, again without having to -- in the normal course of business. Let's put it that way.

Q. Have you made an effort to quantify the switching costs associated with switching away from the four technologies at issue here in an effort to determine whether or not there's lock-in?

A. Yes.

Q. Could we bring up DX-317.

Does this chart summarize the quantification work that you've done?

A. Yes.

Q. What did you consider as your scenario for the new technologies or the alternative technologies that would be switched to when there was a switching away from the four at issue?

A. This is a DRAM example -- an SDRAM example. It doesn't deal with two -- with the third and fourth of the four technologies. It deals with a shift from programmable CAS latency and programmable burst length to fixed latency and fixed burst length.

Q. Okay. And does that then assume -- and I'm in some sense reading this off your chart -- does that assume that if you move to three fixed CAS latencies and four fixed burst lengths that you end up with the cost of switching to a manufacturer of four different parts to replace the one?

A. I'm sorry. I didn't -- I wasn't following the question.

Q. Sure.

In your chart you talk about twelve different part types in total?

A. Right.

Q. How do you get to that?

A. The twelve different part types are a multiplication of the various combinations of three different CAS latencies times four different burst lengths, so whereas before you had one part which was programmable in any of these directions, now you have twelve parts.

Q. Okay. And what is the source of the dollar

figures that you've set forth on DX-317?

A. You remember earlier in the day when we spoke about Mr. Geilhufe's numbers being divided into fixed costs and variable costs, these are the fixed costs -- and I want to come back to the definition of that word -- these are the fixed costs associated with the substitution of the alternatives that Mr. Geilhufe analyzed in this connection.

Q. Okay. And in that regard, what is important to you about the definition of fixed costs?

A. What's important is that it's a definition that pertains particularly to this change. It's not fixed costs in the way that building a plant is a fixed cost. That is, too, by some standard. But this is the analysis of an episode.

The episode is to change programmable latency and burst into fixed burst and fixed latency, and certain of the costs that Mr. Geilhufe named are one-time-only costs associated with design or qualification, something like that.

So those are fixed in the sense that they don't recur with each chip produced. The variable costs are each chip produced create -- has additional -- bears additional cost. These are one-time-only costs associated with this project.

Q. Can you walk us through, if you would, your calculation of switching costs based on Mr. Geilhufe's data for the scenario you've just described?

A. Yes. There were design costs named in different cost categories by Mr. Geilhufe for fixed CAS latency that added up to $300,000 and -- sorry -- a hundred thousand dollars per chip times three chips, and the hundred thousand dollars per chip times four burst length chips, individualized, and you see them summed on the first row of this chart labeled "design costs." So that is $700,000.

Shall I continue?

Q. Yes. Then what are the qualification costs that you've included in your calculation?

A. Mr. Geilhufe named qualification costs of $250,000 per chip, and that would be multiplied by 12 for the 12 chips that come out of this project.

Q. And what about for -- another cost element was phototooling costs. What does that refer to?

A. The last of these one-time-only project-related costs was $50,000 per chip for phototooling, and that gets multiplied by 12. And after the summation and the multiplications, the product of this is $4.3 million in switching costs, that is to say, in the costs associated with moving from the -- a programmable CAS

latency and programmable burst to fixed latency and burst length.

Q. And how does this calculation inform your opinion about whether or not there would be lock-in?

A. Well, I don't think $4.3 million is a small amount of money by my standards, but by the standards of DRAM production costs in general, it is a modest amount, and the conclusion that I draw from it is that if fixed latency and burst were a good alternative in terms of -- in cost-performance terms, then the cost of switching from programmable to fixed would be about $4.3 million.

Q. How does that number compare to the royalties at issue in this case with respect to simply SDRAM?

MR. ROYALL: For clarification --

MR. STONE: Let me rephrase. Let me withdraw and rephrase.

BY MR. STONE:

Q. You talked earlier about comparing the additional costs of various alternatives to a royalty of .75 percent charged by Rambus?

A. Yes.

Q. And if a rational standard-developing organization felt that they could avoid, in some fashion rationally avoid the payment of royalties to

Rambus at that rate of .75 percent, do you have an understanding as to how those royalty numbers compare to the switching costs?

A. This $4.3 million is small in relation to the royalties that are being charged.

So if, for example, a royalty -- if, for example, the manufacturers were using royalty-bearing technology, like programmable latency and burst, and fixed latency and fixed burst were equivalent in cost-performance terms, then they could make that switch for $4.3 million, approximately -- it's just an estimate -- and save the royalties and that would -- and it would be a small price to pay.

Q. Do you have an understanding as to how long it would take to implement a change from the programmable CAS latency and programmable burst length to the use of fixed CAS latency and fixed burst length?

A. I'm relying here entirely on Mr. Geilhufe, and I believe his testimony was something like from six months to a year, in other words, within that redesign interval of less than 18 months.

Q. In computing the switching costs, have you taken into account the opportunity cost of engineers?

A. Yes. Not explicitly, but it's there.

Q. And tell us -- first tell us what you

understand the phrase "opportunity cost of engineers" to refer to.

A. Opportunity cost is another way of saying economic cost. It's the cost that economists think of first and foremost, and what it means is the cost of -- what it means is that the cost of employing somebody, in this instance, is really the cost of taking them away from the next best alternative. It doesn't show up that way in accounting records, but that's the real cost of using somebody's time.

Q. And how are those opportunity costs taken into account in your computation?

A. Well, Mr. Geilhufe based his calculations on his estimate of engineers' wages and those wages are a measure of opportunity cost.

So it's not as if opportunity costs would come into it again or twice over. When you speak of the opportunity cost of an individual, generally by assumption, although things sometimes get out of whack, what you're referring to is that, the person's wage in the marketplace.

Q. Have you considered whether coordination problems involving DRAM manufacturers and the maker of complementary goods would prevent switching from the two technologies we're talking about, programmable CAS

latency and programmable burst length, to the alternatives that you've considered?

A. Yes.

Q. And in that regard, just remind us if you would what the complementary goods are that you would consider.

A. The complementary goods are memory controller, modules, the microprocessor first and foremost, the sockets and motherboard.

Q. In your opinion, Dr. Rapp, would any coordination issues with the manufacturers of those complementary goods and the DRAM manufacturers prevent such a switch in technology from occurring?

A. It would not.

Q. Why not?

A. My answer is that the resolution -- that coordination happens all the time in this industry, that that is what JEDEC is about, that coordination happens among manufacturers outside of JEDEC all the time, and there's no evidence that I could identify that suggests that coordination problems of the sort that are posed by this are not solved again in the normal course of business.

Q. Did you look in the record to see whether you find evidence of such coordination problems having been

an obstacle to switching in the past?

A. Yes.

Q. And did you find any such evidence?

A. No.

Q. Did you also consider the possibility that once the DRAM industry had made some investments in using some or all of the four technologies at issue here that it would after that be harder to get an agreement amongst them and to coordinate on the change to some other technologies?

A. I understand the proposition. I think that the situation is no different from -- I mean, it's harder in the sense that there's an existing technology and it's not as if they're starting from scratch, but it's no -- but the industry hasn't started from scratch for a long period of time, so I don't think the coordination problems when faced with finding an alternative to these Rambus technologies, if that were to have paid off, would be any harder here than in other situations that the industry routinely faces.

Q. Have you considered the possible argument that users of specific features might have different incentives that might interfere with coordination, such as one manufacturer that might prefer a burst length of 8, for example, and one that might prefer a burst

length of 4?

A. Yes.

Q. And has that caused you in any way to rethink or change your opinion?

A. No. The same answer that I gave earlier applies. But in a certain sense the experiment has been performed in history in this case because there was such a deliberation, as I understand it, with respect to the DDR-II standard. There were differences of opinion about that and interests were divergent at the outset and a resolution was achieved. In this case the resolution was to preserve programmability, but nevertheless it was a coordination problem the likes of which we're talking about.

Q. I want you to assume if you can, Dr. Rapp, that let's say roughly 50 percent of the manufacturing capacity today is licensed by Rambus to make use of the four technologies in question and that 50 percent of the market in terms of capacity roughly is not. Can you make that assumption?

A. Sure.

Q. Have you considered the argument that, because some of the manufacturers are licensed and some are unlicensed, they have different incentives with respect to these coordination problems that would make it more

difficult for them to switch?

A. I have considered that.

Q. And what is your opinion regarding that argument or that possibility?

A. I don't think that it is a strong argument, and the reason that I don't think it's a strong argument or even a plausible argument is that the incentives are not all that divergent. All manufacturers, all other things being equal, have an -- I'm sorry. Let me start that again.

All manufacturers have an interest in the availability of alternative technology at low cost in cost-performance terms, so I don't recognize how the assumption that you gave me about licensure should affect the ability of manufacturers to achieve whatever standardization is necessary.

Q. Let me ask you a couple other arguments I want you to consider and respond to if you would.

Have you considered whether the need to achieve economies of scale and production volume might cause the DRAM industry or manufacturers to sort of home in on a single standard at any given point in time?

A. Yes.

Q. And is that a factor that impacts the issues

we're discussing now?

A. It does impact it, and unlike some of the arguments that we've addressed, it's not something to be dismissed out of hand. Economies of scale and economies of cumulative volume are very, very important forces in the DRAM industry, but they do not compel a single standard.

Economies of scale happen at the plant level. We observe in the marketplace that there are variations in chips, sometimes produced out of a single plant, different speeds, different DRAM technologies, so acknowledging that economies of scale matters, as I do, is not to say that economies of scale would drive the industry to require a single standard.

I'm not saying that you could have a half a dozen or a dozen standards. That's not my opinion. My opinion is that one standard is not dictated by the economics and the technology of the industry.

Q. And do you have an understanding as to whether at any given point in time during the period 1990 up through today multiple standards have existed in the DRAM industry?

A. Yes. Multiple standards in the following sense. First, multiple technologies have existed, some major, some minor. And I'm talking about the

coexistence of RDRAM and SDRAM and DDR DRAM.

RDRAM is not a JEDEC standard and it hasn't achieved a very high market share, but it's an interesting example in this regard anyway, particularly because those who follow the semiconductor industry at a point in the not too distant past were uncertain about whether RDRAM would take over at least a large share of the market or whether DDR would, and the forecasts from that era envisioned the market being divided up between those two, and nobody -- and that seemed a plausible outcome.

In addition, as I've said, we have different generations coexisting and we have different, let's call them, designs or flavors, different speeds coexisting, so you have my answer.

Q. Okay. And does your understanding in the regard you've just explained it to us inform your decision with respect to whether or not there's lock-in?

A. Yes. It reduces the -- in other words -- what -- what that tells me, what that history tells me, is that in addition to whatever I've said about the cost side that lock-in is not likely to happen in this industry because of the -- because scale economies are not so powerful that they drive the

industry necessarily to a single technology at any one time.

Q. Have you also considered the possible argument that network effects or network externalities make it impractical for any firm or even a group of firms to depart from the standard and create an alternative?

A. Yes.

Q. And do you accept or reject that argument?

A. I reject it.

Q. Why is that?

A. For much the same reason. Network externality -- the implication of network externalities is that the compatibility requirements of the industry's users is so high that only one standard can exist, and if the industry is in that standard, then presumably it is locked into that standard.

Just like a -- well, never mind the examples.

And I find that not to be true.

Q. Do you have an opinion based on the understandings you've described in your own economic analysis as to whether numerous versions of DRAM could successfully coexist in the marketplace?

A. My opinion is that numerous versions if you mean numerous competing standards is too many to

coexist.

Q. And what is your view as to what would be reasonable to expect in this industry?

A. I'm a little reluctant to go beyond saying more than one or a few, and that is necessarily imprecise. There's no analysis. It's based upon my reading of the history without any more precise analysis than that.

I think the facts that I've spoken of earlier suggest that coexistence like that is possible, but I want to -- I want to qualify the answer.

Q. In your opinion, Dr. Rapp, were DRAM manufacturers at any point in time from 1990 up until today locked into using the four technologies at issue in this case because of switching costs?

A. In my opinion, they were not.

Q. And have you explained to us in your prior answers the bases for that opinion?

A. Completely.

Q. Okay. If then it was not due to lock-in, do you have an explanation as to why these four technologies were carried forward from SDRAM to DDR SDRAM, and so on?

A. Sure. I think it was because they were the superior technologies in cost-performance terms along

the lines of which I described this morning.

Q. And would that opinion be true as well with respect to the inclusion of these four technologies in DDR-II?

A. Yes.

MR. ROYALL: Your Honor, I -- I'm sorry. I just want to interrupt because I think there is something that's inaccurate on the record, and I think it's probably not intentional. I'm sure it wasn't intentional.

But the question earlier was whether -- if I followed it, it was whether he had an opinion as to why the four technologies were carried forward from SDRAM to DDR? Was that -- I think that was the question.

MR. STONE: I misspoke.

BY MR. STONE:

Q. Let me go back to that question.

A. Uh-huh.

Q. Let me get my understanding clear and see if it comports with yours.

Of the four technologies at issue here, two of them were included in SDRAM?

A. Yes.

Q. And all four were included in DDR?

A. Right. And subsequently standardized into DDR-II, just to jump ahead.

Q. Okay. And have you formed an opinion as to whether the initial selection of the two in any way mandated through application of the theory of lock-in the later selection of the four?

A. My opinion is they do not, and for this let me see if I can be clear. I do not think lock-in accounts for any either carryover, in other words, carryover of the two into DDR, or man -- nor do I think that lock-in mandated the adoption of the other two, PLL and DLL on a chip and dual-edged clocking.

So lock-in has no part in any of it is my opinion.

Q. And have you considered as part of your understanding base, if you will, the decisions to include these features in DDR-II?

A. Yes.

Q. And how has that informed your opinions, if at all?

A. Well, it strengthens my opinions because this is in the history that we're relating across essentially the 1990s. This comes late in the game, DDR-II. There have been multiple design changes across the decade. There is now a new standard being formed.

It's one that's being formed in years when the licensing intentions of Rambus are clear for the industry -- unarguably clear for the industry to see there has been litigation, and so forth, by that time, and yet the industry chose to standardize on the four technologies.

Q. And in your opinion, was the decision after that additional information was available, was it due at all to lock-in?

A. In my opinion, it was not.

Q. Are there implications from your opinions regarding the absence of any lock-in and the possibility that Rambus has achieved any additional market power through its alleged conduct at JEDEC?

A. The conclusion that lock-in is not a feature of technology in this industry carries with it the explicit implication that it is not a source of the acquisition or maintenance of market power.

Q. Let me ask if we could bring up a slide you prepared, DX-318.

And this might be helpful at this point in the questioning, Dr. Rapp.

Can you tell us what this slide is intended to convey?

A. Sure. I want to employ language that has been

used -- I want to explain my opinions about market power using the language that was used by Professor McAfee I believe earlier in the trial, and that is the distinction to use -- to employ the distinction between ex ante and ex post.

Q. And why don't you start by explaining those two terms if you would as you use them.

A. All right. Not translating from the Latin, but just talking about what we mean by that in this context.

Q. Please.

A. We mean before and after a standardization decision, so when we are thinking about SDRAM, in my way of thinking, ex ante means before 1993 and the standard was fixed, and ex post means after 1993. And if we were speaking explicitly about DDR, we'd pick a later year.

Q. And the heading on your chart, Rambus Has Acquired No Additional Market Power, let me take you to that first.

I think you said earlier today, you're not saying that Rambus by virtue of its technology and its patents has no market power, are you?

A. That's correct.

Q. And so when you address additional market

power, what do you mean to be addressing by that?

A. I'm referring to market power that is alleged to have been acquired by Rambus as a result of its actions in JEDEC, in other words, as a result of its alleged failure to disclose whatever intellectual property interests complaint counsel believes it should have disclosed.

Q. And when we talk in your testimony and in connection with this chart about ex ante and ex post, are those the time periods in which you're assuming that whatever it is alleged Rambus should have disclosed was in fact made known?

A. I am talking about before and after standardization.

Q. Right.

A. Before and after standardization is fixed.

Q. And for these purposes, do you mean to look at whether before standardization the disclosure was made that in some fashion that is alleged Rambus should have made and then after standardization you assume the disclosure is made after as well?

A. Yes.

Q. Okay. What is your conclusion regarding whether or not Rambus acquired any additional market power ex ante, that is, as a result of not making the

alleged required disclosure known prior to that time?

A. My conclusion is that Rambus acquired no additional market power ex ante, and the reason for that, as I've described throughout the day, is because the technology was superior to begin with and, in addition, because compatibility requirements were not so strong that alternatives, if they were available, couldn't have been employed.

As a result of that, I don't believe that formal standard-setting reduced the uncertainty -- sorry -- reduced the substitution possibilities of alternatives. They just weren't as good. And Rambus' market power was unchanged by formal standard-setting. That is the -- that's the story up to formal standard-setting ex ante.

Q. Let me ask you about the ex post situation.

Just assume that there was some required disclosure that was not made by Rambus and the information did not become known until after the standards had been developed and investment had been made in the manufacture of those products.

Is that a reasonable description of the ex post scenario?

A. Sure.

Q. In the ex post scenario, have you formed an

opinion as to whether Rambus acquired any additional market power as the result of the conduct in which it has been alleged to have engaged?

A. Yes. And I would put it this way. I would say that it neither acquired market power nor was it able to sustain excess market power, if you will, or additional market power. And the reason for that is because even after standardization, after disclosure, the opportunity -- if substitutes were available -- that's always with an "if" -- if substitutes were available that were just as good or were better, switching was possible because switching costs weren't high.

Q. Based upon the analyses you've described for us earlier today, did you also form an opinion as to what technology would have been selected regardless of what time period the alleged disclosures were made?

A. Yes. My opinion is that the four Rambus technologies were the technology of choice throughout this period and that a rational manufacturer or a rational JEDEC, that is, choosing the best alternative in cost-performance terms would have selected the Rambus technologies.

Q. Okay. We can bring that slide down if you wouldn't mind.

And let me ask you about a slightly -- let me ask about a different term.

Does the discussion we've just been having about switching costs and lock-in have a bearing on the issue of entry barriers?

A. It's not so much that it has a bearing -- well, yes. I mean, they're one and the same thing or very close to one another.

Q. Well, if you would, first tell us sort of how an economist thinks of entry barriers.

A. An entry barrier is -- we're picking all the examples that are real plain-language ones. It's something that impedes the entry of a new competitor. Usually we're talking about product markets. Now, in a technology market, it means something that impedes the entry of a new technology.

JUDGE McGUIRE: Mr. Royall?

MR. ROYALL: Yes, Your Honor. I'm not sure how far down this line Mr. Stone intends to go, but my concern is that I do not recall any discussion of entry barriers in Dr. Rapp's report, and it could be that --

MR. STONE: Where I want to go, Your Honor, is to demonstrate that as Dr. Rapp analyzed this question, entry barriers and switching costs and lock-in are one

and the same, just to show that that's the common thread between them so that his discussion of switching costs and lock-in is in his mind exactly the same thing as discussion of entry barrier.

JUDGE McGUIRE: Mr. Royall?

MR. ROYALL: My concern, Your Honor, is that no such connection was made in his report, and as far as I can recall, and I could stand to be corrected, but there's no discussion of entry barriers in his report.

JUDGE McGUIRE: If it's not in his report, Mr. Stone, I'm not going to hear it.

MR. STONE: Your Honor, two comments to that.

One, I think all that was necessary to be disclosed in the report was the factual basis for his opinions, which was.

And my recollection is that Professor McAfee's testimony on entry barriers was something we also heard for the first time here in trial, and this is really in response to that testimony.

MR. ROYALL: Well, I think that statement is incorrect as a factual matter, and I'd be happy to show that Professor McAfee's report did include a discussion of entry barriers explicitly. I'd be happy to show that.

JUDGE McGUIRE: Is that in his expert report?

MR. ROYALL: It is in Professor McAfee's expert report.

The second thing I would say is that the statement -- the other statement was incorrect, that the report is not required merely to show the factual basis. It's required to state the conclusions, and that conclusion wasn't stated.

JUDGE McGUIRE: That's correct.

BY MR. STONE:

Q. Let me rephrase it this way.

Have you -- is it your opinion that there are no -- is it your opinion as to -- let me frame it this way.

Are there any economic impediments, in your opinion, to switching from the use of the four technologies at issue here to alternative technologies?

A. There are not, for the reasons that I gave.

Q. Okay. Did your analysis and opinions earlier expressed lead you to a conclusion as to whether or not there has been any harm to competition as a result of Rambus' alleged failure not to disclose certain information to JEDEC?

A. Yes.

Q. And what is your opinion in that regard?
A. My opinion is that the alleged JEDEC -- the alleged Rambus actions in JEDEC did not cause harm to competition.
Q. Have you prepared a slide to summarize your conclusion in that regard?
A. Yes.
Q. Let's bring up DX-319 if we might.
Is DX-319 a slide you prepared?
A. Yes.
Q. And does it outline the basis for your opinion that there was no harm to competition --
A. Yes.
Q. -- as a result of any alleged failure to disclose on Rambus' part?
A. Yes.
Q. When you say on this slide "Disclosure would not have affected the outcome because there are no cost-performance equivalent technologies to Rambus' technologies," are you referring in the phrase "Rambus' technologies" to the four features at issue here?
A. I am, yes.
Q. And does that statement with that clarification accurately describe your opinion?

A. It does.

Q. At the bottom of this demonstrative that you've prepared it says "in complaint counsel's hypothetical but-for world."

Do you see that?

A. Yes.

Q. Let me ask you about that.

In this context, what do you understand to be the characteristics that are relevant of complaint counsel's hypothetical but-for world?

A. That everything about the real world is the same in this hypothetical but-for world except that the disclosures that complaint counsel alleges should have been made were in fact made.

Q. And in that but-for world where those disclosures were made, have you formed an opinion as to what rational manufacturers or rational standard-developing organizations would have done?

A. Yes.

Q. And what is that?

A. The actual world and the but-for world would be identical with respect to that choice. And the conclusion is that if -- given the disclosure, if the disclosures had been made, the economics of the choice is as I have described it and the Rambus technology

would have been chosen, then it follows that competition is not adversely affected by the alleged failure to disclose.

Q. Thank you.

Let me switch you to a slightly different topic if I might, Dr. Rapp. And by way of background, let me ask, if you would, to simply explain what an economist means or how they use the terms "predation" and "predatory conduct."

A. The shorthand way that I speak about this and I think that it is a common usage or consistent with the way economists think about it generally is that predatory or exclusionary conduct is an investment in the destruction of a rival.

Q. Let me ask you -- I think you have a chart that might help all the rest of us follow along with you.

Let's bring up if we could DX-320.

And is this another chart you prepared?

A. Yes.

Q. And on definition there where you said "investment in the destruction of a rival," is that what you meant by the testimony you just gave?

A. Yes.

Q. Okay. And if you would, I asked you about

predation, and let me ask you before we move on whether that's a term that means essentially the same as the term we sometimes hear for exclusionary conduct.

A. Yes. More or less. There are subtle differences between the two, but the economist's test is the same.

Q. Now, I think it's probably a matter of economic knowledge and common knowledge that a lot of companies would like to see their competitors not do so well in the marketplace.

A. Right.

Q. And is every time you do something in an effort to seek advantage over a rival, does that qualify as investment in the destruction of a rival as you use it here?

A. Just the opposite. We call that competition.

Q. Okay. So what are the -- you have here the word "hallmarks."

What are the hallmarks that we would look for for predatory or exclusionary conduct?

A. Well, it is the key off the word "investment." If you think about the way investment works, you disgorge a certain amount of money up front and then you have to wait until the investment pays off, and

that is in the nature of predation or exclusion as well.

So there are two parts to it. What we're talking about here or the test that economists use is a conduct test, the way firms behave in the marketplace, and the first part of that conduct consists of the investment part and that is short-run actions that don't make sense except in terms of their adverse impact on a competitor.

So it is short-run actions without an independent business justification.

Q. And then that in the second period of time they hope to recover that short-term investment?

A. Right. After the investment period comes the return period, and the return is that you knock a rival out of business and the opportunity to exercise market power, monopoly power, then presents itself.

Q. Can you give us an example of conduct that is predatory or exclusionary?

A. Sure. The most frequent example is a case of pricing below cost, but not just below any cost, below average variable cost. And the reason that pricing below average variable cost is a perfect paradigm for predation is because there's no good reason for doing it, with a few examples, a little footnote for things

that aren't worth discussing here. There are exceptions to every rule.

But by and large, what pricing below average variable cost means is that every time you make an extra sale, you lose more money, and you don't want to do that in the normal course of business. You'd rather stop producing that product or even go out of business rather than purposefully increasing your losses.

So there's no business justification for that. The only reason to do that, barring the footnotes, is if it's going to pay off sometime later.

Q. Now, can you give us an example of similar low-pricing conduct that might have an adverse effect on competitors but that would not be classified as predatory or exclusionary by economists?

A. Sure. There are some kind of below-cost pricing that is procompetitive and economists applaud that. And that is pricing below total cost where in some sense you're reducing your margins or even running losses for a while, but not intensifying your loss with every sale that you make.

And there are good reasons for doing that, for pricing below cost, and it hurts competitors, particularly if they are -- if they're less efficient

than you. But even if they're not, it drives them into a loss-naming situation also.

So it's no fun to be in a market like that unless you're a consumer. If you're a consumer, you're better off as a result of that. And in the end, there's nothing bizarre about it, and therefore it passes the predation test.

Q. Are there examples involving intellectual property where conduct may have an adverse effect on competitors but where that conduct would not be classified as predatory or exclusionary by economists?

A. Sure. Just the opposite. Invent a terrific, new, cost-saving technology. Suddenly -- and it's proprietary. It's a trade secret or you patent it. Your costs are lower than everybody else. It drives them out of business. Either that or you can get much higher margins, but your strategy is to drive them out of business.

That's part of a process that economists call creative destruction, and it's what makes competition work. Even though it's hard on the business that fails and it's hard on their employees, too, it's what creates productivity in the economy. There's nothing exclusionary or predatory about that despite the fact that in the normal sense of the word competitors are

excluded.

Q. Is there a part of this analysis as to whether conduct is predatory or exclusionary that requires you to determine whether there was a valid efficiency rationale for a company acting in a particular way?

A. Yes, it's part of the analysis.

Q. Okay.

A. If there is a valid efficiency rationale, it tells me that the conduct is not exclusionary.

Q. And have you -- have you been asked to assume that Rambus did not disclose information to JEDEC that, let's say, as complaint counsel contended should have disclosed to JEDEC, have you been asked to consider that scenario and whether there would be a valid efficiency or business justification for not having done so?

A. Yes.

Q. And is that a test that economists would normally apply in determining whether conduct was predatory conduct?

A. Yes. The search for a business justification is a part of that test.

Q. Let me ask if we could bring up DX-321.

Is this a chart that you prepared, Dr. Rapp?

A. Yes.

Q. And is this intended to help us understand your testimony regarding whether there was a valid efficiency or business reason for not disclosing certain information?

A. Yes.

Q. Okay. Can you tell us in your opinion what reasons there are, what valid business reasons there would be for not disclosing additional information regarding intellectual property?

A. Yes. The reason that comes directly to mind is the protection of trade secrecy, and in this case the trade secrets that are at issue are the disclosures not about the technology per se but about Rambus' intentions, so --

JUDGE McGUIRE: Now, I assume in that regard you're testifying regarding only patent applications as opposed to issued patents?

THE WITNESS: That is correct. Issued patents are out in the world, as I understand it, so there's no secrecy there.

BY MR. STONE:

Q. And let me try to -- would your analysis -- let me ask it this way.

Would your analysis apply to patent applications that had been filed as well as to

someone's beliefs or intentions regarding filing patent applications in the future?

A. Yes. Or intentions about claims that might be filed in the future, yes.

Q. Okay. And by "claims that might be filed in the future" do you include within that amending applications to add new claims or change them?

A. Yes. Exactly that's what I had in mind.

Q. Okay. In this chart -- and maybe it's a useful way to walk through some of the questions I have on this -- DX-321, you mention, "If Rambus had made the additional disclosures that complaint counsel said it should have made, Rambus would have," and your first point is "jeopardized patent claims."

Can you tell us what you mean by that point?

A. Yes. And I'm relying to some degree on my background -- we've established that I'm not a lawyer, but I have some acquaintance with intellectual property protection, the institutions of intellectual property protection, but I'm also relying upon the trial transcript of Mr. Fleisler who I believe addressed -- who does address these issues.

And what this says is that one of the ways -- one of the reasons for wanting to protect applications and intentions and treat them as a trade secret is that

to do otherwise runs certain risks of losing protection, and the risks that you lose are making available information that will enable technology competitors to go to our Patent and Trademark Office in the United States and file interferences and you make information available -- and it would -- the disclosures would make information available that would enable firms to get to the patent offices of other patent authorities that use a first-to-file rather than a first-to-invent patent regime, so you run a certain amount of risk that your patent protection could be weakened.

Q. When you say on this chart, DX-321, that if these additional disclosures had been made, Rambus would have lost competitive advantages, and then you have two bullet points, induce work-around efforts and disclosure of R&D focus, what do you mean to refer to there, if you could explain?

A. There I'm talking more about giving up strategic advantage, not the loss of formal patent protection but the fact that disclosing applications and intentions enables competitors to know what you're up to in your R&D efforts and enables them to begin work-around efforts earlier and enables them to know what you're up to in some general sense.

For the same reason that trade secrets are normally the subject of protection, and you know, when business plans, for example, come into litigation, they get stamped "confidential" because people want to have their business intentions and strategies kept private, this is something that loses that advantage when it is disclosed.

Q. In your opinion, Dr. Rapp, can keeping information about pending or future patent applications confidential be procompetitive?

A. Yes. For the same reasons that I just mentioned, we keep trade secrets of various sorts, including not just technology but strategic trade secrets, what we're going to do next, we keep them under our hat, and it's procompetitive to do that.

Q. And from an economist's point of view, can nondisclosure of information about pending or future patent claims serve to enhance consumer welfare?

A. Again, for the same reason, the answer is yes, and to the extent that it makes better competitors of firms that protect their intellectual and commercial property, the answer is that they are better able to compete, and that competition produces more output, lower prices and consumer welfare in the economy.

Q. And do you consider in coming to that

conclusion whether there's any effects on innovation from this nondisclosure?

A. That's probably the most powerful force. Innovation is a very, very important engine for productivity and economic growth in the United States, and it depends -- and innovation depends upon the preservation of incentives to innovate, and that includes being able to control your -- not only the research but the development of your intellectual property, which includes patent policy -- obtaining patent rights.

Q. Let me ask you -- focus you on a specific question here if I might.

Can a company that is a member of a standard-developing organization -- let me start that over.

Can a company that is a member of a standard-developing organization benefit from not disclosing information to that organization without regard to what standard that organization may or may not ultimately hand out?

A. Yes. And --

Q. And so what I want you to assume for that is that the member may or may not get any benefits out of what standards are ultimately developed. My question

is whether -- are there benefits to that member of not disclosing to the organization separate and apart from the standards that are developed?

A. Yes.

Q. And how is that or why is that?

A. Well, the benefits that I just named, I was talking about society as a whole a minute ago, but the benefits on a firm to keeping control of its own development and intellectual property protection strategy are benefits that are not dependent on which standard is chosen or the -- or any of the outcomes in the standard-setting organization. It's independent of those. It has to do with maximizing its ability to be a -- to operate competitively.

Q. And now I want to be clear about a couple of things, especially in light of a ruling on an in limine motion regarding what you will and will not testify about.

Am I correct that you're not expressing an opinion here today about whether Rambus was for any reason free from liability or sanction if it violated rules that it should not have violated? Is that correct?

A. Correct.

Q. Okay. Are you looking at the questions that

I'm putting to you about these questions of business justifications for nondisclosure from the perspective of antitrust economics?

A. Yes.

Q. Okay. And I want you to stay focused on this as a question of antitrust economics if you can as we go forward, but I want you to assume from that perspective that Rambus did not disclose some information about pending or future patent applications that it was required to disclose.

And so setting aside whatever JEDEC or other groups might do in response to that failure to disclose, do you have an opinion as to whether such conduct would be exclusionary or predatory from the perspective of antitrust economics?

A. It would only be exclusionary from the perspective of antitrust economics if there were no business justification for it. And as we move from the general to the particular, in this instance I believe that not to be the case. In other words, I believe that there were business justifications.

Q. Okay. Have you considered, for purposes of the opinions you've formed, the possibility that Rambus made a conscious decision to jeopardize the enforceability of its intellectual property by not

making certain disclosures?

A. I made no assumptions about what goes on in anybody's consciousness. As an economist, I'm able to look at incentives and choices, but I can't -- I can't make readings of people's minds.

Q. And did you look at the record in this case to determine from the perspective of conduct and choices whether there was any evidence that you could find that Rambus had intentionally jeopardized any of its patents?

MR. ROYALL: Your Honor, I would object to this question as going beyond the scope of the expert's report. The issue that is being raised here is an issue that was raised in Professor McAfee's report. The witness had an opportunity to respond to that in his report, and he did not, and for that reason I would object to this line of questioning.

JUDGE McGUIRE: Mr. Stone?

MR. STONE: I don't think that correctly summarizes the factual predicate of where we find ourselves today. I think in fact that this witness is entitled to respond to testimony that to a significant extent we heard here for the first time in trial.

You'll recall that counsel put up on the screen a quote from the deposition of Mr. Davidow and

asked Mr. McAfee or Professor McAfee about it, and it's that particular issue that I was trying to drive to with this question, which I don't think this witness could have anticipated until we got to the point in the trial where we were that Professor McAfee testified.

MR. ROYALL: Mr. Stone was careful in his wording of that answer I think by saying that he was responding to an issue that had been raised in significant part at trial.

The fact of the matter is this issue was raised directly in Professor McAfee's report, and that report was available to this witness a month before he wrote his report. He did not respond to that issue in his report. And if you like, I can point you to a stipulation that we entered into after that report was written which was designed -- it was something that I asked for. It was designed to make sure that respondents acknowledged that they were limited to what conclusions that were set forth in that report. And the fact that this same issue came up at trial is not a justification for going beyond the scope of the witness' expert report.

JUDGE McGUIRE: Objection sustained.

Objection sustained.

BY MR. STONE:

Q. Dr. Rapp, let me frame my question this way if I might.

In considering whether or not there was any conduct that would be classified as predatory or exclusionary, have you considered -- in addition to the procompetitive or business justifications for nondisclosure, have you given consideration to economic incentives that Rambus faced at the time?

A. Yes. Particularly with respect to the short-run element of the predation test having to do with whether there were -- whether there were sacrifices made.

Q. And what is your conclusion in that regard?

A. My conclusion in that regard was that I was unable, in the course of arriving at a conclusion about the subject of exclusionary conduct, I was unable to find evidence that Rambus expended costs or took risks that were -- that were only compensable by the exclusion of another technology, that, in other words, did not have a proper business justification. And my finding was that no such risks were borne.

Q. Earlier in your answer today you mentioned one of the procompetitive issues or one of the business justifications to be the protection or preservation of

trade secrets. Do you recall that?

A. Yes.

Q. And I want to ask you, at a point in time when a patent application has become known -- well, let me ask it this way.

Let me just ask you to assume that Rambus' original patent application became known to various people in the industry as the result of the publication of an international or European version of that application or in some other fashion. Can you assume that?

A. Sure.

Q. Once that application was known, were there, in your opinion, any trade secrets to be protected by the nondisclosure of other patent applications that were related?

MR. ROYALL: Your Honor, I object. The question calls for a legal conclusion.

MR. STONE: It does not, Your Honor. It goes to his understanding previously testified to based on testimony he's heard and his own experiences as to whether there's value in patent --

JUDGE McGUIRE: Overruled.

THE WITNESS: I just need to have it back again. I lost the thread.

BY MR. STONE:

Q. Okay. Let me try to restate it, and I'll try not to create a question that leads to another objection.

A. If it could be read back, that's all I need. I understood it. I just lost the thread.

Q. Let me just try it.

Assuming that the original '898 application of Rambus' had been disclosed, was there after that disclosure any trade secrets that you have had in mind that Rambus would have reason to keep confidential that related to other patent applications or the further prosecution of that '898 application?

A. Yes.

Q. And what are they?

A. They are the additional applications, intentions to file additional applications or to modify claims.

Q. If one were to say that conduct is predatory or exclusionary if it involves concealing information, would that be a sufficient definition to meet the economist test for predation or exclusionary conduct?

A. No.

Q. If you added to that question an additional condition that it would have some harm on competition,

would that again be sufficient to meet the economist's definition of predation or exclusionary conduct?

A. No.

Q. Have you considered the arguments that Rambus' conduct excluded commercially viable alternatives in coming to your conclusions that Rambus' conduct was not predatory or exclusionary?

A. Yes.

Q. And does that affect your opinions or cause you to change them in any way?

A. It does not. I believe that the test that I outline, the two-part investment test, is the way that antitrust economics virtually requires that you consider the subject of predation or exclusion. In any event, I think it's the best way to look at it. And other statements don't get you there.

Q. And let me ask you about one other statement if I might and see if this in any way changes your views.

If the perceived relative cost of alternatives was raised, in addition to the other elements I just stated, would that be sufficient to make conduct predatory or exclusionary?

A. No.

Q. Is your view as to the proper definition of

exclusionary conduct or predatory conduct one that's commonly accepted within the field of economics?

A. Yes. I believe it's widely accepted.

Q. Did you hear -- strike that. Let me just leave it where we are.

The elements that I just related to you in my questions, excluding efficient or superior alternatives, excluding commercially viable alternatives, raising the relative cost of alternatives, and having an effect on competition, taking those four into account, are those four together sufficient to define exclusionary or predatory conduct?

A. They are not. They're all result-related. The way that antitrust economics goes about analyzing predation or exclusion is by means of assessing the conduct, and if you take those four together -- I have to -- either three of the four or all four of them speak to the outcome, so there is a circularity about them that disqualifies them as an adequate test by themselves for predation or exclusion.

Q. Are there procompetitive acts or procompetitive conduct that could lead to the same four results?

A. To answer that question I need -- because I

don't have the four --

Q. Let me ask it a little differently, Dr. Rapp.

A. Okay. But forgive me. I'll need the four in order to give you a proper answer, just to save time.

Q. Let me ask it in a slightly different way.

Could exercising intellectual property rights to exclude a competitor in the market, would that by itself be exclusionary?

A. Certainly not.

Q. Could that be procompetitive?

A. Absolutely. That's what patents are about, excluding others.

Q. And could exercising one's intellectual property rights to charge royalties which might raise the costs of rivals, would that necessarily be predatory or exclusionary?

A. On the contrary.

Q. Could it be procompetitive?

A. Yes.

JUDGE McGUIRE: You said, you know, "on the contrary." Would you expand on that and explain to the court why as to the contrary.

THE WITNESS: Again, just because I'm having trouble hanging, we're talking about royalties being raised.

JUDGE McGUIRE: On competitors.

THE WITNESS: Sure. A patent grants -- as you know, Your Honor, a patent is a deal between an inventor and society, and the royalty is part of that deal. It comes with a grant of exclusivity and you can -- the way the patent laws are structured are you can charge the moon if you want or you can just simply say I'm not charging a royalty altogether. It is the reward for having produced something novel and useful and it's -- and even though the effect on a competitor is adverse, society wins in that trade-off.

MR. STONE: Thank you, Your Honor.

BY MR. STONE:

Q. Let me ask you now about protecting trade secrets.

If a company protects its trade secrets and prevents their use by other companies, is that necessarily predatory or exclusionary or can that be procompetitive?

A. No. It could be procompetitive. That's why trade secret laws are there, to protect trade secrecy.

Q. Is there anything about the taking of risk, incurring risk, that would necessarily make conduct either predatory or exclusionary?

A. Certainly not.

Q. Why not?

A. There are two reasons. First, businesses and individuals take risks all the time. It goes without saying. So to say that risks are being taken explains nothing about predatory or exclusionary. That's reason number one.

Reason number two is that to talk about -- people and businesses take risks in order to get gains, if they take those risks, the risks deliberately. So to assess their -- to speak of risks without speaking of the gains that go along with the risks is telling one-half of the story. It's misleading and it doesn't get you anywhere and therefore is unrelated to the analysis of exclusion.

Q. In coming to your conclusions that the opinion that you've expressed earlier that Rambus' conduct was not predatory or exclusionary, did you take into account the testimony of Professor McAfee?

In other words, were you here to hear him -- no. That's a very bad question.

Were you present in the courtroom when he testified?

A. Yes.

Q. And did you consider the arguments that you heard him express with respect to whether Rambus'

conduct was predatory or exclusionary?

A. Yes.

Q. And did any of the arguments you heard him express cause you to change or modify your opinions?

A. No. They hardened my heart.

Q. Said with a smile?

A. Yes.

Q. Thank you.

I want to move to a different topic, Dr. Rapp.

JUDGE McGUIRE: Okay. I want to inquire, Mr. Stone, before you move on to your next topic.

And I think, Doctor, you just testified as to why you felt it made economic sense for a company to avoid disclosure of unprotected IP.

THE WITNESS: Yes.

JUDGE McGUIRE: Would it then -- would there be any other incentive for such a company to participate in an industry group that determines standards if in fact that group required them to disclose unprotected IP? And if the answer to that is no, then what would that say from an economic point of view about the future of such groups in an industry?

THE WITNESS: There are good reasons why a firm would wish to preserve its intellectual property and still be a member of a standard-setting group or

another group that required disclosure. There's one subject that we'll have to put aside to -- that I'll have to put aside in answering your question, and that has to do with the clarity or the ambiguity of those rules.

So for the purposes --

JUDGE McGUIRE: We're not talking about any ambiguity. We're talking about in my hypothetical an organization that clearly required early disclosure of patent applications or unprotected IP.

THE WITNESS: Right. There are still reasons why a firm would wish to be a member of that group rather than be excluded from doing business altogether and despite the requirement that they disclose.

What that says about the future of this, of the organization, is that there is an ambiguity that needs to be resolved.

In other words, it says it is -- there is a degree of disequilibrium or disharmony whereby a participant in that group has -- let me expand a little on your hypothetical.

Let's say a procompetitive reason for wanting to be a member of that group, to make its technology available to the group, and yet at the same time has to endure the cost of disclosure. It is a problem for

that group and, Your Honor, it's a problem for standard-setting in this country. It's something that people who are in that line of business have to cope with. It's a trade-off. But for the individual firm, assuming clarity about the rules, it's still a choice that they may make for procompetitive reasons.

I'm answering you as an antitrust economist. I don't get to decide, and I'm grateful for that, about, you know, what's right or wrong in the world of standard-setting.

JUDGE McGUIRE: I'm not asking you that.

THE WITNESS: But from the standpoint of antitrust economics, we want contributors of technology to participate in standard-setting groups. It's very important that they not be excluded from doing so. And to the extent that they have to live with trouble because of disclosure rules, it poses problems for them and for the future of standard-setting.

JUDGE McGUIRE: So in my hypothetical, ultimately it's up to that individual company to decide to involve themselves in a group that does require early disclosure of unprotected IP.

THE WITNESS: Absolutely.

BY MR. STONE:

Q. May I just follow up on this topic.

Dr. Rapp, I would just like to follow up on the court's questions.

A. Sure.

Q. And just assuming clarity so we don't have to deal with that issue, assuming clarity and no ambiguity, would you expect in your experience that different companies might make different decisions to participate or not participate depending on their own analysis or calculus of the costs and benefits?

A. Yes. But from my standpoint as an antitrust economist, I would say that the hoped-for outcome from the standpoint of efficiency and consumer welfare is that firms that can make contributions to technology are not deterred from participation in standard-setting by disclosure rules.

Q. Okay. Let me move to a different topic now if I might, Dr. Rapp.

Would you characterize -- let me ask you this way.

Have you heard the DRAM industry characterized as one that is resistant to radical change?

A. I have.

Q. Do you agree for purposes of your economic analysis with that characterization?

MR. ROYALL: Your Honor, that's -- that

question is asking him to -- whether he agrees with a -- with a factual issue relating to what is true or may be true of this industry.

MR. STONE: Let me ask it differently. I'll withdraw that question.

BY MR. STONE:

Q. Can I ask you to assume for purposes of your testimony here today that the manufacturing of DRAM is a competitive market?

A. Yes.

Q. And I'm not asking you your opinion whether it is or it isn't. Just assume that for me if you would.

In a competitive market, would an economist expect to see an industry that is resistant to radical change?

A. No.

Q. Why not?

A. We would expect to see the opposite, and that applies to its input markets and technology markets, generally speaking. Because competition compels firms to seek competitive advantage. Even if there's coordination about compatibility issues, competitive advantage is what competitive industries are all about. And that means if opportunities arise to capture competitive advantage by making radical changes, then

even though it's uncomfortable, we expect it to happen in competition.

Part of me has to say, the part that is a manager of my own -- not my own business but a firm that I'm a member of, that nobody really loves radical change. If you have to make massive investments or put up with upheaval, on the whole you'd rather live a quieter life than that, but competition requires it.

And it is only in the circumstance where you have undue coordination, kind of cartel-like behavior, where the -- where firms can collectively get away with a quiet life. Otherwise, preference is to the contrary; change is compelled by competition.

Q. Does the process of standardization create a situation in which the standard-setting organization and its members control the progress of technology?

Does that question make sense?

A. In very general terms?

Q. Let me see if I can reframe this.

I'm struggling a bit, Your Honor, because I'm trying to avoid referring back to any of Professor McAfee's testimony, if you'll give me just a second.

JUDGE McGUIRE: Take your time.

(Pause in the proceedings.)

MR. ROYALL: Your Honor, while we're taking this time, let me say that I'm concerned that we're getting very close here to an area of testimony that was walled off by virtue of the motion in limine that was granted, and that earlier answer in which the witness referred to cartel-like behavior, I'm very concerned that that runs quite close to running afoul of Your Honor's ruling on the efficient breach theory motion.

JUDGE McGUIRE: Yes.

MR. STONE: And I'm trying to very much avoid that, Your Honor, as I indicated earlier. I don't think that's where I'm headed with this at all. I don't intend to be headed there in any manner. Let me say that.

BY MR. STONE:

Q. Let me ask you a general question this way, Dr. Rapp.

Does the need for standardization that you've described earlier which arises in certain circumstances, does that need create a situation where manufacturers will in fact get together to act in concert to control the progression of technology?

In other words, do they have to do that in order to standardize?

A. No. What they have to do in order to standardize is to solve compatibility requirements, not to control the direction of technology.

Q. Okay. Have you also heard an argument that the DRAM industry, maybe not unlike other industries, is -- resists the payment of royalties to others?

A. Yes.

Q. And is it -- when you take that into account, that people may not want to pay royalties, does taking that into account, does that in any way change your opinions about whether in a competitive market royalties might well be paid?

A. It doesn't -- well, taking it into account leaves me with the opinion that in a competitive market, if the best solution taking account of licensing arrangements is one that involves payments of royalties, then competition dictates that royalties will be paid.

To speak of an aversion to royalties or a dislike for paying royalties is -- it may be the private sentiments of business executives, but it's something that competition watches over.

Executives in the automotive industry probably hate paying healthcare costs for their workers that add up to such high a proportion of the cost of an

automobile, but they don't have any choice. In order to get the workers on the assembly line, they have to pay a competitive wage which includes those benefits. And the same thing applies to technology inputs. Nobody likes paying for lots of things, but competition requires them to do it.

Q. Let me ask you then to bring up if we could DX-322.

And in that regard, if the -- following up on your last answer maybe -- if in cost-performance terms the four technologies in question here were superior to any of the alternative technologies, even assuming the payment of a royalty to Rambus, would you then consider as an economist that in a competitive market that there would or would not be a willingness to pay those royalties?

A. The royalty would be paid in a competitive market.

Q. Okay. Let me ask you about DX-322. This is the same chart we looked at earlier at the commencement of your testimony today I believe, and let me ask you whether you have now stated the bases for your conclusion as stated on this document that there's no good economic substitute for the four technologies or features that are at issue in this case.

A. I have.

Q. Have you also shared with us the basis for your view that Rambus did not gain any market power from its alleged failure to disclose in JEDEC?

A. Yes.

Q. Have you expressed the bases for your view that manufacturers at JEDEC were not locked into the four technologies at issue?

A. Yes.

And I have also -- I'm just -- you may be anticipating this, but I want to make sure that my conclusions include the conclusion about harm also, so allow me to say that even though there is not a bullet point here, that I've also given you the -- given the court the basis for my opinion that no harm to competition has arisen from Rambus' alleged actions in JEDEC, if I may.

Q. Okay. And finally, using the economist's definitions of "predatory" or "exclusionary," were the actions or inactions by Rambus in JEDEC as alleged by complaint counsel ones that would be properly characterized as predatory or exclusionary?

A. My conclusion is that they were not, and I've given you the basis for them.

MR. STONE: Thank you. I have no further

questions.

JUDGE McGUIRE: Thank you. We'll take a ten-minute break and be back with cross-examination.

Hearing in recess.

(Recess)

JUDGE McGUIRE: At this time we'll hear the cross-examination of the witness. Mr. Royall?

CROSS-EXAMINATION

BY MR. ROYALL:

Q. Good afternoon, Dr. Rapp.

A. Good afternoon.

Q. Am I right that you were retained in this case sometime very shortly after the commission voted out its complaint against Rambus in June or July 2002?

A. Yes.

Q. Is that right?

And that was not your first assignment for Rambus; correct?

A. Correct.

Q. At the time you were retained in this case, you had been doing work on behalf of Rambus for at least a couple of years; right?

A. Yes.

Q. You were retained by Rambus to serve as an expert in the Infineon litigation; is that right?

A. That's so.

Q. And you submitted an expert report, in fact I think two expert reports in that case?

A. Yes.

Q. And you were deposed?

A. Yes.

Q. And you said earlier in response to Mr. Stone's questions that you ultimately didn't testify at trial in the antitrust claim in that case because the antitrust claim was dismissed?

A. So far as I understand it, that's what happened.

Q. And you understand, don't you, that the basis for the dismissal of that claim had to do with the narrow issue of market -- geographic market definition?

A. It did, yes.

Q. There's no other issue that you understood that was the basis for the dismissal of that claim in that case?

A. Did you say no other issue?

Q. Yeah. You don't understand that there was some other issue in addition to the question of geographic market definition that was cited as a basis for the dismissal of that claim?

A. On the basis of what I heard in the courtroom, I agree. That's not a complete understanding, but that's what I heard to be the case.

Q. And did you have any disagreement with the Infineon expert in that case on the subject of geographic market definition?

A. I did not. I mean, there was -- either I had no opinion at all or I was willing to live with his. The answer is no.

Q. So the basis -- the issue on which you understand the claim in that case -- the antitrust claim in that case was dismissed was not an issue on which you were disagreeing with the other side?

A. That's right.

Q. And you were also retained by Rambus to serve as an expert in the Micron litigation; is that right?

A. Yes.

Q. And you also submitted two expert reports in that case?

A. I believe so.

Q. And you were also deposed?

A. I was.

Q. Now, before the commission voted out its complaint in this case in June of 2002, you made appearances before the commission and the commission

staff on behalf of Rambus; is that right?

A. I did.

Q. And the purposes -- or the purpose of those appearances was to persuade the commission not to pursue litigation against Rambus; right?

A. That was the purpose of the delegation and of the visits. My purpose was to prevent -- was to present economic reasoning about the case, and the answer is yes, it was to that effect.

MR. ROYALL: May I approach, Your Honor?

JUDGE McGUIRE: Yes.

BY MR. ROYALL:

Q. Now, do you recognize this document that I've just presented to you, Dr. Rapp?

A. Yes.

Q. And this is a copy of a May 28, 2002, what we would call here at the commission a white paper, that you coauthored with Dr. Lauren Stiroh; is that right?

A. That's correct.

Q. And Dr. Stiroh is an economist on the staff at NERA; is that right?

A. Yes.

Q. And in this white paper you and Dr. Stiroh argue that Rambus' challenged actions or inactions, as you understood them, while a member of JEDEC caused no

harm to competition or consumers?

A. Yes.

Q. Do you recall that?

A. Right.

Q. And this white paper is not the only written submission that you made to the commission in advance of the complaint in this case being voted out; is that what you recall, that there were others?

A. The other thing that I recall was a set of what we might call paper slides. If there was another prose document, I don't recall, but there may well have been.

Q. Well, just to refresh your recollection on that, let me see if I can point your attention to page 3 of this document and the first footnote which is identified not with a number but with an asterisk at the bottom of page 3.

Your Honor, I apologize. I didn't give you a copy. I guess you do have this on the screen.

JUDGE McGUIRE: I can see it on the screen.

BY MR. ROYALL:

Q. Okay. And do you see in that footnote on page 3 of this white paper --

A. Yes, yes.

Q. -- there's a reference to previous submissions

on November 5, 2001?

Do you see that?

A. Yes.

Q. And then there's another reference to one dated April 12, 2002?

A. Quite right.

Q. So does that refresh your recollection that there were other narrative submissions --

A. Yes.

Q. -- prior to this?

Now, is it fair to say, Dr. Rapp, that even before you were officially retained in this matter, that is, in connection with the complaint that was ultimately issued by the commission, you had already concluded that the conduct at issue here, the basic conduct challenged here, had caused no harm to competition?

A. Yes, it's fair to state that. And although I don't remember the particulars of my opinions in the Infineon and Micron cases, the research that I had done there was parallel to much of what we've done, so sure.

Q. So on that issue even before you were retained in this case your mind was already made up?

A. My mind was made up after about two years of

research on the subject, and my mind, I hasten to say, wasn't made up on every aspect of things because this has been a more thorough discovery for my purposes from the standpoint of the economics than even the District Court cases, so there were certain aspects of what I have concluded that have changed as a result of my work here, but so far as the basic conclusion about harm to competition, that's correct.

Q. And do you recall that between the dates of the latter of the two narrative submissions that we saw referenced in that footnote, which was April 12, 2002, between the date of that submission and this submission, the May 28, 2002 submission that I've actually presented to you, between the dates of those two submissions, do you recall that you testified before a joint FTC-DOJ hearing on competition and intellectual property?

A. I do.

MR. ROYALL: May I approach, Your Honor?

JUDGE McGUIRE: Yes.

MR. STONE: Your Honor, I note the documents being used now are not marked with exhibit numbers. I don't think they're on the exhibit list. I could be wrong. But they're not marked with exhibit numbers and haven't been identified as such and I don't understand

them to be being used at the moment for impeachment, so I'm not sure there's any proper basis for the use of documents which are not on the exhibit list, at least at this time, that he's shown --

JUDGE McGUIRE: Mr. Royall?

MR. ROYALL: Yes, Your Honor. These two documents are not on the exhibit list.

It's my understanding that within the cross-examination certainly of an expert, if not in the direct examination of an expert, in this case as in -- as is typically the truth, that the written submissions of the expert are matters that are -- that is relevant -- or written submissions are relevant matters that can be covered with the expert.

And I would note in that regard that Professor McAfee's book, if you recall, which was a written submission of Professor McAfee, I used that in the direct examination of Professor McAfee and Mr. Stone used it in the cross-examination. That also was not on the exhibit list, and there was no objection to the use of that document.

And given that these are the relevant written submissions of this expert, it's no different than if he had written an article and published it in the law review. I see absolutely no basis to object to

questions about them. I don't plan to offer them in evidence. And certainly from that standpoint --

JUDGE McGUIRE: Are they going to be used for impeachment purposes or -- I'm trying to understand what purpose you are going to use them for.

MR. ROYALL: Well, one of the purposes would be to establish the views that this expert had relating to these matters before he was retained in this case, and I think that's -- that's relevant if not for impeachment certainly for bias or should I say predisposition of the witness on the views as they relate to this case.

JUDGE McGUIRE: All right. Mr. Stone, one last comment.

MR. STONE: Yes, Your Honor. I think just going back to the book, for example, I did use it to impeach. I don't recall Mr. Royall used it at all in his examination except to show the cover on a slide because I recall that when I used it for impeachment Mr. Royall didn't have his copy available and I remember sharing mine.

So I think the use of a prior writing is permissible for impeachment, not otherwise, and I don't think it's being used here for impeachment. The fact that this witness has had views on this subject before

he testified here today I think he acknowledges readily. He's not being impeached with that.

I also have a concern that at least as to the white paper -- I don't think it applies to the other paper -- the white paper I believe is a nonpublic document and entitled to be treated as a nonpublic document in accordance with what I think is the usual practice within the commission.

But I do think it should be limited to the use of these documents for impeachment, and he's not being impeached.

JUDGE McGUIRE: To the extent that it might show some prior predisposition or bias, I'm going to entertain this line of inquiry, but I'm going to keep an eye on you on this, Mr. Royall.

MR. ROYALL: I understand, Your Honor. And I don't plan to go through in excruciating detail these --

JUDGE McGUIRE: All right.

MR. ROYALL: Thank you.

BY MR. ROYALL:

Q. Now, what I've handed you, Dr. Rapp, do you recognize this --

A. I do.

Q. -- this document?

And am I right that this was a written submission that you made, again coauthored with Dr. Stiroh, in connection with your testimony at that joint FTC-DOJ hearing?

A. Yes.

Q. And that was hearing testimony that you gave at a time you were a paid consultant to Rambus; is that right?

A. I was a paid consultant to Rambus, but I wasn't paid for -- Rambus was not billed for my work in connection with preparing this paper. Dr. Stiroh and I did that on our own account.

Q. All right. Fair enough.

Now -- but referring to other work that you have done on a paid basis for Rambus -- well, actually strike that.

You said earlier I believe on direct that if -- unless I misunderstood you, did you spend about -- presently you spend about two-thirds of your time in NERA on managerial-related responsibilities; is that right?

A. Between half and two-thirds. It varies over the course of a year.

Q. Does that include financial matters relating to NERA's business?

A. Yes.

Q. Since you first started working for Rambus several years ago, do you have an estimate of how much in total NERA has billed to Rambus?

A. I do not.

Q. Is it more than a million dollars?

A. Very likely.

Q. Is it more than $3 million?

A. I doubt it.

Q. Somewhere in that range?

A. That's a broad range, but I guess that answer is yes.

Q. Let me turn now to the expert report that you submitted in this case.

May I approach, Your Honor?

JUDGE McGUIRE: Yes.

BY MR. ROYALL:

Q. Now, do you recognize the document that I've presented you with to be a copy of your expert report in this case?

A. Yes.

Q. And it has the date January 9, 2003. Is that the date that it was finalized or was it finalized shortly prior to that date?

A. Sure.

Q. And you wrote this report with the help of members of your staff at NERA, including Dr. Stiroh; is that right?

A. That's right.

Q. Let me ask you to turn to page 5 of your report.

And on this page, carrying over to the next page, you outline the nature of your assignment in this case or, that is, the issues that you were asked to address, that Rambus asked you to address; is that right?

A. Yes.

Q. So without going through and reading all of the narrative here, am I right that you were asked to develop an expert opinion regarding whether Rambus' challenged conduct could have enhanced the value or market power of Rambus' SDRAM or DDR SDRAM-related patents?

A. Yes.

Q. And you were asked to develop an expert opinion regarding whether the DRAM market is locked into the use of Rambus' technology; right?

A. Yes.

Q. And you were asked to develop an expert opinion regarding whether Rambus is able to charge higher

royalties due to nondisclosure of patent-related information to JEDEC; right?

A. Yes.

Q. And you were also asked to develop an expert opinion regarding whether there were legitimate business reasons for Rambus' conduct --

A. Right.

Q. -- is that right?

And am I right that the only other thing that you were asked to address as part of your assignment in this case is you were asked to offer comments in response to the expert opinions expressed by Professor McAfee?

A. Correct.

Q. Now, let me, if I could, present you with another document.

May I approach, Your Honor?

JUDGE McGUIRE: Yes.

BY MR. ROYALL:

Q. Do you recognize, Dr. Rapp, the document that I've placed before you to be a copy of Professor McAfee's provisional report in this case?

A. Yes. Without even looking at the title I recognize it.

Q. Okay.

JUDGE McGUIRE: I won't ask by how you recognize it.

BY MR. ROYALL:

Q. It makes an impression; you'll agree to that.

I'll withdraw that.

You received a copy of this report, am I right, on or shortly after the date on the cover page, December 10, 2002?

A. Yes.

Q. And so you had this report available to you, let's say, several weeks before you finalized your own report on January 9?

A. Yes.

Q. And your expert report, am I right, contains a complete statement of all of the expert opinions and conclusions that you've developed relating to this case generally? Let me ask that question first.

A. That is -- that's not right. I -- it reflects the sum of my opinions and conclusions and the basis for them up to January 9, and that includes a review of Professor McAfee's report, but as I've testified, I've read -- discovery continued and trial ensued up to this morning and I wasn't immune from the influences of reading -- that's a silly way of putting it.

I read the material subsequent to that.

Q. Are you saying that after completing your January 9 expert report that you developed additional opinions and conclusions?

A. I'm saying not that there are novel conclusions, things unaddressed in the expert report, but I was -- I allowed myself -- in fact I insisted on being informed by what relevant -- information relevant to me was -- came out of the trial.

Q. Are there any particular opinions and conclusions that you can think of that you've expressed today that were not your opinions and conclusions at the time that you finalized your expert report?

A. No. No.

Q. And am I right that your expert report provides a complete statement of your analysis or criticism of Professor McAfee's original expert report, the document that I've placed before you?

A. To the extent that I was able to do it in the space of time that I had, yes.

Q. Now, if we could go back to the May 2002 white paper, and if I could ask you to turn to page 10 of that document.

Do you see the -- there's -- a principal heading there is: Standard-setting Did Not Enhance

Rambus' Market Power? Do you see that?

A. Yes.

Q. And then there are two subheadings below that, and then the first text of -- the first sentence of text states, "A fact widely known to students of intellectual property economics but not to many others is that most inventions, despite being novel enough and useful enough to have earned a patent for their inventors, are worth very little."

Do you see that?

A. Yes.

Q. And you regard that to be a true statement?

A. I absolutely do.

MR. STONE: Your Honor, I am concerned that the white paper, as I mentioned earlier, is a document that I believe was submitted in confidence and is generally maintained by the commission in confidence.

Since this was not on the exhibit list, we were never given notice of its use in connection with this proceeding and there's been no opportunity for there to be any consideration given to whether or not it's entitled to in camera status, so in that regard I think we do have an issue.

The particular paragraph that is up, I have no problem with this particular paragraph, but I do have

concerns about my not having any chance in advance to consider what might be shown.

JUDGE McGUIRE: Mr. Royall, have you contemplated this issue?

MR. ROYALL: Your Honor, I don't believe that any of the language that I have intended to focus on in this document is anything of even remotely of an in camera nature. It's all in the form of -- really it's theoretical propositions, and that was -- my purpose again, as I said, going into this is what was the predisposition of the witness in terms of the theoretical propositions that would apply to this type of analysis.

JUDGE McGUIRE: Then, Mr. Stone, would you like to take a few minutes and confer with the witness and ascertain whether he feels this should be accorded any sort of in camera treatment?

MR. STONE: We can do that, Your Honor.

JUDGE McGUIRE: All right. How much time do you need?

MR. STONE: Two minutes, three minutes.

JUDGE McGUIRE: All right. Let's go off the record and you can confer with Mr. Stone.

(Discussion off the record.)

JUDGE McGUIRE: Mr. Stone, have you had a

chance to confer with Dr. Rapp?

MR. STONE: I have, Your Honor. And reviewing the document reveals that it does contain information which has previously been afforded in camera status, including summaries of certain license agreements, up-front royalty payments, and so on, that is the type of information that has been afforded in camera treatment in the past.

JUDGE McGUIRE: Because it involves other information that has been accorded in camera treatment or in and of itself it contains information of his firm that might --

MR. STONE: No. It contains information of Rambus' which has been accorded in camera treatment in the past.

It may be -- I don't mean to interfere with Mr. Royall's use of it. It may be that Mr. Royall is sensitive enough and confident that he can avoid the use of that information, but I do note that the document does in places contain information --

JUDGE McGUIRE: Okay. Mr. Royall, are you confident and sensitive enough to avoid that or should I call for in camera closed session?

MR. ROYALL: Well, let me say a couple of things.

First of all, I certainly at all times have sought to be sensitive to all in camera issues. The issue -- I can't imagine that any of the paragraphs that I would have in mind to ask about would raise any remote issue.

But the other thing I would say is that we earlier in this case had attached some Rambus white papers to a filing that we made that was not given in camera status, and I'm forgetting which filing it was. There was a concern raised on Rambus' part that there might be an in camera issue.

The understanding that we had from the Office of General Counsel here is that white papers that are submitted to the commission voluntarily, not pursuant to subpoena, are not, cannot, simply cannot be held in confidence because they're subject to FOIA requests, and so I don't believe that there is even a possibility, regardless of what is in this file or this document, and not that I would get into it, there's no possibility that there could be an in camera statement.

But in any event, I think it's a moot issue in that I don't plan to get into any factual material at all.

JUDGE McGUIRE: I was under the impression that

this kind of information would be held in confidence if the party asked so that it would encourage this sort of involvement with the FTC prior to the time of issuance of a complaint.

Would you like to talk to this issue, Mr. Melamed?

MR. MELAMED: I would ask if I could have ten seconds to talk to --

JUDGE McGUIRE: Go ahead.

(Pause in the proceedings.)

MR. ROYALL: What Mr. Melamed and I were just discussing is just the broader question of policy as to white papers. I don't think we need to get into that and I don't think my comments need to be taken as any statement of policy on that.

But I really do think the issue is moot in the sense that I only intend to ask about a few theoretical propositions.

JUDGE McGUIRE: That's fine as long as you don't get into anything that's already been accorded in camera treatment. If you do, I'll be real upset.

MR. ROYALL: No. I promise, Your Honor, I have no intention of doing that.

JUDGE McGUIRE: All right. Proceed.

MR. ROYALL: Thank you.

BY MR. ROYALL:

Q. Now, I believe where we were, Dr. Rapp, was on page 10.

A. Right.

Q. And I focused your attention on the first sentence of text, which I can -- let me just go ahead and read it again -- on page 10: "A fact widely known to students of intellectual property economics but not to many others is that most inventions, despite being novel enough and useful enough to have earned a patent for their inventors, are worth very little."

Do you see that?

A. Yes.

Q. And you regard that to be a true statement?

A. Sure. It's true, if I may, just for clarity sake, because while a patent grants -- is granted for something that is novel as well as useful, a novel technology can have a lot of economic substitutes even though they're technically different enough so that the technology gets a patent.

As a result, economists, intellectual property economists who have studied this subject, find that many, many patents, the vast majority of them, are worth very little in the marketplace, but there are relatively few that are quite valuable.

Q. So in your opinion, ownership of a patent by itself does not automatically confer market power? Would you agree with that?

A. That is correct. Yes, I do.

Q. You would agree, though, that while ownership of a patent does not automatically confer market power, a patent nearly always does confer market power when it protects the right of a technology that is selected as the standard technology either by a standard-setting body or in a de facto sense by the marketplace?

A. Yes.

Q. Now, going back to this same paragraph on page 10, you go on to say: "The value of an invention is determined by how much of an improvement the invention is over the next closest alternative. A new technology that is a solution to a problem that has other older but still satisfactory solutions will have a low market value no matter how technically novel it may be."

Do you see that?

A. Yes.

Q. And you regard that also to be a true statement; is that right?

A. Yes. Right.

Q. Now, am I right that one of the points that you made, theoretical points that you made in this white paper to the commission is that standardization of a technology can in certain circumstances enhance the value or the market power of a technology and simultaneously reduce the value of alternative technologies?

A. Yes. As I testified this morning, at least to most of that.

Q. And let me ask you to turn to page 11 of this white paper.

Under -- or in the second paragraph under heading 2, you state: "The presence and quality of substitutes is an important determinant of value in both product markets and technology markets. We can readily see, therefore, that the act of standard-setting either by markets de facto or by governments or standard-setting agencies de jure may enhance the value of the chosen technology and reduce the value of the alternatives."

Do you see that?

A. Right. The word "may" is important because it distinguishes -- I'm distinguishing may from must, but the answer is as I've testified, sure.

Q. So with that understanding, you agree that's a

true statement, from the standpoint of economic theory?

A. Absolutely.

Q. Now, focusing on the next paragraph, you state, "Standard-setting has the potential to enhance value by reducing the number of comparable substitutes."

Do you see that?

A. Yes.

Q. And then in the last sentence, if I could ask you to look at the last sentence in that paragraph, you state, "In settings where compatibility requirements are high, standards competition may be very important as the choice of a standard may virtually eliminate, not merely disadvantage, competing technologies."

Do you see that?

A. Yes.

Q. And in those circumstances, in the circumstances that you're referring to here where compatibility requirements are high, you regard that proposition to be a valid proposition from the standpoint of economics?

A. Right. Where compatibility requirements are high and we have competing alternative standards that

are more or less equivalent -- sorry -- competing technologies that are more or less equivalent.

Q. And you're aware, are you not, that Professor McAfee has testified that what you describe in that paragraph in terms of the effect, that is, the effect of eliminating alternatives, that that is what essentially has happened in this case?

A. I am aware that that is his opinion, and the differences between our opinions I think are very clear in the record about why he and I differ. It has to do with the nature of the substitution, the quality of the alternatives.

Q. You talked some earlier today about your opinions relating to the issue of harm to competition. Let me ask you quickly before we leave this white paper a couple of questions about statements on that subject.

In that regard, let me ask you to turn to page 18.

A. Uh-huh.

Q. Now, am I right that under heading Roman numeral IV on page 18 and particularly the heading A below that you discuss what you believe must be shown in order to demonstrate harm to competition arising from Rambus' challenged conduct in this case?

A. Yes.

Q. And you say here, if I could focus on the top of page 19, you say here that demonstrating harm to competition in the context of this case can be done in one of two ways, which you outline on the top of page 19; is that right?

A. Uh-huh.

Q. And in both cases what you're referring to, generally speaking, is proof of or proof that the world would be different today if Rambus had disclosed to JEDEC the patent-related information that complaint counsel contends Rambus improperly failed to disclose; is that right?

A. Exactly right. That's what it would take to prove that, right.

Q. And so both of these alternatives that you outline at the top of page 19 involve proof of what would have happened in the so-called but-for world in which hypothetically Rambus had disclosed to JEDEC everything that complaint counsel contends should have been disclosed but was not?

A. Right.

Q. And you told the commission that proof of either one of these but-for-world scenarios in your view would be sufficient to establish harm to

competition provided there was also evidence of lock-in; is that right?

A. Just bear with me while I review what I said. It sounds right, but let me just check.

(Pause in the proceedings.)

Yes.

Q. And just for clarification, I'd ask you to focus on the second of these two alternatives at the top of page 19, which refers to the price of SDRAM to consumers would have been lower because the royalty claimed by Rambus would have been lower.

Do you see that?

A. Yes.

Q. When you referred to consumers here, you agree that from the standpoint of this case the relevant consumers are DRAM manufacturers?

A. In this sentence that's so. We would probably also agree that we don't want to disregard the interests of end users should the question arise, but when I speak of the price of DRAMs to consumers, I'm talking about OEMs and the like.

Q. And I believe you said earlier in response to Mr. Stone's questions that we're focused here on the technology market and in that market the relevant consumers are DRAM manufacturers?

A. Yes. That's right.

Q. And when you refer to price here, what you're talking about is the price of technology used by DRAM manufacturers in making SDRAM; is that right?

A. Actually here I mean there is a -- the literal reading of this sentence, and I think it's what I intended, too -- it's not terribly -- one derives from the other, but when I say the price of SDRAM, that means how many dollars of chip costs. I don't see any other way of reading that. It's my own language. And that is dependent upon -- to some degree upon the royalty.

So there are two prices in that sentence, the royalty and the price of SDRAM.

Q. Well, you're not saying, are you, that in order to prove harm to competition by a but-for world analysis that complaint counsel in your view would have to prove a price effect on the downstream DRAM market? You're not saying that, are you?

A. It is what this sentence implies, but I -- I'm not sure I ought to be -- but -- I am uncertain without sitting down and thinking about it and -- about whether this is a necessary condition for proof of harm to competition.

I think if we're operating in technology

markets that it may be that the royalty is the relevant price all by itself, but I'm not inclined to answer the question in an unqualified way.

Q. You're an expert in intellectual property economics?

A. Yes.

Q. And you can't say whether from the standpoint of proving harm to competition in the context of a technology market proof that the royalty would be lower in a but-for world would be meaningful from the standpoint of harm to competition?

A. And that's not -- the only reason I'm hesitating is because you cast the question in terms of what complaint counsel has to prove, and there's more to that than what antitrust economics has to say. That's all.

Q. I'm not -- I'm honestly not asking you for any legal opinions. I'm just asking for the opinions from your standpoint of your expert testimony.

A. Why don't you ask the question all over again, and maybe I can give you a more clear answer.

Q. Would you agree, in the context in which you were discussing economic proof of harm to competition in this white paper, would you agree that proof that in a but-for world in which these disclosures occurred

that Rambus' royalties would be lower, would you agree that that combined with proof of lock-in effects would satisfy what you were articulating to the commission in this white paper would need to be shown to establish harm to competition?

A. Yes, in that market, in the technology market.

Q. Now, you may set that aside. I don't have any more questions about the document.

I would like to ask you a couple questions about the paper that you submitted in conjunction with your testimony at the joint FTC-DOJ hearings.

A. Uh-huh.

Q. And if I could ask you to turn to page 4 of that.

Now, on page 4, in the first full paragraph in that paragraph you state, "Standard-setting can create market power by making otherwise close substitutes inferior and thereby increasing the royalty rate (price) a technology can command."

Do you see that?

A. Yep.

Q. And you regard that to be a true statement from the standpoint of economic theory?

A. Right. Along with the following sentence that speaks of the reverse, the opposite.

Q. Okay. In going to the next paragraph on page 4, you state there: "One of the goals of standard-setting organizations (SSOs) is to choose a technology as the standard that will yield the best performance at the lowest possible cost. The technology that offers the best performance is not necessarily the first choice if the cost of that technology exceeds its performance advantage."

Do you see that?

A. Yes.

Q. And what you're describing there, am I right that that's your general understanding, putting aside JEDEC or any specific organization, but that's your general understanding of how SSOs operate in selecting among competing alternatives?

A. That's correct. And that's why I use throughout my testimony this odd cost-performance usage that you don't often come across.

Q. Now, picking up in that same paragraph, you state, "A predicament facing the SSOs in trying to choose the technology with the best price-performance trade-off is that price of the chosen technology can change after the standard is determined if the technology owner attempts to extract the value added by the standardization process in royalty fees for the

standard technology."

Do you see that?

A. Yes.

Q. And then right below that you say, "If the SSO were not aware that the technology it was including in the standard was proprietary, it would not be aware of the likely ex post cost of the standard."

Do you see that?

A. Right. Uh-huh.

Q. And let me ask you, what did you mean here when you referred to the ex post cost of the standard?

A. The cost of the standard after the standard had been set in the same way we used ex post and ex ante before.

Q. And am I right that what you're describing here as a matter of economic theory is the potential for firms whose proprietary technologies have been incorporated into a standard to engage in opportunistic conduct after the standard has been adopted?

A. It's -- no. That is too narrow a reading of this. It includes that. The -- well, the answer is that's part of the story. It's not the whole story.

Q. Okay. And that kind of opportunistic conduct in that setting by the firm whose technology was

adopted as part of a standard, that can happen in circumstances in which the SSO, the standard-setting organization, was not aware that the technology that it included in its standards was proprietary, that is, it wasn't aware at the time that it made that decision?

A. Right. But it's also true in circumstances where the technology -- where the proprietary nature of the technology is known. So this doesn't cover the complete set of circumstances. And that is because the price of the technology is, to my knowledge, rarely, if ever, determined ex ante.

So the possibility exists for it in all states of the ex ante world.

Q. Let me ask you to turn to the next page of this paper.

A. Page 5.

Q. Page 5.

In the first full paragraph on that page, you state: "In the absence of knowledge about proprietary IP rights in the technologies under consideration, manufacturers may find themselves the victims of opportunism after the standard has been set. That is, the patent holder may charge a royalty that reflects a premium arising from irreversibility, the cost of

revising the standard to save the cost of royalty. A patent holder may charge such a premium when the patent emerges after manufacturers have made sunk investment in the patented feature of the standard without having predetermined the license fee. Avoiding a license entails new investment cost if the old (potentially infringing) investments cannot be modified to evade the patent."

Do you see all that?

A. Uh-huh.

Q. And am I right that what you were outlining in here in your testimony before the joint FTC-DOJ hearings was a scenario in which the inclusion of a patented technology in a standard could give rise to opportunistic conduct on the part of the owner of the patented technology?

A. Right. And the circumstance as described elsewhere in the paper where that results in a profitable outcome for the patent owner is when the technology is elevated by the standard among its -- among equivalent alternatives.

Q. And in the situation that you describe in the paragraph that I read, there is a risk that the firms that manufacture the products that are being standardized will become victims of opportunism;

right?

A. Yes.

Q. And when you refer here to opportunism, am I right that what you were talking about is the potential for the technology owner to charge higher royalties for its technology after the standard is set than it would have been able to charge before the standard was set?

A. In a limited set of circumstances, yes.

Q. And as you testified, you were present in the courtroom when Professor McAfee testified earlier in the case; right?

A. Right.

Q. And you heard him describing his use of the economic term "hold-up"?

A. Yes.

Q. And am I right that when you use the term "opportunism" here you're referring to essentially what is the same as the economic concept of hold-up?

A. It's close to it.

Q. And am I right that the potential to engage in this type of hold-up and to elevate the royalty rates that you have been able to charge by comparison to what you would have been able to charge before the standards were adopted, am I right that that is one possible

benefit to a firm of not disclosing patents to a standards organization?

A. It is. And -- but just allow me to add that one of the things that economists that study these subjects know is that opportunism exists everywhere in the economy. It happens in -- all of the time, and the distinction between what is opportunism and what is an antitrust issue, what is anticompetitive, is a very considerable distinction.

MR. ROYALL: Your Honor, could I -- I hate to do this, but could I move to strike that answer. I'm concerned that the witness is giving me a lot more than I'm asking for in the questions. And in that case I was simply asking a question of whether the term "opportunism" here was the same generally as the concept of hold-up that's referred to, and much of that answer I think went far beyond the question.

JUDGE McGUIRE: Sustained.

MR. STONE: Your Honor, could I be heard in response to that?

JUDGE McGUIRE: Go ahead.

MR. STONE: I think the question put was Mr. Royall's question of am I right that a concept, and I think the witness' answer that you're right with this qualification is a full and complete answer, and to

strike a portion of the answer that was necessary I think for the witness to agree to the question of "am I right" was appropriately included in the answer.

Further, if he's going to move to strike, I object to the question on the grounds that a question of "am I right" is improper as to form because this witness has no basis as to whether Mr. Royall's state of mind is such that his statement is right or wrong.

Now, I don't normally make those objections because I think the witnesses will take care of themselves, but here where Mr. Royall tries to limit the witness to a portion of the answer I think it unfairly deprives the witness of the need -- of what I heard him say was a need to qualify the answer.

JUDGE McGUIRE: Overruled. But I'll let you take that up on cross-examination.

MR. STONE: Thank you, Your Honor.

BY MR. ROYALL:

Q. Let me restate the question. I'll take the "am I right" part out.

But is it correct, Dr. Rapp, that what you were referring to in this --

JUDGE McGUIRE: I'm sorry. Not cross-examination. Redirect.

MR. STONE: I did understand.

JUDGE McGUIRE: I'm keenly aware we're in cross right now.

BY MR. ROYALL:

Q. Yeah.

Is it correct, Dr. Rapp, that the economic concept that you're referring to here by the term "opportunism" is analogous to the economic concept of hold-up that was described by Professor McAfee?

A. It is related.

Q. And is there a way in which opportunism as you've described it here is different from the concept of hold-up purely as a matter of economic theory?

A. I don't have it on the tip of my tongue, but the answer is that there is. I'm just -- I just don't have it in memory.

Q. Now, going on to the next paragraph on page 5 of this written submission in connection with your testimony, in that paragraph you outline what you refer to as three important conditions that you believe must be met in order for this type of opportunism that you've described to be a concern within a standard-setting body. Is that a fair characterization of what you discuss in that paragraph?

A. It looks to be.

Q. And what I'd like to do is just to walk you through the three points that you made in that paragraph.

And with Your Honor's permission, I'd like to make some notes as we do that.

JUDGE McGUIRE: Go ahead.

BY MR. ROYALL:

Q. And first of all, I need to title these notes Conditions Necessary for Opportunism. Just let me leave it at that.

Now, referring to that paragraph on page 5 of the document that we're focusing on, first of all, you say that for opportunism to be a concern, the proprietary technology must be essential to the standard or else it could simply be omitted. Do you see that?

A. Right.

Q. And then you go on to say, "An attempt by the patent owner to charge opportunistic royalties would result in manufacturers leaving that particular technology out of the final product."

A. That's the most important point.

Q. So in your view then the first condition for the type of opportunism to be a concern, that you've described to be a concern in the context of a

standard-setting organization would be that the technology must be essential to the standard; right?

A. Yes.

Q. So let me write that down.

Okay. And then continuing in the same paragraph, the second condition that you say must be satisfied for opportunism to be a concern is: There must be costs associated with changing either the standard or the manufacturing process that are greater than the royalty demanded. If investments were not sunk, the standard would (sic) be costlessly changed to evade the license.

Do you see that?

A. Uh-huh.

Q. So am I right then that the second condition would be that the costs of changing the standard or manufacturing process must exceed the royalty demanded?

A. Right.

Q. Okay. Let me write that down.

(Pause in the proceedings.)

Now, the third and final condition that you say must be met or must be satisfied for opportunism to be a concern is that there must be alternatives to the chosen patented technology that could plausibly have

been adopted had disclosure taken place --

A. Right.

Q. -- is that right?

A. Uh-huh.

Q. And your focus here is on what alternatives existed at the time the disclosure should have taken place, allegedly should have taken place; right?

A. Uh-huh.

Q. So then let me make the third point "must have been plausible alternatives to patented technology at time disclosure should have occurred."

And finally, would you agree that the question whether any of these conditions is satisfied in a real-life example, assessing that question as an economist would depend on a careful assessment of the relevant facts?

A. Let me think about that for a minute. I'm -- I'm sure that -- if the idea is to apply this to a real-world situation, then the answer to that is yes. But I want you to understand that this is in the nature of a model. It's not a real-world situation. And so I don't want to have it assumed that this can be applied to any real-world set of facts. Okay?

Q. But -- and that was my question. Putting aside the theoretical soundness of these propositions, my

question was to determine whether they apply in a real-world example would require a careful assessment of the relevant facts?

A. Yes, I agree.

Q. So the last thing I'll write --

A. Can I interrupt, Mr. Royall?

Q. Sure.

A. If you write -- maybe you're solving my problem. I was going to suggest drawing a line. If the title of this is Conditions Necessary for Opportunism, then let's not -- then the fourth is not a condition for opportunism. The fourth is a condition for correctly applying a model of a specific circumstance to the relevant facts.

Do you see my problem?

Q. No. I understand. I wasn't going to write a number 4. What I was going to write was whether these conditions apply in real world depends on careful analysis of facts. Okay?

A. Okay.

MR. ROYALL: And I've lost track of where we were with DXs.

JUDGE McGUIRE: I think it's DX-323 if I'm not mistaken.

MR. ROYALL: DX-323?

JUDGE McGUIRE: I believe so.

MR. ROYALL: Thank you.

(DX Exhibit Number 323 was marked for identification.)

BY MR. ROYALL:

Q. Now, you agreed, Dr. Rapp, that assessing, in the case of a real-world example, or real-world scenario, whether these factors would apply in the context of an economic analysis that that would depend on a careful analysis of facts?

A. Uh-huh.

Q. And what I'd like to talk about now is the amount of factual analysis that you did in reaching the conclusions set forth in your expert report in this case.

And in connection with that, let me ask you to turn if you would to your report and specifically to Exhibit 2 to your report, which as you know is at the very end.

Now, Exhibit 2, which is essentially two and a half pages long, this -- am I right, this is a complete list of the documents and other information that you relied upon or considered in connection with the work leading up to the completion of your expert report in this case?

A. Yes. Apart from the background knowledge that I described or -- sorry -- that arises from the experience that I've had working in this and related industries that I described at the outset of my testimony.

Q. And let's walk through this.

First of all, referring to the very top of the first page of Exhibit 2, before completing your report in this case you reviewed the commission's complaint; is that right?

A. Yes.

Q. And shortly before finalizing your January 9 report, you were able to review the reports of some of Rambus' other experts, the ones identified here, Soderman, Fleisler, Geilhufe and Janis; is that right?

A. Yes.

Q. And we've already noted that before completing your report you reviewed Professor McAfee's original expert report; right?

A. Right.

Q. And in terms of interviews, before completing your expert report in this case you interviewed two of Rambus' technical experts, specifically Dr. Soderman and Mr. Geilhufe; correct?

A. Uh-huh. You're not leaving out the Jacob's

report for a particular reason?

Q. Perhaps only because I -- yeah, I may have missed it.

So there's also the Jacob report?

A. Thank you.

Q. That's something that you reviewed before you completed your own report?

A. Yes.

Q. In terms of Rambus documents or business records, Exhibit 2 identifies a June 2002 Rambus license agreement. That's something that you considered in connection with the work you did leading up to the completion of your report?

A. Yes.

Q. And in addition to this, I believe you informed me in your deposition that you also considered a document prepared by your staff that was a sort of synopsis of the terms of different Rambus licenses; is that right?

A. Yes.

Q. So that was not a Rambus business document per se, but it was a summary of information that your staff compiled from looking at Rambus business documents; right?

A. Right. Uh-huh.

Q. And you also reviewed some publicly available information in connection with the work you did leading up to the completion of your report, and you list that information starting on page 1 of Exhibit 2 and then continuing through essentially the end of Exhibit 2; right?

A. Right.

Q. And included in that publicly available information were various trade press articles that you've reviewed; right?

A. Yes.

Q. And also included in that information were the two JEDEC standards that you identify on the top of page 2 of Exhibit 2, that is, the 21-C standard and then the DDR SDRAM specification; is that right?

A. Yes.

Q. And the 21-C standard, you understand that to be the standard relating to the establishment of the SDRAM standard --

A. That's right.

Q. -- right?

And also included in that publicly available information were some economic articles that you considered; right?

A. Yes.

Q. And a few Web sites that you identify here?
A. Yes.
Q. And Rambus' '898 patent application, that was another thing that you listed; is that right?
A. Uh-huh.
Q. Let me ask you quickly about that.
From the standpoint of developing your economic conclusions, did you derive anything of significance from reviewing the '898 application?
A. Just a degree of familiarity with the Rambus technology, not in and of itself but as an illustration for what I have learned from others about the nature of Rambus' technology at the outset.
Q. And then you -- turning to the third page of Exhibit 2, you also reviewed the 2001 and 2002 Rambus 10-K reports; is that right?
A. Yes.
Q. Now, understanding that I didn't go through the title of every trade press article or every economic article, is there anything else in terms of categories of information that you reviewed that I missed?
A. No. I would just note that it's just worth mentioning that some of those Web sites are extensive sources. The Intel Web site is where the various

specifications and specification addendums for different design -- what's the word we're using? -- redesigns of DRAMs. There are a couple of other. There are -- somewhere in here will be InStat statistical data, and that is an extensive source.

But what's in here is what I relied on, nothing more, nothing less, until the time of trial.

Q. And I understand that -- well, let me -- actually let me strike that.

Are you saying that the materials that you identify here are the materials that you relied on you said until the time of trial? By that do you mean that you've reviewed some trial testimony since the trial started?

A. Right. And exhibits that have come out in the trial that I had not seen before. Transcript and testimony.

Q. Understanding that you have looked at those additional materials since the trial started, what I would like to ask you about now is that -- we have a list, because you've provided it with your report, of the materials that you did review and rely upon in developing the opinions set forth in your report, and what I'd like to ask you about now are the materials that you did not review in developing those opinions.

And since we don't have a document summarizing that, with Your Honor's permission, I'd like to make some notes of that.

And I'll title these notes Materials Not Reviewed by Dr. Rapp, and I'm going to go ahead and put in the date of the report so it's clear that's the context here, pre-1/9/03.

JUDGE McGUIRE: That's the date of his expert report?

MR. ROYALL: Yes, Your Honor.

JUDGE McGUIRE: Okay.

BY MR. ROYALL:

Q. Now, other than the one license agreement identified on Exhibit 2 to your report and the synopsis of Rambus license terms that your staff prepared, there are no other internal Rambus business records that you relied upon or considered in the course of completing your expert report in this case; correct?

A. Correct.

Q. So the first point I'm going to write is "no Rambus business records other than Toshiba license agreement and license term synopsis."

And you had an understanding, Dr. Rapp, with Rambus' lawyers that you and your staff would have

access to any internal Rambus business record that you wanted to see; is that right?

A. That's right.

Q. And you understand that Rambus has produced in this case a large volume of business records; right?

A. Right.

Q. Hundreds of thousands of pages?

A. Yes.

Q. Or you wouldn't be surprised if it were that?

A. Right.

Q. And yet in completing your report you only found the need to look at one Rambus business record and then a summary of the terms of some Rambus licenses?

A. That is correct.

Q. And in the work leading up to the completion of your report you did not rely upon or consider business records produced in this litigation by other companies besides Rambus?

A. Right.

Q. So the second point I'm going to make and write down here is "no third-party business records."

And in the work leading up to the completion of your January 9 report you did not rely upon or consider any deposition testimony; is that right?

A. That is right.

Q. Not a single deposition?

A. Right.

Q. So the next point I'll make is "no deposition testimony."

And on page 2 of Exhibit 2 we noted earlier that you list the two JEDEC standards that are relevant in this case or that have been a major focus of the case, the SDRAM and DDR standards; right?

A. Uh-huh.

Q. Those are things that you did review?

A. Yes.

Q. And those are technical documents; right?

A. Right.

Q. You're not a technical expert?

A. Right.

Q. So you looked at those really more as background as opposed to something that you're relying on for purposes of your economic testimony; right?

A. They have -- certainly the -- I -- the design elements of the standard are nothing more than background. The date and frequency of standards is -- of standards is something that I rely on more directly, and I'm including in that not only the JEDEC specifications but the Intel specifications, too.

Q. Well, let me clarify.

My question was: You identify on your list of considered materials the two JEDEC specifications or standards?

A. Right.

Q. And is there something that you derive of significance from those technical documents that's of relevance to your economic conclusions?

A. Other than their dates, no. The rest is background.

Q. And besides those two technical JEDEC specifications, in the work leading up to the completion of your expert report in this case, you did not rely upon or consider any records relating to JEDEC or JEDEC activities?

A. Correct.

Q. And you did not rely upon or consider any JEDEC minutes?

A. Right.

Q. Okay. So I'm going to make the fourth point "no JEDEC materials/minutes other than two technical specifications."

And am I right that you also did not rely upon or consider in developing your opinions in this case any notes taken by any representative at any JEDEC

meeting?

A. That is correct.

Q. Or any reports relating to any JEDEC meeting?

A. Right.

Q. And you didn't rely upon or consider any internal Rambus business records relating to any aspect of JEDEC activities; correct?

A. That's correct.

Q. So the next point I'll make is "no notes/reports on JEDEC activities."

And we've already established that in completing your expert report you had an opportunity to review Professor McAfee's expert report; right?

A. Yep.

Q. And you had access to that report several weeks before completing your own report?

A. I did.

Q. And do you have a copy of Professor McAfee's report in front of you?

A. I do.

Q. Let me ask you to turn -- I'm sorry. I had intended to tab this for you in your copy, but if you turn, you'll see the -- putting aside the appendix III portion of the narrative, that the principal portion of the narrative is the 193-page part and then there's the

CV and then right after that there's something called appendix II. Oh, I see there's a page number. It's page 206 of CX-3079.

A. I'm with you. I think. Yes.

Q. So are you with me, you're on appendix II?

A. Yes.

Q. Now, appendix II is comparable to your Exhibit 2; this is Professor McAfee's list of materials that he relied upon or considered. Do you see that?

MR. STONE: Your Honor, I object to the use of Professor McAfee's report in this way because, as the court has ruled, the reports are not in evidence. Professor McAfee was here and testified as to what he did and did not rely on, and I think trying to get the report in by showing its contents through the back door because it was shown to this witness is an inappropriate use of a document which is not admissible.

MR. ROYALL: Your Honor, I'm not intending to offer anything of substance here. I'm simply asking what this witness reviewed. We've established that he reviewed this report and I want to ask him if he reviewed certain materials that are cited. I'm not intending to --

JUDGE McGUIRE: What materials about this report do you intend to have him review?

MR. ROYALL: I'm sorry?

It's nothing of substance. I'm not going to ask him a single question about any narratives. It's just the list of documents that's attached.

JUDGE McGUIRE: We'll proceed on that basis.

MR. ROYALL: Thank you.

BY MR. ROYALL:

Q. Now, referring to Exhibit or, rather, appendix II in the McAfee report, you'll see that this list of materials goes on for I think it's about 60 pages.

Let me ask you to turn to page 8 of Professor McAfee's appendix II. This is page 214 of the overall exhibit.

A. Uh-huh.

Q. Starting on that page, do you see that there's -- starting on the page and actually it's continuing to page 19 of appendix II, do you see there's a list of Bates numbers or production numbers all starting with the letter R?

A. Yes.

Q. Now, I'll represent to you that those are references to documents that were produced by Rambus in

this case.

In completing your expert report, am I correct you did not review or consider any of these various Rambus documents identified in appendix II of Professor McAfee's report?

MR. STONE: I --

THE WITNESS: Let me say that I think that I had --

JUDGE McGUIRE: All right. Just a second.

MR. STONE: I do object, Your Honor. The witness has testified to what he did review. He testified he didn't review any Rambus documents. This is cumulative, this line of questioning.

JUDGE McGUIRE: Sustained.

BY MR. ROYALL:

Q. Well, I -- what I was leading up to, but maybe I can just get to the bottom line without going through this, am I correct, Dr. Rapp, that in completing your expert report you did not review or consider any of the various Rambus documents, JEDEC-related documents or third-party related documents that were identified in Professor McAfee's report which you had available to you for several weeks before completing your report?

A. I am not sure. I may have reviewed some of

them, but not -- none of them rose to the level of real consideration. I think I had the document set at my disposal or my staff did, but they did not enter into my opinions, and I would -- and you can add them to the list of materials that were not reviewed.

Q. All right. So point 6 will be "no Rambus/JEDEC/third-party records cited in McAfee's report."

Now, on the subject of interviews, you did -- you've explained that you did interview Mr. Geilhufe and Dr. Soderman in -- prior to completing your report; correct?

A. Right.

Q. Am I right, though, that in connection with your work on this matter leading up to your report you didn't interview any Rambus employees or former employees?

A. If you remember what I mentioned to you at my deposition and recall the fact that I had been working on Rambus-related material, subject matter for two years before this assignment, you remember that there were in fact a series of interviews that I had had prior to my retention in this matter but that were relevant and formed part of my background and understanding in the case.

Q. Am I correct, Dr. Rapp, that -- well, first of all, you're talking about interviews that you conducted not in connection with this case but in connection with some other case; right?

A. In connection with some other case that raised the same issues, yes.

Q. Okay. And in -- am I right that the interviews that you're talking about that you conducted in another case, that you don't rely on those interviews and you haven't considered those interviews for any particular point in relation to your expert report and your opinions in this case?

A. That's correct. They don't relate to any particular point. They were background.

Q. So would it be fair then to include that on the list?

A. You decide, Mr. Royall. It's your list. I've described to you the situation and I won't make the judgment for you. Okay?

Q. Well, the question here -- the question this relates -- let me directly make it clear that this relates to work you did in this case and obviously the stuff that you've identified as having relied upon or considered in this case and I think your testimony --

A. But before you write, so to help you make your

decision, if I may, I want to have you bear in mind that the subject matter of market power and lock-in was the subject matter of the Infineon and Micron cases, and the people that I interviewed at Rambus included a list of perhaps four or six people whose -- who contributed to my background in the matter but did not contribute to any specific point.

That's -- the record is now clear and the list is yours to write, clear as far as I'm concerned.

Q. You're not disagreeing with what you said earlier, that you did not rely on any of those interviews and you did not consider any of those interviews for any particular point in your report in this case or in connection with your opinions in this case?

JUDGE McGUIRE: Now, where is that testimony?

MR. ROYALL: I'm reading -- I can --

JUDGE McGUIRE: I'm sorry. You're reading from what?

MR. ROYALL: His deposition in this case.

JUDGE McGUIRE: His deposition.

MR. ROYALL: But to be fair to the witness, let me -- I should present him with that.

THE WITNESS: I recall it, just to save a moment. I agree with that absolutely. I've described

as background information the discussions that I had with Mr. Tate, Mr. Karp, Mr. Garrett, and so forth. They do not relate to any particular point or opinion in my expert report and whether they -- whether your -- and the list is yours to make.

BY MR. ROYALL:

Q. And you didn't identify any interviews with any such individuals on Exhibit 2 to your report in this case which was entitled Documents Relied Upon but which included interviews?

A. Correct.

JUDGE McGUIRE: Mr. Royall, let me just interject here. You've gotten six points already. How much further do you intend to go?

MR. ROYALL: This is the last point.

JUDGE McGUIRE: My timing is always impeccable. Go ahead.

MR. ROYALL: Thank you for your patience, Your Honor.

(Pause in the proceedings.)

MR. ROYALL: So this will be DX- --

JUDGE McGUIRE: 324.

MR. ROYALL: Thank you.

(DX Exhibit Number 324 was marked for identification.)

MR. STONE: I think in fairness, Your Honor, to the question Mr. Royall has asked, I think what he did was he asked him about whether they were listed on appendix II, and I think the point 7 should be no interviews listed on appendix 2 because there are interviews referenced consistent with the witness' testimony earlier in his report.

So I think just so the chart is consistent with the question that was last asked, I think it should be listed on Exhibit 2.

JUDGE McGUIRE: Mr. Royall, do you want to change that accordingly? It's your chart.

MR. ROYALL: Can I -- just if I could confer with Mr. Stone to see what he's referring to.

(Pause in the proceedings.)

Well, Your Honor, I think the record is clear as to the nature of what he considered and whether it related to this case or not.

JUDGE McGUIRE: That's fine.

Did you want to just comment, Mr. Stone, other than what you just made, because your comment is also on the record?

MR. STONE: No. I'll bring it up on redirect, Your Honor. I'll pursue it then.

JUDGE McGUIRE: All right.

BY MR. ROYALL:

Q. Dr. Rapp, I'd like to now read a statement to you, and you'll see the statement is on the screen. What's on the screen will be DX-325 I believe.

Let me read this statement and ask you if you agree with it:

"The reliability of any example of economic reasoning depends, in part, on the quality of its underlying assumptions. All assumptions are not equal. Reasoning which rests on baseless assumptions is less reliable than reasoning based on assumptions that are well-founded in facts and evidentiary materials."

Do you see that?

A. Yes.

Q. Do you agree with that statement?

A. Not only do I agree with it, I think they are words to live by.

Q. And in fact you recognize these are your words?

A. Yes. And I'm proud of them.

Q. And do you recall where you wrote these words?

A. They were written in one of my prior expert reports or one of the Micron reports I believe.

MR. ROYALL: And may I approach, Your Honor?

BY MR. ROYALL:

Q. Now, I've handed you a document of a report from the Micron case.

Is this the report you're referring to?

A. I won't know that until you tell me the page number.

Q. Turn to page 2.

MR. STONE: Your Honor, this document is under a protective order in that case and I think it should be maintained in a manner consistent with that protective order.

JUDGE McGUIRE: Mr. Royall?

MR. ROYALL: The only statement that I intend to ask about in this report at the moment is this very general statement that we flashed on the screen.

JUDGE McGUIRE: He's already testified that that statement was contained I believe in the report. Do you need to show this report?

MR. ROYALL: I think actually, Your Honor, for this -- I may want to come back to this, but for this purpose, I agree that I don't need to --

JUDGE McGUIRE: Good.

MR. STONE: Thank you, Your Honor.

JUDGE McGUIRE: Because it is --

MR. ROYALL: He has the report.

JUDGE McGUIRE: Because it is protected and it's not a question of going into an unprotected -- the whole report is protected as I understand it, so --

MR. ROYALL: I'm not sure about that, but I agree it's not necessary for me at this point to go into it.

JUDGE McGUIRE: All right.

BY MR. ROYALL:

Q. But you have the report in front of you, Dr. Rapp, and just in context, am I right that the statement that we were discussing earlier that was contained in DX-325, that that was a statement that you made in the context of critiquing the report of another economist?

A. Could you just --

JUDGE McGUIRE: Can we take that off the screen.

THE WITNESS: And could you just give me a page number.

BY MR. ROYALL:

Q. Page 2. We don't need it on the screen but just for your own purposes.

A. Can you find it in the hard copy on page 2?

Q. I'm sorry. I may have given you the wrong page

number.

Yeah. I apologize. I did give you the wrong page number. Page 4.

A. Good.

Q. So the question again was: Am I right that this statement that you recognized earlier as being a statement from an expert report that you had written, am I right that this was a statement that you made in the context of criticizing another economist's work?

A. Yes.

Q. And that other economist was Dennis Carlton, professor at the University of Chicago?

A. That's correct.

Q. And am I right that you believe that it is important for an economist to try to ensure that his or her assumptions and conclusions are well-founded in evidentiary materials?

A. Right. And may I just add that that refers to the connection between the foundations for assumptions and the specific subject matter that the economist is addressing, not the universe of subject matter.

So my critique of Professor Carlton had to do with the fact that he imagined a set of alternatives at that stage in the history of Rambus-related litigation without offering any basis for the assumption that

there were alternatives, and so I criticized him on the basis of baseless assumptions. It was specific to the -- to his assignment and the basis for his assumptions.

Q. Well, as a general proposition, do you agree that it is appropriate to question the reliability of an economist's conclusions if those conclusions are not well-founded in the relevant facts and evidentiary materials?

A. Yes, it absolutely is. And in order to do that aptly, correctly, you have to identify the set of conclusions that the economist is stating and identify what's missing about the background facts and evidentiary materials.

For example, if you have an economist who is offering statements about costs and there are no cost data behind his opinions --

JUDGE McGUIRE: Okay. That's obvious. The court takes notice of this line of inquiry and I don't think we need to go into it.

MR. ROYALL: That's fine.

BY MR. ROYALL:

Q. And do you believe, Dr. Rapp, that in reaching the conclusions reported in your expert report in this case that you did a sufficient amount of work to ensure

that your conclusions were well-founded in facts and evidentiary material?

A. Yes, I absolutely do. And the difference between the volume of materials that I reviewed and the volume of material that Professor McAfee reviewed has to do with the differences in our assignment and with material in Professor McAfee's report that have nothing to do with my assignment or for that matter I think anything in the case.

Q. Let me go back -- may I approach, Your Honor?

JUDGE McGUIRE: Yes.

BY MR. ROYALL:

Q. I want to go back to these notes I made earlier, DX-323, and you'll recall these were conditions -- we titled this Conditions Necessary for Opportunism, and the first condition that we identified based on what you had written in connection with your testimony in the DOJ-FTC hearings was that the technology at issue must be essential to the standard. Do you recall that?

A. Uh-huh.

Q. And am I right that it's your understanding in -- that in this case the technology at issue -- that is, the Rambus technologies that are at issue here are in fact essential to the standards that are at issue

here, namely, the SDRAM and DDR standards?

A. No. No, sir. That's completely incorrect. And to --

JUDGE McGUIRE: No. He just asked you if that's correct or incorrect and he can follow up.

MR. ROYALL: Thank you, Your Honor.

BY MR. ROYALL:

Q. Let me follow up on that.

Are you saying that in your -- as you understand it, that the Rambus technologies, the four Rambus technologies at issue here, are not necessary inputs to the manufacture of SDRAM and DDR SDRAM?

A. What I'm saying is that they are not essential in the way that the model described by DX-523 -- is that? Is that the number?

JUDGE McGUIRE: It's 323.

BY MR. ROYALL:

Q. It's 323.

A. -- DX-323 describes.

In other words, the word "essential" there as in my testimony refers to a much, much different and more restricted set of circumstances.

Q. Let me ask you -- well, let me ask you first of all -- I want to clarify what you mean by that, but you do agree, don't you, that the Rambus technologies

that you've described earlier, what you mean by that term "Rambus technologies," that the Rambus technologies at issue here, that those technologies are necessary inputs to the manufacture of SDRAM and DDR SDRAM?

A. That they are necessary inputs, yes.

Q. Okay. But now let's see if we can clarify what you mean when you say that despite having the view or the understanding that those Rambus technologies are necessary inputs to SDRAM and DDR SDRAM as those standards are formulated today, you don't agree or you hesitate with agreeing with the proposition that those technologies are essential to those standards as you use that term or as it's described in DX-323?

A. That's correct.

Q. And why? How are you using the term "essential" here that differs from the concept of whether those technologies are necessary to the standards as they're formulated today?

A. The JEDEC standard for DRAM is a large, complicated affair that involves very, very many components and lots of circuitry. The four Rambus technologies are necessary technological inputs to that because they are and to the extent that they are

superior to the next best alternative, which I've measured in cost terms and described in performance terms.

The story that I was telling in the testimony was a simplified story for purposes of explaining the features of standard-setting organizations and what they have to contend with, and that is a story of a technology that is one with the standard.

In other words, if you -- if the technology is unavailable, then the standard goes away. And nobody has ever contended that that is true of the four Rambus technologies however valuable they must be.

Q. So are you saying --

A. Essential -- just to clarify, essential as in the English language meaning of the word, that they are the essence of the standard.

Q. And you believe that technologies would have to be essential to a standard in that sense for any hold-up or opportunism concerns to arise?

A. For the statements in the paragraph from which these have derived to be true. No, not for any conditions of opportunism, but for a reading of the paragraph as I wrote it.

Q. Well, to be clear about that, let's assume, in reference to DX-323, let's assume it were true that the

cost of changing the SDRAM and DDR standards today exceeds the relevant royalty amounts, that is, the Rambus royalty amounts that you testified about earlier that you assumed earlier?

A. Right.

Q. Let's assume that condition were satisfied.

A. Okay. Contrary to fact.

Q. I'm just asking you to assume this.

A. Okay.

Q. And let's assume then that the third condition that is identified on DX-323 were also satisfied, that is, that there were plausible alternatives to the Rambus technologies at the time that the disclosures allegedly should have occurred.

A. Right.

Q. So we're assuming that both the second and the third conditions on DX-323 were satisfied.

Now, is it your testimony, your expert testimony, that if those assumptions were to hold, that as you understand the facts in this case relating to Rambus' technologies and their relations to the SDRAM and DDR standards that there still would not, as a matter of economic theory, there would still not be any concern about opportunism in this case?

A. It depends. In that case, in that setting

where the technology and the standard are not one and the same, it depends. And what it depends on is the word "plausible" in the third item on your list.

In other words, I haven't drawn any sharp distinction between the conditions of substitution in that model because I started off by saying the technology is essential. It's like assuming away substitutes to say that. And that's a simplified story for the sake of explaining the issue.

If you want to use that list as an analytical tool for describing in general terms rather than this particular model the conditions necessary for opportunism, then you have to modify some of the words. You have to modify the word "essential" and you have to modify the word "plausible," and when you do those two things, you can generalize.

Q. And I'm not sure that I'm following you. I don't want to go back all over this entirely, but how would you need to modify the term "essential"?

A. Well, if you want to be -- if you want to generalize, then you -- then let's use the words that we were using. Let's say technology must be a necessary input. Okay? That brings us closer to the condition that we're talking about.

And then the third statement, which I can't

quite read --

Q. I can read it to you.

A. I can read enough to see. Thank you, Mr. Royall.

But let us say in that case must have distant alternatives. Of course -- and then we have a necessary technology, the cost of manufacturing must exceed, and rather than merely plausible, we've got -- we've said something about where the alternatives lie.

Q. Now, what you're describing now in terms of wanting to modify these terms, are you saying that you would need to modify the terms in that way in order for this list to state the conditions that you believe would be necessary for opportunism to exist?

A. Yeah, in general -- in more general terms than the model that I was using in that statement.

Q. Well, why did you not use those terms when you testified before the FTC and the DOJ hearing?

A. For the sake of explication. I was describing a narrower set of circumstances that are a starker case for opportunism to make it clearer. And there are such things that come up in the world if you -- if you have a technology that is -- that's essential to the standard.

Q. And you said that to generalize these

conditions you would change the word "essential" in the first condition to "necessary"?

A. Yes.

Q. But you -- and you agreed earlier that these technologies are -- Rambus technologies are necessary to the SDRAM and DDR standards?

A. Right. But necessary is different from essential. Necessary meaning that they are -- that it would be necessary in the sense that it would be -- it would be costly and inefficient to substitute away from them.

Q. So you would agree that with changing this first condition on DX-323, changing the word "essential" to "necessary," if that change were made, you would agree that this condition is satisfied in this case as you understand the facts?

A. If you substitute "a necessary input," yes, just as we did before.

Q. And with that substitution, you would agree that condition is satisfied?

A. With that substitution.

Q. Okay. Let me -- I'm just going to cross out for the record on Exhibit DX-323, I'm going to put a line through the word "essential" and then I'm going to write "necessary input" and I'm going to put a check to

denote that that -- with that change --

A. You might want to write "a necessary input," but it doesn't matter that much.

Q. I'm happy to try to fit that in.

With that change to item 1 on DX-323, you agree that that condition is satisfied in this case as you understand it?

A. Right. The way that I use the term "necessary input," yes.

Q. Now, let me shift to another topic.

JUDGE McGUIRE: All right. Mr. Royall, let me inquire of you before you make that shift. It's approaching 5:30. How much longer do you have in mind proceeding this afternoon?

MR. ROYALL: I have a topic that I believe I could cover in ten minutes or less if -- I can stop now as well. But if we want to use the time, I could use it, or we could start back in the morning. I'm indifferent.

JUDGE McGUIRE: Well, ten minutes doesn't -- well, let's just stop right now if that's okay.

MR. ROYALL: I'm happy, Your Honor, to do that.

JUDGE McGUIRE: And just so we'll know tomorrow, how much time do you anticipate taking to

conclude the cross?

MR. ROYALL: I expect to go into the afternoon certainly.

JUDGE McGUIRE: Okay. Okay. We will adjourn then and convene tomorrow at 9:30 a.m.

(Time noted: 5:22 p.m.)

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: July 22, 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: July 22, 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