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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Wednesday, July 23, 2003

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TRIAL VOLUME 48

PART 1

PUBLIC RECORD

BEFORE THE HONORABLE STEPHEN J. McGUIRE

Chief Administrative Law Judge

Federal Trade Commission

600 Pennsylvania Avenue, N.W.

Washington, D.C.

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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.

Before we get started today, any housekeeping tasks we need to take up?

MR. ROYALL: Your Honor, the only thing was something that we raised yesterday. I don't know if Mr. Stone is prepared to comment. I understand it's not a major issue, but this revealed preference issue, we can either deal with that now or later.

MR. STONE: I can respond.

I think although Professor McAfee did not use the words "revealed preference," Mr. Royall is correct on that, his testimony in the transcript on June 25, which is volume 35, beginning at page 7255 and continuing through 7256 does describe what I think I understand and I think Dr. Rapp understands to be the theory of revealed preference in his description of it at that point in the testimony.

So I think that's my response. If I used the words in asking my question and suggested he used those words, I was plainly incorrect. I think the concept was plainly revealed in the testimony.

JUDGE McGUIRE: Now, as I understand the issue, you're opposed to that testimony being offered by

Dr. Rapp?

MR. ROYALL: You know, I think with this, with that clarification on the record, it's probably fine.

The thing that I was concerned about and I'm still concerned about, but I don't think we probably need to do anything, is that it sounds like the question that was asked and that was answered amounted to Mr. Stone's interpretation of testimony and then an agreement with his interpretation.

JUDGE McGUIRE: I think the point has been made. I'm going to hear it and then I'll determine its due weight.

MR. STONE: Thank you, Your Honor.

MR. ROYALL: I think that's fine. Thank you, Your Honor.

JUDGE McGUIRE: Then at this time we'll continue the cross-examination by complaint counsel.

Dr. Rapp, if you'll have a seat, please. I caution you, you're still under oath from Tuesday.

THE WITNESS: Thank you.

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Whereupon --

RICHARD T. RAPP

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

CROSS-EXAMINATION (continued)

BY MR. ROYALL:

Q. Good morning, Dr. Rapp.

A. Good morning.

Q. I'd like to start with today, I'd like to come back to one of the slides that you prepared in connection with your direct examination, and it's the slide that was marked as DX-305.

Do you recall this slide?

A. Yes.

Q. I wanted to ask you about the last bullet point on this slide where you say, "'Standard' SDRAM sold in the market today embodies Intel's specifications and omits JEDEC elements."

Do you see that?

A. Yes.

Q. Can you name any specific or identify any specific JEDEC elements that are omitted from standard SDRAM sold in the market today?

A. No, not specifically.

Q. So what did you mean by this statement if you can't identify any specific elements that are omitted?

A. Could you ask your colleague to shrink that quote back so that I can read the preceding paragraph.

Q. Can we magnify the slide for all of our benefit just to see the text better.

A. Good.

Q. Great.

A. My understanding comes from Exhibit RX-2103-14, and there was also testimony, as I recall, about this subject, about the creation of PC -- of the PC100 specification. And it is that to which I'm referring that involves the subtraction of JEDEC elements from the -- from the Intel version of the standard.

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technologies" as you defined it earlier?

A. Certainly not.

Q. And you don't know whether -- because you don't know what is omitted, do you know -- do you know for a fact if anything was omitted?

A. I know only what the testimony and this statement say, which are both nonspecific, so I assume that something was omitted because they say that something was omitted, but what that something is I do not know.

Q. And you say that you understand that there is testimony about PC100 in the record?

A. Yes.

Q. Do you understand that PC100 included programmable CAS latency and programmable burst length?

A. Sure.

Q. And do you have an understanding as to why Intel in setting the PC100 specification chose to include programmable CAS latency and programmable burst length?

A. I think there were two reasons. One reason relates to the standard, that it was part of the JEDEC standard, and I don't think that -- and I am inferring -- it's an assumption on my part -- that

JEDEC (sic) did not want to disturb the standard except insofar as the resolution of incompatibilities was involved.

And I remember from the testimony that the reason for the revision by Intel of the JEDEC specification was that the specification -- that the JEDEC standard was not specific enough to resolve incompatibilities that arose in the manufacturing process, and Intel's purpose, as I understand it, was to resolve those incompatibilities, which it accomplished by removing certain elements from the standard.

If removing JEDEC technology would not accomplish that, there's no reason, I infer, why Intel would do it.

Q. I think, Dr. Rapp, I think you may have misspoken in that answer. Let me point this out just in case I'm right.

I think in your answer you said that it was your assumption, assumption on your part, that JEDEC did not want to disturb the standard except insofar as -- you meant Intel?

A. I meant Intel. I'm sorry.

Q. Now, is it your understanding that Intel included -- and let me focus this question just on

programmable CAS latency for the moment -- that Intel included programmable CAS latency in the PC100 specification because it was already in the SDRAM parts and had been previously balloted and approved by JEDEC?

A. I would be willing to infer that.

Q. And would you infer the same as to the reasons why Intel included programmable burst length in the PC100 specification?

A. Yes.

Q. And would you infer the same as to -- well, strike that.

Are you aware of any Intel specifications that relate to DDR SDRAM?

A. I know that there are Intel specification addenda to the standard as the speed ratings of DDR have increased, yes.

Q. And do you understand that those Intel addenda include all four of the so-called Rambus technologies?

A. Yes.

Q. And is it your understanding that the reason Intel included those technologies in those DDR-related addenda are the same as the reasons you understand that programmable burst and programmable CAS latency were included in the PC100 specification?

A. It's just an inference, but yes.

Q. Let me shift to another topic.

You're aware, are you not, that Professor McAfee in connection with his work in this case has defined relevant antitrust markets?

A. Yes.

Q. And other than possibly disagreeing with the particular wording of Professor McAfee's market definitions, am I right that you don't find that this is an issue that between yourself and Professor McAfee merits engagement or dispute?

A. The answer is yes insofar as the market definitions that he -- that he arrived at for -- let me see if I get this right -- for markets ex post, but the story, as I heard it, in his testimony of market definition leads me to disagree not with the ultimate definitions that he's using but what he believes the relevant markets were ex ante.

Q. Let me, if you don't mind...

(Pause in the proceedings.)

You're saying that you disagree with Professor McAfee's definition of the relevant markets in the ex ante period before the standards were adopted?

A. As I heard him describe it in testimony, if my

A. Sure.

Q. Now, referring to the markets, the relevant markets that Professor McAfee defined, am I right, is it correct, that you believe it is sensible to provisionally include in each of those markets all of the alternative technologies that have been identified by complaint counsel's experts?

MR. STONE: Your Honor, I object. As Mr. Royall has brought out, the question of market definition was not addressed in Dr. Rapp's report, it was not covered in direct examination, and an effort to get him to testify about Professor McAfee's views on market definition is outside the scope.

JUDGE McGUIRE: Mr. Royall?

MR. ROYALL: Your Honor, I do not believe that this is outside the scope. The subject of market definition is relevant to the subject of market power, and he has offered conclusions about market power in the very relevant markets that we're discussing, and so that's what this is leading up to, is his opinions on market power.

JUDGE McGUIRE: Overruled.

BY MR. ROYALL:

Q. Now, referring to the markets that Professor McAfee defined, am I correct that you,

Dr. Rapp, believe that it is sensible to provisionally include in those markets all of the alternative technologies that have been identified by complaint counsel's experts?

A. For purposes of analysis, yes.

Q. Okay. And so let's -- if we could pull up DX-187. And again enlarge that so we all can see, please.

This is DX-187, which was used with Professor McAfee's testimony, and as you see, it relates to what he termed the latency technology market.

And am I right that you believe that it is sensible to provisionally include in this relevant market defined by Professor McAfee all of the -- not only the programmable CAS latency technology but all of the technologies that are identified here, at least those with the check marks?

A. Yes. Where "provisionally" means not to -- not to form a conclusion but to consider those.

Q. Okay. And so that I don't need, necessarily need to go through all of these, the four slides, if I were to bring up the slides relating to the burst length technology market, data acceleration and the clock synchronization technology market, those terms

being terms that Professor McAfee used, you would have the same testimony with respect to all of the alternatives that are identified on those slides from Professor McAfee's testimony that are checked?

A. That because he regarded them as in the market that I regard them as provisionally worthy of inclusion for the sake of analysis.

Q. You can pull that slide down.

Now, referring collectively to all of these alternatives that Professor McAfee included in his relevant markets, you have not done any analysis focused on addressing how closely any of those alternatives competes with the four so-called Rambus technologies; correct?

A. Wrong.

Q. And why is that wrong?

A. Because the analysis of the cost -- of the differences in the cost of using those technologies is an analysis of the quality, of their quality as substitutes.

Q. Let me ask the question in a slightly different way.

Am I correct that you have not made a judgment about whether or not any or all of those substitutes identified by Professor McAfee as being included within

as substitutes would extend to that, even though I didn't do a formal relevant market analysis.

MR. ROYALL: May I approach, Your Honor?

JUDGE McGUIRE: Yes.

BY MR. ROYALL:

Q. Dr. Rapp, I've just handed you a copy of the transcript from your deposition in this case, and on this issue that we're discussing I want to see if I can refresh your recollection.

A. Okay.

Q. I may need --

MR. STONE: Your Honor, I object in that he has not testified to a lack of recollection, no recollection refreshed. If he can impeach him with a transcript, I think that's the proper use of it. But I don't think it's proper to refresh when the witness has not evidenced any lack of a recollection.

MR. ROYALL: Your Honor, that's fine. I'm simply trying to be polite about it, but what I'm doing is -- it amounts to impeachment.

JUDGE McGUIRE: Then why don't you proceed, and we'll decide which way he's headed here, Mr. Stone.

MR. STONE: Thank you, Your Honor.

BY MR. ROYALL:

Q. Could I ask you, Dr. Rapp, if you could to turn

to page 74 of your deposition transcript.

A. Sure.

Q. Now, on page 74 of your transcript starting on line 6, I asked the following question: "Are there other alternatives that should be regarded as also being included in those relevant markets?"

And I'll represent I was referring to Professor McAfee's relevant markets.

A. Sure.

Q. There's an objection and then you answer: "Well, for the sake of analysis, I think it is -- it's sensible provisionally to include the alternative technologies that have been proposed by complaint counsel's expert witnesses. Whether or not they remain in the relevant market has to do with their quality as substitutes, and I have not made a judgment about whether or not any or all of them are close enough substitutes to remain in the relevant market after the analysis is over."

And then I ask, at the bottom of that page, "And the analysis that you're referring to is an analysis focused on assessing how close these alternatives compete with the" -- and there's an error here. It says "pro-Rambus" and I think it should say "for Rambus technologies on cost-performance;

correct?"

And then your answer is: "Precisely."

Do you see that testimony?

A. Uh-huh.

Q. Now, that is the testimony -- those are the questions I asked and the testimony that you gave in your deposition; right?

A. Uh-huh.

Q. Now, if we could come back to Professor McAfee's report -- do you have that in front of you?

Could I ask you to turn or flip to page 104. This is page 104 of Professor McAfee's report. I focus your attention on paragraph 135.

A. I'm with you.

Q. Now, a moment ago you made a distinction between ex ante and ex post issues concerning market definition?

A. Right.

Q. And I believe -- I don't want to misstate it, but I believe you said that you believe that Professor McAfee for the first time at trial made a distinction between ex post and ex ante market definitions that he had not made in his report?

A. I think that's right.

Q. Let me ask you to focus on paragraph 135 and the first sentence of that paragraph of Professor McAfee's report where he says, "Because the point of this section is to characterize the relevant markets in order to determine the range of acceptable substitutes influencing the purchase patterns of buyers ex ante, it is important to set forth my understanding of what principles are useful to make these determinations."

Do you see that?

A. Yes.

Q. And then going on to the next page, 105, paragraph 136, the first sentence, he says, "The identification of ex ante commercially viable alternatives was made substantially more difficult as the result of Rambus' own challenged conduct."

Do you see that?

MR. STONE: Your Honor, I must object to this line of questioning in this fashion. A, Professor McAfee's report is not in evidence. B, I was prohibited yesterday, on Mr. Royall's objection, from referring this witness to things that Professor McAfee had said to ask him whether he agreed or disagreed. I couldn't do it. And I framed all my questions not to ask him about what Professor McAfee

did or whether he agreed or disagreed, just about concepts.

And I think Mr. Royall is now -- he's taking words out of a report that's not in evidence that he attributes to Professor McAfee --

JUDGE McGUIRE: All right. Mr. Royall, I'm going to uphold that objection. I tried to -- I want to be consistent, and I think that's exactly what's occurring here, so I want you to restate your inquiry in a way where we're not quoting Professor McAfee's report into evidence.

MR. ROYALL: Can I be heard on this?

JUDGE McGUIRE: You can be heard, but --

MR. ROYALL: Because I don't think there is an inconsistency.

JUDGE McGUIRE: Well, go ahead.

MR. ROYALL: He said there's an inconsistency. I don't believe that there is.

In terms of (Rdisrctiwe'rerm the but TjT(18 is?d

was the nature of the objection.

Now, here what we have is a witness who said that he believes that something came up that was new in the testimony at trial of Professor McAfee that wasn't in the report, and so all I'm doing -- I'm not trying to put this report into evidence.

JUDGE McGUIRE: Well, that's what you're doing because it's being read into evidence.

Now, if you want to ask him to, by himself to read it and then ask him if that helps him recall as to whether or not the professor included this area in his report, do that.

But what the objection is, as I understand it, is that you are reading excerpts from Professor McAfee's report into evidence, which he was not allowed to do earlier, and I'm upholding that objection.

MR. ROYALL: And just to be clear for the record, but I am doing this for the purpose of refreshing recollection and I'm happy to --

JUDGE McGUIRE: Then let's do it in a way that's not going to be in conflict 1 - m But what om 15oidsrrenn.

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BY MR. ROYALL:

Q. Now, I won't read any more of these statements, but does seeing this reference to -- this discussion of ex ante in Professor McAfee's report, does that refresh your recollection that this issue was raised and discussed?

A. Not the issue that I had in mind.

Q. And what's the distinction that you had in mind?

A. The distinction that I have in mind is that, to the best of my recollection, the McAfee report speaks only of the ex ante market, the before-standardization market, in which Professor McAfee contends that all of these substitutes were available, the ones with the check marks on the previous exhibit.

The only thing that I was calling attention to is that, as I remember it, Professor McAfee's testimony extended to a statement where he said, And ex post, after standardization, there is nobody in those relevant markets except Rambus because all of those substitutes had been eliminated, and that was the part of his testimony that seemed to relate to relevant market analysis to which I took exception in my earlier testimony today.

Q. I may have misunderstood you earlier. I

understood you to say that you understood that Professor McAfee mentioned the ex ante market definition for the first time at trial, but now, I now understand you to be saying that you understood that he mentioned the ex post market definition for the first time at trial.

A. Yes. I may have misstated it.

Q. So going back to the earlier question and how this first came up, as it relates to the ex ante nature of the market definition in Professor McAfee's report, am I right that, as it relates to that, you don't disagree with the Professor McAfee's market definitions or you at least don't find that that merit -- that issue merits engagement?

A. It's correct that I do not find that that issue merits engagement.

Q. You were present I believe in the courtroom during Professor McAfee's testimony or some portion of it?

A. I was for all of it.

Q. And so --

A. Nearly all of it.

Q. -- you understand that after defining the markets in the ex ante sense to include many or most of the technologies that were identified on the slides

like the one that I showed you earlier, Professor McAfee later considered what competition Rambus' technologies face today or in the ex post period in those markets from these same technologies that he identified?

A. That's what I'm recalling.

Q. And you understand that Professor McAfee concluded that as of today, that is, in the ex post period, none of these other technologies that he had included in the ex ante market definition are close enough substitutes to Rambus' technologies to remain in the market; right?

A. Yes. That is what I recall.

Q. And you have not yourself conducted any analysis or made any judgment about whether any or all of those alternatives in fact are close enough substitutes to Rambus' technologies today that they should remain in the relevant markets; correct?

A. Not simply correct. My answer is that I have done an analysis of substitution, but without respect to Professor McAfee's market definition boundaries.

My testimony has been that both ex ante and ex post the substitutes that Professor McAfee deems to be commercially viable are relatively weak substitutes because they are inferior in cost-performance terms.

And what I did not do is to make that statement in relation to a relevant market either defined by Professor McAfee or anybody else.

But I would not have the fact that I didn't use a market definition framework for drawing conclusions about substitution read to mean that I believe that those -- that I'm uncertain about whether they are poor or weak -- good or weak substitutes.

Q. Could I ask you -- let's pull this page down off the screen.

A. That is my understanding.

Q. And it's your understanding that two of these technologies, that is, the programmable CAS latency and programmable burst, are included in SDRAMs and in the JEDEC SDRAM standards; correct?

A. Yes.

Q. And all four of these so-called Rambus technologies are included in DDR SDRAMs and in the JEDEC DDR standards; correct?

A. Yes.

Q. And am I right that it's your understanding that programmable CAS latency and burst length as used in SDRAM devices and in DDR SDRAM devices help to reduce the cost characteristics of those devices?

A. Yes.

Q. It is not your understanding that those two technologies serve to increase the performance or the bandwidth of those devices?

A. That statement is true with the understanding that alternative is fixed latency and burst length.

Q. Well, let me see if you can answer that question without reference to what the alternatives are. Let me ask the question again.

Isn't it correct that you do not understand that those two technologies, programmable CAS latency

and programmable burst length, increase the performance or the bandwidth of SDRAM or DDR SDRAM devices?

A. I can't answer it unless you say increase compared to what.

Q. And you don't understand that those two technologies increase the speed or the bandwidth of these devices compared to earlier generations of DRAM; is that correct?

MR. STONE: Objection, Your Honor. Vague and ambiguous with respect to "earlier generations." Also outside the area of this witness' direct testimony and clearly outside the area of this witness' expertise.

JUDGE McGUIRE: Sustained.

MR. ROYALL: May I be heard, Your Honor?

JUDGE McGUIRE: You can be heard.

MR. ROYALL: I'm not asking for a technical opinion on this. I'm asking for his understanding. He's made -- he spent most of his direct examination talking about his understanding of technical issues as he learned from Mr. Geilhufe and Dr. Soderman. That's point one.

Point two is that this is within the scope of his direct as it relates to his conclusions about market power and which are based in insignificant part

on comparing these technologies to alternatives as used in these devices, and that's the reason I'm going into this issue.

MR. STONE: And I think what was within the scope of his direct was clearly he compared these features to the various alternatives that Professor McAfee described, but he did not do a comparison with respect to any earlier generations, whatever that's meant to refer to, and it's as to the question about earlier generations that I objected, that it's both vague as framed and there's no foundation for that.

JUDGE McGUIRE: Outside the scope. Sustained.

MR. ROYALL: I can reword it to get around that issue.

JUDGE McGUIRE: That's the idea.

MR. ROYALL: Well, there were two issues -- I'm sorry -- I understood him to be making.

JUDGE McGUIRE: Right. There are two issues, so right, but it is outside the scope in the context that he's raised the objection.

MR. ROYALL: Yes, Your Honor. Thank you.

BY MR. ROYALL:

Q. Putting aside earlier generations of DRAM, it's your understanding that programmable CAS latency and

programmable burst length add to the cost-reducing aspects of SDRAM and DDR SDRAM but not to the performance-enhancing aspects of those devices; correct?

A. Correct, compared to fixed latency and burst length.

Q. But at one point in time you did understand that programmable CAS latency and programmable burst were in part responsible for increasing the bandwidth or data rate of SDRAM; correct?

A. There was an earlier time that I thought that that was so.

Q. And you told the commission in your white paper that we saw yesterday that that was true; isn't that right?

A. You would have to point me to that.

Q. Let me ask you to look at -- and again, I -- I'm going to stay clear of anything that would be remotely of a confidential or in camera nature.

Let me just focus you on page 5 of that white paper, in the first full paragraph.

Just highlight the first sentence or so of the first full paragraph beginning "Rambus' inventions."

And you say there, "Rambus' inventions allowed SDRAM, DDR DRAM and RDRAM to run at speeds

significantly faster than existing alternatives."

Do you see that?

A. Yes.

Q. And you now understand that that statement is incorrect?

MR. STONE: Your Honor, that is an absolutely misleading use of the "Rambus' inventions," which in this portion of this white paper are clearly defined as something other than the four features that have been the subject of the witness' testimony today.

JUDGE McGUIRE: Are you saying that that is an incomplete statement?

MR. STONE: I think it's a statement taken out of context because right above it --

JUDGE McGUIRE: I will then give you an opportunity under the rule of completeness to incorporate whatever else you feel would help to put it in --

MR. STONE: Then I'll wait until the question and answer is completed to do that. I'm sorry, Your Honor.

JUDGE McGUIRE: All right.

BY MR. ROYALL:

Q. Now, putting aside when you say in that statement what you say about DDR and RDRAM -- I'm just

focusing on SDRAM -- am I correct that you now understand that it is not correct that the Rambus inventions, CAS latency -- programmable CAS latency and programmable burst length, allowed SDRAM to run at speeds significantly faster than existing alternatives?

A. Compared with fixed latency, yes.

Q. And then referring to page 8 in the same white paper, again the first full paragraph, that first sentence, do you see you refer to -- you say, "While RDRAM is typically hailed as a revolutionary achievement, some of the elements that allow RDRAM to achieve the speeds of which it is capable have also been incorporated into SDRAM and DDR, giving these products speed advantages that substantially differentiate them from prior generations."

Do you see that?

A. Yes.

Q. And you understand that that statement in your white paper is -- you now understand that that is an incorrect statement as relates to SDRAM?

A. I have to say that I would write that differently with the understanding that I achieved by subsequent research. I would have --

JUDGE McGUIRE: But does that answer his

question? Is that incorrect as it applies to SDRAM?

THE WITNESS: It is. It is.

BY MR. ROYALL:

Q. And it's incorrect because the subsequent research that you referred to caused you to understand that the use of those two Rambus technologies in SDRAM added to the cost-reducing elements of that technology but not to the performance-enhancement elements?

A. Right. But everything that I said in this regard is on the assumption that the alternative is fixed latency and burst. When you speak about programmability, it's sort of natural to talk about nonprogrammability as the alternative.

I'm not saying in fact that I would write this differently. I'm just saying that there are alternatives that have been proposed by complaint counsel and Professor McAfee where the difference between those alternatives and the Rambus technologies of programmable CAS latency and burst length would involve a difference in performance.

Q. Now, with respect to -- let's pull this down off the screen.

With respect to the dual-edged clocking and on-chip PLL or DLL technologies, which you understand to be included in DDR SDRAM, those technologies you do

understand to add to or to enhance the performance or speed of DDR SDRAM devices; is that right?

A. Yes. Tremendously in fact.

Q. Now, despite the fact that you understand that RDRAM and DDR SDRAM share in common the four Rambus technologies, you understand that there are differences between RDRAM and DDR SDRAM; correct?

A. Sure.

Q. And it's your understanding that the principal differences relate to the fact that RDRAM uses a packetized signaling transmission and incorporates a narrow bus architecture; is that right?

A. Yes. But let me register that my understanding there is imperfect, that I don't know whether that's the complete story.

Q. Shifting gears, you agree that formal standardization of technologies can benefit competition and consumers; correct?

A. Yes.

Q. And one of the potential benefits of formal standardization is that it can help to create a market consensus about which technology to use?

A. That is so, within the confines of the solution of compatibility requirements.

Q. And when formal standardization has these

benefits in terms of helping to create a market consensus, that can lead to reduced costs and reduced uncertainties; correct?

A. Yes. Associated with, again, the resolution of compatibility requirements, not making products uniform in all their characteristics.

Q. And formal standardization can reduce costs by allowing for the achievement of economies of scale?

A. Yes.

Q. And in fact you would agree, wouldn't you, that achievement of economies of scale is a benefit of formal standardization in the case of SDRAM, that is, JEDEC's SDRAM standards?

A. Yes.

Q. And another potential benefit of formal standardization is that it can in some circumstances improve the extent to which products in a given marketplace are compatible with one another?

A. That's the principal advantage.

Q. And you agree that that kind of compatibility is important when it comes to SDRAMs?

A. I'm sorry. What kind of compatibility?

Q. Bear with me just a moment.

A. Sure.

(Pause in the proceedings.)

Q. You said that improvements -- well, strike that.

Compatibility in terms of helping things fit together better, that's a type of compatibility that you agree is important to the SDRAM marketplace; right?

A. Yes, if "things" refer to the compatibility between memory and other parts of the -- of a single device or system.

Q. Now, I believe we may have only touched on this subject earlier in connection with your white paper, but let me come back and ask you.

You do agree, don't you, that formal standardization can result in enhancing the market value or market power of technologies that are standardized, that can be the effect of formal standardization?

A. It can be.

Q. But it's your view, isn't it, that this is less likely to occur when the technologies being standardized are so-called revolutionary technologies?

A. Yes.

Q. And when you use the term "revolutionary" in that context, by that you're referring to a technology that represents a substantial advance in performance

relative to older technology or existing or known alternatives?

A. Right. Performance -- advancement in performance or a substantial cost saving.

Q. And another way of describing what you mean by "revolutionary technology," by that term, is a technology that has no close economic substitutes; is that right?

A. Correct.

MR. ROYALL: Now, with Your Honor's permission, I'd like to make a few notes?

JUDGE McGUIRE: Go ahead.

BY MR. ROYALL:

Q. I'd just like to make a couple of notes, Dr. Rapp, on what you mean when you use the term "revolutionary technology."

A. Forgive me, Mr. Royall, but I will be able to see it better from that distance if you get a nice, fresh marker. No, you don't have to bring it closer; it's just that it's so faint.

JUDGE McGUIRE: Yeah, your marker is running out there. We're having problems with these markers, the government-issued ones.

MR. STONE: I think the government used all the ink in it yesterday.

(Discussion off the record.)

BY MR. ROYALL:

Q. This will be a two-tone slide.

Now, just referring to your earlier testimony, the first thing, if you don't object to this, the first thing I was going to write here is "revolutionary technology" -- this is just shorthand -- "revolutionary technology equals substantial advance/no close economic substitutes."

A. Fine.

Q. Is that all right?

A. Yeah.

Q. And you agree that revolutionary inventions can be of great value; correct?

A. Certainly.

Q. Or in an economic sense?

A. Certainly.

Q. And am I right that there are two circumstances in which in your view a revolutionary invention would have great economic value? Let me ask you -- I'll ask you one first.

One is where the invention offers new product characteristics that are desirable to customers who are without alternatives?

A. Yes.

Q. And the second is where the invention reduces cost in a way that cannot be achieved through other means --

A. Yes.

Q. -- right?

And those are the only two circumstances that in your view a technology can appropriately be regarded as revolutionary?

A. As I sit here, yes.

Q. And for a technology to be labeled revolutionary, as you use the term, the technology not only must provide benefits, but those benefits must be desired by customers?

A. Yes.

Q. And so desirability by customers is a condition that must be present for a technology to be revolutionary, as you define the term?

A. Yes.

Q. So let me make that the second point: "To be revolutionary invention must be desired by customers."

And you acknowledge that it's possible that a technology could offer a substantial advance unachievable through alternative technologies where those benefits are nonetheless not desired by customers?

A. The possibility exists.

Q. And in that case the technology in issue, despite offering benefits unachievable through alternative technologies, would not satisfy your definition of revolutionary; is that right?

A. I haven't really thought about it. I'd be willing to go either way on it. It's not crucial to the characteristic of being revolutionary.

Imagine that somebody invents a new product and the new product is both different from anything else and awful in some respects so that nobody wants it. It can be both revolutionary and not desirable.

I don't have an opinion about that either way really because it doesn't speak to the issue of what is revolutionary and what is not in the everyday sense of the word.

Q. Could I ask you to look at your deposition, page 67, your deposition in this case.

Focusing on line 19, I asked the question: "Is it also possible that a technology might be revolutionary in terms of permitting a great performance advantage but still not have substantial" -- I'm sorry. I'm reading the wrong question. Strike that.

Now, picking up on the prior page, 65, at the

bottom of the page -- I'm sorry -- 66, I asked the question starting on line 24, "Would you agree that an invention or product could be revolutionary in the sense that you describe" --

A. I'm sorry. Did you say the bottom of 65?

Q. 66. I'm sorry. At line 24.

A. I'm with you now.

Q. I asked the question: "Would you agree that an invention or product could be revolutionary in the sense that you describe in that paragraph" -- and I think I was referring to a paragraph in your report -- "but still not be of great value to the market?"

And you answer, starting at line 3 on 67: "The only case as a matter of logic that I can think of that to which that would apply is the case of a cost-reducing process that is reducing the manufacturing cost of a product that the market rejects. The prior condition states desirability of consumers -- to consumers as a reason, and that carries with it the implication of value. That's the basis for my reasoning."

And then I ask, "Is it possible that a product might be so ahead of its time that it lacked substantial current market value because relatively few customers had current needs or near-term needs for such

advanced features or performance?"

And your answer is: "Yes, I think that such a thing is possible. I think that it violates the desirable-to-consumers condition, but it could be so, yes."

Do you see that testimony?

A. Yes, I do.

Q. Now, does that in any way refresh your recollection or help you to answer the question that I posed to you earlier, which was whether you agree that for a technology to be labeled as revolutionary, as you use the term, it -- I'm sorry.

The question was: And you acknowledge that it's possible that a technology could offer a substantial advance unachievable through alternative technologies where those benefits are nonetheless not desired by customers?

A. I'm sorry. I have just lost -- I want to give an answer that's meaningful and I'm not sure what a yes or a no would signify after that, and it's my fault for not following the thread.

Q. No. It's my fault, Doctor.

The question I had asked you earlier is whether -- was -- that I think caused some complication was whether you acknowledge that it's

possible that a technology could offer a substantial advance unachievable through alternative technologies where the benefits are nonetheless not desired by consumers.

A. And I believe that I said yes to that.

Q. Okay.

A. That does not -- we haven't yet invoked the definition of the word "revolutionary" or the phrase "revolutionary technology."

Q. And if that were the case, the technology in issue, despite offering a benefit unachievable through alternative technologies, would not satisfy your definition of revolutionary?

A. That's what I'm not -- and I think that must be where I stopped following last time. I'm not sure that's right.

Q. Well, for it to be revolutionary it has to be desired by customers, and if the technology that we're speaking of is one that is not desired by customers despite offering some significant benefit beyond what's available with alternatives, you would agree that, because the condition of being desired by customers isn't satisfied, it's not revolutionary?

A. It's -- it is -- I mean, certainly there are revolutionary technologies that get invented and never

make it to the market. It may be that the definition is too broad, and if I have to recant, then I will.

People invent things that are revolutionary and don't go to market and customers never know about it. The quality of revolutionary by itself has to do with the advance over prior technologies. The desirability of it is separate from that.

JUDGE McGUIRE: Okay. Mr. Royall, I just want to interject here and ask you exactly where you're headed with this line of inquiry, because I'm not cognizant of how pertinent this is to -- or can't we get there in a much quicker fashion?

MR. ROYALL: Your Honor, I think that we can, but I do think that the question -- the issue of how the witness defines the term "revolutionary technology" is a very important issue in the context of his testimony in this case.

JUDGE McGUIRE: That's fine. I just want to see if you can expedite the examination on that.

MR. ROYALL: I'll seek to do so.

Let's pull that down.

BY MR. ROYALL:

Q. You acknowledge, don't you, that a technology might be revolutionary in terms of permitting a great performance advantage but still not have a substantial

market value because the performance advantage comes at a comparably high cost?

A. Yes.

Q. And you agree, don't you, that in the DRAM marketplace the technologically superior alternative does not always win?

A. I admit to that possibility.

Q. And you acknowledge the possibility that a product that offers dramatic performance improvements may be ahead of its time from the standpoint of what customers are demanding at a given point in time?

A. Certainly, yes.

Q. And if a technology were so ahead of its time that it was not demanded by customers, that would not satisfy your definition of revolutionary?

A. That's where I'm not following. It is -- it could be revolutionary and still not satisfy the demand of customers and satisfy their demand some years later. In other words, there is a time frame that needs to be considered.

Q. Okay. But appreciating that, from the -- if you were to evaluate whether something is revolutionary from the standpoint of a time frame in which customers were not demanding the performance characteristics that that technology offered, maybe they would in the

future, but from that standpoint, from that point in time, you would not say that that technology is revolutionary at that time?

MR. STONE: Your Honor, I object on two grounds.

One, it's beyond the scope. I just checked the transcript. The word "revolutionary" was not used at all yesterday in the testimony that this witness provided.

And secondly, this line of questioning on the definition of "revolutionary" has now become cumulative.

JUDGE McGUIRE: That's sustained on the ground that it is becoming cumulative. The scope question I'll -- I will hear you on that, Mr. Royall.

MR. ROYALL: Well, the -- I believe that this is well within the scope of the direct testimony. The witness, in answering my questions earlier, has agreed that formal standardization is less likely to enhance market power when the technologies are revolutionary.

JUDGE McGUIRE: But that's on your examination. The question is the scope of their examination.

MR. ROYALL: Oh, yes, but the question -- the issue related to whether formal standardization leads

to market power. That is one of the essential conclusions --

A. If they are both revolutionary and desired by customers. Now I'm going to draw a distinction between those two. If they are -- if the characteristic that makes them revolutionary is something that is desired by customers, then the answer is sure.

Q. And am I right that it's your view that Rambus' RDRAM technology when it was first introduced into the marketplace was a revolutionary technology, as you define the term?

A. Yes.

Q. And as you define the term, Rambus' RDRAM technology was more revolutionary than either SDRAM or DDR SDRAM?

A. Yes.

Q. In your view, DDR is not a revolutionary technology; is that right?

A. To the extent that DDR's performance characteristics derive from inventions that were first embodied in RDRAM, then the answer is no. If it's simply a matter of comparison to a previous generation, then the answer -- then that's a different story.

Q. Well, you said that to be revolutionary the technology cannot have close economic substitutes; right?

A. Right.

Q. Did DDR when it was introduced have close economic substitutes?

MR. STONE: Your Honor, I do object again that this goes beyond the scope. The question of whether DDR has economic substitutes and the question of how RDRAM did in the market, which seem to be the subjects of this line of examination, are well beyond the scope of the direct.

And I don't mean to inhibit the ability to do a cross-examination that brings you back to the issues that were covered on direct, but I do think these issues were not touched on on direct at all and are beyond the scope.

JUDGE McGUIRE: Mr. Royall, I'm really at a point where I'm going to cut you off now. I think you've explored this issue adequately.

MR. ROYALL: Your Honor, if I could just be heard on this because I do believe this to be a very significant issue.

Putting aside what questions were asked of the witness on direct -- and I'll acknowledge the word "revolutionary" may not have come up -- in the witness' expert report, which the commission's rules require set forth the bases for the opinions and

conclusions, the same opinions and conclusions that he testified to yesterday, the bases for those conclusions on market power and other issues included in a very central way this issue of a revolutionary technology and the relevance of that, and so my position would be that because that was a basis for the conclusions that we heard about yesterday -- it may not be a basis that came out on direct, but it was nonetheless a basis and indeed a central basis for those conclusions -- that it would be prejudicial to our case to be deprived an opportunity to conduct this examination.

JUDGE McGUIRE: I think you've had the opportunity. The issue here is how much more time do you feel you need to spend on this and I feel you need to spend on this, so it's not a question of not having had the opportunity. You've been on this now for several minutes.

I will inquire of you again, how much more time do you intend to spend on this?

MR. ROYALL: I -- I'm happy, Your Honor, in response, to expedite this portion of the examination, but I will say that this is such a central issue that I don't feel like I can leave this issue alone given that it was -- it may be something that was for

reasons -- Rambus for their own reasons has chosen not to focus on as a basis, but it is a central basis in the report.

But I'm happy to expedite and move through much of what I was planning to cover in deference to Your Honor's preferences, if that's what you would like.

MR. STONE: I want to respond only on one point.

We don't agree it's central. The witness hasn't said it was central. He may agree or disagree with that point. I don't agree it's central. I disagree only to the extent that Mr. Royall characterizes the report one way or the other.

JUDGE McGUIRE: Ultimately I have to decide whether it is central to the arguments of either side, so you can go into it for somewhat more, Mr. Royall, but I'm just not going to allow you to continue on this for the next, you know, half hour. I'm just not going to let you do it, and then you can make whatever arguments that you want.

But I'll give you some more inquiry on this, but you know, you need to decide what questions you want to be sure to cover on this because you just don't have much more time to spend on this, so --

MR. ROYALL: I understand, Your Honor.

JUDGE McGUIRE: So for the second time I'm going to ask you to expedite this and I'm not going to ask a third time.

MR. ROYALL: Thank you, Your Honor. And what I propose to do is to move away from the issue for a moment and then see if I need to come back to it.

JUDGE McGUIRE: Okay.

BY MR. ROYALL:

Q. Let me shift gears for a moment, Dr. Rapp, and ask you about what your understandings or assumptions

constraints imposed by the existence of alternative technologies; correct?

A. Yes.

Q. And some of the alternatives to, let's start with, programmable CAS latency and programmable burst length are in your view close enough alternatives that they provide some competitive constraint on Rambus' ability to increase the royalty rates relating to those technologies?

A. Yes.

Q. And in your view, there are also competitive constraints imposed by alternatives on Rambus' ability to increase royalty rates relating to the use of its technologies in DDR SDRAMs?

A. Yes.

Q. And in your view, the competitive constraints on Rambus' ability to raise its royalty rates for SDRAM devices are such that it would not be profitable for Rambus to attempt to raise its current rates, that is, or what you assume to be its current rates above the levels that you've assumed to exist today?

A. That's an inference. I mean, I -- among the various opinions that I've offered in the past day and a half, I don't want that to rise to a high level of analysis. I'm assuming that Rambus' royalty rates are

constrained by substitutes, and that is the -- that's the extent of my understanding. Or substitution possibilities I should say.

Q. You agree that the level of market power associated with a product or technology depends in significant part on the extent to which there are price-constraining alternatives for that technology?

A. It depends upon whether there are close economic substitutes. Price-constraining alternatives are -- you know, can be present and can be a force, but it is the -- let's put it this way. It's the closest price-constraining alternative that is the relevant one in response to your question.

Q. And you agree that if standard-setting activities were to have the effect of eliminating price-constraining alternatives as commercially viable alternatives, that could have the effect of enhancing the market power of the technology that was standardized?

A. In certain circumstances, yes.

Q. Now, in explaining your views on market power in this case in your expert report you use something in your report that you refer to as a matrix. Do you recall that?

A. Yes.

are incompatible?

A. Yes.

Q. And in a market in which a user or manufacturer can easily substitute between different incompatible technologies, you would say that there are low compatibility requirements?

A. Right.

Q. And in markets where users or manufacturers cannot easily substitute between different incompatibility -- different incompatible technologies, you would say there are high compatibility requirements; right?

A. Right.

Q. And in the matrix that we're referring to, the outcomes that you depict in terms of high and low compatibility, those outcomes you think should -- are more appropriately thought of as a continuous spectrum of outcomes from low to high compatibility?

A. In reality, they are continuous as opposed to the presentation device of a dichotomous, either/or, yes-or-no matrix, that's correct.

Q. And in the matrix that we're referring to, you also considered the extent to which a technology could be categorized as a minimal advance as opposed to a great leap forward; is that right?

A. Yes.

Q. And by "a minimal advance" you're referring to a technology that has a number of preexisting cost or performance equivalent alternatives?

A. Yes.

Q. And generally speaking, a minimal advance as you think about it is a technology that absent formal standardization will have low value or low market power?

A. Right.

desirability by consumers, but generally, yes.

Q. Let me ask you to look at your expert report, paragraph -- I'm sorry -- footnote 31, which is on page 14.

And am I right that in that footnote of your report you note that your report uses the term "revolutionary" or sometimes "great leap forward" to refer to a substantial advance in performance relative to older technologies or existing or known alternatives?

A. Yes. And then it goes on to say, "Thus, revolutionary implies having no close economic substitutes," which satisfies the first of those conditions but not the second on your chart.

Q. And you -- but you would define the term "great leap forward" in the same way?

A. Yes. As revolutionary, as it appears in footnote 31, correct.

Q. We can pull that down off the screen.

Now, all things equal, where the technology involved or where the technology that we're considering involves only the most minimal advances, standardization through a formal standard-setting process in your view would have greater potential to add value or market power to the technology?

A. All else equal, yes.

Q. Now, in terms of this matrix that you've used in describing your opinions on market power to the commission, to other courts and in this case, you have views on how you would characterize the four Rambus technologies that are at issue here in the context of such a matrix; is that right?

A. Yes.

MR. ROYALL: May I approach, Your Honor?

JUDGE McGUIRE: Go ahead.

We'd better mark that -- let's mark that as I think it's 326.

MR. ROYALL: That sounds right. Thank you.

(DX Exhibit Number 326 was marked for identification.)

MR. ROYALL: I'll go ahead and mark this one before we go ahead.

(DX Exhibit Number 327 was marked for identification.)

BY MR. ROYALL:

Q. I hope -- I don't know if you can read my writing, but what I've written on this four-quadrant matrix, on the top left I wrote "minimal advance," top right "great leap forward."

Does that correspond with the matrix we've been

discussing?

A. Yes.

Q. And in the -- on the vertical axis on the top I wrote "low," referring to low compatibility.

Does that correspond with your matrix?

A. Yes.

Q. And on the bottom I wrote "high," referring to high compatibility --

A. Right.

Q. -- and that corresponds?

And then I'm just going to put arrows up and down on both axes to reflect this concept of these -- both of these being continuous spectrums or continuous ranges, as you described earlier --

A. Right.

Q. -- right?

those right here (indicating)?

JUDGE McGUIRE: Where is "here"?

BY MR. ROYALL:

Q. For the record -- I'm sorry -- right on the line between "minimal advance" and "great leap forward" but in the low compatibility range?

A. Well, yes, if it's -- it should be a little over from the line, not right on the line. But -- but yes. In other words, not squarely in the "great leap forward" category.

Q. So close to the border?

A. Yes.

Q. Okay. And I'm placing my finger close to the border so --

A. I'm understanding that matrixes don't really work that way, but let's put it close to the border.

Q. So I've put the -- I've written "R-1" on the far left-hand of the "great leap forward" category but in the low compatibility region, and R-1 to refer to programmable CAS latency and programmable burst length.

A. Okay.

Q. Does that reflect your views as to where you would place those technologies in this matrix?

A. Yeah. Understanding that these are approximate

and conceptual and not based on calculation the way some of my other testimony has been.

Q. And understanding that, am I right that you would then place the other two Rambus technologies, on-chip PLL/DLL and dual-edged clock, in the middle of the "great leap forward" box on a horizontal -- horizontally but still in the same low compatibility region?

A. Still in the low compatibility region. "The middle" means squarely in the "great leap forward" category.

Q. So I've written "R-2" to refer to that and then I've just defined R-2 to refer to DEC, or dual-edged clock, and PLL/DLL.

Now, am I right that at an earlier point in your thinking about the issues in this case you would have placed all four of the Rambus technologies on this matrix in essentially in the place where I've written "R-2" in this box? Is that right?

A. That is correct.

Q. And you later, based on further analysis and review of facts or understanding of facts, you later came to the view that the programmable burst length and programmable CAS latency technologies should be moved further to the left as reflected in DX-327; is that

right?

A. Yes.

Q. And that's because over time you gained a fuller or more complete understanding of the extent to which those technologies satisfy the great leap forward or revolutionary definition as you defined that definition earlier?

A. Yes.

Q. Now, as we've noted earlier, as you noted earlier, this matrix that I've drawn up here, this is my effort to characterize or to depict it, but this -- essentially this same matrix is something that you have used in various written submissions in addition to your expert report in this case?

A. Yes. As a device for explaining in general terms the relationship between compatibility requirements, the degree to which a technology leapfrogs earlier or extends beyond earlier technologies and the likelihood that standardization will enhance market power.

Q. And within the framework of your analysis and in your opinions, the placement of these technologies in the low compatibility region of this matrix is quite significant, is it not?

A. Yes, it is.

Q. And it's significant because within the framework of your analysis, placing these technologies in the low compatibility region makes it far less likely that formal standardization of these technologies would enhance the market value of the technologies; is that right?

A. Right.

Q. But in another case, in the Infineon case, you took the position that when it comes to positioning SDRAM on the same matrix, the compatibility requirements were sufficiently high that SDRAM should be positioned on the bottom row of the matrix, that is, in the high compatibility region; isn't that right?

A. That was not my position. That was a single question and answer in a deposition and either it was a mistake on my part or it was -- it had to do with the context of the question.

If you -- if you were to look at my Infineon expert report, you would see that I did not have a change of heart or I didn't have an earlier opinion that was different from my current opinion at all about compatibility requirements, notwithstanding a question that reads as you describe.

MR. ROYALL: May I approach, Your Honor?

JUDGE McGUIRE: Go ahead.

BY MR. ROYALL:

Q. Dr. Rapp, I've just handed you a copy of your deposition in the Infineon case, and let me ask you, if you could, to turn to page 128.

A. I just need to pause for one second if I may. It will take me a little longer to get to that page.

Q. Oh, sure.

(Pause in the proceedings.)

Just tell me whenever you're ready.

A. Sure. Just give me a second.

(Pause in the proceedings.)

128 you said.

Q. Yes.

And I don't think that the copy that we have here has line references. By my count, I would like to start at what is line 12, which is the first question on page 128 of that transcript.

A. I'm with you.

Q. And the version of it that's on the screen does have line references and it shows that I was actually off in my count. It's line 13.

A. Uh-huh.

Q. And starting with that line, my question was: "And if you do need the same device in order to

accomplish what you need, then we're in the situation where there is high compatibility requirements?"

I'm sorry. This was not my question; it was the lawyer's question in the Infineon case.

A. Right.

Q. Your answer: "Yes.

"QUESTION: In order for the system to work, the machine that you're putting it into to work?

"ANSWER: Right.

"QUESTION: Now, SDRAM has to work in a specific way. It interacts with the microprocessing unit. It interacts with other parts of the computer.

"ANSWER: Right.

"QUESTION: And so SDRAM, if you change some part of SDRAM, it may impact how the other parts of the computer perform; correct?

"ANSWER: I agree."

We're now on page 129.

MR. STONE: Your Honor, I move to strike this line of questioning and object to it on the grounds it does not impeach. The witness admitted that he gave testimony in his Infineon deposition and this testimony is not at all impeaching. He's admitted that he gave testimony in his Infineon deposition just as he was asked by Mr. Royall initially, and the

reading from that deposition transcript does not impeach him.

JUDGE McGUIRE: Mr. Royall?

MR. ROYALL: Your Honor, I submit that it does impeach because he did not merely say that he gave testimony, but he said that he gave testimony and it did not involve placing these technologies in a different region on the matrix, and that's what I'm seeking to do through this impeachment --

JUDGE McGUIRE: Overruled.

MR. ROYALL: -- is to show that he did.

BY MR. ROYALL:

Q. So picking up on page 129, the question was: "So SDRAM is a situation where there are high compatibility requirements?

"ANSWER: I agree.

"QUESTION: So we're now no longer in the top row of your chart; we're now in the bottom row of your chart?

"ANSWER: Right.

"With respect to SDRAM?" was the question.

"ANSWER: Correct.

"QUESTION: And so with respect to SDRAM now, we're in a situation where standards may be important if the technology is a minimal advance, and standards

preceded by colloquy about the difference between parts compatibility and network compatibility.

But insofar as I answered that question yes to the proposition that RDRAM technology belonged in the high compatibility region of the matrix, that was wrong. My -- I'm sure that my expert report in Infineon did not indicate that that was so. And that would not have been my opinion if we were -- if I had testified at trial.

Q. Just to be clear, you made a reference to parts compatibility versus systems compatibility; right?

A. Right.

Q. The matrix that I've drawn here and that you've used in other reports, it doesn't -- it doesn't relate to parts compatibility.

When you use the term "compatibility" in this context, you're referring to systems compatibility; right?

A. I'm referring to compatibility in general, but right in the sense that high compatibility requirements implies -- sorry -- that it -- I'm going to start that answer again.

The reference is to compatibility requirements in general on that matrix, and generally speaking,

when you see high compatibility in the lower half of that matrix, what I have in mind is network compatibility.

Q. So when you answered the question of the Infineon lawyer and said so SDRAM -- the question was: "So SDRAM is a situation where there is high compatibility requirements?

"ANSWER: I agree.

"QUESTION: So we're no longer in the top row of your chart; we're in the bottom row of your chart?

"ANSWER: Right."

When you said that, you were saying that SDRAM was in the high compatibility, meaning high network

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3 compat1rement, yomarketplaceompatibility requ19ity requAjTYesjTT R

time; isn't that right?

A. They have.

Q. You are not of the view any longer that a single, large, sophisticated purchaser of DRAM could realistically specify its own requirements for memory; is that right?

A. Correct. I think that a single microprocessor manufacturer, Intel, can specify essentially its own standard and have the industry follow along, but I do not think that it is true either of the manufacturer or a consumer, that is to say, a buyer of DRAM.

Q. And am I right that you acknowledge that there are advantages to commoditization of DRAMs?

A. Yes.

Q. And you agree that it would be contrary to the economics of the DRAM industry for a single DRAM manufacturer to attempt to develop a unique specification for DRAM at the cost of losing benefits of commoditization?

A. I just need to have that back again.

(The record was read as follows:)

"QUESTION: And you agree that it would be contrary to the economics of the DRAM industry for a single DRAM manufacturer to attempt to develop a unique specification for DRAM at the cost of losing benefits

of commoditization?"

THE WITNESS: The answer is yes with the following qualification. I think that it would probably go against the economics of the industry for a single DRAM manufacturer to define a specification that would be incompatible with other DRAM of that generation. But I do not -- but that does not mean that individual DRAM manufacturers cannot diversify their products in ways that do not affect compatibility so that we can have product diversity in that market.

BY MR. ROYALL:

compatibility requirements within the context of this

which standard-setting creates value?

A. No. What I'm really trying to get at in that particular respect is whether it is possible to have multiple flavors, multiple specifications, not necessarily many, but a few, so that the -- and it is the overall matrix that speaks to the issue of value. The connection betweenu-- I'm sorry.

likely to enhance value in markets in which multiple

industry standards can coexist; is that right?

A. Yes.

Q. And in a market in which compatibility requirements are low, it would be more likely that multiple standards could simultaneously coexist?

A. Right. Multiple standards or specifications, correct.

Q. And in your view, standardization is more likely to enhance value -- I'm sorry. Let me restate that.

And in your view, standardization is more likely to enhance value in markets in which industry standards either cannot or do not coexist; right?

A. Just read it back for me, please.

Q. I can restate it.

A. It's clear. I just lot the thread.

Q. That's fine.

In your view, standardization is more likely to enhance value in markets in which multiple industry standards either cannot or do not coexist?

A. Yes.

Q. And in a market in which compatibility requirements, as you define that term, are high, it would be more likely that there would be only one dominant standard in the marketplace; is that right?

A. Yes. At the extreme -- again, this matrix talks about the limits, minimum advance, great leap forward, high compatibility at the extreme, low compatibility. The answer is yes.

Q. So in a way, isn't the compatibility requirements consideration a proxy for the importance of having a single industry standard in the relevant marketplace?

A. It's not a proxy. It is a -- it is a -- there is a causal economic connection. By using compatibility requirements, I am trying to, in this, what is essentially a teaching device, trying to make clear what the issue is underlying the possibility of having multiple standards.

Q. And would you agree that in a market in which historically there were, say, to pick a number, twenty competing standards, each with 5 percent of the market, that type of market is one that you would place on the extreme low end of the compatibility continuum --

A. Yes.

Q. -- right?

And a market, by contrast, in which historically there were only one dominant standard accounting for 90 percent or more than 90 percent of

the market, you would put that type of market on the extreme high end of the compatibility continuum, maybe not the very end but up toward the end of the high end?

A. Well, if that were necessary as a result of the compatibility requirements rather than for some other reason, the answer is yes. If that were an outcome that would be required in all circumstances, the answer is yes. If that condition couldn't be violated, if there always had to be only one, then the answer is yes.

Q. Isn't it true, Dr. Rapp, that the historical evidence in the DRAM industry strongly suggests that this is an industry in which having a single dominant standard is important?

A. No. I think that it is an industry in which the recent history of the standards set within JEDEC suggest that they do things one at a time, but it is not an industry in which the economics and the engineering requirements, insofar as that I understand them, compel a situation where you can't have coexisting different specifications of DRAM.

Q. Well -- and you have, as part of developing your opinions in this case, you've considered the market shares attributable to different DRAM

architectures over time; is that right?

A. I have looked at that subject, yes.

Q. And that's something that you report in Exhibit 3 to your expert report; is that right?

I'll give you a moment to look at that.

If I can clarify that, the data on historic market shares of different DRAM architectures is something that you report in that exhibit to your expert report.

A. Right.

MR. ROYALL: If I could approach the easel?

JUDGE McGUIRE: Fine.

BY MR. ROYALL:

Q. Now, referring to that exhibit to your expert report, Exhibit 3, am I right that the numbers that you report there are broken down by DRAM architecture for the years 1994 through 2006?

A. Yes.

Q. And the numbers given for 2002 and beyond are forecasted numbers as opposed to historic numbers; is that right?

A. Correct.

Q. And the numbers for the prior years 1994 to 2001 are historic revenue data for different architectures; is that right?

A. Yes.

Q. Now, I'd like to make some notes based on that information, if you could follow along with me.

Am I right that for 1994 your Exhibit 3 reports that the leading DRAM technology by market share was fast page mode?

A. Yes.

Q. And in that year you report that fast page mode had a 96.7 percent share?

A. Yes.

Q. So I'm going to write my notes here, DX-3 --

JUDGE McGUIRE: 328.

MR. ROYALL: 328. Thank you.

(DX Exhibit Number 328 was marked for identification.)

BY MR. ROYALL:

Q. I'm just going to round that off to 97 percent.

And I round down, too. I'm not only rounding up.

Now, in 1995 fast page mode was still the leading technology and you report that in your Exhibit 3; right?

A. Yes.

Q. And in that year you report that it had an 87.2 percent share; is that right?

Q. I'll round that to 61 percent.

And then in 1999 you report that SDRAM again had the highest share and in that year it was a 69.3 percent share; is that right?

A. Yes.

Q. So 69 percent for SDRAM.

And in 2000 you report that SDRAM again had the highest share and it was a 78.4 percent share; is that right?

A. Right.

Q. So 78 percent for SDRAM in that year.

And then the final year for which you report historic data, 2001, again SDRAM had the highest share at 69.7; is that right?

A. Yes.

Q. So round that to 70 percent for SDRAM.

And since what we've been talking about here are the shares of the leading technology, I'm just going to title this Shares of Leading DRAM Technologies, and I think the years are apparent from the exhibit.

Now, I'd be happy to give you a calculator -- I think we have a calculator -- if you want it. But I'm told that if you average these numbers that the average comes out to be 71.25 percent.

Would you like to verify that?

A. I'd be happy to assume it if an assumption would suffice.

Q. I think that's fine, and the record will reflect that I represented that to be true, and I'm just going to write "average equals" and round that as well to 71 percent.

Now, doesn't this data from your report

or anything like that. The following year, just one year later, SDRAM is in the market and has captured, if I'm reading this right, a 33.5 percent share and FPM isn't gone with either.

So what we've got in any given year is the market being divided among incompatible standards. Now, I don't know whether that's true of FPM and EDO, but it seems to me that it teaches exactly the opposite thing, that there is no technological requirement that only one standard has to dominate.

Q. Dr. Rapp -- are you finished?

A. I am.

Q. Dr. Rapp, isn't it true that you are unaware of any time in the last 13 years, going back to 1990, in which there was not a single dominant standard in the DRAM industry?

A. If by "dominant" we mean one higher than the other, yes, but if -- but you can't look at those numbers and take that statement to mean that there is no coexistence of different standards in the market. The numbers say the opposite.

Q. It is your understanding, is it not, that at every point since 1990 there has been a single dominant standard in the DRAM industry?

JUDGE McGUIRE: Okay. Mr. Royall, I'm going to

ask you as to how you define the term "dominant," because he just answered that question based on his understanding, so I guess we need to ask yours now.

MR. ROYALL: I'm happy to withdraw the question and accept his earlier answer on that.

JUDGE McGUIRE: Thank you.

MR. STONE: Your Honor, are we -- I don't mean to interrupt, but are we getting at a break point?

MR. ROYALL: Very close. I was about to suggest that actually.

BY MR. ROYALL:

Q. Now, I understand that you have things to say about economic theory and you have things to say about what maybe the historical data show, but focusing just first on the historical data -- and I have one or two questions here and then we can take a break -- you're not saying that this historical data shows that this is a marketplace in which multiple standards have simultaneously coexisted?

A. That's exactly what I'm saying. That's precisely what I'm saying.

Q. Isn't it true, Dr. Rapp, that you admit that the DRAM industry is not full of examples of multiple standards coexisting?

A. It's --

Q. At least within the same generation?

A. Ah. No. It's an industry -- I agree with that. It is an industry that one generation sron srof0 sc(4(

the ones that I gave earlier, FPM and EDO, but they are both within a single generation and they both coexist.

JUDGE McGUIRE: Okay. Very good. I think this is a good time then to take a break. We'll be off the record for ten minutes.

MR. ROYALL: Thank you, Your Honor.

(Recess)

JUDGE McGUIRE: At this time you may proceed with your inquiry, Mr. Royall.

MR. ROYALL: Thank you, Your Honor.

BY MR. ROYALL:

Q. I'd like to move on to another subject, Dr. Rapp.

A. Uh-huh.

Q. Am I right that it's your conclusion that Rambus' challenged actions or what you understand to be Rambus' challenged actions at JEDEC did not affect JEDEC's choice of memory technology?

A. Yes.

Q. And you believe or it's your conclusion that in a but-for world in which Rambus had disclosed all of the patent-related information that complaint counsel contends it failed to disclose or wrongfully failed to disclose that in such a but-for world the disclosure of

Rambus technologies?

A. That's correct. I hadn't studied the balloting and so forth.

Q. And you didn't know, for instance, whether prior to their ultimate adoption there was any opposition within JEDEC to the use of any of those four technologies?

A. Right.

Q. And you didn't know whether any alternatives to those four technologies were discussed within JEDEC?

A. Right.

Q. And you didn't know which companies in particular were most vocal about promoting any particular alternatives?

A. Right.

Q. And you didn't know --

MR. STONE: Your Honor, I object. The line of questioning about what JEDEC did or didn't do was a line of questioning to which Mr. Royall objected on the grounds it was not covered by his expert report, and I was not permitted to question about this area.

Having foreclosed my questioning on this area, his efforts to go back into the -- I understand he made an argument earlier that Mr. Rapp had not done a

detailed analysis of JEDEC's behavior, which he admitted, but to go into this detail is beyond the scope of the direct and inconsistent with the objections earlier made by complaint counsel.

JUDGE McGUIRE: Mr. Royall.

MR. ROYALL: Yes, Your Honor. My objection was simply that I didn't believe the witness should be permitted to testify as to matters that aren't in his expert report and it was a perfectly appropriate objection. What I'm doing now is demonstrating that he reached a conclusion without certain information, which I think is perfectly appropriate cross-examination.

JUDGE McGUIRE: Overruled. I will hear it on that basis.

BY MR. ROYALL:

Q. And you didn't know, Dr. Rapp, when you reached that conclusion which companies in particular were most vocal about promoting any particular alternative?

A. Right.

Q. And you didn't know what pros or cons may have been discussed within JEDEC relating to any given alternative?

A. Yes.

Q. And that's because you did not look at the evidence, that is, before completing your expert report, you did not look at the evidence relating to the process through which JEDEC made the decisions that it in fact did make in developing the relevant standards?

A. All of that is correct.

Q. And so you developed your opinions about the commercial viability of various alternatives without having any understanding as to why JEDEC in fact chose the four Rambus technologies over any alternatives that it may have considered?

A. Yes. And that is because the commercial viability and substitution qualities of those alternatives are independent of what got said in JEDEC.

Q. Now, don't you agree, Dr. Rapp, that knowing the reasons behind JEDEC's selection of -- and let's focus on SDRAM for the moment -- but knowing the reasons behind JEDEC's selection of SDRAM as the standard, the current formulation of SDRAM, knowing the reasons behind JEDEC's selection of SDRAM as a standard is something that would be important for the purpose of evaluating the economic soundness of whether a given alternative in the but-for world would or would not

have been attractive to JEDEC?

A. No. My job is to provide an economic analysis of substitution based upon cost-performance, and it is -- it's not necessary for me to know about the JEDEC process or the opinions of JEDEC members in order to make my contribution to the record in this case.

Q. Let me ask you, if you can find it in front of you, if you could take a look at the rebuttal report that you submitted in the Micron case which we briefly touched on yesterday.

A. I have it.

Q. Let me ask you to turn to page 6 of that report.

A. I'm with you.

Q. And in this report you were setting forth your critiques and comments on the Micron expert's economic conclusions, that is, Professor Carlton's conclusions; is that right?

A. Uh-huh. Yes.

Q. And in the first paragraph on page 6 you state, "Knowing the reasons behind JEDEC's selection of SDRAM as the standard is important for evaluating the economic soundness of the assumption that the members would have switched to an alternative

technology if Rambus' potential future royalty demands were disclosed at the time the SDRAM standard was being set."

Do you see that?

A. Yes.

Q. That was a statement that you made in the context of criticizing Professor Carlton's work or his conclusions; is that right?

A. Yes.

Q. And in that case Professor Carlton offered the conclusion that if Rambus made the patent disclosures to JEDEC that it has been argued it failed to make or should have made, JEDEC would have switched to alternatives, that was the conclusion he was offering?

A. Right.

Q. And what you were saying here was that, in the course of criticizing Professor Carlton, was that in your view an economist cannot offer sound economic conclusions about what JEDEC would or would not have done in terms of switching to alternatives without knowing the reasons behind JEDEC's selection of the SDRAM standard; right?

A. All of that takes place in the absence of the kind of information that Mr. Geilhufe and Dr. Soderman provided. This critique of Professor Carlton had to do

with the fact that the two of us were opposed to one another as experts in this trial and Professor Carlton had proposed that there were alternatives to the Rambus technology without stating what those alternatives

to alternatives because you submitted that he didn't know the reasons behind JEDEC's selection of SDRAM as the standard; right?

A. In a different context than this one, right.

Q. And you have offered conclusions in this case about what JEDEC would have done in a but-for world in

at issue here and that have been allegedly not disclosed in a wrongful way, your opinion that if that were to have happened in a but-for world JEDEC would not have altered its memory technology choices in these standards, in developing that opinion, am I right that you also did not give consideration to JEDEC's specific processes or rules for dealing with patent disclosure-type issues?

A. Well, I understood in general terms what they were, but I didn't delve into them in forming that conclusion.

Q. When you wrote your report in this case, isn't it true that you did not have any understanding one way or the other as to whether JEDEC's rules impose any limitations on the ability of JEDEC committees to adopt standards that incorporate patented or patent-pending technologies?

A. I don't recall. I think I must have had some information, but if that's what I testified to, then I'll stand by it.

Q. Well, let me ask you to take a look at your deposition --

A. Okay.

Q. -- in this case, page 196.

And I'll just refresh your recollection on what

you did testify to in this case.

A. Let me catch up.

Q. Oh, I'm sorry.

A. That's all right.

Q. Starting on line 7, my question was: "Do you have an understanding as to whether JEDEC's rules impose any limitations on the ability of JEDEC committees to adopt standards that incorporate patented or patent-pending technology?

"ANSWER: I don't. Sorry, I don't have that particular understanding."

Do you see that?

A. Yes. I'd just like to look behind that a little bit. The "yes" was to that I've seen it.

Have I got a different pagination here or am I looking at the wrong document?

Q. I'm sorry.

If I could approach, Your Honor.

The transcript from this case is this document (indicating). You may be looking at the Infineon one.

A. Thank you.

Q. And it's page -- I'm sorry. I thought we were on the same page. It's page 196.

A. Just let me catch up and have a look a bit at what surrounds that. 196?

Q. Yes.

A. I see the question and answer. Just let me refer you back, if I may, to the preceding page.

There's a question that reads as follows: "Assuming Rambus had disclosed to JEDEC that it possessed patents or patent applications that related to JEDEC's standardization work, do you have an understanding as to how, in terms of its process, JEDEC would have responded to such disclosures?"

And I answered: "I understand that at some point -- and I don't know where, if the -- that a request, if that is the right word, for an assurance that licenses would be granted on a reasonable and nondiscriminatory basis would be requested, that the request would be made."

The reason that I'm reading that is because that's the antecedent to your question. It does bespeak some understanding about what would go on in JEDEC under these circumstances. And the later question sort of assumed that had been taken care of I think.

Q. And just to complete this before we leave this page, immediately after what you read, I asked the question on the bottom of page 105 starting at line 21: "Do you have any further understanding of what would

have happened in terms of JEDEC's process had Rambus disclosed the existence of relative patents or patent applications?"

And you answered, "No."

A. Right.

Q. Okay. Now, when you developed your opinions as to what JEDEC would have done in a but-for world in which Rambus had made the challenged disclosures or nondisclosures, you were not aware of anything in JEDEC's rules or in its procedures that might have precluded JEDEC from using Rambus' technologies if they ranked higher on a cost-performance basis than all alternative technologies; is that right?

A. Right.

Q. And when you developed your opinions, you were not aware of whether in the history of JEDEC there has ever been a situation in which a company had disclosed a patent or patent application to JEDEC and JEDEC proceeded to adopt that proprietary technology as part of its standard?

A. Right.

Q. I'm sorry. You said "right"?

A. Uh-huh.

Q. Now, let me move to the subject of lock-in, and in that regard let me ask you to take a look at -- we

can put this on the screen -- DX-317, which is a slide that was presented in connection with your testimony, your direct testimony yesterday.

Can we blow that up? Is that -- that's not what I had marked as DX-317.

Okay. Now I think we're on the same page.

Do you see the slide on the screen, Dr. Rapp?

A. Yes.

Q. This is a slide that you prepared relating to your opinions on switching costs and generally the subject of lock-in; is that right?

A. Yes.

Q. And you say here -- and the title of this slide is Switching Costs Are Relatively Low, and that is your opinion, that the switching costs that are relevant to your economic analysis of the markets at issue here are relatively low?

A. I didn't hear the question. My economic analysis of?

Q. It's your opinion that the switching costs that are relevant to your economic analysis in the context of the markets at issue here, that those switching costs are relatively low?

A. Yes.

Q. And the categories of costs that you refer to

on this slide, DX-317, are design costs, qualification costs and phototooling costs.

Do you see that?

A. Yes.

Q. Is it your opinion that those are the only relevant categories of cost to look at from the standpoint of assessing switching costs in the context of this case?

A. For this particular technology, yes.

Q. Are there additional switching costs that you would look at in context of other technologies?

A. The -- what I'm doing here is using an SDRAM example. Whatever it was that Mr. Geilhufe recorded about switching with respect to the two DDR technologies that don't appear in SDRAM, for example, they might be included.

Q. Well, without referencing Mr. Geilhufe's testimony, can you tell me whether there are other switching costs that you believe are relevant to consider besides these three costs either in the context of these technologies or other technologies?

A. To the extent that we are speaking about switching from other Rambus technologies, then the -- then any up-front costs associated with that switch are appropriate. I don't think that there are any costs

other than design, qualification and phototooling, but

the fixed latency and fixed burst length technologies --

A. Yes.

Q. -- is that right?

And would it be relevant from an economic standpoint to consider such costs on a per-manufacturer basis or a per-plant basis?

A. Certain of the costs if more than one line were involved or more than one plant were involved might conceivably be greater.

I don't know what Mr. Geilhufe's assumption was about phototooling. Oh, he -- yes, his assumption was that this was phototooling associated with a given product run, so I think he has -- I don't know what he assumed about the number of plants, but presumably the phototooling that he was reckoning with was for a full production run, so the answer is that whether it's at the manufacturer level or the plant level is immaterial to me. It's been taken account of.

Q. And the only basis that you have for the numbers that you report here is Mr. Geilhufe; is that right?

A. Right.

Q. And you don't present an example I don't believe or you have not presented an example of the

costs associated on a -- for a single manufacturer associated with switching from the technologies used in DDR to alternative technologies?

A. That's right. And I haven't presented other alternative SDRAM alternatives other than fixed burst and CAS latency. But the numbers are characteristic, looking at Mr. Geilhufe's tables, the design costs that are listed and qualification costs are all in the same magnitude.

Q. You agree, don't you, that from the standpoint of assessing lock-in in this case it's important to look beyond the cost of a single manufacturer and to take into account the costs that would be borne by the entire DRAM manufacturer or the minimum multiple DRAM manufacturers?

A. You could multiply this as needed by the number of manufacturers.

Q. Now, if the DRAM industry as a whole or multiple DRAM manufacturers were to seek to work around Rambus' technologies by defining alternative versions of the SDRAM and DDR SDRAM standards, you acknowledge, don't you, that for that effort to be successful, in terms of leading to commercially viable alternative products, there would have to be changes in other products besides DRAMs for that to be a viable avenue;

is that right?

A. Yes, I agree.

Q. And if a group of DRAM buyers or the DRAM industry as a whole were to attempt to pursue this round of developing alternative standards to work around Rambus' patents, they would need to coordinate with manufacturers of other products; correct?

A. Yes.

Q. They would have to coordinate with the makers of microprocessors; right?

A. Yes.

Q. The makers of chipsets?

A. Yes.

Q. Motherboards?

A. Socket makers. Motherboards, I'm -- I guess you could include that, but I'm not really sure.

Q. You're not sure?

A. Certainly the makers of sockets if different pin configurations are required.

Q. Do you know, Dr. Rapp, who Mr. Richard Heye is?

A. I read testimony of his, but I don't recall his affiliation. I know that he testified in this trial.

Q. Okay. So you have read trial testimony from

Mr. Heye?

A. Yes.

Q. Mr. Heye is an executive of AMD. I don't know if that refreshes your recollection, but I'll represent that to you.

A. Sure.

Q. Let me pull up, if we have it, the demonstrative exhibit that Mr. Heye created at trial. Can we blow that up so that he can -- so we all can see this?

Can you see that on the screen?

A. Yes.

Q. Have you seen this demonstrative exhibit before? This is DX-30.

A. Yes, I have.

Q. Does that demonstrative exhibit help you in any way in identifying what other component manufacturers other than the ones that we've identified so far, microprocessors, chipsets, socket makers -- and you're unsure about motherboards -- but other than those manufacturers, does this exhibit help you to identify any other manufacturers that -- component manufacturers that DRAM producers would have to coordinate with in order to successfully develop alternative versions of the JEDEC standards that work

around Rambus patents?

A. No. Not without knowing what the alternatives are and which components are implicated by the change.

Q. Let's pull this down.

Have you calculated the switching costs that would be associated with changes to any other products other than DRAM products in the event that there were an effort to work around the JEDEC -- work around the Rambus patents through alternative JEDEC standards?

A. No.

Q. Have you even considered what the costs might be to chipset manufacturers, microprocessor manufacturers, socket manufacturers or anyone else?

A. No. I have considered that coordination efforts and changes in an industry as dynamic as the computer industry take place all the time, and I infer from that that costs to these other makers of complementary goods would for the most part be accomplished within the framework of continually changing your products.

Q. Are you saying, Dr. Rapp, that from the standpoint of assessing lock-in on this case that you don't think that it's relevant to consider or quantify what coordination difficulties there would be or costs that would be borne by manufacturers of products other

than DRAM?

A. No. I think it's appropriate to consider that but that it is also a fair inference that the order of magnitude of those costs are going to be the likes of which I have described in connection with my SDRAM example rather than the magnitudes that Professor McAfee spoke about when he talked about billion-dollar fabs and things like that.

Q. What basis do you have to speak to the magnitude -- relative magnitude of the costs that would be borne by non-DRAM manufacturers in the event of a change of the sort we're describing? What basis do you have to compare the magnitude of that to the magnitude of the costs that would be borne by DRAM manufacturers?

A. The understanding that circuitry is subject to continual change in the computer industry and that switching costs are, generally speaking, relatively low when there is -- when change is routine, in the same way as in the DRAM industry.

Q. Have you read any trial testimony in this case that suggests that the manufacturers of products other than DRAMs would experience costs, would have to incur costs if the JEDEC standards were changed to work around Rambus' technologies?

A. I don't recall testimony, but I'm sure that that's so.

Q. And have you not taken account of such testimony in developing your views on switching costs --

A. I have. I haven't quantified those costs, but in my statement that switching costs are low, I haven't seen evidence to the contrary.

Q. Do you know who Mr. Andy Bechtelsheim is?

A. I'm sorry. Say the name again.

Q. Andrew Bechtelsheim. Are you familiar with that name?

A. I'm not.

Q. Are you aware that a Mr. Andrew Bechtelsheim testified in this case?

A. Yes.

Q. Did you read his testimony?

A. I did not.

Q. I believe you may have said on your direct testimony that costs -- I don't want to misstate your testimony, but let me just ask you this and tell me if this is your view or not -- that costs to be meaningful must be subject to quantification. Is that your view?

A. Yes. I do believe that.

Q. You think that's a sound view from the standpoint of economics?

A. Yes, I do.

Q. So if a cost cannot be quantified, it's not subject to quantification, from the standpoint of economics, you think that's a meaningless cost?

A. I think it is -- I think that it is not subject to analysis. I don't know what the word "meaningless cost" is, but I agree that and I stated I believe correctly that quantification is required when costs are discussed.

Q. You say that costs if they can't be quantified are not subject to analysis, and yet in answers you just gave me a moment ago you said that it's your view that the costs, costs that you haven't quantified, to non-DRAM makers of a change of the sort that we've been describing are low relative to the costs to DRAM makers. That's your conclusion; right?

A. No. Not relative to the cost of DRAM makers, relative to the costs that Professor McAfee spoke of. If you heard -- if I said that the costs of manufacturers were lower than the costs of DRAM makers, I didn't intend that.

Q. Oh, so the costs to non-DRAM makers of the change of the sort that we're describing could actually

be higher than the costs of the DRAM makers; is that right?

A. Yes. But in the same -- the same magnitude. In other words, in the millions of dollars, not the tens of or hundreds of millions of dollars.

Q. If you haven't quantified those costs, Dr. Rapp, how can you offer an opinion that the costs would be in the same magnitude?

A. It is an inference based upon my understanding, and it is only an understanding, of computer technology.

Q. And is that a meaningful inference, meaningful economic inference, despite the fact that you haven't quantified those costs?

A. It is less meaningful than the quantification inference.

Q. You would agree, don't you, that among the types of costs to consider in a lock-in analysis relevant to this case would be the costs associated with sunk investments?

A. Only insofar as those sunk investments would need to be replaced with other investments, and it is the replacement costs that I -- that are the relevant costs. It is not the historic sunk costs that are relevant.

Q. And have you considered whether in the event of a change in the JEDEC standards to work around Rambus' patents either DRAM manufacturers or other manufacturers would be required to replace sunk investments?

A. I am confident that that is not the case for DRAM manufacturers, and that is based upon discussions with Mr. Geilhufe and his testimony about what the costs of substituting alternatives are, and so far as other manufacturers, non-DRAM manufacturers, I have only an inference to draw on that.

Q. You haven't looked at the evidence that bears on that issue?

A. I have not.

Q. And you haven't quantified the amount of any such sunk costs if they exist?

A. Correct. But again, it is not the sunk costs that matter; it is the going-forward costs associated with substituting for whatever sunk investments are abandoned in some hypothetical.

Q. You say it's not the sunk costs that matter. Let me show you something.

I apologize, Your Honor.

May I approach?

JUDGE McGUIRE: Yes.

BY MR. ROYALL:

Q. I've just handed you a document, Dr. Rapp. Do you recognize this document?

A. Yes.

Q. Am I right that these are slides that you presented to the commission prior to the complaint being voted out in this case along with the white paper that we touched on yesterday?

A. Right.

Q. I don't want to discuss this at any length, but I would like to ask you to look at page --

MR. STONE: Your Honor, Mr. Royall yesterday made reference to presentations made to the commission before the complaint was voted out. My concern is that he's trying to suggest an argument that the commission has already ruled on this issue based on a presentation that was made precomplaint, and I want to just be clear -- I don't think that would be proper for him to do so and I don't think that's what he means to suggest, but if there was any such suggestion or if we might hear some argument later, I'd want to address it with a line of questioning that I otherwise think is probably not pertinent here.

JUDGE McGUIRE: Mr. Royall?

MR. ROYALL: Whether one could make any such

suggestion, I'm not meaning to. And so that's not -- the only reason I draw that distinction is just to make clear that this is not something that he prepared in the context of after he was retained in the case.

MR. STONE: Thank you. That's all I wanted to clarify.

JUDGE McGUIRE: And so clarified.

MR. STONE: I appreciate it.

BY MR. ROYALL:

Q. And I simply want to ask you to refer to page 2 of these slides, white -- slides that accompanied your white paper.

And do you see on that page, in discussing the question of how standards can affect market power of intellectual property, at the bottom of the page, you say "by affecting scarcity of alternatives through increasing the cost of alternatives" and you have a reference to lock-in and a bracket that encompasses three things, sunk investments, switching costs and coordination difficulties?

A. Right.

Q. Do you see that?

A. Yes.

Q. And this is something that you presented to the commission in the context of essentially the

investigation that led to this very case; right?

A. Sure.

Q. Now, you said a moment ago -- I forget exactly what your testimony was, but I thought you said that sunk investments are not a relevant consideration for lock-in.

A. I didn't say that they were not a relevant consideration. I said that you have to think about them in the right way, and it is -- all I'm referring to is the same considerations to which I testified in my direct testimony when I was talking about coal plants. It is not the fact of abandoning a plant that is the relevant cost; it is what you have to do to replace the capacity.

So yes, sunk investments are important, sunk in the sense that they're not irreversible, but if there were -- in other words, I'm sure that if I was -- if discussion of this with commissioners took place, my opinion would be the same, and I think -- while I won't represent what all economists agree or don't agree, but there is a general proposition in economics that sunk costs are irrelevant for economic decision-making.

And the significance of sunk costs in this context is based upon an assumption that it would be

costly to replace what is abandoned. That's the only point. Not that sunk costs are irrelevant.

Q. Okay. Thanks for that clarification.

A. Sure.

Q. The only -- of the various categories that you refer to here inside the bracket that leads to lock-in, the only type of costs that you have quantified in this case and even then only by way of example are switching costs; right?

A. What I have quantified is switching costs. What I understand is that there are not sunk investments that would be abandoned and have to be replaced in connection with switching technologies. And coordination difficulties I believe are continually resolved among DRAM manufacturers and the manufacturers of complementary goods. That's my opinion.

Q. Now, is it possible, Dr. Rapp, that the aggregate costs that would be borne by non-DRAM manufacturers in the event of a change to work around Rambus' technologies, is it possible that the aggregate costs that would be borne by non-DRAM manufacturers might actually exceed the costs that would be borne by the DRAM manufacturers --

A. Yes.

Q. -- given such a change?

Mr. Mailloux, and I think because of the length of this examination, by the time we're done with it, it will be pretty late today.

What we now think our schedule would be -- and let me take a minute and run it past you -- we won't have any witness after Dr. Rapp is concluded today. We will call Professor Teece the first thing tomorrow morning. I expect we'll get to the point where cross-examination of Professor Teece starts tomorrow but will not conclude.

Complaint counsel have advised us that they have no objection to starting, if the court would allow us, starting a little earlier on Friday at 9:00. We're going to call Mr. Wiggers, Hans Wiggers, who's a third-party witness, who will be quite short. We can put him on at 9:00, interrupt Professor Teece so that -- Mr. Wiggers is retired -- so that he can testify and get home, and then complete Professor Teece on Friday.

And what we thought we would do on Monday is we will just have the deposition testimony on Monday of Mr. Brown, which is very short, and of Mr. Mailloux, which is some video and some reading, which is about two hours, and then we will call our last witness on Tuesday.

JUDGE McGUIRE: So you anticipate a short day on Monday.

MR. STONE: I do, Your Honor.

JUDGE McGUIRE: Okay. Good. Because I have another engagement that I need to squeeze in sometime between tomorrow and Monday, so perhaps that's when I'll try to do that.

MR. STONE: We will certainly on Monday, barring something completely unexpected, be done by the lunch break and really sooner than that I believe.

JUDGE McGUIRE: Very good.

Then let's take a break. In any event, then we'll be done here today by 5:00 I suspect?

MR. ROYALL: I'm not sure -- well, I would certainly expect so, yes.

JUDGE McGUIRE: Because if we -- I was only going to take maybe an hour break today for lunch so we don't go too late, but is that good?

MR. STONE: I think that's best.

JUDGE McGUIRE: Then let's convene back here at 1:30.

MR. ROYALL: Thank you, Your Honor.

(Whereupon, at 12:25 p.m., a lunch recess was taken.)

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

(1:31 p.m.)

JUDGE McGUIRE: At this time we'll continue with the cross-examination of the witness.

Mr. Royall.

MR. ROYALL: Thank you, Your Honor.

BY MR. ROYALL:

Q. Dr. Rapp, I'd asked you earlier what types of non-DRAM devices might have to be changed in order to accommodate a change in the JEDEC standards to work around Rambus' patents. You mentioned I believe CPUs, chipsets, sockets, and you weren't sure whether motherboards might or might not --

A. Only because I'm not sure whether -- when people speak of motherboards, what they mean is a bunch of different devices mounted on the main circuit board of a computer, and I don't know whether for any substitution of an alternative the motherboard itself needs to be changed.

Q. Let me ask you about that.

In assessing the lock-in question, have you considered the specific type of change that would have to be made to go to any given alternative that's been raised as a possibility in the case?

A. I -- the -- I haven't considered, with the

exception of the example that I gave, anything other than the general fact that it would be circuitry design changes.

Q. Let's pull up a document that was marked as a demonstrative exhibit with Professor McAfee's testimony. I think it's DX-221. Let's try to blow that up a little bit, make it easier to see the demonstrative, the picture here.

Do you recall this demonstrative, Dr. Rapp?

A. Yes.

Q. And you'll see that there are references to various components types of products that relate to -- in some way to DRAMs. And let me ask you, starting with connectors -- do you see the reference to connectors?

A. Yes.

Q. On the top?

A. Yes, I do.

Q. Do you know what a connector is, as that term is used in reference to DRAM?

A. I think that it refers to what I was calling sockets.

Q. And so you've already said that you understand that sockets might need to be changed to accommodate a new DRAM standard; right?

A. That would depend upon what alternative was substituted.

Q. And depending on what alternative was substituted, is it possible also that hard drive storage would have to be changed to accommodate such a change?

A. Yes, depending upon the alternative.

Q. Is it possible that modems might have to be changed depending on the alternative?

A. Yes.

Q. And is it possible that memory modules, referring now to the bottom left, might have to be changed depending on the alternative?

A. Yes.

Q. And would your answer be the same for graphics cards?

A. Yes.

Q. And graphics subsystems?

A. Yes.

Q. And CDROM/DVD drives?

A. Yes. In all cases. Possible depending upon the alternatives.

Q. Okay. Thank you.

We can pull that down, and let's go back to Dr. Rapp's DX-317.

This is the slide we were discussing earlier as one of your slides that presents your -- the example of switching costs that we were discussing earlier.

A. Yes.

Q. When you were assessing the amount of switching costs that might be entailed by changes to work around Rambus' patents, did you take into account the issue of whether DRAM manufacturers at a given time might have different densities of products in production?

A. I am not sure. I'm inclined to punt because the word "density" is not one with which I'm familiar.

Are you talking about the size of the DRAM?

Q. Well, just before I tell you what I understand density to be, and I don't purport to be the expert, but you don't understand what the term "density" means in reference to DRAMs?

A. I think in terms of size when I think in terms of memory, you know, in o2r5jdunderstand wdut445ea, ann witheun

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densities of SDRAM in production at one time?

A. If we're talking about the same thing, then the answer is yes.

Q. And do you have an understanding of how many densities it is common for a single DRAM manufacturer to have in production at one time?

A. I think perhaps fewer than four. I'm not sure. In the low single digits is what I believe to be the case.

Q. And isn't it true that for a DRAM manufacturer to avoid Rambus' patents, if the DRAM manufacturer were to seek to do that, they would need to make changes to each of the densities of SDRAM or DDR that they had in production in order to avoid the patents?

A. Yes.

Q. And in assessing lock-in, did you consider whether avoiding Rambus' patents with respect to each density of product in production would require multiples of the lock-in costs that, for instance, you give as an example in DX-317?

MR. STONE: Your Honor, could I just -- the question may be vague. Could I just inquire whether when Mr. Royall uses the word "density" he means it to mean size, 256-megabit or 512, as the witness was using it earlier, and not some other term, because I know

we've heard the term used in different contexts in the course of trial.

JUDGE McGUIRE: Mr. Royall?

BY MR. ROYALL:

Q. Well, let's -- using that term as you understand it to refer to 256-megabit or 512-megabit --

A. I don't want to be guilty of getting it wrong. I said I use "size" for that. If that's what you intend by "density," that's fine, but I can't certify that the -- that density refers to that characteristic.

Q. Okay. Well, referring to size in that way, the 256 megabits or 512 as an example --

A. Sure.

Q. -- did you consider in assessing lock-in costs whether for each of those different sizes of an SDRAM or DDR SDRAM a manufacturer would have to incur multiples of the switching costs that you describe as an example here on DX-317?

A. Well, the answer is yes. It depends upon the technology to which we switch.

Remember what I've done is I've taken a technology that involves the substitution of twelve parts for one. That's the nature of substituting fixed latency and burst for programmable latency and

burst.

So what I reckon is that if we were talking about another technology that involved only a hundred thousand dollars of design costs, for example, that the amount for that might be less than this. But I acknowledge that this is for -- this is starting with one part, this example, and if we were talking about a manufacturer who had to start with three different parts, then whatever the switching costs were, whether it was this amount or a smaller amount, then it would be multiplied by the number of parts that they were starting off with.

Q. And I believe you agreed earlier that the costs that were presented here in DX-317 were for a single manufacturer and to the extent that these changes were being made across the industry by multiple manufacturers you would have to multiply the costs by the number of manufacturers that were incurring such costs; right?

A. Yes.

Q. And do you have an understanding of how many DRAM manufacturers there were in, to pick a year, 1995?

A. Between five and ten major ones.

Q. And what about, to pick another year, the year

2000? Do you have an understanding of how many?

A. Fewer than that because of mergers.

Q. Is time a relevant consideration in an analysis of the costs of lock-in?

A. Time -- time isn't a cost, but time is a relevant consideration in considering lock-in, yes.

Q. You say time is not a cost, but wouldn't you agree that from the standpoint of economics time can impose costs?

A. That in certain circumstances that when time is expended that it can have cost consequences, that the expenditure of time can have cost consequences, yes.

Q. Have you considered how long it would take either the DRAM industry as a whole or multiple participants in the DRAM industry to agree upon a single or uniform approach for working around Rambus' patents if that were to be attempted?

A. I did consider that.

Q. You did?

A. Yes.

Q. And what amount of time do you believe or have you assumed that that would take?

A. I've assumed that that would take no more time than normal redesign efforts take.

As I've said before, this is an industry, both the DRAM industry and the larger components industry, where technical change happens with high frequency and redesigns occur with high frequency, and I took for my assumption the fact that the changes that would be necessary to create and implement new designs involving the substitution of these alternatives could be done in a time frame of normal redesigns.

Q. And when you say normal redesigns in the DRAM industry, what specifically, what type of redesigns are you referring to?

A. I'm talking about either process changes, redesigns in connection with die shrinks, or other sorts.

Q. And again, just to make it clear we're talking about the same thing, my question was solely focused on the time it would take for multiple DRAM participants to agree upon an approach to working around Rambus' patents, not to implement it but to agree upon it. And did you understand, in your testimony earlier, did you understand my question that way?

A. I thought you were speaking of both agreement and implementation.

Q. I'll get to implementation, but have you considered separately the time it would take multiple

DRAM participants to agree upon an approach, a uniform approach for working around Rambus' patents, if they were to seek to do that?

A. No.

Q. Do you know how long it took JEDEC to agree upon the SDRAM specification from the start of the process to the end of the process?

A. No.

Q. Do you know how long it took JEDEC to agree upon the DDR specification from the start of the process to the end of the process?

A. If memory serves, something on the order of about three years.

Q. Do you have any views as to how big a change was involved in moving from SDRAM to DDR?

A. I have a sense that although the two are connected generations of DRAMs that the change was very substantial, that it was a major effort because every single feature of the chip, except for the basic memory array, needed to be considered as to whether it would change or whether it would remain the same. That's different from changing a single attribute or two attributes of a standard.

Q. Well, is it different as in the case of DDR changing four attributes of the standard?

A. I'm sorry. I don't understand the question.

Q. I'm referring to the four Rambus technologies that would need to be worked around in order to create a noninfringing version of DDR.

A. But the question doesn't carry with it the implication that those are the -- I'm sorry.

Let me hear the question again.

JUDGE McGUIRE: Could the court reporter please read back the question.

MR. ROYALL: Your Honor, to expedite things --

JUDGE McGUIRE: All right. Go ahead, Mr. Royall.

BY MR. ROYALL:

Q. Have you considered how a change to work around the Rambus patents in SDRAM or DDR SDRAM would compare in magnitude to the changes that were entailed in JEDEC moving from an SDRAM standard to DDR standard?

A. I am assuming, and it is merely an assumption, that it would take far less time to consider changes in four characteristics than it would to consider changes in most characteristics of a new generation of DRAM, such as DDR SDRAM.

Q. You say that that's an assumption that you're making.

What is the factual basis for that assumption?

A. The factual basis for that assumption is simply an understanding that there are many, many times more characteristics that would need to be considered to set the entire DRAM standard for a new generation of DRAM than there would be to consider those four changes.

In other words, whether changes take place or not from one generation to the next, I assume that specifying or setting the standard for a new generation requires a consideration of many features, and the factual basis for that is my review of the JEDEC standards and the report on DDR-II that bears Mr. Macri's name.

Q. That's something that you looked at after you completed your expert report in this case; is that correct?

A. That's correct.

Q. And you understand that in moving from SDRAM to DDR JEDEC added at least two specific features, dual-edged clocking and on-chip PLL/DLL; right?

A. Yes.

Q. Can you name any other specific features that JEDEC added in moving from the SDRAM to the DDR standard?

A. I cannot. But if I had Mr. Macri's report, I could name a lot of characteristics of DDR SDRAM that were considered by JEDEC and needed to be addressed in the course of setting the DDR-II standard, at least according to that report. Subjects other than and more numerous than the two additional Rambus technologies embodied in DDR SDRAM -- I'm sorry. Go ahead.

Q. The Macri report you're talking about --

A. Yes, it was about DDR-II.

Q. -- it's about DDR-II; it's not about SDRAM to DDR?

A. I'm sorry. That was a mistake. So it's just the JEDEC DDR-II standard that I have to base my opinion on.

Q. All right. Well, let's put DDR-II aside.

A. The DDR standard.

Q. Do you have any understanding as to what features other than dual-edged clocking and on-chip PLL/DLL were added when JEDEC moved from SDRAM to the DDR SDRAM standard?

A. The answer is that I do not have any specific knowledge of that.

Q. Do you know whether there were features added in the move from SDRAM to DDR other than dual-edged

clocking and on-chip PLL/DLL?

A. I do not specifically know.

Q. Now, you said that you -- as part of your lock-in analysis you haven't considered specifically the amount of time it would take for multiple DRAM manufacturers to agree, putting aside implementation, but to agree upon a uniform approach to working around Rambus' patents; right?

A. Right.

Q. But you have considered how long it would take to implement an approach to working around Rambus' patents once there had been an agreement on such an approach; right?

A. I have to say I am vague on whether or not it is once there had been an agreement or whether it includes that agreement.

Q. And you say you're vague because what you have in mind is not your own analysis of this issue but Mr. Geilhufe's analysis?

A. No. It's because what I have in mind is the routine -- is the interval, the routine interval of design changes in the DRAM industry to which those outside the DRAM industry have to accommodate as well.

Q. But your understanding as to whatever this routine interval is is based on something you learned

from Mr. Geilhufe?

A. No. It's based upon testimony in -- well, Mr. Geilhufe did -- yes, that's right. It was either Mr. Geilhufe or Dr. Soderman who told me about this, who informed me about this initially. Since then, there has been trial testimony about this subject.

Q. Do you have any understanding as to whether either Mr. Geilhufe or Dr. Soderman were involved in any way in JEDEC's process of defining the SDRAM or DDR standard?

A. I understand that they were not.

Q. Now, am I right that you have not as part of your lock-in analysis sought to separately quantify any costs associated with the period of time it would take to either agree upon an approach for working around Rambus' patents or to implement such approach?

A. Right. For reasons that I've already given.

Q. Do you agree that opportunity cost is a relevant consideration from the standpoint of assessing lock-in?

A. Opportunity costs of what, I'd be inclined to ask.

Q. Well, can you think of any opportunity costs or are you aware of any testimony that would suggest that there are any opportunity costs that might arise in the

course of DRAM manufacturers or other component suppliers seeking to work around Rambus' patents?

A. Well, the opportunity cost that comes to mind is the opportunity cost of engineers and devotion of their activities to working around the Rambus patents in your example.

Q. And are you aware of any trial testimony on that subject?

A. Certainly I know the subject has come up. I don't recall -- bear with me a second.

I think that Professor McAfee had something to say about that.

Q. Are you aware of any trial testimony on that subject from participants in the DRAM industry who testified in this trial?

A. Not at the moment, no.

representing that this relates to testimony, but just to take a number -- let's say that it would take ten engineering -- the term we use is full-time equivalents or --

A. Sure.

Q. -- more antiquated term I think would be man-years or engineering years -- to work around Rambus' technologies, so we're talking about ten engineers -- years of -- ten engineer years.

A. Right.

Q. And let's say that each engineer makes a hundred thousand dollars, so without discounting it for the time value of money or anything else, let's just assume that we're talking about a million dollars in terms of the engineering years quantified by the salaries of these engineers to work around Rambus' patents.

A. Right.

Q. A million dollars?

A. Uh-huh.

Q. Now, do you think that that would, from an economic sense, would be the relevant calculation of the opportunity -- the full extent of the opportunity costs that a DRAM manufacturer might incur if it were to devote ten engineer years to working around Rambus'

patents?

A. Yeah, I can't think of anything else. In other words, in the assumption that you've -- that you've given me.

Q. From the standpoint of economics, would you conclude that the benefit to an employer is equal -- of an employee's time is equal to the salary that that employee makes, or is it possible -- let me add to that.

A. Sure.

Q. -- or is it possible in an economic sense that the employer gains more value or surplus from the employee's time beyond what salary the employee is paid?

A. Well, the surplus is ptir1 a9kea tharA2huyis

the DRAM manufacturer would be suffering some setback in its business in terms of what those engineers might otherwise be doing to advance the interests of that company in developing other products or in doing other things that they might otherwise be doing? Do you -- will you agree to that proposition?

A. Yes. But you would have to agree to the proposition that the devotion of engineers to that purpose, if it were value creating for them in saving them the costs, for example, of paying a royalty, is -- that there's a symmetry there that they could be -- that their next best alternative next to that could be lower and less valuable to the employee than their employment in working around the Rambus patents.

Q. Isn't it possible that the cost in terms of opportunity cost of forgoing the other work that these ten engineers or ten engineer years would have gone to within the company, that the opportunity cost of that to the company shifting those resources to this project would have caused the company to incur costs potentially far exceeding the salaries associated with those ten engineer years?

A. Why would the -- I'll have to answer the question why would they not hire more engineers if there were value to be created by employing more in

that fashion.

Q. Have you considered whether there might be any form of scarcity in the market for engineers knowledgeable about DRAM design issues? Have you considered that issue?

A. Yeah, I've considered it, and I considered that it is reflected in the wage in your assumption about a hundred thousand dollars.

Q. Is it your testimony, Dr. Rapp, that the DRAM industry is not today and never has been locked into JEDEC's SDRAM standards?

A. I can't speak to never has been. That's -- that goes beyond the scope of my studies, so the answer is no.

JUDGE McGUIRE: Well, there's two questions there, whether it's either not today or I think never has been. Your answer seems to speak to the latter. I'm not sure if you answered, you know, the former, though.

MR. STONE: And I just want to object that as to lock-in as to the SDRAM standard, if counsel meant that as opposed to the two technologies at issue here that are in the standard, it does go beyond the scope of the direct. I'm not sure whether he meant to do that or not.

MR. ROYALL: Well, I can re-ask the question to accommodate both issues.

give me just a minute and I'll see if I can be helpful.

Q. Just so the record is clear, you're referring to the statistics attached in exhibits to your report?

A. Yes. Exhibit 3 to my expert report.

I would say I guess in looking at this that we're not there yet, so it would be sometime in the future that the lock-in effect arising from end of life for SDRAM would occur, not in 2003.

Q. Now, you recall, don't you, Dr. Rapp, that the figures that you present in Exhibit 3, they don't present actual historic figures for 2002 or 2003, those are forecasted numbers?

A. Right.

Q. So how can you say that we're not there yet based on forecast -- you can't say that, can you, based on forecasted numbers, because you don't know whether those numbers square with reality, do you?

A. That's fair. That's fair.

Q. So without having the actual numbers in front of you, you can't really answer that question; is that fair?

A. I think that's right. The reason I can't answer it is because SDRAM may not be in fact at the end of its life. You're right.

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Q. What would the -- what would you have to see in the actual historic numbers in terms of market share for SDRAM to cause you to conclude that it had reached its -- the end of its life cycle?

A. Market share is less relevant than actual shipments, but a diminution of, to very, very small volume, of shipments.

Q. Do you have any particular volume numbers in mind?

A. No.

Q. Now, if we could go to slide -- this is DX-320. It's one of the slides that was presented in connection with your direct testimony.

If we could blow that up a little bit.

Do you see this slide on your screen?

A. Yes.

Q. Now, you set forth in this slide, DX-320, your understanding of the relevant economic considerations for assessing whether conduct is predatory or exclusionary; is that right?

A. Yes.

Q. And you say here that one of the hallmarks of exclusionary conduct is evidence of short-run actions that would be contrary to self-interest but for an adverse impact on competitors; is that right?

e-mail, between Richard Crisp and one of the lawyers advising JEDEC (sic) about the advisability of remaining in JEDEC, and the concerns had to do with jeopardizing -- with Rambus jeopardizing its future patent position.

Q. Okay. So in your answer you've said that you've seen a dialogue of this sort that you recall being advising JEDEC (sic) abwer you've said m3Lo2(

potential that a failure to disclose could jeopardize Rambus patents but rather the potential that a disclosure could jeopardize Rambus patents?

A. Right.

Q. Right?

A. Yes.

Q. And you can't tell me, you can't point me to any specific evidence that you've seen that during the time Rambus was a member of JEDEC that anybody at Rambus actually had that concern, can you?

A. Correct.

Q. Now, let me ask you the alternative question.

Have you seen evidence that Rambus during the time it was a member of JEDEC did have concerns or that others associated with Rambus, like its lawyers, did have concerns that the failure to disclose patent-related information to JEDEC might potentially jeopardize Rambus patent claims?

A. No. I can't say that either. The right phrasing for my purposes is that JEDEC's continued participation in JEDEC by whatever meaning, for whatever reasons and whatever activities that comprehends would jeopardize Rambus' patents, not disclosure issues.

Q. Are you aware of any evidence that during the

time Rambus was a member of JEDEC that the company's either in-house or outside patent counsel advised Rambus of the potential that failure to disclose patent-related information could lead to so-called equitable estoppel risks?

A. You're asking me whether I recall?

Q. Yeah, whether you're aware or you recall any such evidence.

A. Not to that specific degree, no.

Q. Are you aware of any evidence that any Rambus lawyer during the time it was a member of JEDEC advised Rambus of the potential that failure to disclose patent-related information could lead to potential antitrust risks?

A. No. Again, the answer is the same because I don't recall the subject of disclosure in the dialogue, merely that of participation in JEDEC's standard-setting activities.

Q. And have you sought at any time before or after writing your report in this case to investigate whether the record reveals any evidence of the sort that I've described in those questions?

A. Yes. I've reviewed the materials that I have in mind now as I answered your previous questions.

Q. Have you reviewed either documents written by

or testimony given by Mr. Lester Vincent?

A. Yes.

Q. And in that testimony have you or in those documents have you seen anything to suggest that Lester Vincent alerted Rambus to the potential of equitable estoppel risks associated with failures to disclose patent-related information at JEDEC?

A. I don't remember the disclosure part of it. The rest of it I do.

Q. Have you studied the factual record as it pertains to Rambus' decision to withdraw from JEDEC in mid-1996?

A. Yes.

Q. Are you aware of evidence that Rambus made that decision in part based on legal advice about the risks to its patents of continued participation in JEDEC?

A. Yes.

Q. And I take it from your earlier answers, though, that you're not aware that -- of that advice being in any way linked to concerns or potential concerns about failures to disclose patents or patent applications?

A. In response to that question, the only thing that comes to mind is notes that reflect uncertainty on

the part of the lawyer who was advising JEDEC about whether silent participation could lead to unspecified legal problems, and again I emphasize that it was uncertainty on the part of the lawyer at that time.

Q. You refer in DX-321 to patent interferences and races to the patent office.

Do you see that language?

A. Yes.

Q. Now, are these potential concerns -- are these concerns that you saw referenced in documents or testimony in this case from -- either written by or given by employees of Rambus?

A. I don't recall.

Q. Isn't this more of a theoretical proposition that you're raising here as opposed to something that you've seen in the facts of the case; that is, aren't you referring here to the potential as a theoretical matter that disclosure of patent-related information to JEDEC might have jeo yopo t 'pthat

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A. It's real enough in the sense as an analysis of incentives, what the incentive is of somebody who has proprietary strategic information about its patent program and the incentives to keep that information secret.

Q. So referring to the "jeopardize patent claims" bullet point and the two subbullets below that on DX-321, you're not saying that it's your understanding of the facts that these are in fact reasons why Rambus chose not to disclose certain patent-related information to JEDEC?

A. It's my understanding of the incentives.

Q. Now, going to the next point, lost competitive advantages, do you see that?

A. Yes.

Q. You say that one of the lost competitive advantages to Rambus of disclosing patent-related information to JEDEC is that this could induce work-around efforts. Do you see that?

A. Yes.

Q. And in your view, this is a reason why it would not have been in Rambus' interest to disclose additional patent-related information to JEDEC?

A. Sure.

Q. Is that your view?

A. Sure.

Q. Have you seen contemporaneous evidence, again, in the way that I've defined that term earlier, referring to the time period that Rambus was a member of JEDEC, have you seen evidence from that time period that this in fact was a concern that influenced Rambus' decisions regarding disclosure of patent-related information to JEDEC?

A. No. I haven't seen anything in the record.

Q. So is this -- this again is more in the nature of you applying economic theory to discuss incentives that might apply in this context?

A. It's an analysis of the incentives of somebody who has proprietary strategic information and why they would want to keep it secret.

Q. Now, how could inducing work-around effects, how could that cause a loss of competitive advantage to Rambus?

A. In the normal bargain between a recipient of a patent and the government, the deal is that when -- at this time, that when the patent is published, the information is available to the public in a way that it had not been before, and at that point work-around efforts are induced by the publication of the patent.

Keeping the patent process confidential as it

was at this time prevents that from happening, and to disclose patent applications or intentions about patent claims induces early work-around efforts before they would normally arise with the publication of the patent.

Q. And again, to be clear, what you're describing is your views from the standpoint of economic theory about what incentives might apply in this context as opposed to something that you've seen in the factual record of this case relating to actual concerns of Rambus during the period in which it was participating in JEDEC?

A. Right. I haven't seen any writings about this in the record. I'm not sure it rises to the level of economic theory. It has to do with understanding the patent system and understanding the incentives of the way the patent system acts on inventors.

Q. Now, if disclosing additional patent-related information to JEDEC could have caused Rambus to suffer a lost competitive advantage by inducing work-around effects, does it also follow that by not disclosing such information to JEDEC Rambus gained a competitive advantage?

A. It does not follow, unless you -- because the competitive advantage -- it gained a competitive

advantage only relative to the time when its patents would normally issue, not to any other -- not at any other point.

That didn't come out clearly. I'm sorry. Let me think about that answer a bit.

Q. Well, I'm happy to do that, but let me phrase a different question and see if that may give you an opportunity that --

A. But let the record reflect that answer was a monologue.

Q. Would you agree that if in fact the effect of Rambus not disclosing the additional patent-related information that you refer to in general terms in DX-321, if the effect of that were to have been that by not disclosing that information Rambus avoided inducing work-around efforts, if that were the effect, would you agree that, by avoiding that, Rambus would have gained a competitive advantage?

A. I would agree with that, but a context of my answer is that work-around begins when the patent is issued. So the gain of ave gained

patent issues?

A. In the normal course of events where the application and everything is secret, then people don't know what they're working around. Obviously there may be parallel efforts towards the same technology, but you don't know that you're working around the patent until you see the patent. Right?

Q. But you agree that if Rambus had disclosed additional patent-related information to JEDEC, including patent applications, not-yet-issued patents, that that might have induced work-around efforts focused on what JEDEC participants understood to be covered or purportedly covered by the patent applications that were disclosed?

A. Right.

Q. And you agree that it's possible -- I'm not saying that you're commenting on this as a factual matter, but you agree that it's possible that that would have been the effect of Rambus disclosing additional patent-related information, that it would have had the effect in this but-for world of causing JEDEC participants to commence efforts to try to work around what they understood these patents or patent applications to purportedly cover?

A. Yes. Not patents, patent applications.

Because if it's a patent, then it's out in the world.

Q. Well, it's out -- it's out in the world, but it

concerns of that sort associated with potential adverse consequences of disclosing additional patent-related information?

A. I don't recall any.

Q. So is this, this point, of the nature of the other, other points that you make in this slide, that that is it relates to what you understand based on input about these issues from others of the incentives that might influence decisions of this sort in this context?

A. Yes.

Q. Do you understand or do you have an understanding as to whether all of the additional patent-related information that you refer to here as information that complaint counsel says should have been disclosed, do you have an understanding as to whether that information, all of that information, relates to patents or patent applications that derive from Rambus' '898 patent application?

A. My understanding is that it is at least principally that. I don't know whether the '898 patent is comprehensive.

Q. Do you have an understanding as to whether the specification, the technical specification, from the '898 patent application was at any point during

the time Rambus was a member of JEDEC publicly available?

A. Yes.

Q. And your understanding is that at some point it did become -- that specification did become publicly available?

A. Yes.

Q. Do you have an understanding as to when that occurred?

A. I don't recall.

Q. Let's assume that JEDEC members had available to them the technical specification from the '898 patent application sometime in 1993.

A. Okay.

Q. Now, if that were true, how is it that disclosure of additional patents or patent applications that relate back to the '898 application could have led to a loss of competitive advantage through disclosure of R&D focus?

A. To the extent that the additional patent applications speak to which elements of the '898 description JEDEC (sic) intended to file subsequent claims to, that is precisely what I mean by the disclosure of R&D focus.

Q. And so that information about what claims

Rambus -- well, strike that.

In your answer, just to be clear, you referred to what JEDEC intended to file?

A. I'm sorry. Rambus.

Q. You meso0cQQQQQQQ16.0001 734.3999 Tm/Cs6 cs 0 0 0 scntvC

agreed that an economist's work is properly subject to criticism to the extent that assumptions are made that are not well-founded in facts and evidentiary materials; right?

A. Yes.

Q. And the assumption that you make here, is this -- that we focused on in terms of whether additional disclosures would have added to add that information to what JEDEC already knew about Rambus' intellectual property, is the assumption that you make here not one that you've sought to determine whether it is supported by facts or evidentiary materials?

A. Let me answer you in this way. If that were an assumption that complaint counsel and Professor McAfee regarded as invalid, then there would be no claim of competitive impact, would there, at least in my way of thinking. The implication that everything that might have been disclosed by Rambus to JEDEC was already known to JEDEC carries with it an implication that the disclosure would be without impact.

Q. Okay. And that's the basis upon which you made this assumption?

A. Yes.

Q. Now, let's assume that it is true, just for sake of assumptions and for the sake of this question,

that Rambus, while it was a member of JEDEC, was concerned that disclosure of patent-related information, additional patent-related information, to JEDEC might entail the risks that you describe on DX-321, assuming that Rambus actually had those concerns during the time it was a member of JEDEC.

A. Okay.

Q. Is it your testimony that Rambus would have a legitimate business justification for violating JEDEC's

mandated by JEDEC's rules or disclosures that should have been made consistent with good-faith participation with the JEDEC process, but either way that they're disclosures that we're assuming Rambus should have made for one or both of those reasons. Okay?

A. Okay.

Q. And assuming that were the case, is it your testimony that you think that despite that assumption -- and I'm asking you to make the assumption -- that Rambus, if it were to have had these concerns and contemporaneous with its participation in JEDEC, would have been justified, would have had a legitimate business justification for not disclosing information that either the rules or the process of JEDEC would have required be disclosed?

clear on the record he was not going to talk about whether that would justify or not justify violating a rule which might lead to sanctions that JEDEC might impose or otherwise because I was conscious of that ruling, which Mr. Royall at one point reminded us of the ruling, on that efficient breach motion, and I think this question goes directly to that and puts me in an awkward position of opening the door to a line of questioning that I was prohibited from going into yesterday.

JUDGE McGUIRE: Mr. Stone, response?

MR. STONE: I think you mean Mr. Royall.

JUDGE McGUIRE: I'm sorry. Mr. Royall?

MR. ROYALL: Your Honor, I'm not intending at all to open the door to that. That's a very separate issue.

The efficient breach issue has to do with an argument that something about JEDEC's process might arguably give rise to some claim that breaches of JEDEC's rules could be justified in some theoretical economic sense. That's not what I'm talking about.

I'm talking about the slide here, and I'm simply asking whether these considerations, which are not -- it's not the efficient breach considerations -- but these considerations are ones that would cause this

witness to conclude that acting in a way that was inconsistent with JEDEC's process or rules would be justified. That's all I'm asking.

MR. STONE: Your Honor, if I might be heard?

JUDGE McGUIRE: Go ahead, Mr. Stone.

MR. STONE: Just briefly.

I limited the questions very narrowly, consistent with Your Honor's ruling, to this witness' opinions as a matter of antitrust economics because Your Honor's in limine ruling says that under this -- describes our theory that we're prohibited from pursuing as being that breach of the JEDEC patent disclosure rules is fully excused because, and then it goes on to these reasons, and counsel is asking whether we were entitled for one reason or another to breach those rules.

JUDGE McGUIRE: What page are you on there in my order?

MR. STONE: It starts on page 10, Your Honor.

JUDGE McGUIRE: Page 10. All right.

MR. STONE: And I was just going to get to the --

MR. ROYALL: If I could comment, just to be clear, what Mr. Stone said is I'm asking the witness whether Rambus would be entitled for one reason or

another to breach the rules. That's the point I'm making. I'm not asking that. I'm asking whether he believes that Rambus would be entitled because of these reasons, the reasons on this slide, not one reason or another.

MR. STONE: But this witness was not permitted to testify whether there could be any reason to violate a rule and I didn't ask him whether there was any reason to violate a rule. I asked him a very simple question, which was as a matter of antitrust economics are there procompetitive or legitimate business reasons to avoid early disclosure. And I didn't ask about breaking any rules. I didn't ask him to form an opinion about the rules or whether they would have been broken.

JUDGE McGUIRE: Well, based on my order on page 10, we talk about the arguments there that have been made by respondent regarding this efficient breach theory. It speaks in terms to nondisclosure that was made with the intent to counter supposedly illegal anticompetitive rules within JEDEC. And I don't take that as to be the import of the inquiry here.

MR. ROYALL: That's exactly right, Your Honor.

JUDGE McGUIRE: Now, is that correct,

Mr. Royall?

MR. ROYALL: Yes, Your Honor.

MR. STONE: Okay.

JUDGE McGUIRE: On that grounds, I'm going to hear this line of inquiry, and you can certainly follow up on your further redirect if you feel it necessary.

MR. STONE: I appreciate it.

JUDGE McGUIRE: But I do not see this inquiry as of yet as approaching the theory of the efficient breach that I earlier said I wasn't going to hear about. And if it gets to that point, then we're not going to hear it.

MR. STONE: That's fine, Your Honor.

JUDGE McGUIRE: Okay.

MR. ROYALL: And everything -- I agree with everything you said in terms of your understanding of my questions. I just want to make clear that I did not intend and I'm not understanding you to say that I will be -- if I simply ask questions in the context of this slide that I have now opened the door into efficient breach, because if that's the case, then I want to be very --

JUDGE McGUIRE: You have not opened the door to efficient breach.

MR. STONE: No. All he's opened the door is to whether this witness can testify on redirect as to the subject matters that he inquires about, and I understand that's not efficient breach as so far the question has yet been asked, but I do think he's opened the door to something that we didn't cover yesterday in direct because I thought we weren't permitted to, so he is beyond the scope of direct, but as to that objection, I think I'll wait and see how far beyond that scope --

JUDGE McGUIRE: Now, what is that that you're referring to so I've got a little heads-up?

MR. STONE: Certainly, Your Honor.

Yesterday in the transcript, thinking this is what I needed to do, I said: "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?"

He said, "Correct."

And what I was trying to do was say I simply wanted him to testify whether from a perspective of antitrust economics where there is a requirement for conduct to be predatory that you show there was -- you can show it was not predatory if you show a legitimate

business justification for it to limit him just to that antitrust economic question, so I framed it very narrowly to avoid anything to do with JEDEC's rules, which -- and I do think counsel is now at least opening the door to this witness' testimony on JEDEC's rules and a violation.

I do think that's beyond the scope. I understand it may not be --

JUDGE McGUIRE: Based on the efficient breach.

Well, if you open the door on the inquiries as to his understanding of the rules of JEDEC, then I'm going to allow counsel an opportunity to go into it on his redirect.

MR. ROYALL: Your Honor, let me make a suggestion. Having heard -- because I do think I did not recall it was as clear as that, I think he limited the witness' testimony in that question on direct in a way that really satisfies what I'm getting at here. And I do not want to open the door to an area that you've ruled --

JUDGE McGUIRE: I'm sure you don't, but let's be careful that -- well, then --

MR. ROYALL: So having been reminded of that, I'm happy to both gloss over this and move on to something else.

JUDGE McGUIRE: Very good.

BY MR. ROYALL:

Q. Now, let's assume, Dr. Rapp, that the risks that you refer to as potential risks on the slide that we've been discussing, which I seem to have misplaced, DX-321 I believe it is, am I right that -- pardon me. Strike that.

Let's assume that those risks again did in fact exist in the sense that they were concerns of Rambus during the time period that it was a member of JEDEC.

If that were true, is there any reason why Rambus would not have known of those risks at the time it joined or before it joined JEDEC?

A. Well, the principal reason has to do with the way that the disclosure policy was presented in JEDEC and whether there were changes over time in the policy, changes over time in the way that the policy had been advertised to its members, and so forth.

Q. Do you agree that the risks that you identify or potential risks that you identify on this exhibit, DX-321, could be avoided by Rambus simply by not participating in JEDEC or not joining JEDEC?

A. Well, the answer is yes, subject to a couple of massive qualifications. The first is that that

supposition depends upon the availability and the clarity of the policy. And the second consideration is even bigger, and that is whether the decision by Rambus to remain outside JEDEC carried its own set of risks, nonparticipation or nonappearance in a forum where decisions are being made that participants in the DRAM industry are party to which JEDEC would have to absent itself from.

Q. Now, this slide, DX-321, it doesn't say anything about whether or not JEDEC's rules are clear or not; right?

A. Right.

Q. And would you agree that if we assume that JEDEC's rules were crystal-clear that these in your view would still be legitimate potential concerns on the part of Rambus or a similarly situated company with respect to additional disclosures? Even if the rules were crystal-clear, would it be in your view that these would still be concerns, valid concerns?

A. Yes, they still would be.

Q. Okay. So let's then -- let's not make any assumption about whether the rules were clear or not because this slide doesn't relate to that. Does it?

A. Well, it depends upon what question you're about to ask me, but the safest course is to assume

that the rules are clear if that's useful.

Q. Well, this slide doesn't relate to whether the rules are clear; right? It doesn't say anything about that. And you've agreed that the considerations that you explain here would apply regardless of whether the rules are clear; right?

A. They would still be in force if the rules were not.

Q. Okay. So then the question is: Could Rambus avoid these potential drawbacks or concerns simply by having not joined or participated in JEDEC at all?

A. Not without creating another set of risks for itself, commercial risks, potentially larger than the risk of participating.

JUDGE McGUIRE: But you seem to be saying that it would at least avoid those risks that he's just indicated by being involved in JEDEC? That's not to say that you didn't answer there would be other risks that it would have to consider if it were offered independently of JEDEC?

THE WITNESS: Yes, it would. Staying out of JEDEC would avoid risks of disclosing inside JEDEC, yes, Your Honor.

BY MR. ROYALL:

Q. Thank you.

Now, I'm going to move on to something else, and this will be the last topic.

In your -- and having said that, Your Honor, this is going to take on the order of 20-25 minutes.

JUDGE McGUIRE: I would rather you go ahead and just as soon finish. If anyone needs to take a break, let me know. If not, I'd rather you complete your cross and then we'll take a break.

MR. ROYALL: Okay. I'll do that. Thank you.

BY MR. ROYALL:

Q. In your direct examination, you spent a significant amount of time explaining your understanding of the views and conclusions of Rambus' two technical experts, Mr. Geilhufe and Dr. Soderman; right?

A. Yes.

Q. And we've already I think heard from you that you acknowledge that you yourself are not a technical expert?

A. Yes.

Q. But your economic testimony depends in various ways on technical information that you are assuming to be true based on what you've learned from Mr. Geilhufe and Dr. Soderman; right?

A. Yes.

Q. And that information that you've learned from these two gentlemen includes information about variable and fixed costs associated with different DRAM technologies; right?

A. Yeah.

Q. And it includes information on technical advantages or disadvantages associated with various DRAM technologies; right?

A. Yes.

Q. And it includes information about whether the various DRAM technologies may or may not be covered by Rambus patents --

A. Yes.

Q. -- right?

And other than those general categories of information, are there other general categories of information that come to mind that you've relied on Mr. Geilhufe and Dr. Soderman for?

A. I think that covers it.

Q. And the input that you've received from Mr. Geilhufe and Dr. Soderman is important to a number of your economic conclusions, is it not?

A. Very much so.

Q. Let's pull up the first demonstrative exhibit used with your testimony. And I've again misplaced my

copy with the DX numbers on it.

Did you say 302?

MR. MELAMED: Yes.

MR. ROYALL: 302? Thank you.

Okay. And if we could enlarge that.

MR. MELAMED: That's 303.

MR. ROYALL: It is 303, but in fact this was the one I had in mind.

BY MR. ROYALL:

Q. Do you see DX-303 on the screen?

A. Yes.

Q. And this is a broad summary of your conclusions --

A. Yes.

Q. -- is that right?

And would you agree that the input that you received from Mr. Geilhufe and/or Dr. Soderman was an important factual predicate for each of the first three conclusions identified in the bullet points on this slide?

A. Yes.

Q. And the input you received from Mr. Geilhufe and Dr. Soderman was also an important predicate to the conclusions that you reached and explained in your expert report about whether Rambus' technologies or

other technologies are, quote-unquote, revolutionary; right?

A. Yes. And for the sake of completeness, because this slide is somewhat incomplete, their conclusions figure in my conclusion about impact upon competition as well.

Q. The impact upon competition of Rambus' challenged conduct; is that what you're referring to?

A. Yes.

Q. And input that you received from Mr. Geilhufe and Dr. Soderman was also an important factual predicate to your analysis of whether the four Rambus technologies have close economic substitutes?

A. Yes.

Q. And also that information was an important predicate to your analysis as to whether formal standardization of Rambus' technologies added to their market value or market power?

A. Yes.

Q. And that input was an important factual predicate to your analysis as to or your conclusions as to whether additional disclosures by Rambus would have led to the adoption of different JEDEC standards?

A. Yes.

Q. And that input was important -- an important

factual predicate to your conclusions as to whether -- well, actually I think that sums it up. Strike that.

Now, based on the input you received from Mr. Geilhufe and Dr. Soderman, you conducted your own analysis focusing on whether if JEDEC had known that the four Rambus technologies -- if JEDEC had known that Rambus would expect to have royalty payments for the use of those technologies in DDR SDRAM and in SDRAM, it would have been economically rational for JEDEC or JEDEC participants to switch to alternatives versus proceeding to adopt standards incorporating those technologies; right?

A. I'm sorry. I just need it read back.

Q. It was a very long question. I apologize for that, but --

A. My fault.

Q. -- I can read it back. If that's all right.

JUDGE McGUIRE: Yeah, go ahead.

BY MR. ROYALL:

Q. The input that you received from Mr. Geilhufe and Dr. Soderman, based on that, you conducted your own economic analysis; correct?

A. Yes.

Q. And that analysis focused on whether, if JEDEC had known that Rambus would expect royalty payments for

the use of those four technologies in DDR SDRAM and in SDRAM, it would have been economically rational for JEDEC or JEDEC participants to switch to alternatives versus proceeding to adopt standards incorporating those four technologies?

A. Yes.

Q. And in doing the analysis that you did, you've not made any assumptions about the way that the JEDEC process or the rules work; right?

A. Right.

Q. And you have just assumed that a rational standards organization and rational members of such an organization would choose the best cost-performance options; right?

A. Yes. By and large that's right.

Q. And at the end of your analysis you conclude that Rambus' technologies, even if the royalties associated with them were factored in -- and by that I mean the royalties that you've assumed -- but even if those assumed royalties were factored in, at the end of your analysis you've concluded that those technologies would still be the best cost-performance alternatives compared to other alternatives that you considered?

A. Yes.

Q. And for purposes of your analysis you assumed that the programmable CAS latency and burst length technologies together would have a .75 percent royalty associated with them; right?

A. Yes.

Q. And you assumed that the other two technologies, dual-edged clock and on-chip PLL/DLL, together with the prior two technologies would have a 3.5 percent royalty associated with that collection of four technologies; right?

A. Yes.

Q. And you compared the cost of these Rambus technologies assuming those royalty rates to the additional variable and inventory costs associated with alternatives, borrowing that information or those cost figures from Mr. Geilhufe; right?

A. Yes.

Q. And to make an apples-to-apples comparison, if you will, you converted Mr. Geilhufe's cost information into numbers reflecting a percentage of the selling price of either SDRAM or DDR SDRAM --

A. Yes.

Q. -- right?

And to do that, you calculated a weighted average selling price for both of those products, SDRAM

and DDR SDRAM, based on information that you obtained from an industry report; right?

A. Yes.

Q. Now, having covered in a broad sense your methodology, let me ask you about some of the components of the methodology.

First let me ask you about the relevant time period.

I understand that you've used this analysis for various purposes, but to the extent that you used this analysis that we're discussing to draw economic conclusions about what would have been rational for JEDEC or JEDEC participants to do faced with the choice between Rambus' technologies and alternatives, to the extent that that's the question that you're focused on, do you agree that the relevant time frame to focus on for such an analysis is the so-called ex ante time frame, that is, before the relevant standards were adopted?

A. Not necessarily. In other words, the relevant time frame may be the anticipation by decision makers in the ex ante period of the course of the DRAM product life cycle. In other words, it doesn't have to be any one moment in time.

Q. Well, I'm not asking whether there's -- you

have to have a precise moment in time, but you agree that from the standpoint of analyzing what would have been rational for JEDEC to do in a but-for world in which they knew in advance of adopting the standards that Rambus would be seeking royalties associated with these four technologies, from the standpoint of assessing that type of but-for world type question, you agree that the relevant time period would be the ex ante time period, that is, before the standards were adopted?

A. Let me answer you this way and see if it's helpful because this is what I regard as the correct answer.

The relevant time period in which to situate the hypothetical decision maker is the ex ante period. That does not imply that the time horizon of the ex ante decision maker is only in the ex ante period.

Q. I think I understand. I appreciate the clarification.

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right?

A. Sure.

Q. Now, then let's talk about the cost component of your analysis.

All of the cost information that you used in your analysis came from Mr. Geilhufe; right?

A. Yes.

Q. And in conducting the analysis summarized in your report, you didn't seek to obtain cost information on various alternatives from JEDEC or JEDEC participants or documents that might speak to what cost information they might have had on these alternatives; right?

A. Right.

Q. And you didn't review JEDEC-related materials to see if you could corroborate the cost information that you obtained from Mr. Geilhufe?

A. To the best of my knowledge, there was none, but I did not.

Q. Well, you say to the best of your knowledge there was none. Did you investigate that issue and actually review documents to see whether there was such information?

A. The answer is that my -- that we did make a request, in other words, and my staff looked for cost

information at the time available. The reason that there was none that I considered in the expert report is that none was available to me.

Q. So putting aside whether you saw any such information, I take it from your answer that you agree that if there were such information it would be important for you to consider; that is, if there were information about what JEDEC or JEDEC participants in fact believed to be the case with respect to the cost of the alternatives that you considered, it would be important for you to consider that information?

A. Only if it were the relevant decision-making costs. The answer is sure, but "cost" is a very broad term and it has to be the right sort of costs.

Q. So you agree that those costs would be relevant to consider, and it's your understanding that there simply is no evidence in the factual record that bears on what JEDEC or JEDEC participants understood to be the relevant costs associated with the alternatives you considered; right?

A. That's not true. I understand that there was testimony in this court that JEDEC participants, manufacturers' representatives, testified that certain alternatives would be more or less costly or more or less advantageous.

Q. My questions relate to what information you considered when you finalized your report --

A. I'm sorry.

Q. -- and set forth your analysis.

A. The answer is I didn't have any at my disposal.

Q. And it was your understanding there was none?

A. Well, my staff didn't find any that was relevant.

Q. And you don't understand Mr. Geilhufe to have testified as to what cost information JEDEC or JEDEC participants had in this ex ante time period?

A. That was not the nature of his testimony. As I understand it.

Q. Now, if JEDEC or JEDEC participants had, at the time period in which they were developing the relevant standards, if in that time period they had information about the costs of these various alternatives that you considered that was different from Mr. Geilhufe's cost information, that might undermine the economic conclusions that you have made about what decisions would be rational for JEDEC or JEDEC participants to make in the but-for world; right?

A. It could, but it would depend greatly on the nature of that cost information and whether it was

appropriate to solving the problem that we are solving by the cost analysis, Mr. Geilhufe's and subsequently mine.

Q. So you'll acknowledge that if it were the case that JEDEC or JEDEC participants had different information about the costs of these alternatives, that might suggest that JEDEC participants would have reached different conclusions than the conclusions that you have reached and still have been acting in an economically rational manner?

A. I will admit to the possibility that it would suggest that, but nothing more. In other words, it would not indicate that. It would raise the possibility of it. And what the actual analysis would consist of was understanding the nature of the costs that were under consideration.

Q. Well, and you'll agree as a general proposition I assume that depending on what information JEDEC participants had in this relevant time period about the alternatives that you considered as part of your analysis, that whatever information they had -- and we're not making any assumptions about what information they had or what it would have shown -- but whatever information that they had could have impacted what choices would have been economically rational for such

in this time, based on the information that they possessed, the economically rational thing would have been to support the use of various alternatives over the use of Rambus' technologies, you cannot rule that out, can you?

A. Let me say that I can't rule that out except to the extent that the information isn't available at all, in which case there would be no basis for assuming its existence.

I won't rule anything out of the realm of possibility, but at least at the moment, we're talking about hypothetical information that's presumably very different from the information contained in Mr. Geilhufe's and also Dr. Soderman's estimates. We'll include performance or -- I understand you're limiting the current inquiry to costs.

Q. To costs.

A. But I do want you to remember that performance is part of my analysis as well.

Q. Now, let's talk about the royalty rate assumption in your -- that aspect of your analysis.

We've already identified what royalty rates you assume.

Do you think it's a reasonable assumption that in the but-for world that we've been discussing JEDEC

and/or specific JEDEC participants would have known specifically what royalties Rambus would seek in connection with the four technologies that we've been discussing in the event that those technologies were adopted as part of JEDEC's standards?

A. Whether they would know with precision? Is that the question?

Q. Yes.

A. No, I don't think they would.

Q. But your analysis assumes they did, they would have known with precision precise royalty rates; correct?

A. It assumes -- and it's a standard assumption in economics -- that they would have been able to anticipate what turned out to be a market outcome. It doesn't assume they would have known with precision. It assumes that that is the best estimate, that the actual royalty rates ex post are the best estimate ex ante.

We know very well that royalty rates for patent licenses aren't usually known with precision before patents are granted and licensing programs begin. It's a best estimate.

Q. Is it possible -- wouldn't you agree it is possible that in the but-for world JEDEC participants

might have been required to make judgments and choices between Rambus' technologies and alternative technologies without knowing what royalties Rambus ultimately might charge for the use of its technologies if they were used in the JEDEC standards?

A. Without knowing with precision but with a certain capacity for anticipation if they had the disclosure at their disposal and if they knew about what the alternatives were.

Q. And have you considered how uncertainty about the royalty rate in the relevant ex ante time period might have affected the choices or the economically rational actions of JEDEC participants?

A. Yes.

Q. You have considered that?

A. To the following extent. I assume that there is a kind of confidence interval around the analysis that I've done that nobody would expect an estimate of perfect precision after the fact, but what we have are a set of best estimates, best estimate of the royalty rate and best estimate of costs, and those are the ones to use in that circumstance just as a matter of normal practice.

Q. Is it your understanding that at all times relevant to this case that Rambus internally had in

mind the same royalty rates to charge for SDRAM and DDR that it ultimately did charge when it signed licenses?

A. That's not my understanding, no.

Q. It's your understanding, isn't it, that the amount of what royalty rates to charge is something that thinking about that varied over time even within Rambus? Right?

A. Sure.

Q. And wouldn't you expect that to the extent that JEDEC participants were uncertain about what royalty rates that and Rambus itself was uncertain about what royalty rates would apply that there could be varying projections from JEDEC participant to JEDEC participant and they could differ from the royalty rates that you have assumed in material ways?

A. Yes. I think that's fair. And I think the best single estimate of what the outcome of the variety of different possible forecasts is is the royalty rate that came in fact to be Rambus' royalty rate, the Rambus license royalty rate.

Q. Let's talk about the price assumptions in your analysis.

And Your Honor, in the interest of full disclosure, I've said this is going to take about

25 minutes. It will take a little bit longer than that. I'm happy to keep going before we take a break.

JUDGE McGUIRE: How much more time? And we'll decide if we want to take a break.

MR. ROYALL: It may be 30 more minutes from now.

JUDGE McGUIRE: Why don't we take a short

relevant price figures would be, if they were available, would be the price figures that JEDEC participants would have used in making their own judgments or calculations about the potential cost of Rambus royalties?

A. Without reference to any particular time period, is the question whether the price data that JEDEC members had at their disposal was relevant? I'm not sure what the question is, I should say.

Q. Well, you've sought to analyze what decisions would be economically rational in the but-for world for JEDEC participants faced with information about Rambus --

A. Yes.

Q. -- patent claims on these technologies.

And to the extent that price comes into that type of calculus, wouldn't you agree that the relevant price figures, if this information were available, would be the prices that individual JEDEC participants would have used in making their own calculations about the potential cost of Rambus royalties?

A. Yes. If you'll allow me to say that the anticipations of price that they would have used, then the answer is yes.

Q. And are the reasons why we refer to anticipated

prices is what we're talking about here are prices relating to products that in this analysis would not even have yet been standardized?

A. Right. The product is not yet for sale.

Q. Right.

And you understand that the DDR -- I'm sorry -- the SDRAM standard was established in '93?

A. Yes.

Q. And do you understand that, give or take, SDRAM products didn't reach volume production until 1996?

A. Yes.

Q. And SDRAM products are still being produced today; right?

A. Yes.

Q. So from the standpoint of the JEDEC participant in 1993 seeking to assess the cost of the Rambus royalties, if they were to do that in anything approaching an accurate sense, they would have to be making projections about the cost of not-yet-standardized devices in the marketplace extending out many years into the future?

A. Right.

Q. And you understand, don't you, that the DRAM industry is one that has some history over time of

price volatility?

A. Yes.

Q. And would you agree that it's hard to project what the price for a given DRAM device will be in the future?

A. I agree. And that's why a good assumption about a piece of information that will substitute for these anticipations in an economic analysis is a

You're aware, are you not, that in the real world there have been instances in which JEDEC participants have disclosed patent-related information to JEDEC?

A. Yes.

Q. Have you looked at the factual record in this case to determine whether in instances in which this has happened JEDEC participants in deciding what actions to take have applied the same type of analysis or methodology that you applied?

A. No.

Q. And would you acknowledge that it's possible that JEDEC participants faced with such situations apply an analysis that is somewhat different from the analysis or methodology that you apply?

A. In its specifics, certainly. In general terms, I believe that the analysis that I applied is very basic and fundamental, and that has to do with the evaluation of cost and performance and the arraying of alternatives in cost-performance terms and for valuation purposes comparing one with the next best alternative. I think that that is very, very widespread and not likely to vary much.

Q. But you said earlier -- you're not moving away from the testimony you gave earlier that you have

A. Yes. But I remember his testimony to the effect that he is a designer of products that employ memory and that have the similar circuitry to memory applications, specific integrated circuits among them.

Q. You're aware that he's never done work on synchronous DRAMs; right?

A. I recall that. Sorry. "Work" meaning design of a synchronous DRAM chip? Yes.

Q. Now, referring to DX- -- I believe DX-307. Could we pull that up.

Now, this is a slide that you prepared relating to the alternatives to programmable CAS latency in your analysis; is that right?

A. Yes.

Q. And you identify the explicitly identify in read command alternative as being covered by Rambus patents on this slide. Do you see that?

A. Yes. Based upon my reliance on Dr. Soderman.

Q. And putting aside the patent issue, it was your determination that this was the least costly of the alternatives that you considered; is that right?

A. Yes.

Q. And then going to DX-309, this relates to alternatives to programmable burst length.

Do you see the burst terminate alternative --

you concluded that was the least costly of the alternatives; right?

A. Least costly in terms of Dr. Geilhufe's implementation costs but not the least costly in terms of performance penalty.

Q. And putting aside the patent issue, the explicitly identify in read command alternative would be the second least costly of the alternatives that you've considered to programmable burst length; is that right?

A. Yes.

Q. Now, going to DX-311, you discuss on this slide the cost penalties associated with alternatives not covered by Rambus patents; is that right?

A. Right.

Q. And what you show here is that even combining the least costly alternatives not covered by Rambus patents you end up with a cost, an additional cost as a percentage of average selling price greater than Rambus royalties; is that right?

A. Yes.

Q. But you don't consider on this slide what the least costly combination of alternatives allegedly covered by Rambus patents would be; right?

A. Correct.

Q. And am I right that the least costly combination of those alternatives would be the explicitly identify in read command for programmable CAS latency and the burst terminate option for programmable burst length, that combination would be the least costly combination?

A. It would be the least costly in terms of

explicitly identify in read command for both programmable CAS latency and programmable burst; right?

A. Without reference to patent coverage?

Q. Without reference to patent --

A. Yes.

Q. And that based on Mr. Geilhufe's information, that would add .42 percent to the cost as a percentage of average selling price; right?

A. Yes.

Q. And that again would be less than the Rambus royalties; correct?

A. And that too carries with it performance penalties, bandwidth issues.

Q. You say at the bottom of this slide, DX-311, that a rational manufacturer would have chosen to license from Rambus rather than incur a higher cost for the alternatives, but that's only looking at alternatives that Dr. Soderman says are not covered by Rambus patents; right?

A. It is, but the conclusion also means to take account of the performance penalties as well, and if penalties that appear to be less costly in terms of manufacturing implementation have a high cost in terms of system performance, that is, a computer system, that

would be taken account of also.

Q. And when you refer to performance penalties -- and could I ask you to take a look at DX-310.

When you refer to performance penalties, are you referring to the information that's of the sort that you list in the far right-hand side of DX-310 for these, the four alternatives that are discussed?

A. Yes. But there's additional information as well at our disposal.

Q. And am I right that you haven't sought to quantify the costs associated with any of those so-called performance penalties?

A. I have not, but I heard Dr. Jacob quantify one of them, and that has to do with the burst terminate command. He said that there was a 10 percent or 10 to 15 percent -- I forgot which -- performance penalty associated with burst terminate.

Q. Now, focusing on programmable -- or I'm sorry.

Focusing on the fixed CAS latency and fixed burst length, you find that, based on Mr. Geilhufe's analysis, using fixed CAS latency would have increased the cost of a DRAM by .82 percent; is that right?

A. Relative to -- I don't have a copy of readable slides here, so let's just -- I'm sure that's right, but let's just put it back on the screen if we may.

These are too small for me to work with.

Q. I believe that's DX-309.

MR. STONE: His CAS latency is 307.

MR. ROYALL: Sorry. Thank you. DX-307.

May I approach, Your Honor?

JUDGE McGUIRE: Yes.

MR. ROYALL: I don't want to slow this down, but pulling these things up on the screen is taking a while.

THE WITNESS: Thank you. That's helpful.

BY MR. ROYALL:

Q. DX-307.

A. Your question was?

Q. Actually let me withdraw that question in the interest of time and move ahead.

Am I right that putting aside infringement, each of the alternatives to -- let me ask about programmable burst length -- are in your view commercially viable substitutes to the Rambus technologies?

A. It's a vague term with which I'm uncomfortable. They are --

JUDGE McGUIRE: That's all you need to say then.

THE WITNESS: Thank you, Your Honor.

BY MR. ROYALL:

Q. Could I ask you to take a look at your deposition, page 165, from this case. And I'm trying to move as quickly as I can here, but I'm going to ask you to turn to page 165.

A. I am.

Q. Line 11.

I asked you about -- I said, "What about the fixed burst length alternative to programmable burst length? Is that a commercially viable substitute for programmable burst length?

"ANSWER: According to my definition of commercially viable, yes."

Next question: "And would it also be a price-constraining alternative to burst length absent formal standardization? My answer is yes."

A. Okay.

Q. And then let me just continue because it relates to the broader question.

Then I asked, "What about the other alternatives to programmable burst length discussed in Exhibit 7," referring to your exhibit to your report, "are any of these commercially viable substitutes, as you define the term?

"ANSWER: Putting aside the question of

Q. But you didn't perform any analysis that would show or that would allow you to conclude that JEDEC would have produced a standard that had a number of different fixed CAS latencies if that alternative were chosen by JEDEC; is that right?

A. Well, here -- I hope I get the generation right this time -- but here I think the history of the DDR-II standard is relevant. Maybe not. Maybe that's burst length.

Answer, no.

Q. Are you aware of evidence in this case that suggests that if JEDEC had used fixed CAS latency that it would have settled on only one value for fixed CAS latency?

A. I have not seen any evidence to that effect.

Q. Are you aware of evidence that if JEDEC had used fixed burst length as to work around programmable burst length that it would have settled on only one value for fixed burst length?

A. No. I do recall that there was testimony, perhaps it was by Mr. Polzin, if he was of AMD, and perhaps others that spoke of the advantages of the flexibility of programmable latency, so presumably there was some advantage to manufacturers of having the availability of more than one value for both latency

and burst.

So far as burst length is concerned, I recall the DDR-II history where the preference was for preserving two burst lengths.

Q. Moving to explicitly identify latency and burst length in the read command alternative or alternatives, you agree that the read/write command alternative for -- to programmable CAS latency is -- would be a commercially viable substitute?

A. If I said so in my deposition, then according to the definition of "commercial viability" that I used there, I would certainly stipulate to that.

Q. Well, I don't want to take the time to point you in your deposition if I don't have to.

Would you be willing to acknowledge that as you used that term or understood that term in your deposition that you acknowledge that that was true?

A. As I understood it in my deposition, yes. I haven't changed my opinion since then.

Q. Okay. Now, you find, based on Mr. Geilhufe's cost analysis, that explicitly identifying the CAS latency and burst length in the read command, that both of these would involve -- increase the cost of a DRAM by .21 percent?

A. Yes.

Q. Is that right?

A. Yes.

Q. And you're aware that Mr. Geilhufe's cost estimates in that regard are predicated on his understanding that additional pins might have been required to implement this alternative?

A. I do not recall. In other words, this is distinguished from the use of pins as you can see on the table, so -- and Dr. Soderman does not speak of requiring pins -- I guess my understanding had been that extra pins were not required for this alternative.

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performance issue.

Is it your understanding that that performance issue does not exist in the context of specifying burst length?

A. I would have to go back to Dr. Soderman's table to see whether that's an omission. I presume that it ought to be the same in that the cost is the same and that both are deemed to be infringing and the need of a register similar to a mode register appears to me -- and this is just an understanding or really a guess I have to say -- that it would be the same, that, I have to check.

Q. Let's turn to alternatives to dual-edged clocking. And I believe that is the subject of DX-314.

A. I'm with you.

Q. Now, am I right that based on Mr. Geilhufe's cost analysis that you conclude that using double clock frequency would increase the cost of a DRAM by 5.46 percent relative to the current standards?

A. Yes.

Q. Not -- I'm not representing that those numbers are specified or set forth on that exhibit.

A. It's on page 12 of my charts.

Q. DX-313.

And nearly all of the costs are based -- of

those costs are based on the on-DIMM clock that Mr. Geilhufe believes would be required; is that right, for that alternative?

A. No. If -- I'm -- let me see. I do not -- I'm not sure. I would have to return to his testimony on that.

Q. And let's --

A. I'm not certain.

Q. Let's move on in the interest of time to alternatives to on-chip PLL/DLL. And that is discussed on DX-315.

Am I right that you've not performed any economic analysis based on Mr. Geilhufe's analysis of the costs of alternatives to on-chip PLL/DLL?

A. Correct.

Q. And that's because Mr. Geilhufe didn't produce to you any estimates of the costs of those alternatives?

A. No. One of the alternatives he was able to produce cost estimates for -- well, one out of four didn't seem sufficient to assume -- not easier but seemed fairer in some sense to assume zero.

Q. Now, you discuss on DX-315 four alternatives to on-chip PLL/DLL and what I take to be references to performance issues that you understand to be associated

with those alternatives; is that right?

A. Yes.

Q. Now, you don't discuss on this slide the alternative of not using a DLL at all; is that right?

A. Right.

Q. But you do understand that that is an option that would have been viable, that is, simply not using a DLL or PLL at all, that -- you understand that that would be viable for clock speeds up to 200 megahertz; is that right?

A. That's my understanding.

Q. And you understand that production of a DRAM chip without an on-chip PLL or DLL would be technically feasible for clock speeds up to that level; right?

A. That's my understanding.

Q. And you understand that the next generation of DDR SDRAMs, the generation that may be in progress as we speak, will involve clock speeds of 200 megahertz; correct?

A. I -- I'm not aware of that. I thought the clock speeds of 200 megahertz had already been exceeded.

Q. Well, I want to make sure that you understood my question not to refer to data rates but rather to

clock speeds.

A. I am still not sure.

Q. Let me ask you to -- well, strike that.

In any event, it is your understanding that simply not using an on-chip PLL/DLL would be a viable option, commercially viable option for clock speeds up to 200 megahertz?

A. Yes. I understand that it would be undesirable for -- to design a generation of DRAM at -- that is limited to -- that has no headroom in terms of clock speed. That designers wish to exceed those -- that clock speed within the life of the generation of DDR SDRAM.

MR. ROYALL: Your Honor, I move to strike that answer as going beyond the question. And I'm happy not even to repose a question because I think it may already be asked and answered. If Mr. Stone wants to raise this issue on redirect --

JUDGE McGUIRE: Sustained.

Now, let me ask you a question. How much more time are you going to take?

MR. ROYALL: I have one last question.

JUDGE McGUIRE: It's a good thing. Okay. I was going to put you on the clock.

Go ahead.

MR. ROYALL: Thank you, Your Honor.

BY MR. ROYALL:

Q. Let me just -- this issue of commercially viable, just so the record is clear in how you've defined that term in your definition, let me ask you to take a look at page 157 of your deposition in this case.

On that page starting on line 12, do you see I asked you, "Just so we're clear, what is your definition of that term," referring to commercial viability?

And you said: "My definition of that term includes choices not made. In other words, it includes possibilities to which customers could shift even though the higher -- even though they are not first on the hierarchy of choices and therefore may not be chosen."

Do you see that?

A. Yeah. Excellent.

Q. So does that remind you of what context you had for that term "commercial viability" in the context of your deposition and the testimony that has related to your deposition today?

A. Perfectly. Thank you.

Q. And you accept that definition?

A. Yes, I do.

MR. ROYALL: Thank you. No further questions.

JUDGE McGUIRE: All right. Thank you, Mr. Royall.

Mr. Stone?

MR. STONE: Thank you, Your Honor.

JUDGE McGUIRE: Redirect?

REDIRECT EXAMINATION

BY MR. STONE:

Q. Hello, Dr. Rapp.

JUDGE McGUIRE: Well, good to see you again.

BY MR. STONE:

Q. Good to see you again. How's that?

You were asked some questions about the least costly alternatives when you ignored whether or not they were covered by Rambus patents. Do you recall that?

A. Yes.

Q. Would it be correct that according to your calculations with respect to the two features at issue in SDRAM, if we were to ignore Rambus patents and any royalties associated with those patents, the least costly alternatives according to your computations would be programmable CAS latency and programmable burst length?

A. Yes.

Q. And would those be ones that had the fewest, if any, performance disadvantages?

A. Yes.

Q. Let me ask you -- you were asked some questions today and perhaps even yesterday by Mr. Royall about whether certain things are possible. Do you recall those lines of questions?

A. Vaguely.

Q. For example, a question like "would it be possible that"?

A. Yes. Sure.

Q. In the opinions that you expressed yesterday in your direct examination, did you express those opinions as ones that you believed as an economist and according to economic principles are opinions that would be more likely than not?

A. That was my intention in my testimony.

Q. Okay. Let me go back to something you were asked about yesterday, the subject of opportunism. Do you recall that subject?

A. Yes.

Q. In your view, how prevalent or common is opportunism, as you were asked about that subject yesterday?

A. Opportunism is everywhere in the economy, and the reason that opportunism is everywhere is that nobody is able to -- it's very rare that people are able to specify perfect contracts, and as long as contracts are imperfectly specified, people can take advantage of the fact that they are -- that they're imperfect. So it happens a lot.

Q. Is there a necessary relationship between opportunism and anticompetitive behavior from the perspective of an antitrust economist?

A. No. There is no necessary connection because the world would be filled with antitrust violations if there were.

Q. So can you put that in a -- let me ask it in a different sense.

Does the fact that there is -- that opportunism exists mean that every time it exists that anticompetitive behavior will result?

A. That is not the case, if that's clear.

JUDGE McGUIRE: You're saying that is not the case that every time there's opportunism that it follows that anticompetitive behavior would result?

THE WITNESS: Yes.

Thank you, Your Honor.

JUDGE McGUIRE: Okay.

BY MR. STONE:

Q. Let me ask you if you would to turn to the white paper that you were shown earlier by Mr. Royall.

A. Got it.

Q. And let me ask you to turn to page 10 of that document. I believe at the top of that -- well, I'm going to have to bring this up.

I don't have it on our system, Your Honor. Let me see if I can bring it up on the ELMO.

Now let's see if I can do this (indicating).

A. That's good.

Q. Is that good?

A. Uh-huh.

Q. You were asked earlier about that first paragraph that begins "A fact widely known to students of intellectual property"; correct?

A. Yes.

Q. What was the purpose for including that particular paragraph in this white paper?

A. Nothing other than to initiate a discussion of value which relates eventually to market power, and that initial sentence was there to advise readers of this paper that even though we sometimes speak of patents as patent monopolies, that in an antitrust sense the word "monopoly" means something very

different and that you can have a patent with all the seals and ribbons and not have anything like a monopoly, and that's more frequently the case than not.

Q. And did you go on from that in the next paragraph to describe a methodology of analysis that is related to the methodology that you've presented here?

A. Yes. In the first paragraph, the second sentence and what follows, the same basic methodology is the one that I've used. It's the essence of economic valuation.

And the second sentence of the first paragraph reads, "The value of an invention is determined by how much of an improvement the invention is over the closest alternative." The second paragraph expands on that.

Q. And does the third paragraph in which you state that "Of course revolutionary inventions -- useful technical advances with weak or nonexistent economic substitutes -- by exactly the same principle can be of great value," is that an effort to build on the introductory paragraph that you were asked about by Mr. Royall?

A. Yes. While it is true, as I said at the

outset, that most patents aren't worth much, there are a few that are worth a great deal, and since that's the subject of the inquiry, that -- we got to saying -- I got to saying that, my coauthor and I, by the third paragraph.

Q. And is the next sentence of that third paragraph, "Processes or products embodying such inventions will themselves be valuable either because the new product characteristics are desirable to consumers or without alternative means to satisfy those desires or because product costs have been reduced in ways that could not be accomplished by other means," consistent with the testimony you've presented in this proceeding?

A. Yes. Absolutely.

Q. Let me show you page 19 in that white paper, which I believe you also were shown by Mr. Royall with respect to the numbered paragraphs at the top of this page.

And to put those two numbered paragraphs on page 19 in context, you need to consider the text that follows in the next paragraph, the one that I have a little line alongside?

A. Yes.

Q. And in that paragraph where you say -- are you

talking about what the FTC would need to show, in your view, to establish from an economic perspective that there had been anticompetitive behavior?

A. Yes.

Q. And was it your view at the time of the white paper that if chip manufacturers could switch to the noninfringing alternatives at very little cost, then there is correspondingly very little scope for harm arising from Rambus' nondisclosure of patent applications?

A. Right.

Q. Is that consistent with your testimony here?

A. Yes.

Q. And did you, for purposes of this white paper, on page 20, the next page, did you talk at that time about the existence of proposed alternatives and potential cost penalties that might be associated with them in reference, among other things, to the declaration of Mr. -- Dr. Horowitz?

A. Yes. At the top paragraph.

Q. Yes.

And did you acknowledge in this white paper that you had not at that time quantified the costs of the various alternatives, in the paragraph that follows?

A. Yes.

Q. Okay. You were shown some slides by Mr. Royall -- one slide by Mr. Royall, that were used in meetings with personnel at the Federal Trade Commission. Do you recall that?

A. Yes.

Q. And the slide I believe he showed you was this one that I have up, which talks about by affecting scarcity of alternatives through increasing the cost of alternatives, it then lists sunk costs, switching costs and coordination difficulties and brackets those to combine to represent lock-in?

A. Yes.

Q. On the next slide that you used in the course of these meetings, did you summarize your conclusion that if there are low switching costs -- well, let me just ask you, what did you summarize in the paragraph under no change in the cost or availability of alternatives? Just the first point where it leads to no lock-in.

A. That where there are low switching costs or small sunk investments that there is no -- that one would expect or predict no lock-in in that circumstance.

Q. Again, is that testimony that you believe to be

consistent with the testimony you've provided here in this proceeding?

A. Yes.

Q. Let me ask you, do you have the Micron rebuttal report that Mr. Royall showed you?

A. Yes, I do.

Q. I think what he showed you was on page 6 of that document. You can take a look at that and see if you can confirm that that's consistent with your recollection.

A. Help me to find where in the document.

Q. He asked you about that JEDEC determined the standard I believe with respect to Professor Carlton, and then at the bottom of page 6 he referred you to the statement that reads, "Professor Carlton has presented no means to determine whether Micron's assertion that JEDEC members would have switched," and so on. I think this is where he brought you to the question of your statement about Professor Carlton. If you recall different than that, please tell me.

MR. ROYALL: If I could just interject for the record, I think the language --

MR. STONE: You're right.

MR. ROYALL: -- on this page is starting with "knowing." It's that language.

MR. STONE: Thank you very much, Mr. Royall.

BY MR. STONE:

Q. Go to the top of the page where it says "Knowing the reasons behind JEDEC's selection."

A. Yes.

Q. And do you recall this was the portion of the text you were asked about by Mr. Royall?

A. Yes.

Q. Let me ask you to turn just if you would to the preceding page of this rebuttal report.

And to put in context, if we can, the sentence that you were asked to look at by Mr. Royall, in the preceding paragraph did you discuss that while Professor Carlton and you were neither one experts in semiconductor technology, you were both capable of evaluating the economic costs and benefits of alternatives to technology on the parties at interest?

A. Yes.

Q. And did you go on say you just needed sufficient information to do that?

A. Yes.

Q. Is that the computation that you have performed in connection with the testimony here?

A. Yes.

Q. Now, let me ask you, do you still have a copy

of the paper you wrote following the hearings with respect to the joint hearings of DOJ and FTC?

A. Right. It was written I think prior to, but I ought to have it on this pile.

Q. I have another copy. Let me just hand you mine.

May I approach, Your Honor?

Let me hand you mine.

A. Thanks.

Q. Dr. Rapp, in connection with the testimony which you provided at those joint hearings, were you compensated by anyone for that testimony?

A. I was not.

Q. And in connection with the preparation of this paper, were you compensated by anyone for your work on the paper?

A. No. Well, sorry. I was paid my salary by NERA, but NERA was not working for anybody.

Q. And let me ask you to look -- in connection with this, the testimony you gave to the joint hearings and the preparation of this paper, did you disclose that you had previously been retained and performed services for Rambus?

A. Yes. In the first footnote on page 1, Lauren Stiroh and I, the two authors of the paper,

said: "Many of the opinions in this submission also appear in the draft paper Market Power and Technology Markets available from the authors on request. We have also developed certain of our ideas about standard-setting in our role as economic consultants to Rambus, Incorporated, a semiconductor memory technology developer."

Q. And did you in this paper arrive at certain conclusions with respect to how standard-setting organizations should conduct themselves? Is that one of the things you arrived at as conclusions in this paper?

A. I'm not sure it went quite that far. I think it was -- oh, I'm sorry.

MR. ROYALL: No. I don't want to interrupt your answer.

THE WITNESS: I think it was probably a discussion of the incentives and consequences of standard-setting rules but didn't rise to the level of giving advice to standard-setting -- about how to -- how to fix rules.

BY MR. STONE:

Q. Okay.

MR. ROYALL: All I was going to say is if he was planning to go into that subject it's beyond the

scope, but it sounds like --

MR. STONE: I had not intended to go any further. I was just trying to put in context what the subject of that paper was.

BY MR. STONE:

Q. Turn if you would to your expert report, which is CX-3059. And just a couple of questions about your expert report.

First, do you recall you were asked about appendix II which listed various documents that you had reviewed?

A. Yes.

Q. If you would turn to page 6 of this document, but I suspect it's going to be -- it is page 6. No, it's not. Go to page 7 if you would.

Okay. Wrong report. That's not going to work. That's a different one. That must be an old one. I'll use the ELMO.

Sorry. I should have checked it.

A. Page?

Q. Page 6.

A. 6. Yes.

MR. STONE: I apologize, Your Honor.

THE WITNESS: It relates to appendix II, if that's helpful.

BY MR. STONE:

Q. Okay. And let me just direct your attention to the very top of this document under the heading Documents Relied Upon.

Did you there summarize the documents you relied upon in preparing your expert report?

A. Yes. And documents and interviews -- sorry -- documents and reports and analyses.

Q. And did you state there that you and economists working with you had conducted interviews with Rambus personnel and technical experts?

A. Yes.

Q. And did you also there describe your review of various trade press and other documents as well as deposition testimony?

A. Yes.

Q. And let me ask you if you would to turn to page 13 and take a look at footnote 28.

Okay. Do you have footnote 28 in front of you?

A. Yes.

Q. And did you there disclose that part of the analysis expressed in your expert report had also previously been included in prior writings or incorporated into your previous expert reports, which

you then cite?

A. Yes.

Q. Was it your intention in presenting your expert report to try to set forth in these various places all of the information that you had referred to in connection with preparing your report and coming to your opinions?

A. Sure.

MR. STONE: Your Honor, I wanted to go into the appendix -- the Exhibit 3 document for a moment because I think only a portion of these numbers were previously gotten into the record through the chart that Mr. Royall prepared, but I wonder if I might have just a moment to confer with him on this.

JUDGE McGUIRE: Yeah, go ahead.

(Pause in the proceedings.)

MR. STONE: Okay. Let me do it this way, Your Honor.

JUDGE McGUIRE: I assume that didn't go well.

MR. STONE: It didn't go as well as I thought.

What I wanted to get into the record was the numbers from this chart that are in addition to the numbers that Mr. Royall had offered, and let me see if I can do it expeditiously this way.

MR. ROYALL: Could I just mention what the

issue I understand to be here.

Because I want to expedite this as well, but I think the issue is Mr. Stone I believe wants -- wanted to know if I would allow or not object to the admission of this part of the expert report, but I understand that there's -- because of Mr. Stone's own objections that we've had established ground rules here that expert reports are not admissible, and that's my concern, is that that doesn't seem fair to me that even a portion of this expert report should be admitted when ours over his objections --

JUDGE McGUIRE: Well, you're not asking it to be admitted to the court, at least -- I know you've asked him, but you haven't asked me now because you're trying --

MR. STONE: If he would have agreed, I would have asked, Your Honor, but I'm not saying he's obligated to agree on this.

MR. ROYALL: But obviously I'm happy to see if we can try to expedite this in some way short of admitting that.

JUDGE McGUIRE: I think that's what he's trying to do now; right?

MR. STONE: Let me just try to see if I could.

JUDGE McGUIRE: Right.

BY MR. STONE:

Q. If we can do this, if you'll allow me to try in this fashion, just so we know what the various numbers that you were asked about by Mr. Royall, for 1994, is the data that you had available to you data which reflected that the revenue share for fast page mode was 96.7 percent and for other DRAMs it was 3.3 percent, to total 100?

A. Yes.

Q. For 1995 for fast page mode was it 87.2 percent, for EDO was it 9.9 percent and for other was it 2.9 percent, again by revenue?

A. Yes.

Q. And those are actual numbers?

A. Those -- yes, those are actual percentage numbers.

Q. And then for 1996 was it for fast page mode 39.4 percent, for EDO 52.7 percent, for SDRAM 4.3 percent, for RDRAM .5 percent and for other 3.1 percent?

A. Yes.

Q. For 1997 was it 8.1 percent for fast page mode, 55.2 for EDO, 33.5 for SDRAM, 1.3 for RDRAM and 1.8 for other?

A. Yes.

Q. And then for 1998 was it 8.8 percent for fast page mode, 27.6 percent for EDO, 60.8 percent for SDRAM, 1.6 for RDRAM and 1.3 for other?

A. Yes.

Q. For 1999 was it 10.5 percent for fast page mode, 17.5 percent for EDO, 69.3 percent for SDRAM, 1.1 for RDRAM and 1.5 for other?

A. Yes.

A. Yes.

Q. You recall that earlier today you were asked some questions about why you thought that Intel had removed some aspects of the JEDEC specification. Do you recall that testimony?

A. Yes.

Q. And you pointed to a citation to a particular exhibit? Do you recall that?

A. Yes.

Q. Could we bring up RX-2103-14.

MR. ROYALL: Your Honor, as you may recall, when I sought to show exhibits to Professor McAfee on redirect, it created some objections, and I was able to show a couple, so I'll -- we're just --

MR. STONE: I'm very much at the couple stage.

MR. ROYALL: Okay. In fairness, then I won't object.

THE WITNESS: Thank you.

BY MR. STONE:

Q. Thank you. I apologize.

If you could blow up under 1.1.

Where it says in this document, which is in evidence, where it says under section 1.1 on page 9 of Exhibit RX-201-14 that the objective of the document is to define a new synchronous DRAM specification, PC SDRAM, which will remove extra functionality from the current JEDEC standard SDRAM specification, and goes on from there, is this the language in this document that you were referring to in your slide you were asked about?

A. Yes.

Q. Thank you. We can take that down.

You were asked some questions about your Infineon deposition and how you referred to certain DRAMs I guess as compatible. Do you recall that?

A. Yes.

Q. And you were shown some pages from your deposition?

A. Yes.

Q. Over the lunch hour did I give you a copy of your Infineon expert report to review?

A. Yes.

Q. And did you go back and review your Infineon expert report to see whether you -- in that report how you characterized the compatibility of SDRAM?

A. Yes.

Q. And what did you find?

A. I found that, as I expected to find, that I categorized it as of low compatibility requirements just like I testified in this trial, indicating or confirming that the answer that I gave in the Infineon deposition was just a mistake.

Q. And you acknowledge it as such today?

A. I do.

Q. Earlier today you were asked about the effect of standardization on economies of scale. Do you recall that?

A. Yes.

Q. Would your testimony with regard to the effects of standardization on economies of scale be the same whether the standardization was de facto or de jure?

A. No. Standardization can assist in the achievement of economies of scale whether the standard is formally set or set by the marketplace.

Q. Let me make sure I understood your answer correctly then because I think I might have had a

double negative or something.

A. Oh.

Q. Let me just ask it this way.

For purposes of the effect of standardization on economies of scale, does it matter whether the standardization is de jure or de facto?

A. It does not.

JUDGE McGUIRE: Can I follow up on that?

MR. STONE: Certainly, Your Honor.

JUDGE McGUIRE: I know it's getting late.

Is it possible and with your understanding of the DRAM industry for there to be competing standards, both a standard set by an SSO and a de facto standard, at least for a period of time? And if so, can you draw any economic conclusions on the OEMs from that, or is that germane to anything we're talking about?

THE WITNESS: Yes, I think it is, Your Honor, and I think as long as we say two competing standards and not seven or eight --

JUDGE McGUIRE: Right, two.

Just imagine that a decision was made by one or -- one manufacturer or more than one manufacturer in concert with others, the coordination that we were talking about, to produce a substantially cheaper flavor of DRAM that would be consistent with the use of microprocessors that were lower speed or less efficient, somebody who just wants to produce a cheaper machine and everything about it is cheaper.

There isn't a technological reason that would prevent that from happening and that would enable someone more diversity than exists today. The economies of scale happen at the level of the line and the plant, so there's nothing to rule that out.

The level of coordination in the industry within JEDEC has been higher than would normally allow that, but there's nothing in the past, but that's just a matter of history and the way JEDEC operates. There's nothing about the economics of the industry in my opinion that would prevent that.

JUDGE McGUIRE: Thank you.

I'm sorry, Mr. Stone.

MR. STONE: No, no. That's quite all right.

JUDGE McGUIRE: I know it's getting late and we don't want to extend this any longer than it's going to take.

MR. STONE: My view is whenever there's a question that you think we would benefit from to hear the answer, we should.

BY MR. STONE:

Q. Dr. Rapp -- I lost my train of thought. I'm sorry.

You were asked earlier about whether you could think of an example or you were asked something about whether there was an instance of a single manufacturer-developed unique specification for DRAM. Do you recall that?

A. Yes.

Q. And is there any example of that that you can think of?

A. Yes. The example that Dr. Prince offered in her trial testimony that had to do with video RAM. And the example was that Samsung developed a specification, took it to JEDEC. JEDEC wasn't interested, but the -- and Samsung went it alone and succeeded. That's my reading of her testimony.

Q. Okay. Has it been part of your assignment or your investigation in this case to look to see whether patented technology has or has not been included in JEDEC specifications over any period of time?

A. I know that it has, but it hasn't been a

subject of special inquiry on my part.

Q. Okay. Have you looked for purposes of your testimony here today at testimony that has been developed during the trial with respect to the frequency of change in the design of DRAMs?

A. Yes.

Q. And did you, when you were preparing your slides, prepare a couple of slides which summarized some of the testimony you thought was most pertinent?

A. I did.

MR. STONE: Okay. Your Honor, I think, consistent with the prior rulings, I'm not going to offer what he's done or even bring it up on the screen. I simply wanted to establish that it was part of the work that he had done. I hope that's consistent with the rules.

JUDGE McGUIRE: Noted.

MR. STONE: Thank you.

BY MR. STONE:

Q. Let me go to the question of opporBY so. estion of op

could realize a greater benefit from the efforts of an engineer than what the engineer cost you in terms of salary, and so on, would it make economic sense if that were a true proposition for a company to hire more engineers?

A. Yes.

Q. And if a company was making more money or

see the totality of that advice?

A. I didn't see the full totality of that advice, but I did ask one of your colleagues at some point to share what was available with me.

Q. So you saw --

A. I can't claim that it was a thorough inquiry, but I did look into it.

Q. Okay. In your opinion, does Rambus have competitors in a technology market?

A. Yes.

Q. And in a general sense, who are the competitors that Rambus has in a technology market?

A. Well, among others, its competitors are the R&D apparatus of the manufacturers. They are producing DRAM technology. There are other -- fabless DRAM technology companies, and all of them compete in general terms. That's not with respect to the relevant markets that Professor McAfee defined, but even there, too, the principal competitors I would say are the integrated R&D operations of the DRAM manufacturers.

Q. Okay. You were asked some questions by Mr. Royall about how much money NERA has been paid by Rambus over the course of its consulting work. Do you recall that?

A. Yes.

Q. As a percentage of NERA's income over the three or four years that you have been providing those services, can you estimate what percentage that money has been?

A. Well, I wasn't clear about what NERA has been paid, but if the answer were a million dollars, our annual revenues are $140 million, so it's well less than 1 percent of that.

Q. And does your personal compensation by NERA depend at all upon on the extent of your consulting work?

A. My personal compensation depends not at all on my consulting work. My personal compensation depends upon a combination of things that are how well NERA does as a firm as a whole, how well the Mercer, Inc. parent company does, and how well Marsh & McClennan Companies does. Nobody who sets my pay cares much about my own personal billings.

Q. You were asked some questions earlier today about whether Rambus has market power with respect to the four technologies. Do you recall that?

A. Yes.

Q. And in your opinion, does Rambus' market power with respect to those four technologies rise to the

level of monopoly power?

A. No.

Q. And is its market power as you understand it consistent with the market power derived without -- let me see if I can reframe that.

Have you formed an opinion as to whether the market power that Rambus has with respect to those four technologies is due to any nondisclosure of information by Rambus to JEDEC as contended by or alleged by complaint counsel?

A. No. My opinion is that the market power that Rambus possesses in these four technologies arises solely out of the distance between the cost-performance qualities of the Rambus technologies and the next best alternative.

Q. And one final subject I think, if I might, Dr. Rapp.

On a couple of occasions yesterday and today you have either been shown or asked about the language on this particular demonstrative that was used by Mr. Royall (indicating). Do you recall that?

A. Yes.

Q. Is the testimony you've presented during the two days that you've been on the stand in your opinion consistent or inconsistent with the standards that you

have set forth in your previous report as quoted on this demonstrative?

A. I believe that it has been consistent with that, and I include in that the answers that I gave to Mr. Royall when he showed that in certain respects that I didn't have a quantitative basis, and I hope I was clear that those ought to be given less weight than in the cost analysis and the analysis of performance that I gave.

I think that for the assignment that I was given and tried my best to carry out, it's a necessity that real quantitative analysis be used, and I tried my best to be consistent with that quotation in which I quote words to live by and I believe that.

Q. And are you comfortable from your perspective as a professional economist with the reliability of the opinions you've expressed here?

A. Yes, I am.

Q. And I believe the document I just showed you and you were testifying about, Dr. Rapp, was DX-325, so we note that for the record.

I have no further questions, Your Honor.

JUDGE McGUIRE: Thank you, Mr. Stone.

Any further recross, Mr. Royall?

MR. ROYALL: Very brief.

JUDGE McGUIRE: Thank you.

RECROSS-EXAMINATION

BY MR. ROYALL:

Q. Dr. Rapp, you recall Mr. Stone asked you about some language in your expert report -- I don't even know -- you're welcome obviously to turn there, but it

Q. Am I right that for purposes of your expert report in this case you did not rely upon or consider any information that you obtained through interviews of Rambus personnel?

A. That is correct with the proviso that I think I gave you when I was deposed, and that is that there was an earlier set of interviews with Rambus personnel. They formed the -- some background understanding that I have and that went into my opinions, and it's -- and we both understand what that means I think.

Q. By way of background?

A. Yes.

Q. And am I right that for purposes, notwithstanding this statement on page 6 of your expert report, for purposes of forming the conclusions set forth in this report, you did not rely upon or consider any information that you obtained or learned through reading the deposition testimony?

A. Everything that I've relied upon was listed in the appendix of my report.

Q. And I think as we established yesterday, there are no depositions identified in that appendix II?

A. Right.

Q. Now, very quickly, with reference to the -- you were asked about your testimony in the Infineon

case.

A. Yes.

Q. You mentioned that you had looked at your report in the Infineon case.

That report that you looked at was a report that was written before you testified in the deposition that I asked you about; right?

A. That's correct.

Q. And so the deposition that you gave was a -- the deposition testimony that I asked you about, that was deposition testimony that you gave in answering questions about that same report --

A. Right.

Q. -- correct?

The final question I wanted to ask you about, Mr. Stone asked you about to the extent to which you had looked into the record about advice to Rambus regarding JEDEC. Do you recall that?

A. Yes.

Q. And I think you said that you had asked one of Mr. Stone's colleagues to see whatever was available in terms of contemporaneous legal advice relating to that --

A. Yes.

Q. -- that set of issues?

And am I right that you don't recall anything about what you saw in any such evidence beyond what you testified to in your answers in cross-examination?

A. I think that's fair, that there's not anything else that -- of relevance to my testimony or the questions that I was asked by you that's part of my recollection as a result of that, the review of those documents.

Q. And just to give some reference point in that, and the questions that I was asking you about had to do with whether you're aware of any contemporaneous evidence that Rambus had concerns that additional disclosures of patent-related materials might have adverse consequences for Rambus; right?

A. Right.

Q. Do you recall that that was the general context?

A. Yeah. See if this is helpful. The answer that -- the answers that I gave you to your questions represent my full knowledge and recollection of the subject.

MR. ROYALL: Thank you.

No further questions.

JUDGE McGUIRE: Thank you, Mr. Royall.

MR. STONE: No questions, Your Honor.

JUDGE McGUIRE: Thank you.

And Dr. Rapp, you're excused from this proceeding. I thank you very much for your testimony. And for your information, right across the street is a little pub and you may want to go there and have a soft drink or something.

THE WITNESS: It's actually an airplane that I have in mind. Thank you, Your Honor.

JUDGE McGUIRE: Okay. Counsel, very good. We'll convene tomorrow morning at 9:30.

MR. STONE: Yes.

JUDGE McGUIRE: Th Yes.