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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TRIAL Volume 36

PART 1

PUBLIC RECORD

BEFORE THE HONORABLE STEPHEN J. McGUIRE

Chief Administrative Law Judge

Federal Trade Commission

600 Pennsylvania Avenue, N.W.

Washington, D.C.

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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.

Any items we need to take up this morning before we begin?

MR. ROYALL: I don't believe so, Your Honor. My estimate is it may be about two hours before I'll be complete with the direct.

JUDGE McGUIRE: All right.

Sir, you may take the stand again, please.

And Mr. Royall, you may proceed with your examination of the witness.

MR. ROYALL: Thank you.

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Whereupon --

RANDOLPH PRESTON McAFEE

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

DIRECT EXAMINATION (continued)

BY MR. ROYALL:

Q. Professor McAfee, before we go further today, let me ask, do you recall that yesterday there were a few slides that you noted, as you saw them when they were pulled up on the screen, you noted that there may

have been errors?

A. That's correct.

Q. Let me ask that we pull up the slide that was previously marked DX-200.

And can we run the animation on that.

You'll recall I showed you a slide very similar to this one yesterday, and there was an error that you noted. Do you recall what the error was?

A. Yes. "Use toggle mode" had not been checked.

Q. And is this, what's now on the screen, is this version of the same slide correct?

A. Yes, this is correct.

Q. Let's mark this version of the slide as DX-213.

Was there -- in connection with this toggle mode issue, did you also note yesterday that there was a slide that you thought was missing from the presentation slides?

A. Yes. That's correct.

Q. Would you pull up the next slide.

A. That is not the slide.

MR. STONE: It should be the next one.

BY MR. ROYALL:

Q. Is this the slide that you recalled yesterday that was missing from the presentation?

A. Yes, it is.

Q. And this relates to the toggle mode technology and your conclusions that this technology is a commercially -- or was a commercially viable alternative to the dual-edged clocking technology?

A. That's correct.

Q. Let's mark this as DX-14.

JUDGE McGUIRE: 214.

MR. ROYALL: I'm sorry. DX-214.

BY MR. ROYALL:

Q. Now, were there any other slides that you recalled yesterday that when you saw them you thought there were errors in the slides?

A. Yes. There was an omission on a slide as well.

Q. And let me see if we can pull that -- pull the next slide up.

Is this the slide that you recalled having an error?

A. Yes, it is.

Q. And I think this may be a new version of the same slide.

Do you recognize something in this slide that was omitted from the slide that you saw yesterday?

A. Yes. The last bullet point was not present on

the slide yesterday.

Q. Let's mark this as DX-215.

Now, this slide relates to your conclusion, as you explained yesterday, that the alternative of keeping each DRAM single data rate and interleaving banks on the module, that that alternative was a commercially viable alternative to use of dual-edged clocking; is that correct?

A. That's correct.

Q. And you said that the last bullet point that is listed here on DX-215 was omitted from the slide that you saw yesterday. Now that we have a corrected version of the slide here in DX-215, let me ask you about that last bullet point.

And the statement you make in that bullet point is: "Royalties may be a problem."

Can you explain what you mean by that?

A. Yes. Generally, royalties for intellectual property impose a penalty on a technology with respect to market selection, and so the fact that this method, the method that I'm referring to here, at least in the implementation by Kentron, comes with royalties to Kentron, makes it a -- it may not be commercially viable against some of the other alternatives I've identified, although I think it would remain

commercially viable in comparison to the Rambus technology.

Q. Despite this issue of royalties then, is it your conclusion that this technology that's discussed in DX-215 was a commercially viable alternative to the Rambus dual-edged clocking technology?

A. Yes.

Q. Now, before we go on, I'd like to briefly come back to something else that we discussed yesterday, and this relates to the distinction between assumptions that you've made and expert conclusions that you've drawn.

And in relation to that, could we pull up from yesterday DX-157.

Do you recall this slide, Professor McAfee?

A. I do.

Q. And you testified about this slide yesterday, and I believe you explained that the factors that are identified in the four bullet points at the bottom of the slide are factors that were relevant to your analysis as to whether the risk of hold-up, the economic concept of hold-up, would arise in a given industry.

Is that a fair summary of what you had to say about this?

MR. STONE: Your Honor, I do object to Mr. Royall's summarizing of the testimony and to his leading the witness through the form of his question, which I believe is improper.

MR. ROYALL: Your Honor, I'm happy to restate. I'm just trying to speed things along. I'm just trying to clarify something from yesterday. But I'm happy to do that.

JUDGE McGUIRE: Okay. Go ahead and restate then.

BY MR. ROYALL:

Q. Without re-covering too much territory, let me just ask you to explain again what you were seeking to convey through this slide.

A. This slide lists the economic aspects of an economic environment or an economic situation which would tend to -- which would be informative about the risk of hold-up facing participants in the industry.

So for example, when the size of specific investments is large, the risk of hold-up is greater. And that's what this slide is setting out, the important characteristics of the environment that would relate to the risk of hold-up.

Q. Let's then go to DX-160.

Now, we now have on the screen DX-160 that was

identified yesterday. Do you recall this slide?

A. I do.

Q. And what were you seeking to convey through this slide?

A. So this slide provides my assessment of these economic factors in the DRAM setting; that is to say, it provides my assessment of the size of specific investments, of the costs of changing standards, of the importance of IP and the ease of reaching agreement in relation to other industries with which I'm familiar.

Q. Well, let's start with the first point, size of specific investments, under which you have a red check mark and the word "substantial."

What do you mean to convey by that?

A. In my review of the facts and in comparing the facts to the economic concept of specific investments, I find that a substantial number of the total investment -- the total investment is very large, but not all of the investment is specific or represents specific investments, and that a substantial amount of investment is specific to the DRAM technology, and so that is to the standard that is at issue.

Q. When you refer here to the size of specific investments in the DRAM industry being substantial, is that an assumption on your part or does that reflect

your economic conclusion?

A. Well, it's a simple conclusion in the sense that it reflects my application of the economic notion of specific investments to the types of investments made in this industry.

So the input to this analysis -- it is an analysis. It's a simple analysis. The input to this analysis is the set of investments and a characterization of those investments as to what they do, and the output is to characterize those investments as either specific or not and assess whether the investments that meet the economic condition of being specific are in fact substantial or not.

Q. Moving to the second bullet point on DX-160, costs of changing standards, below that your slide has a check mark and then the words "switching costs."

What are you meaning to communicate or convey through those worth?

A. My use of the term "switching costs" is the economic concept of switching costs. I think it's actually in accord with the way lay people use the term "switching costs," that is, it's the costs of switching.

But what I've done here is look at -- is assess

the costs of changing standards as to whether those are -- whether a significant proportion of those costs or a significant amount of the costs are in fact switching costs or are they just costs of doing business that would be incurred whether or not the standard was switched.

Q. When you refer here to switching costs in reference to the issue of the costs of changing standards, does that reflect an assumption on your part or is this part of your economic conclusions?

A. So again, this is part of my economic conclusions in the sense that I have characterized costs as being either switching costs or not and found that there are a substantial volume or substantial magnitude of costs that are in fact switching costs.

Q. The third point is "importance of IP," below which you have a check mark and the word "high."

What are you meaning to communicate through those words?

A. So this is in comparison to other industries, and intellectual property in this industry is both fast-paced and extensive, that is, there are a lot more patents in this industry than in a typical industry and they are also more rapidly paced, that is, there are more new inventions on an annual basis than you find in

most industries, and that leads to the conclusion that intellectual property is important, from an economic perspective, in this industry.

Q. And how does -- well, before I -- strike that.

When you refer to the importance of IP in this industry, the DRAM industry, as being high, is that an assumption on your part or does that reflect an economic conclusion?

A. Well, that reflects an economic conclusion, the basis of which I just set out, which was in comparison to other industries.

Q. And does that economic conclusion bear on your broader conclusion that there is a significant risk of hold-up in the DRAM industry?

A. It does.

Q. The final bullet point on this slide refers to ease of reaching agreement, and below that your slide has a check mark and then the words "difficult and time-consuming."

What are you meaning to communicate through those words?

A. There's actually an economic theory associated with the ease of reaching agreement, and what I'm referring to in this bullet is my assessment of whether this industry has an easy time reaching agreement,

which essentially arises from the theory when most of the participants have interests that are aligned, or whether they have a difficult time reaching agreement, which arises when you have diversity of opinion and widespread disagreements.

And so the ease of reaching agreement in this industry appears to be difficult and also time-consuming. The time-consuming is an empirical matter.

Q. When you say that ease of reaching agreement in this industry appears to you to be difficult and time-consuming, is that an assumption on your part or is that a part of your economic conclusion?

A. That's part of my economic conclusion.

Q. And does that conclusion have any bearing on your broader conclusion that there is a significant risk of hold-up in the DRAM industry?

A. It does. It is a contributor to my conclusion that there is a significant risk of hold-up.

Q. And how does that factor contribute to your conclusions on hold-up?

A. The ease of reaching agreement reflects on how difficult it would be to avoid hold-up by changing the standard, for example.

Q. I'd like to make clear -- you've used the term

"assumption" and we've made distinctions between the conclusions and assumptions, and I'd like to make it clear for the record what you mean by the term "assumption" when you use that word relating to the work that you've done on this matter.

A. So I use "assumption" to mean anything I don't have firsthand knowledge of myself.

So that is to stay, if I -- I'm not a DRAM manufacturer, I have no firsthand knowledge of DRAM manufacturing processes, so what I understand about them is an assumption on my part and the facts that I use are assumptions. They are not part of my economics training.

Q. And for your purposes in reaching and explaining your economic conclusions, is it important to you to be clear about what assumptions you've made?

A. Yes. Conclusions generally are only as good as the assumptions on which they're based. False assumptions will tend to lead to false conclusions, and so as a consequence, it's important to me to be clear about my assumptions so that the context of my conclusions is clear and also to verify my assumptions so that I get the right answer.

Q. Have you done anything to verify or corroborate the assumptions that you've made in relation to the

work that you've done on this matter?

A. Yes. I think as I testified yesterday, I've made a very extensive study of the facts in this situation, I've read a tremendous amount of -- a tremendous number of documents, I've interviewed witnesses, and I've read the trial transcript as well up until this week to verify that my assumptions are in fact consistent with the true situation in this industry.

Q. Is the amount of work that you've done relating to verifying and corroborating facts in connection with your assignment in this matter, is that typical of the amount of factual investigation that you ordinarily conduct in connection with the government and private consulting assignments that you've had in the past?

A. I think this is actually the largest amount of -- my largest investment in fact-finding of any case that I've personally worked on.

Q. Is there a reason for that?

A. Well, it's a complicated case. It has a lot of aspects and several different market levels. In fact, one of our early slides -- one of my early slides showed three different market levels.

And so one of the complexities of this case is

that the economics of the technology market are driven by the economics of the DRAM market and the economics of the DRAM market are driven by the economics of the downstream PC and other applications markets, so that makes for a more complicated market structure.

In addition, it's very challenging technology.

Q. Now, we touched briefly yesterday on your expert report and noted that the text of the expert report combined with the text of Appendix 3 to the report, which contains your case study, together those aspects of your expert report approximate 400 pages or slightly less than 400 pages.

Is that amount of length typical of the types of expert reports that you've generated in other government and private consulting assignments?

A. This is longer than any other expert report I've generated by a significant margin.

Q. And is there a reason why your expert report in this case is significantly longer than other expert reports that you've written in connection with other consulting assignments?

A. It would be the same reason that I gave earlier for doing more investigation, and this is in fact a reflection of the level of detail of investigation which I've done.

MR. ROYALL: Your Honor, before I move on, I would like to mark Professor McAfee's report as a demonstrative exhibit.

JUDGE McGUIRE: Any objections, Mr. Stone?

MR. STONE: I don't understand what it would be demonstrative to, Your Honor.

If it's demonstrative to show that it's 400 pages in length, I don't think we need to mark it to prove that it's 400 pages in length.

If it's demonstrative because he wants someone to refer to the text of it later on in comparing findings or in reviewing this case on appeal, that would be inappropriate and inconsistent with Your Honor's ruling on its admissibility.

I'm not sure what it's demonstrative of except its length and I've allowed the testimony about its length to be -- there's no question that Professor McAfee with the assistance of his colleagues has written a very lengthy report, but I don't think it should be marked and --

JUDGE McGUIRE: Mr. Royall, you are cognizant of my earlier order on expert reports, so in what context are you now seeking to have this at least marked?

MR. ROYALL: Well, I do believe, Your Honor,

that, respecting your earlier ruling about the admissibility of expert reports for the contents, the substantive contents of the report, that it is nonetheless relevant to have in the record as a demonstrative exhibits that have been used with experts.

I've used many slides today that help to explain the testimony, and reference to the expert report likewise does.

And the other point I would make is I do think it is highly relevant that this expert has done a substantial volume of work that he has done relating to facts and that that is simply what's reflected in the report itself.

MR. STONE: And Your Honor, I've allowed without objection -- and it likely would have come in had I objected in any event -- the amount of time he spent on this, the length of the paper that he's written. All of that is in the record.

The report itself is not demonstrative of any of his testimony. It's not a useful aid to understand his testimony. His testimony is here in the record.

The report is not demonstrative of or illustrative of his testimony except to the extent that it's voluminous, and I think to make a 400-page report

a demonstrative simply to prove that it's 400 pages in length bends the demonstrative rule to the breaking point, and I don't think -- I think this is an effort to put it into the record for its substance and content which the court has correctly ruled it should not be put in the record for.

JUDGE McGUIRE: Let's be real clear as to exactly the context that you're offering this, because if I agree to have it marked, that's the only extent that it's going to be marked.

MR. ROYALL: Yes, Your Honor.

JUDGE McGUIRE: So let's be real clear on that now, Mr. Royall.

MR. ROYALL: Yes, Your Honor. I understand.

I will note, first of all, that I have used this as a demonstrative exhibit in the trial. I've used it by reference to help the witness explain the nature of the work that he did.

His CV and resume are included here, and I believe that that is a fully proper demonstrative exhibit as well, and also the list of materials that he reviewed and persons that he interviewed, which is included here for demonstrative purposes.

And the only thing I would note is I have no objection -- we will have no objection to Rambus' --

JUDGE McGUIRE: No, you won't, especially if I have this marked, you will have no objection because I would offer them the same courtesy, so to speak.

MR. STONE: Your Honor, if I can just respond.

This is a disguised effort to get around your ruling in limine. It may not be intentional, but that is indeed what will happen.

If we're to look at this demonstrative to find out the names of the people that Professor McAfee spoke to, we are now looking at the report for its content and substance and it is being offered in evidence for its content.

If it's important to list the names of the people Professor McAfee talked to, that can be elicited orally in examination.

JUDGE McGUIRE: Here is what I want you to do.

I am also concerned about the content of this report being offered in an attempt perhaps to go around my other order. I'm not saying that that's your intention necessarily.

What I would ask the parties to do is to confer and see if there are any pertinent portions of this report that you feel could be marked and that way we can avoid entering the entire report.

If you can then agree, so be it; if not, then

I'll rule. Okay?

MR. STONE: We'll certainly do that, Your Honor.

MR. ROYALL: We can do that at another time.

JUDGE McGUIRE: Okay. Good enough.

MR. ROYALL: Thank you.

BY MR. ROYALL:

Q. Yesterday, Professor McAfee, I believe that we concluded the day by discussing your various relevant technology market conclusions, and the last point that we touched on was the geographic scope of the relevant markets that you defined. And with that, I believe that we've covered the first of the five key economic questions that you identified earlier in the morning.

I'd like to come now to the second key economic question, which, as you explained yesterday, is the question of whether Rambus possesses substantial market or monopoly power in the relevant antitrust markets that you have defined.

Let me ask you, before we go any further, in addressing that question, if you could define for us what you mean by the terms "market and monopoly power" and how, if at all, those two things differ from one another.

A. Yes. I've prepared a slide on that topic.

I think as I testified yesterday, there's not complete consensus or unanimity in the way these terms are used, but there is consensus in monopoly power being stronger than market power, being substantial and being durable and involving prices -- the ability for a company to maintain prices above competitive levels.

Q. When you use the term "durable" in the context of monopoly power, what specifically are you referring to?

A. For a significant period of time. That is, there are many firms that for a very short period of time increase their prices, but that would cause entry that would soon dissipate the profits and force the prices back down. Such a situation means exploitation of a temporary circumstance is not generally considered to be monopoly power. Instead, the power must be durable, long-lasting, in order to be considered monopoly power.

Q. Before we go further, let's mark this as -- I believe this will be DX-216.

Have you concluded, Professor McAfee, based on your economic analysis, whether Rambus possesses monopoly power in any of the relevant markets that you've defined?

A. Yes. I've determined that Rambus possesses monopoly power in all of the relevant markets.

Q. All five of the relevant markets that we discussed yesterday?

A. That's correct.

Q. What factors did you consider in concluding that Rambus possesses monopoly power in all five of the relevant antitrust markets that you've defined?

A. There are three major indications of monopoly power which I've prepared a slide to indicate, three major indications.

Q. So this slide which is now on the screen will be DX-217.

Is this the slide you're referring to?

A. Yes, it is.

Q. Let me ask you to explain -- there are three points here. Let me ask you to explain what you're referring to by the first bullet point on DX-217.

A. The technologies that I had identified as commercially viable alternatives to Rambus' patented technologies are no longer commercially viable because of the incorporation into the dominant JEDEC standards, the incorporation of those technologies into the dominant JEDEC standards.

Q. And moving to the second point, which refers to

substantial barriers to entry, is that a factor that you considered in concluding that Rambus possesses monopoly power?

A. Yes. Barriers to -- I spoke earlier in the definition of monopoly power about the need for it to be durable, and the reason for the durability, the requirement of durability, is that many firms can raise their prices only to prompt entry which would then undo the effects and force prices back down.

The notion of a barrier to entry is what prohibits that from happening and so hence is a requirement for finding of monopoly power.

Q. And the final bullet point on DX-217 refers to "Ex post pricing of Rambus' technologies substantially exceeds their ex ante value."

What do you mean by that?

A. What I mean by that is an indication of monopoly power is the exercise of monopoly power. Pricing at a level that's significantly above the ex ante value of the technology would suggest the exercise of monopoly power, which of course would be an indication of monopoly power.

Q. Now, going back to the first of these three points, in describing what you mean by the language in the first bullet point, you referred to Rambus'

technology being incorporated into the JEDEC standards?

A. Yes.

Q. And is that relevant to your determinations about monopoly power?

A. It is. And I've prepared a demonstrative which refers back to the funnel model of technology choice that we discussed yesterday.

Q. This will be DX-218.

Is this the demonstrative you're referring to?

A. Yes, that's correct.

Q. And what are you seeking to convey through this demonstrative?

A. This demonstrative illustrates the incorporation of technology in the evolutionary progression of standards from SDR to DDR to DDR-II and it illustrates a number of things.

Starting with in 1993 with the SDRAM standards, the Rambus technology was one of several alternatives that we discussed yesterday, and the selection of the Rambus technology into the standard is illustrated by the -- it's the R in the middle coming out from the SDRAM's funnel.

Q. So to be clear about this, you have three funnels on this slide, DX-218.

The funnel on the far left, that refers to the process through which JEDEC developed the SDRAM standard; is that correct?

A. That's correct.

Q. And the funnel in the middle refers to the process through which JEDEC developed the DDR SDRAM standard?

A. That's correct.

Q. And does the funnel on the far right refer to the process through which JEDEC has developed the -- or is developing the DDR-II SDRAM standard?

A. My understanding is it is developing the standard. It's not finalized yet. But yes, that refers to the DDR-II process.

Q. And the yellow arrow with the R attached to it in the far left of this demonstrative, that refers to Rambus technologies that were considered during the SDRAM standardization process?

A. That's correct.

So programmable burst length and programmable CAS latency, depending on which technology is at issue, could be one of the technologies labeled with an R where alternatives that we discussed yesterday are labeled with A and B. And those technologies are selected by the SDRAM standard and incorporated into

that standard.

Q. And what are you meaning to depict by the yellow arrow with the R on it coming out of that first funnel, the SDRAM funnel?

A. Well, we had -- so that depicts the selection of that technology in SDRAM as an input into the next technology, the DDR standard.

And we had quite a long discussion yesterday of the evolutionary nature of the standards developments and the importance of evolution, evolutionary developments, and so that the tendency within JEDEC -- and we had a long discussion of the economics of this -- but the tendency within JEDEC is to build on the previous standard, and so this illustrates the incorporation of the SDRAM technologies into the DDR technologies.

Q. There's a second yellow arrow with an R on it pointing into what you've identified as the DDR funnel in the middle of this demonstrative. What are you meaning to depict through that second yellow arrow?

A. This depicts new technologies incorporated or potentially incorporated, that is, that are vying for incorporation, into the DDR standard and the yellow R there refers again to Rambus technology, such as dual-edged clocking or on-chip PLL/DLL.

Q. And then there's another yellow arrow that is coming out of the DDR funnel. What are you meaning to depict through that yellow arrow?

A. That depicts the, again, the evolutionary nature of these standards, building on a platform created from the previous standard.

Q. And finally, there's one last yellow arrow coming out on the far right-hand side of demonstrative DX-218 to the right of the DDR-II funnel. What are you meaning to depict through that?

A. Well, my understanding is that the discussions of DDR-III have already commenced, although they are highly speculative at this time. This would indicate that another evolutionary standard would likely incorporate technology that had been incorporated in the previous standards, and so any future evolutionary standard, that is, something other than a major break, would likely reuse the existing technologies.

Q. Is there any significance to the fact that in DX-218 you have aligned these three funnels in the way that you have?

A. Yes. That reflects the evolutionary nature of these standards. That is, they're building on the platform of the -- each standard builds on the platform of the previous standard.

Q. When you refer to the evolutionary nature of JEDEC's SDRAM standards, are you expressing an assumption or an economic conclusion?

A. That term is used of course in the industry quite extensively, but it's also used by economists, and so I'm using it as an economist. It is my understanding, and as I testified yesterday, it's my understanding that the meaning in which I use that term is consistent with the way that the industry uses it. But I'm using it in -- as an economic term.

Q. And by that do you mean your use of that term in this context reflects an economic conclusion on your part?

A. Yes. And we had a discussion of the economics of evolutionary developments yesterday.

Q. Generally speaking, does the mere inclusion of a patented technology in an industry standard necessarily give rise to monopoly power?

A. Not necessarily. There are standards that fail to be adopted in the marketplace and in such a standard incorporation would not give rise to monopoly power.

Q. And have you reached a conclusion as to whether the incorporation of Rambus technology in the DDR, the SDRAM and DDR SDRAM standards contributes to Rambus'

monopoly power in the relevant markets that you've defined?

A. Yes, it does.

Q. And how does the incorporation of those technologies in the JEDEC standards contribute to the monopoly power that you've concluded Rambus possesses in those markets?

A. Well, the JEDEC standards have dominated the DRAM industry for most of the last ten years or all of the last ten years, and as a consequence, those standards have been very successful in the marketplace.

And I have a slide, which we've already seen --

Q. This slide that's now on the screen was marked yesterday as DX-141.

And in the context of your conclusions about monopoly power, what, if anything -- what, if any, significance do you attribute to the statistics or facts depicted in this slide?

A. That the JEDEC standards have been -- have dominated the marketplace for -- in DRAM and continue to dominate the marketplace.

Q. In this slide there are various colored regions or areas.

Which of these areas do you understand to

reflect the presence of JEDEC -- or the impact of JEDEC standards on the DRAM industry?

A. So the green, the orange, the blue and the yellow are all, to my knowledge, JEDEC standards, that is, fast page mode, extended data out, SDRAM, DDR.

Q. Are there any regions or areas in this chart, DX-141, that are not associated with JEDEC standards or that you do not understand to be associated with the JEDEC standards?

A. My understanding is RDRAM was never standardized by JEDEC, and that's the red area. And I just don't know about the gray area, which is other standards.

Q. And to be clear, before we leave this slide, why is the dominance of JEDEC standards in the DRAM industry relevant to your conclusions as to Rambus' monopoly power in the relevant markets that you've defined?

A. It's in essence the means by which the monopoly power is created. That is, this is the standard which has been adopted by the industry. The ability to charge for that standard provides monopoly power through the process that we discussed yesterday of the adoption of the standard; that is, to practice the standard requires paying for the technologies.

Q. Do you have an understanding of what proportion of total commercial DRAM production in the world today is subject to Rambus patent claims?

A. Yes. And I've prepared a slide that illustrates that.

Q. I believe this would be DX-219.

What are you seeking to convey through this slide?

A. So this shows three major DRAM -- types of DRAM, RDRAM in the left circle, RDRAM, SDRAM and DDR, that is, the Rambus DRAM, SDRAM and the DDR SDRAM, and what proportions those were -- it says today, although these are actually mid-2002 numbers, and so it shows those proportions.

And in the right side of the circle it shows the patents asserted over the JEDEC standards SDRAM and DDR SDRAM by showing them in the same color as the RDRAM.

Q. And have you calculated what percentage of total DRAM, commercial DRAM production in the world today is subject to Rambus patent claims?

A. It's in the upper nineties. It's a very small percentage that I don't know that is subject to Rambus patent claims.

Q. And that small percentage being reflected by

the green slice in the pie chart on the right-hand side of DX-219?

A. That's correct.

JUDGE McGUIRE: I'm a little confused here as to that answer. He's saying in the first instance it's in the upper nineties and then he's talking about a very small percentage.

I'm a little confused as to what you're referring to there.

THE WITNESS: It's the small percentage that's not subject to.

JUDGE McGUIRE: That's not. Okay. All right.

BY MR. ROYALL:

Q. So just to be clear then, referring to this demonstrative, DX-219, and the -- of the two pie charts, the pie chart on the right-hand side, does the region that is colored red or maroon in that pie chart, does that region reflect pictorially your understanding of the extent of the DRAM industry over which Rambus is asserting patent claims?

A. That is my understanding, although as I said, I don't know about that green wedge one way or the other.

Q. Now, if we could go back a couple of slides to DX-217, which we covered a moment ago.

In this slide, which lists the factors that you considered as indicia of Rambus' monopoly power, in the first bullet point you refer to Rambus' technologies today being the only commercially viable alternatives.

Do you see that?

A. I do.

Q. And can you explain how you arrived at that conclusion and how it relates to your broader conclusions about monopoly power?

A. Yes. I'd be happy to.

Q. Do you have a slide that may help you explain that?

A. I do. I'd like to refer back to a slide that -- when we talked about commercially viable alternatives, I presented a slide that illustrated the market using circles.

And in this case, this illustrates a set of commercially viable alternatives to the technology C that is a -- all of those are price-constraining to technology C, and the process of standardization has the effect of locking in the industry to the technology selected, which might have been from an ex ante perspective any of those seven technologies that are commercially viable.

But having chosen and having embedded the technology in the standard, the industry becomes progressively more locked in -- we should have some dynamics --

Q. Before we do that -- I'm sorry. Go ahead. This is an animated slide?

I'm sorry. Continue, professor.

A. The industry becomes progressively more locked in and then the other -- as investments are made in the standard and in the technologies embodied in the standard and in the practice of the standard, that is, developing the methods of production and the complementary goods, and the effect of that is to cause the other alternatives to fall away and become impractical.

Q. Let's go back to the first view of this same slide, which I believe will be DX-220.

Now, in the initial view of this slide, DX-220, we see again the same types of concentric circles that you used yesterday to describe the process by which you've defined relevant markets; is that correct?

A. That's correct.

Q. And so the -- just referring back to that explanation, the outer gray circle which encompasses

the other two circles and all of the letters on this slide except H, does that outer gray circle comprise the, in this case, what you would term the relevant antitrust market?

A. That's correct. This is prior to the incorporation of any of these alternatives into a standard.

Q. And in your earlier explanation you were talking about the narrowing of alternatives or the elimination of alternatives, and by that are you saying that the -- over time there is a narrowing of the contents of a relevant market in a way that excludes products that in an earlier time period were included in the relevant market?

A. That's correct.

Q. And let's run the animation again.

Now, let's stop there. The second view of this slide, DX-220, has the word "ex ante" at the top. Can you explain what the significance of that term is as you use it in this slide?

A. Yes. As I testified, the starting point for this slide is prior to the incorporation of any of the technologies into a standard, that at that point all of the commercially viable alternatives are available or are price-constraining on the technology that will

ultimately be selected.

Q. Then moving to the next view, and now in the third view of this slide, DX-220, the word "ex post" appears and the only letter that's circled is C.

Can you explain, just so it's clear for the record, what you mean to communicate through that view of this slide?

A. Yes. As the investments in the standard are made, the industry becomes progressively more locked into the standard, that is to say, the switching costs now grow over time and the specific investments grow over time, and those contribute to lock-in, that as those specific investments grow at some point you reach a point where the existing technology, that is, the technology incorporated into the standard, has monopoly power and the other alternatives are no longer commercially viable.

Q. You've now described the process by which a relevant market over time can be narrowed and products that were commercially viable alternatives through that process can be eliminated.

Have you reached any conclusion as to whether that type of narrowing and elimination of commercially viable alternatives has occurred in this case?

A. Yes. And it occurs for reasons that we

discussed yesterday, but I've actually prepared a demonstrative to illustrate those reasons.

Q. And I think we now have that on the screen. This will be DX-221.

Can you explain what you're seeking to convey through this demonstrative?

A. Yes. This demonstrative -- so first from left to right refers to time in this demonstrative even though it's not labeled there.

This demonstrative illustrates that once a standard is issued and assuming that the standard is adopted, you get an increasing over time level of investment into the standard, and so you have manufacturers examining how to produce the standard, you have complementary components like modules, graphics cards, chipsets and the like being produced, and it takes -- so as a fact, it takes a substantial amount of investment to produce these complementary goods.

That's not something that I'm testifying to, it's something that I'm assuming, but I think there's adequate support in the record.

And this illustrates those investments being made and they grow over time. That is, the day the standard issues, those -- the size of those investments

might be quite modest. Two or three years later, the size of those investments could be substantial, and those investments contribute to lock-in to that standard, so that as the volume production occurs or as the commercialization of the standard occurs, the industry gets progressively more locked in to that standard.

Q. And does this relate at all to what you were describing yesterday about the connection between the late disclosure of intellectual property and the hold-up condition?

A. It does. And I've prepared a demonstrative referring back to the discussion we had yesterday or the demonstratives used yesterday.

Q. Is this -- the demonstrative on the screen, is this what you're referring to?

A. Yes, it is.

Q. And this will be DX-222.

Can you explain what you're seeking to convey through this demonstrative?

A. This demonstrative begins with what appears quite similar to the demonstratives used yesterday in that it shows three competing technologies, one of which has been labeled Rambus or R for Rambus, that are potential candidates for being included in the

standard. It should be understood that all three of those technologies are commercially viable candidates for being included in the standard.

And then it also illustrates, as we discussed yesterday, the deployment of resources locking the industry in and increasing the value of whatever technology is actually incorporated. And that's illustrated in this graphic by the increasing dollar signs as the -- moving to the right. So again, time in this picture goes from left to right.

Q. And I believe this may also be an animated slide.

We're now looking at the second view of this demonstrative, DX-222. Can you explain what you are seeking to convey through the animation that just occurred?

A. Yes. In this case the Rambus technology was selected by the standard-setting process, technologies A and B fall away, and the value of the Rambus technology, because of its incorporation into the standard, rises.

Q. You referred to the concept of lock-in. That concept is being depicted here through the increasingly larger dollar signs and the increasingly intense use of the color green; is that what you were

saying earlier?

A. Yes. That's correct.

Q. And does the lock-in effect that you've described have any consequence in terms of the ability of the industry to respond if it learns late in the process of patented intellectual property being included in the standard?

A. Yes. Actually as we discussed yesterday, this is just a classic case of economic hold-up; that is to say, after the lock-in occurs, it's now possible for the owner of a patented technology to hold up the industry and expropriate some portion of the investments that have been made into this technology.

Q. Does the lock-in effect that you've described have anything to do with the costs that would be associated with changing standards after they've been adopted and industry investments, specific investment has taken place?

A. Yes. The size of the lock-in is essentially measured by the cost of changing the technology to a technology that did not infringe.

Q. And have you as part of your economic analysis considered what costs would be associated with changing JEDEC standards today?

A. Yes. And I prepared a slide that lists some of

those costs.

Q. Is this the slide you're referring to?

A. It is.

Q. I believe this will be DX-223.

You have a number of points here. Let's take them one at a time.

Let me ask you to start with the first point where you say, "Develop new technology standards."

Would you explain what you mean by that and how that relates to the conclusions you've reached about the costs of changing JEDEC standards today.

A. Yes. A significant cost associated with attempting to get out from under Rambus IP in the JEDEC standards would be to produce an alternative standard that did not infringe, that is, that didn't use any of the four patented technologies, and so costs of doing that are one of the sources of lock-in of the industry. That is to say, if those costs are high, the industry is locked in by that -- at least by that amount.

Q. And does the cost of developing new technology standards relate in any way to the time that it would take to develop new standards?

A. Well, in fact perhaps the most important and certainly one of the most important aspects of the

costs is not the actual financial costs but the cost of delay. That is, there's a substantial amount of testimony and there's also some economic analysis supporting the proposition that it does take a very long time to actually create a standard. And I've prepared a slide that is relevant.

Q. Let's identify this next slide as DX-224.

And this slide refers in the title to -- poses the question: How long would it take to create a noninfringing standard?

This is the slide you're referring to?

A. Yes, it is.

Q. And what are your seeking to communicate through the information presented in this slide?

A. So this slide actually seeks to illustrate -- well, so first let me say, the challenge of creating a new standard that gets out from under Rambus IP -- this is supposed to be suggestive, but I don't take it to be proof, of the delays necessary to create a noninfringing standard. That is to say, they are doing other things when they create these standards besides getting out from under an existing IP.

But this suggests -- this is at least suggestive of the lengths of time that it takes to both develop standards and to deploy standards.

And I should say that it's not just the development of the standard that's the relevant time. To get out from under the intellectual property you have to both develop and actually commercialize the technology.

And so -- now, let me also add that the years listed on this are at least somewhat confusing.

The SDRAM standard took approximately two years to develop and another four years before full volume production was -- occurred. Ramp-up, that is, the point where the penetration starts to rise fairly dramatically, was maybe half of that period, so roughly 1995 or 1996.

So when it says two to six years, this is -- I find that at least confusing. Let me actually be more specific to say two years to develop the standard and somewhere more than four years before full deployment of the standard took place.

With DDR, the development of the standard took approximately four years and there was a shorter time before volume production, full volume production occurred.

And DDR-II, my understanding, is still not finalized as of today.

Q. Now, just to make this point clear, you've

considered here by the two different color arrows in reference to SDRAM and to DDR SDRAM both, as I understand it, the time that it took JEDEC to define those standards and the time it took for the industry to ramp up to volume production?

A. That's correct.

Q. And from the standpoint of addressing the question that we were discussing in reference to the earlier slide, DX-223, which had the title Costs of Changing JEDEC Standards Today, from the standpoint of addressing that question, why is it relevant for you to look not only at the time that JEDEC in the past has taken to develop standards but also the time that the industry has taken to ramp up to volume production?

A. Because you don't get out from under a royalty, that is, you can't avoid paying a royalty until you're actually producing the alternative product in volume and can reduce the volume of the existing product.

This goes back to the basic economics of the DRAM industry, which is you want -- the plants are enormously expensive and you want to run them full out, that is, 24/7, as they say, during the -- well, you want to run them full out constantly, and so until

you've actually ramped up the production, you'll be producing the infringing product and paying royalties.

Q. We've talked a fair bit conceptually about this economic concept of lock-in, but let me ask you this in case it isn't already clear.

How do you reach the conclusion, economic conclusion, as to whether the DRAM industry is locked in to the SDRAM, JEDEC SDRAM standard?

A. Well, lock-in is itself a continuum; that is to say, you could have in principle a small amount of lock-in or a large amount of lock-in.

I find, because of the scope and the size of the investments, that there's actually been -- into a standard that there's actually a relatively large amount of lock-in in this industry to the standard that's been deployed in volume.

Q. And is there a point in time at which, based on your economic analysis, that lock-in effect began to exist or materialize?

A. Well, even at the time a standard issues there has been some investment in the standard, although it's relatively modest compared to what will come after it.

As I said, it is somewhat -- it is a continuum, the concept of lock-in, and it's something that grows

over time. It's certainly been accomplished by the time that ramp-up starts. At that point most of the specific investments in the complementary goods have been made by the producers. Because in order to deploy the standardized product in volume, it requires those complementary goods. Things like chipsets and the like are also being produced. And so that the industry is -- at that point has certainly been locked in by that time.

Q. Let's go back if we could to DX-141.

This is by now a familiar demonstrative. We've talked about it already once today and yesterday, and it relates to the evolution of DRAM standards.

Does this demonstrative, DX-141, help in -- help you in discussing the issues of ramp-up and lock-in that we were just touching on a moment ago?

A. Yes. You can see, the notion of ramp-up is that essentially that you will have a trickle of the output of the DRAM output for some period of time, and then ramp-up is when the volume starts to dramatically increase.

So you can see that for EDO, for example, the ramp-up is occurring somewhere 1994-1995, that that's where significant volume production is occurring, and

in order to be ramping up at that time it must be the case that there are -- that the complementary goods, that is, the chipsets and the applications that use EDO, have already been provided.

So at that point the industry must be locked in and that the ramp-up must be occurred -- you can see the ramp-up occurring.

Similarly, for SDRAM illustrated with the blue, you can see the volume production starting in the 1996-1997 time frame. And so that corresponds to the ramp-up.

Q. Does the specific investments that you've described and the lock-in relating to specific investments, does that occur in this industry before ramp-up occurs?

A. Yes. The industry would never produce -- the economics of the industry dictate that the industry would never produce large volumes of DRAM if the uses of those DRAM had not yet been deployed.

So that is to say, they're not going to produce the DRAM for inventory in any large volumes and just sit on them hoping that the complementary goods would be provided in the future.

Q. Let's now go back to DX-223.

In connection with this issue of the costs of

changing JEDEC standards today, the second bullet point in DX-223 refers to the difficulty of reaching consensus ex post.

What do you mean by that?

A. By that I mean the actual deployment of the standard itself can interfere with -- can create diversity of opinion within the industry -- I should say, when I say "within the industry," I mean both buyers and sellers; that is, I'm using it in the economic term, the economic notion -- can create disagreements within the industry.

And I've prepared a slide to illustrate the increase in -- the increasing challenge in reaching consensus after a standard has issued.

Q. Is this the slide you're referring to?

A. Yes.

Q. This would be DX-225.

A. That's correct.

Q. And this difficulty of reaching consensus ex post that you described, is this something that contributes to your conclusions about the difficulty of changing the JEDEC standards today?

A. It is. The thought experiment, the economic concept here is, once the standard has issued and has already been deployed, what would it take to get a

consensus from the industry in order to change the standard to one that did not infringe. And a challenge for getting such a consensus to change the standard is that the companies have different positions with respect to the existing standard.

And so, for example, right at the moment, half of the market or approximately half of the market has licenses to produce the standard from Rambus and the other half does not. Now, the half that has licenses is going to feel quite differently about the costs of changing the standard than the half that doesn't, and in fact the half that has licenses might benefit from the lack of licenses of the other half.

Q. When you say here in DX-225 that about 50 percent of the market has licenses, let's be very clear here, who are you referring to and what licenses are you referring to?

A. So this refers to the licenses to produce SDRAM and DDR SDRAM and licenses issued by Rambus. And I should also say what 50 percent refers to is capacity, not 50 percent of the number of producers but 50 percent of the manufacturing industry capacity.

And so roughly half the DRAM that's produced is produced under license and half that's produced is not produced under license.

Q. And so you're saying that there is some number of DRAM producers whose output, total market output, adds up to roughly 50 percent of the total market that do have licenses from Rambus that permit them to, without infringing, produce SDRAM and DDR?

A. That is my understanding.

Q. And then are you saying that there is another roughly 50 percent of market output reflected by other producers that you understand those other producers do not have licenses from Rambus today that would allow them to produce these products without claims of infringement?

A. That's my understanding, yes.

Q. And how do those facts or those understandings that you have relate to this issue in the first bullet point of DX-225 about differing incentives?

A. This creates differing incentives. Having a license or not creates differing incentives ex post.

And let me draw the comparison of prior to the development of the standard these companies all had an interest in producing, in developing the best cost-benefit standard that they could produce. That is to say, they had a common interest in the economics of the standard.

And I don't mean to say that they had

perfectly aligned interests because I don't believe they did. They had some differences in manufacturing capabilities and the like, but they nonetheless had fairly closely aligned interests in terms of producing a standard that buyers would buy and would actually advance the market.

Now, some of the producers, because they are licensed under Rambus, have an incentive actually perhaps not to get a new standard issued so that they'd be legal producers in the hope that the other producers are going to be shut down.

Q. And does that observation relate to your broader conclusions about the existence of lock-in in this industry?

A. Yes. As I said, one of the indicators of lock-in was the difficulty in changing the standard or the difficulty -- the ease of reaching agreement, and this is an impediment to the ease of reaching agreement.

Q. The second principal bullet point on DX-225 states, "Users of specific features have distinct incentives."

What do you mean by that?

A. So this refers to the nature of the investments that have been made in the existing standard can

actually create disagreements about what alternative standards might be employed.

And a good example of this logic is actually the fact that AMD uses a burst length of 8 and Intel uses a burst length of 4. Now, if the original SDRAM standard had had a fixed burst length, probably both of those companies would use the same burst length, that is, the burst length associated with whatever was the cheapest commodity DRAM. And they would have designed their processors to exploit the burst length that was the market consensus.

However, because the standard permitted programmable burst length, now, AMD would be very much harmed -- and this is a fact issue, but there's been testimony by an AMD representative that AMD would be very much harmed if the industry chose a burst length of 4, and that's because they have invested a substantial amount of money in optimizing their processors for a burst length of 8.

And so this -- the existence of these features, that is, the possibility of specifying burst length, has itself created a disparity in incentives within the industry.

Q. And does this relate at all to the concept of specific investment that you discussed yesterday?

A. Absolutely. The investments that AMD made in exploiting a burst length of 8, a specific investment in the programmable burst length feature of SDRAM and DDR SDRAM.

Q. Does this issue that you're describing, that you've just described, does this bear on your conclusions as to the existence or degree of lock-in relating to JEDEC's SDRAM and DDR SDRAM standard?

A. It does. As I -- and for the same reasons as the previous bullet point, that is, the ease of reaching agreement is relative to the scope of lock-in, and here is an example of a challenge to reaching consensus after the fact.

Q. Are there other factors that contribute to your conclusions as to the challenge of reaching consensus about changing the JEDEC standards in the ex post period?

A. I'm sorry. Can you re-ask the question?

Q. Just before we leave this slide, I wanted to ask whether there are any other factors that you haven't already discussed that contribute to your conclusions as to the challenge of reaching consensus about changing the JEDEC standards in the ex post period.

If there are not, we'll move on.

A. Then perhaps we should move on.

Q. Let's go back to DX-223.

Now, we've just covered the first two bullet points on DX-223, the first two of six points relating to the costs of changing JEDEC standards today.

Let's go to the third point. Can you explain what you mean by that point?

A. So design, testing and qualification costs are all specific costs, specific investments, so that is the investments in designing a new DRAM chip, in testing it and in qualifying it for use in various systems would represent specific investments. So the size of those costs are part of the costs of changing JEDEC standards today.

Q. What about the next point that refers to existing component?

A. Existing components that -- I should say the slide doesn't say, but it should be complementary components, that is, components that are designed to work with the DRAM or to exploit features of DRAM, and those include everything from BIOS to chipsets to processors.

The redesign, testing and qualification of those components are also specific to the DRAM, and hence those costs would also be specific investments

associated with the standard.

Q. And those design, testing and qualification costs referring to complementary components and then the other design, testing and qualification costs that you discussed in reference to the prior bullet point referring to the DRAM chips themselves, do those costs contribute to your conclusion about the overall costs and difficulty of changing JEDEC standards today?

A. Yes. Those costs are substantial, and that's a fact issue that the specific costs, for example, the design, testing and qualification costs, are substantial. The economic conclusion is that those costs are specific investments and specific investments of course can, as I've testified, contribute to the lock-in, and so those costs all contribute to the extent of lock-in within the industry.

Q. Let's move on then to the second to last point on this slide, DX-223, which refers to the term "opportunity costs."

Let me ask you first of all to define what you mean by that term.

A. So let me say that I want to refer actually to two different notions of opportunity costs. There's the standard economics notion, which in a normal economics principles class is actually a first piece of

jargon to be introduced. And then opportunity costs refer to the economic notion of cost, which is not an accounting notion, that is -- so the cost of an activity is not necessarily the number of dollars you spend on that activity, which would be the accounting notion, but includes whatever you give up in the process. It includes the lost value of your second best alternative.

And so an opportunity cost in the economic notion is a broader notion than an accounting cost; that is, it includes all of the opportunities that have been forgone by an activity.

The phrases also appear -- or appears frequently in both the trial testimony and in other documents that I've reviewed and it seems to be used in a consistent way with the economic notion.

So here the opportunity costs from an economic notion and also as I understand it's been used in the record, although that's a factual question, the opportunity costs from the economic perspective is when I put a team of engineers on a project such as developing a new standard that gets out from under the Rambus intellectual property, I don't have that team available for other projects that may be valuable to me.

And so the opportunity cost of creating a new standard and getting out from under the Rambus IP is that the engineering talent, the resources, the testing facilities and all of the resources used are not available to other projects which may be profitable. And I believe that is consistent with the way that "opportunity cost" has been used in the course of this trial.

Q. And does this concept of opportunity cost that you've explained relate to your conclusions about the difficulty and costs of changing JEDEC standards today?

A. Yes, it does, because it refers to the -- or it is an example of a cost which is actually specific in the sense that it would be -- in this case it's a specific cost of the switching cost for -- that is, it's a loss in the process of trying to develop alternative standards.

Q. Let's then cover the final bullet point on DX-223 which refers to cost of delay. What do you mean by that?

A. One of the basic economic propositions is that time is money and that a delay creates -- delay loses value; that is to say, obtaining things earlier rather than later is more valuable, and this is why when you

borrow money you have to pay more money back.

So one of the costs of changing JEDEC standards today is that, as we've already discussed, it wouldn't happen overnight, there would be substantial delay, and the delay is in itself inherently costly.

Q. In the items that are discussed on this slide -- well, actually strike that. Let me just ask one follow-up question on your last answer.

No. I think you covered it.

The items that are discussed on this slide relate to your testimony and economic conclusions relating to the difficulty and costs of changing JEDEC standards?

A. That's correct.

Q. And does that issue and do those conclusions factor into the conclusion that you discussed earlier that one of the indicia of Rambus' monopoly power is that in each relevant technology market Rambus' technologies today are the only commercially viable alternatives?

A. Yes, they --

MR. STONE: Objection, Your Honor. Leading and incorrectly states the witness' prior testimony.

JUDGE McGUIRE: Sustained.

BY MR. ROYALL:

Q. Well, let's go back to DX-217.

We've been discussing your views relating to the first bullet point on DX-217 relating to the indicia of Rambus' monopoly power.

Do the factors that we've been discussing in connection with the slide we dealt with previously, DX-223, that is, the factors about costs of changing JEDEC standards today, do those factors relate to the conclusion that you state in the first bullet point on DX-217?

A. They do.

Q. And how do those factors relate to this conclusion?

A. What has caused the other commercially viable or ex ante commercially viable alternatives to fall away is the industry lock-in to the existing standard.

That is to say, the -- those alternatives that I identified yesterday as commercially viable were ex ante commercially viable. Once the standard is issued -- well, actually the issuing of the standard itself may not be enough to cause those alternatives to be commercial -- to cease to be commercially viable. That is, it may be possible to go back and revise the standard and include one of the

alternatives if these complementary investments have not been made.

And the costs of changing the standard bear directly on what costs are there to switching to one of the alternatives, and so those costs are all relevant in the calculation of the commercial viability of the alternative technologies today.

Q. Let's go back to DX-187.

I believe this may be an animated slide.

Do you recall this slide, Professor McAfee?

A. I do.

Q. And DX-187 relates to what you've termed the latency technology market?

A. That's correct.

Q. And when we discussed this slide earlier, you explained which technologies you included in that market as part of your market definition analysis. Do you recall that?

A. That's correct. Yes.

Q. And which technologies did you include in the latency technology market as part of your market definition analysis?

A. Well, programmable CAS latency plus the first four bulleted technologies.

Q. Do you have -- do your views as to what

technologies are in this market today differ from what is reflected in DX-187?

A. Yes, they are.

Q. And how do your views today differ from what you explained earlier when you described the process through which you defined the latency technology market?

A. All four of the first of the bulleted technologies that were included in that market have ceased to be technologies within that market.

Q. And why is that?

A. I would like to contrast it to the ex ante period. At the time that JEDEC first included programmable CAS latency in SDRAM or at the time that the standard was finalized in, say, 1993, the alternative of fixed CAS latency required a relatively modest amount of cost and actually offered performance benefits over programmable CAS latency.

At this point, in order to change the standard, you would now have to incur all of the other costs on the slide that we just looked at to deal with changing the deployment of an existing standard rather than -- which none of those costs would have been required to switch to fixed CAS latency ex ante.

So that is to say, in addition to whatever

costs and benefits were associated with fixed CAS latency in the ex ante period, you now have all of the additional costs associated with lock-in required in order to change the standard.

Q. Does that summarize your views as to why the technologies with the red check marks by them in DX-187 although included in your initial market definition are no longer, in your view, commercially viable technologies in this market?

A. It does.

Q. Let's move to DX-194.

And again I believe this is an animated slide.

Do you recall this slide from our discussion yesterday, Professor McAfee?

A. I do.

Q. And this relates to the relevant technology market that you defined and that you identified as the burst length technology market?

A. It does.

Q. And when you defined that market, can you remind us what technologies in addition to programmable burst length you included within that market?

A. It is the first four bulleted technologies.

Q. All of which have red check marks by them?

A. That's correct.

Q. Do your views differ today as to what technologies are included in this burst length technology market?

A. They do.

Q. And what technologies today would you include in that market?

A. Only programmable burst length.

Q. And why would you not include the other four technologies that are checked in DX-187?

A. Again, the cost --

Q. I'm sorry. I gave the wrong number. In DX-194.

A. As with programmable CAS latency, the economics of changing the technology from programmable burst length today to an alternative technology for setting burst length has -- the economics have changed dramatically because today you have a large installed base and all of the other factors listed on the slide that we had looked at a couple of slides ago are required to actually change the technology.

So that is to say, whereas ex ante you didn't have an installed base, installed base of products, today you have an installed base of products, you have all of the differences and challenges for reaching

consensus and the other factors that we discussed as an impediment to changing the standard. All of those attach only to the technologies not selected; that is to say, they don't attach to programmable burst length, but they hobble the alternative technologies in such a way as to render them no longer commercially viable.

Q. Let's go to DX-200.

Do you recall discussing this slide yesterday, Professor McAfee?

A. I do.

Q. And this slide relates to the relevant market that you identified as the data acceleration technology market?

A. It does.

Q. And can you remind us which technologies in addition to dual-edged clock you included in that relevant market when you defined the market?

A. They're the technologies indicated with the check mark.

Q. And would you include or do you include those same technologies in the data acceleration technology market today?

A. I do not.

Q. Why not?

A. The reason is the same. That is, the

technologies other than dual-edged clocking now have a significant impediment that did not exist at the time in the ex ante period because the act of replacing dual-edged clocking with any of these technologies requires strandings of large specific investments and also the challenges of reaching consensus and the other factors which we've discussed.

Q. Now, finally, let's go to DX-207.

Do you recall discussing this slide with us yesterday, Professor McAfee?

A. I do.

Q. And this slide relates to the relevant market that you've defined and that you've identified as the clock synchronization technology market?

A. It does.

Q. And can you remind us which technologies in addition to on-chip PLL/DLL you included in the clock synchronization technology market?

A. It's again indicated by the four technologies with check marks along with on-chip PLL/DLL.

Q. And which technologies would you include in the clock synchronization technology market today?

A. Only the on-chip PLL/DLL.

Q. And why would you not also include the other technologies that are identified here with red check

marks?

A. As with the other markets, those items now have the impediment to their implementation of requiring challenges of reaching consensus, the loss of the specific investments into the existing technology, and that hobbles the technologies to a point at which they are no longer commercially viable.

Q. Let's go back to DX-217.

Now, we have just been discussing the first bullet point and your views relating to the first bullet point on DX-217 in which you state that in each relevant technology market Rambus' technologies today are the only commercially viable alternatives.

Let's move now to the second bullet point on this slide, which refers to substantial barriers to entry, and let me ask you first of all to define for us what you mean by the term "barriers to entry."

A. So a barrier to entry -- it's a piece of economic jargon that means exactly what it says. It's something that is an impediment to new entrants that is generally not faced by existing incumbents in a marketplace.

So a barrier to entry is something that prohibits new entry and hence permits existing incumbents, for example, to exercise monopoly pricing.

Q. And do you discuss the issue of barriers to entry in the book that we saw yesterday?

A. I do.

Q. Let's go to the next slide.

A. But that's not what the next slide has.

Q. And do you recognize this slide quote?

A. Yes. This is a statement from an early Rambus business plan.

Q. Oh, I'm sorry. I went to the wrong slide.

A. There is no slide from my book.

Q. Okay. Here we go.

This slide entitled Barriers to Entry will be I believe DX-226.

What are you seeking to convey through this slide, Professor McAfee?

A. So there's a fairly long list of recognized barriers to entry within the economics literature. This actually takes a subset of those barriers to entry that are, in my judgment, applicable to the DRAM marketplace or DRAM technology marketplace.

And so this lists the barriers to entry that are relevant in assessing the DRAM technology marketplace.

Q. And where did this list of factors come from or how did you develop this list of factors relating to

barriers to entry?

A. Well, I did actually look at my book, at the list of factors listed in my book and take it from there, although I have to say the list of factors in my book is similar to what you'll find in most economics books, industrial organization books that discuss barriers to entry.

Q. Have you reached any conclusions as to which if any of these factors listed in DX-226 have application to this industry and this case?

A. Yes. In fact I only listed the applicable barriers to entry. The list of total -- there's a long list of barriers to entry in my book. This is only the list of applicable barriers to entry.

Q. And what reasons do you have for concluding that scale is a barrier to entry applicable in this case?

A. Well, let me say that scale is a well-recognized barrier to entry, and we discussed yesterday the presence of scale economies in this industry, and I should say the scale economies operate not just at the plant level -- in fact the plant-level scale economies are not really the relevant ones; it's the industry-level scale economies that create the barrier to entry in this case in the technology

market.

Q. What about the next point, user switching costs? What conclusions have you reached with respect to whether that is an applicable barrier to entry in this case?

A. So "user switching costs" refers to a new entrant is -- has a disadvantage if no one is using the new entrant product just by the fact they're a new entrant, and if there are switching costs, that creates a barrier to entry because the new entrant has to in some sense subsidize customers to switch to them or bears an additional cost relative to existing incumbents, and so switch -- we've discussed switching costs at present in the DRAM and DRAM technology marketplace and that creates a barrier to entry.

Q. What about the next point, strong learning curve? What, if any, conclusions have you reached with respect to whether that concept is applicable to this case?

A. A learning curve is a barrier to entry because a firm that's already gone down the learning curve has an advantage obviously over a firm who has not, and so a new entrant, sort of again by definition, hasn't yet gone down the learning curve, so a strong learning curve means a new entrant has to be better in order to

survive in the industry against the more seasoned incumbent.

And I believe there's a lot of testimony that justifies the conclusion that learning curves -- which, again, learning curves are economic concepts, but the application to this industry does rely on the facts, and I think there's a lot of testimony that justifies the conclusion of a learning curve in the economic notion to this industry.

Q. Referring to the next point, sunk costs, what, if any, economic conclusions have you reached with respect to whether sunk costs are a barrier to entry applicable in this case?

A. Sunk costs are nonrecoverable costs. They have the effect of discouraging entry -- actually that point is at least somewhat controversial, to be fair. But they have the effect of discouraging entry because an entrant has yet -- who has not yet sunk an investment faces a risk of the loss of investment that creates a barrier to entry for the -- because of the risk attached to sinking the costs.

Q. And finally you refer in DX-226 to patents.

What, if any, conclusions have you reached with respect to whether the patents are a barrier to entry applicable in this case?

A. So patents are a classic barrier to entry. They're a legal -- that is, legal, not illegal -- they're a legal barrier to entry created by the government intentionally to promote innovation. They create a classic barrier to entry because in this case the government enforces the prohibition against entry.

Q. Is standardization a barrier to entry in the DRAM marketplace?

A. Yes. Standardization by creating switching costs creates a barrier to entry in this industry. And we've discussed, in the costs of changing the standards, we've discussed the barrier to entry associated with standardization.

Q. Have you seen any evidence that the concept of standardization being a barrier to entry is something that's recognized by market participants in this industry?

A. Yes. And the slide which has already been flashed up is the -- is an example of that.

Q. This would be DX-227.

Let me just read the quote here on DX-227.

It states: "The DRAM industry's penchant for standardization combined with the Rambus marketing strategy of licensing all major vendors make it extremely unlikely that any potential competitor would

be able to gain critical mass enough to challenge an already established and ubiquitous Rambus chip."

Do you see that language?

A. I do.

Q. And do you have an understanding of where that language comes from?

A. Well, I have an understanding of the economic meaning of this language.

Q. I'm just referring to the source.

Do you understand the source of where that language came from?

A. Yes. I understand this to be an early Rambus business plan.

Q. And the source is identified at the bottom of the slide as -- with the date June 1989.

Now, do you, from the standpoint of your economic analysis, do you attribute any significance to this statement?

A. Well, yes. This refers to -- now, it refers in the form of if Rambus becomes the dominant standard or, that is to say, if the Rambus technology or RDRAM I believe would be the actual chip, if Rambus becomes the established technology, it will be difficult to displace them.

And it's the -- standardization is given as

one of the reasons that the Rambus technology would be hard to displace and it's because the competitor if they're not produced in volume, that is, they haven't gained -- the term here is critical mass -- they're not going to be able to challenge the existing standard.

Q. And is that consistent with the conclusions that you've reached as part of your economic analysis of this marketplace?

A. Yes, it is. Only in this case it's actually the JEDEC standard rather than the Rambus technology that was the -- that gained the critical mass.

Q. And why is it extremely unlikely that potential competitors would be able to gain critical mass once a standard has already been established and has become ubiquitous in the marketplace?

A. Well, we've discussed a number of factors both today and yesterday in which the -- that tend to produce an economy of scale. That is, the larger the volume that is produced of a chip, the lower the cost per unit not just of the chip itself but also of the complementary goods. That is, the large investments made to produce complementary goods get amortized over a larger volume of product, which lowers their per-unit costs, which makes it even more attractive to the

marketplace.

And so for the same reasons that there tends to be a dominant standard in this industry, it will tend to be difficult to displace an established standard.

Q. Let's go back to DX-217.

Your Honor, I'm about to go into an area that does involve use of at least one slide that has been given -- I believe Your Honor gave it provisional in camera status?

JUDGE McGUIRE: Do you want to do that now or could we maybe do that toward the end? I'm just trying to think of a way that would require me taking a break here shortly. I guess we maybe can do that now and let the audience take a break and we're done with it.

MR. ROYALL: What I was going to suggest, I do have a little while to go. It's going to take me a little more than two hours to complete this, but if we can cover this now, I don't think it would take very long, and then perhaps we can take our short break and I can come back and finish up.

JUDGE McGUIRE: Let's do that.

And again, I have to advise the audience that the testimony and the evidence we're about to hear is

closed to the public, so I'm going to ask that at this time the public excuse themselves from the courtroom and you will be advised when it's I guess safe to come back in.

Again, I will ask counsel to certify to the court that everyone at their counsel table and everyone behind them is cleared to access this in camera evidence.

MR. STONE: Based on my understanding that this information is information that came from Rambus, all the persons on our side of the room are cleared to be present.

JUDGE McGUIRE: And complaint counsel?

MR. ROYALL: Yes, Your Honor. My understanding is that all of the persons on this side of the room are also cleared to be present.

JUDGE McGUIRE: Okay. Good.

Then let me advise the court reporter that we are now in in camera session.

(The in camera testimony continued in Volume 36, Part 2, Pages 7622 through 7631, then resumed as follows.)

JUDGE McGUIRE: Then you may proceed at this time, Mr. Royall.

MR. ROYALL: Thank you, Your Honor.

BY MR. ROYALL:

Q. Professor McAfee, yesterday you identified your key economic questions, and the third question was whether Rambus acquired market or monopoly power through exclusionary conduct.

Have you reached a conclusion regarding that issue?

A. Yes, I have.

Q. Can you explain the reasons -- strike that.

What conclusion did you reach?

A. That Rambus did acquire its monopoly power through exclusionary conduct.

Q. And what reasons do you have for reaching that conclusion?

A. Well, I have a series of slides. We might want to start with what is exclusionary conduct.

Q. And how would you define or how do you define from the standpoint of economics the term "exclusionary conduct"?

And before you answer that, let's just go ahead and mark this as DX-229.

A. Unlike market power, there's --

(Interruption at the door.)

BY MR. ROYALL:

Q. How do you, Professor McAfee, define from the

standpoint of economics the term "exclusionary conduct"?

A. Unlike market power, there's a consensus on the definition of exclusionary conduct within economics, and it would be conduct that tends to exclude an equal or superior product or competitor.

Q. You mentioned on this slide, DX-229, in the third bullet, "Effect is anticompetitive -- harms consumers."

What do you mean by that?

A. Well, the logic of the definition of exclusionary conduct is that conduct that would exclude an inferior competitor would not have any -- would probably not harm a marketplace. That is to say, it would either have no impact or an insignificant impact on a marketplace by excluding an inferior competitor.

On the other hand, conduct that eliminates equal or superior competitors is generally going to harm consumers by reducing their choice and eliminating competition in the marketplace, and so conduct that tends to exclude superior competitors or products is known as exclusionary conduct and that tends to be harmful to competition and reduce the efficiency of marketplaces.

Q. What do you mean by the last bullet point on DX-229, which states "no valid efficiency rationale"?

A. So again the purpose of defining exclusionary conduct to be the exclusion of superior competitors or products is to ensure that exclusionary conduct is bad for the functioning of marketplaces and hence does not have a valid efficiency rationale.

Q. In assessing whether Rambus' challenged conduct was exclusionary conduct, did you make any assumptions regarding Rambus' conduct?

A. Yes. Indeed I made a lot of them and I have a slide to that effect.

Q. Is this the slide you're referring to?

A. It is.

Q. This will be DX-230.

Can you explain to us what you're seeking to convey through this slide?

A. These are the factual assumptions that I make in order to reach the conclusion that Rambus engaged in exclusionary conduct.

Q. Let me ask you about these assumptions, starting with the first, Rambus possessed IP relevant to JEDEC standards/work. That's an assumption that you're making?

A. Yes, it is.

In order to know whether this assumption is true or not, one has to actually have expertise in assessing whether patents or pending patents are relevant to JEDEC standards, and I do not have that expertise personally.

Q. Going to the next point, Rambus failed to disclose relevant IP as required by JEDEC rules/process, is that an assumption that you have made for purposes of analyzing Rambus' conduct?

A. It is. This is the assumption that Rambus actually did something that mattered, that is to say, that it had something -- that it failed to disclose the relevant IP that was listed in the first bullet and that it was required to by the JEDEC rules.

Q. The next point states, "Rambus engaged in other related misrepresentations while a member of JEDEC."

Is that an assumption that you've made for purposes of conducting an economic analysis of Rambus' challenged conduct?

A. Yes. Although that assumption may be subsumed by the second assumption; that is to say, that assumption is not, strictly speaking, necessary to reach the conclusion if the second assumption is true.

Q. The fourth bullet states, "After leaving JEDEC,

Rambus continued to conceal its IP."

Is that an assumption you have made for purposes of conducting an economic analysis of Rambus' conduct?

A. It is. The importance of that -- again, that assumption is to some extent subsumed by the second assumption, although the overall effect of the conduct depends on that assumption. The magnitude of the effect depends on the assumption.

Q. The second to last point states, "Before, during and after JEDEC participation, Rambus planned to enforce JEDEC-related IP."

Is that an assumption you have made for purposes of conducting an economic analysis of Rambus' conduct?

A. It is. The difference between -- what that assumption says is the behavior was not inadvertent; it was intentional. And that is to say, they did not disclose and they intended to enforce as opposed to an inadvertent failure to disclose, and again, that's an assumption I've made.

Q. And finally, the last bullet point states, "Rambus was aware of legal risks associated with this conduct (i.e., equitable estoppel)."

Is that an assumption you have made for

purposes of conducting an economic analysis of Rambus' challenged conduct?

A. It is. And that actually provides a second route -- that assumption provides a second or alternative route at reaching the same conclusion, so that assumption is not necessary for one of the chains of logic that I will explain, but it is necessary for the other.

Q. In addition to making these assumptions, did you do anything, Professor McAfee, to corroborate for your own purposes the reasonableness of the assumptions that you've made?

A. Yes. I did a great deal of factual investigation. Again, the findings for these assumptions, these are all factual matters themselves.

And as I testified earlier this morning, the quality of my conclusions is very much predicated on the quality of my factual hypotheses, and so in order to get the right answer -- being an academic, I like to get the right answer -- in order to get the right answer, I investigated these assumptions to assure myself that I wasn't wasting my time reasoning from them.

Q. And in the course of doing that factual investigation, did you identify evidence that caused

you to alter or lose confidence in any of these assumptions?

A. No. And I will add that reading the trial transcript corroborated that as well.

Q. Now, having now explained the assumptions that you've made for purposes of conducting an economic analysis of Rambus' conduct and in determining whether that conduct meets your economic definition of exclusionary conduct, having now identified those assumptions, let me ask you about the reasons why I believe you've now explained you ultimately did conclude that Rambus' challenged conduct was exclusionary in an economic sense.

A. Yes. And I have a slide to illustrate the major findings or to list the major findings.

The first of these is that the -- so again, I have assumed a failure to disclose and other misrepresentations. These have the effect of distorting the JEDEC standard-setting process. That is, they provide JEDEC with inaccurate information or with the lack of accurate information, and that information concerning royalties is material to the JEDEC decision-making process.

And so that has the effect of actually causing JEDEC to make mistakes relative to the world that would

exist when JEDEC had accurate information.

Q. Is there anything in economic theory that speaks to whether conduct of that sort is or tends to be exclusionary?

A. Yes. Misleading information tends to be exclusionary generally. And I have a slide that illustrates that.

Q. Let me -- before we go further, the prior slide I believe will be DX-231, and this slide that's now on the screen relating to misleading information will be DX-232.

Can you explain what you're seeking to convey through this slide, DX-232?

A. Yes. Going back to the definition of exclusionary conduct, generally competition works best when consumers are well-informed, and in fact that shows up in virtually every, if not every, principles of economics textbook, that one of the requirements of perfect competition is well-informed consumers.

Providing misleading information tends to prevent competition on the merits by distorting consumer choice away from their optimal choices. That is, when you make choices based on false or misleading information, you tend to make mistakes and you make mistakes more frequently. And the effect of that is

that it will tend to benefit inferior products and harm equal or superior products when concealed information about merits or misleading information about merits is present in the marketplace.

Now, what is essentially the same logic is that if you increase -- by providing information, say, that makes one alternative look better than it is, that has the effect of increasing the relative -- the perceived relative cost of the alternatives. That is, it makes them look more costly than they are, and that will tend to cause them not to be chosen and hence is exclusionary conduct because it harms equal or superior products.

Q. And is there anything in economic theory that speaks to whether conduct that has the effect of raising the cost of alternatives or the perceived relative cost of alternatives is exclusionary?

A. Pardon me? Can you ask me the question again?

Q. Is there anything in economic theory that speaks to whether conduct that has the effect of raising the cost of alternatives or the perceived relative cost of alternatives is exclusionary?

A. Yes. Well, that just meets the definition of exclusionary conduct in that it tends to harm equal or superior products in favor of inferior products and

therefore would be -- it would tend to exclude equal or superior products.

Q. Let's go back to the prior slide, DX-231.

The second bullet point on DX-231 states, "Excluded alternative commercially viable DRAM technologies."

Do you see that?

A. Yes, I do.

Q. And how does that relate to your conclusion that Rambus' challenged conduct is exclusionary?

A. Well, that's at the heart of exclusionary conduct, is to exclude the relevant alternatives. And I've prepared a slide or a series of slides that go through that logic.

Q. Let me ask -- the next slide is DX-233.

Before we talk about the substance of that, let me ask, as part of your analysis of Rambus' challenged conduct, have you given consideration to what likely would have happened if Rambus had disclosed its relevant intellectual property to JEDEC?

A. Yes, I have.

Q. And why have you considered that issue, why is that important to your analysis?

A. Well, in order to reach the conclusion that commercially viable alternatives were excluded by

Rambus' conduct as opposed to by the JEDEC standardization process, I needed to actually ask what would have happened had Rambus disclosed its intellectual property and not engaged in misrepresentation, that is, had not engaged in the assumed challenged behavior.

Q. And does this slide, DX-233, relate to that element of your analysis?

A. Yes. This introduces the standard economic methodology for doing this -- for performing such an analysis, which is known as the but-for world analysis or also known in economics as a counterfactual.

Q. Can you define for us precisely what you mean by the term "but-for world"?

A. Yes. In fact the first bullet does that.

The but-for world is to suppose as a hypothesis that Rambus had not engaged in the conduct at issue, so that is to say it's to assume, contrary to the actual facts, assume that the challenged conduct or the conduct at issue had not occurred and then ask what would have happened under those circumstances.

Q. And the last bullet point here on slide DX-233 refers to standard economic methodology.

Is this a standard economic methodology?

A. Yes, it is. As I said, it's common in any exclusionary conduct case and even more generally as a tool of economics. And the methodology is to apply standard economic reasoning to the changed set of facts under the but-for world hypothesis.

Q. In other economic consulting matters that you've worked on either with the government or private parties, have you engaged in this type of but-for world analysis as part of your economic analysis?

A. Yes, I have.

Q. And in this case did you in fact define for purposes of your economic analysis one or more but-for scenarios or but-for worlds?

A. Yes, I did.

Q. And how did you go about defining such scenarios or but-for worlds?

A. The process is to say what would have happened -- suppose that Rambus had not engaged in the conduct and then ask what would have happened.

And immediately you run up against the question of whether or not Rambus would have issued a RAND letter, that is, whether Rambus would have offered to license its technology on reasonable and nondiscriminatory terms; so that is to say, in order to make a prediction of what would have happened in the

but-for world, I have to know one way or the other whether Rambus would have issued a RAND letter.

Q. Let's go to the next slide. This will be DX-234.

Does this slide relate to your but-for world analysis?

A. Yes. This summarizes the situation that will prevail when Rambus doesn't issue a RAND letter, that is to say -- so to run through the logic, we've hypothesized that Rambus disclosed its IP and did not engage in any of the other challenged conduct. In addition, we're hypothesizing that Rambus does not issue a RAND letter.

Now, in this case the but-for world is very simple. I can jump to the last bullet before looking at the first four.

Without a RAND letter, JEDEC is prohibited by its own rules from including the intellectual property that's been disclosed into the standard. The effect of that is that without a RAND letter, the JEDEC standard will not have Rambus' intellectual property embedded in it, and that -- in this -- you can think about this as the branch of a tree. It's the no RAND letter branch of the tree.

In that event, the standard does not

incorporate Rambus IP, and as a result, we can conclude that in this branch of the tree Rambus' failure to disclose actually caused the inclusion of the Rambus technology in the JEDEC standard. That is to say, we can conclude that there was -- that the misrepresentations mattered.

Q. And have you developed any opinions or conclusions as to whether in such a but-for world Rambus would have issued a RAND letter?

A. Well, I think it's more likely that they would not, but I'm -- I have not reached a level of certainty that allows me to testify that in my -- to my expert opinion they would not. That is to say, my informed judgment is that more than likely they would not, but I'm not prepared to testify that they would not.

Q. And what basis do you have for saying that in your opinion Rambus more likely than not would not have issued a RAND letter in a but-for world in which it had disclosed relevant intellectual property to JEDEC?

MR. STONE: Your Honor, I object to the question. It misstates the witness' prior testimony, which was not his opinion but his informed judgment, and the choice of words by the witness I think should

be honored in his following questions.

MR. ROYALL: I'm happy to restate.

JUDGE McGUIRE: Okay. Restate.

BY MR. ROYALL:

Q. And what basis do you have for saying that in your informed judgment Rambus more likely than not would not have issued a RAND letter in a but-for world in which it had disclosed relevant intellectual property to JEDEC?

A. Well, that is what the first four bullets of this slide set out, are the major bases for my judgment that more than likely Rambus would not have issued a RAND letter.

There are documents and e-mails that suggest that RAND is not consistent with the Rambus business model and that Rambus wanted the flexibility to charge different royalty rates, which would be prohibited by the -- or different royalty rates to different companies, which would be prohibited by a RAND letter.

In addition, not issuing a RAND letter insofar as it makes the standard harder to -- the JEDEC standard harder to design has the effect of encouraging the success of RDRAM, which was one of Rambus' important goals, and so the last bullet points 3 and 4 refer to the fact that not issuing a

RAND letter could have provided some modest amount of assistance in establishing RDRAM as an industry standard.

With all that together, it seems to me that more than likely Rambus would not have issued a RAND letter, but that's not -- I can't draw that as a matter of expert opinion, as a conclusion from my expert opinion. It would be overclaimed.

Q. And when you speak to this issue and express your informed judgments about this issue, are you commenting upon what you understand, from your review of the evidence, to be the economic incentives that would influence such a determination by Rambus?

A. So the -- let me take them in order.

The first bullet point does not refer to economic incentives but refers to my review of the facts.

The second bullet point is a mix of those two; that is to say, it's -- I have an understanding of the value of charging different royalty rates to different companies and the value of that flexibility, but it also has a factual basis.

The bullet points 3 and 4, the success of RDRAM, refers to economic analysis; that is to say, my conclusion that by not issuing a RAND letter there is

some help for RDRAM is actually an economic analysis.

Q. And understanding that you're not expressing conclusions on what JEDEC's rules do or do not provide, is it nonetheless your understanding or assumption that in a but-for world in which Rambus failed to provide a RAND letter, JEDEC, according to its rules, could not or would not use Rambus intellectual property in its standards?

A. Yes, that is my factual assumption.

Q. Did you also consider a but-for world scenario in which Rambus did issue or would issue a RAND letter?

A. Yes, I did.

Q. We now have another slide up, which will be DX-235.

And can you explain to us what you're seeking to convey through this slide?

A. In this case I find that most likely -- so this is again had Rambus disclosed its IP and not engaged in other misrepresentations and also then subsequently issues a RAND letter.

Even so, I find that JEDEC would most likely not have included the Rambus intellectual property in its standards, and the reason is that free and commercially viable alternatives.

In addition, there's an incentive for JEDEC to avoid royalties primarily because of the price sensitivity of the customer and for other reasons that we've talked about. And I think it would be hard to get consensus to include this particular IP given the commercially viable alternatives that I understand to be freely available to this marketplace.

So the -- what the first blue bullet point refers to with its subpoints is more than likely, most likely JEDEC would not have included Rambus intellectual property in its standard.

Q. And have you nonetheless considered a scenario in which JEDEC would have considered or might have considered inclusion of Rambus technology in its standard, provided that Rambus had issued a RAND letter?

A. Yes. The RAND letter does not specify a royalty rate, and it is my understanding that JEDEC does not negotiate royalty rates ever under any circumstances. Again, that's a factual question.

And since a RAND letter doesn't specify a royalty rate, firms are at risk when they've incorporated patented technology that the royalty rates may turn out to be very large. The RAND letter does specify "reasonable," but to a great extent

"reasonable" is in the eye of the beholder.

And as a consequence, the firms have an incentive for ex ante negotiation; that is to say, the firms that intend to practice the JEDEC standard have an incentive to say, Hey, what's this going to cost me? That is to say, to investigate what does the word "reasonable" mean in the RAND letter.

Now, it's my understanding that that would have to be a one-on-one negotiation, that is, it would not be done collectively, and there is some testimony in the trial record that supports a conclusion for an ex ante negotiation.

Q. What do you mean by the point at the bottom of this slide, 235, where you say, "Rambus had different incentives -- 'pure play' technology company"?

A. Many of the companies in this industry cross-license with each other; that is to say, they're manufacturers and they each own licenses that have bearing on the behavior of the other and they have cross-license agreements.

The effect of that is that if one of them tries to charge a lot for its patented technology, it has to fear that the others will respond with equal increased charges.

Rambus is not in that position in the sense

that by virtue of not being a manufacturer, Rambus faces no such risk, no such symmetric risk. And the effect of that is to make it more likely -- from an economic perspective, it makes it more likely that the firms in the industry, that is, the manufacturing firms in the industry -- and actually I emphasize that includes not just DRAM manufacturers but the manufacturers of chipsets who would also pay royalties -- would have incentive to seek out and find out what Rambus had in mind when it agreed to charge reasonable royalties.

And it doesn't take everyone to do this. If a single firm does this and finds out that the royalties are expensive, the expected royalties are expensive, they then have the ability to report this is going to cost us a lot to go this route.

Q. You've explained your reasons for concluding that members of JEDEC in this but-for world in which Rambus issued a RAND letter would have incentives for ex ante negotiation.

Does that element or does that conclusion bear in any way on your conclusions about monopoly power?

A. Yes. Again, in the -- oh, on monopoly power.

Yes, it does. The incentive for ex ante negotiation would be a limit on the monopoly power, on

the exercise of monopoly power, because ex ante the firms have -- the users of the technology, because they have alternatives, have a great deal more bargaining power than they do after they've already deployed the technology and become locked in.

Q. Does that conclusion about incentives for ex ante negotiation have any bearing on your broader conclusions about the exclusionary nature of Rambus' conduct?

A. Yes. In fact, let me actually take both bullets on this slide.

In the first bullet, if JEDEC does not include the Rambus intellectual property, we have immediately a conclusion of exclusionary conduct -- or of -- yes, of exclusionary conduct because the conduct mattered.

In the second case it matters not so much to the actual incorporation of the technology but into the prices that are charged, and so again, the finding is that the conduct matters. It has -- that there is causation.

Q. Referring to the top set of bullet points on this slide, DX-235, in which you state that JEDEC likely would not have included Rambus IP in its standards even if Rambus had issued a RAND letter, do your views in that regard have anything to do with the

issue of lock-in or the potential for lock-in?

A. Yes. JEDEC generally has -- it is my understanding as a factual matter that JEDEC generally has a preference not to avoid -- or not to incorporate intellectual property where alternatives exist. And my understanding, as an economist, of that preference is that that's a rational preference on JEDEC's part as a way of avoiding lock-in.

The incorporation of proprietary technology when commercially viable alternatives exist generally exposes the industry to the threat of hold-up.

Q. Before we leave this issue of the but-for world, do you have any slides that depict the concepts that you've been describing in connection with the but-for world scenarios that you've defined?

A. I do.

Q. Let's go to the next slide. This will be DX-2356.

And what does this -- what are you seeking to depict through this slide?

A. So this is a comparison of the but-for world to the actual world. This will depict the actual world. Here R1 and R2 refer to programmable CAS latency and programmable burst length, B and C refer to commercially viable alternatives in that process, and

the standard-setting for SDRAM is the first large funnel or the leftmost of the large funnels in this.

So the features of SDRAM are going to be determined by the furthest-left small funnels, which will feature the selection of R1 and R2.

Q. And then we've just seen a second view of this same slide and some animation. Can you explain what you mean to depict through that animation?

A. Yes. In fact it's what I just referred to, the selection of R1 and R2 in the process of defining the SDRAM standard. And as I mentioned, R1 and R2 refer to Rambus proprietary technology.

Q. And which Rambus technology specifically do the arrows R1 and R2 refer to?

A. Programmable CAS latency and programmable burst length.

Q. I think there may be another view on this slide?

A. Here, those two technologies have now been incorporated into the SDRAM standard which is issued and is deployed. At that point SDRAM becomes a platform for the development of a subsequent standard DDR. That is to say, the output of the SDRAM standard process as deployed becomes a basis, an evolutionary basis for the development of the DDR standard.

And this illustrates that by showing R1 and R2 being fed into what will become the DDR selection process.

Q. And then I think there may be one more view? What, in this view, what are you seeking to convey?

A. So this illustrates the selection of R3 and R4, which refer to on-chip DLL and dual-edged clocking, into the DDR standard, and they are selected over commercially viable alternatives D and E.

Q. And perhaps there's one more view? Yes.

A. And here --

Q. Go ahead.

A. Here -- and now, all four of those technologies are incorporated into the DDR standard. The first two R1 and R2 were inherited from the base on which DDR built. R3 and R4 are additions to that standard.

Q. And what you've just walked through, does that reflect -- in what's depicted in this slide, DX-236, does that reflect your understanding of what has occurred in the actual world in terms of Rambus' intellectual property being incorporated into JEDEC SDRAM and DDR SDRAM standards?

A. It does.

Q. Let's go to the next slide. This would be

DX-237.

What does this slide depict?

A. This slide starts off with the same environment, but it's going to consider what happens in the but-for world. The actual case that I will consider here is the case either of no RAND letter or a RAND letter issued and JEDEC making the determination not to include the Rambus technology in the standards.

So again, the hypothesis of the but-for world is that Rambus has disclosed its conduct -- excuse me -- disclosed its intellectual property early in the process.

Q. Let's go to the next view.

A. And so as I said under the case of no RAND letter or when JEDEC decides not to include the intellectual property, SDRAM actually gets non-Rambus technologies B and C, which were two of the commercially viable alternatives.

Q. And then is there another view of this slide?

A. And here those two technologies have been incorporated in the standard and the two Rambus technologies were not.

Q. And then is there one more?

A. Then here in the process of defining DDR, DDR

did not inherit the Rambus technologies, so those aren't part of the base of the DDR standard, and the other two Rambus technologies are also not selected.

Q. And I think this may be the final view?

A. And at this point the DDR standard comes out not involving any of the Rambus intellectual property.

Q. And to be clear before we leave this slide, what are you meaning to depict by the fact that in this slide, DX-237, the arrows coming out on the right-hand side of the SDRAM and DDR SDRAM funnels are blue as opposed to yellow?

A. It's that the DDR platform, the DDR technology, does not incorporate Rambus intellectual property.

And I should say that as this diagram illustrates, the DDR was built on the SDR and generally in evolutionary technology the next generation will be built on the previous generation and so in this case the subsequent technology would not be inherited Rambus technology.

Q. Could we go back to DX-231.

Now, DX-231, which we touched on earlier, relates to the reasons why you've concluded that Rambus' challenged conduct is exclusionary. We haven't yet covered the last bullet point on this slide, which states, "Entailed a conscious choice to

jeopardize the enforceability of patented intellectual property."

Can I ask you to explain what you mean by that and how that relates to your conclusion that Rambus' challenged conduct is in an economic sense exclusionary?

A. Yes. Before I -- before I start with that, I want to go back to one of my assumptions, which is to say that Rambus was aware of the legal risks associated with its conduct, so that is to say that's an assumption on my part and not an economic finding or not an economic conclusion.

I have a slide that describes this third bullet point.

Q. Let's see if we can find that.

Is this the slide you're referring to?

A. It is.

Q. This will be DX-238.

A. Yes. And the first bullet point, again, because it refers to knowingly incurred a risk, is an assumption on my part.

Q. And having made that assumption, how have you reasoned, how with respect to this factor, how have you reasoned to the conclusion that Rambus' challenged conduct is exclusionary?

A. Well, Rambus is a technology company. Its business is selling technology. And so to risk losing the enforceability of its patents for a technology company is an extremely serious risk. And the implication from an economist's perspective, that is, from an economic analysis perspective, is that there must have been an expected compensated benefit. That is, there must be a reason for undertaking such a risk.

And there's quite a parallel to predatory pricing. Predatory pricing, as I believe I testified yesterday, is pricing below cost, which is something that on its face appears to be irrational. You're losing money on each item you sell. But the economic explanation for predatory pricing is that if you succeed in monopolizing a market, predatory pricing can pay.

So that is to say, the future gains, the recoupment of the investment in monopolizing the market by way of running losses currently makes up for the losses in the near term. And so if you succeed in monopolizing a market, that actually provides a rational account of why a firm might engage in predatory pricing.

And there's an exact parallel here. The risk,

which is a very serious risk, of having your patents found unenforceable might be compensated by the gain associated with actually ultimately monopolizing the markets.

Q. And have you seen any evidence in the record of this case that Rambus acknowledged that participation in JEDEC created substantial legal risks?

A. Yes. And I have a quote of the Rambus chairman.

Q. This will be DX-239. Let me read this and then I'll ask you about it.

The quote on DX-239, which the source at the bottom of the page indicates this is a quote from a deposition of Rambus' chairman, William Davidow, taken in this case in January of this year, and the quote says: "The only product that Rambus has about this is intellectual property. Doing anything as stupid as putting intellectual property in jeopardy by sitting in a meeting would have been -- passively sitting in a meeting, which is my understanding of what we did, would have been the stupidest management move that I could think of.

"And you know, there isn't -- there is no rational motivation that I can think of that you would

jeopardize the value of your paints by participating in a process that might deprive you of the right to enforce those patents.

"I mean, it's -- there was very little to be gained and everything to be lost. I mean, that's not the kind of thing that you do with a rational manager."

Now, I've read the quote, Professor McAfee, and my question is: What, if any, significance do you attribute to this quote from the standpoint of your economic analysis?

A. Well, this quote definitely for me confirms that the risk that was taken was substantial. That is to say, the -- so as I said, the -- I'm sorry. I've got a little tongue-tied.

That there was a risk taken and that the -- that that was a substantial risk and would need a substantial benefit to recoup the extent of the risk.

Now, his explanation was, well, we couldn't have done it because it would have been too stupid to have done that. That's my reading of this, although of course that's a factual matter of what he meant.

But the normal economist's perspective -- and to be fair, I do actually -- I have encountered firms making mistakes and in my classes I describe or I

present situations in which firms make mistakes and I'm not -- I do not intend to testify that firms never make mistakes because of course on occasion they do.

But on the other hand, the normal economic analysis is to assume that firms aren't making mistakes, that is that they are being deliberate, and in this case if they were being deliberate, they had to have a purpose and essentially the only purpose, candidate purpose, of which I'm aware is to monopolize the market.

And that purpose has the advantage, like predatory pricing, of being sufficiently valuable to make a sizeable risk worthwhile.

Q. And the predatory pricing analogy that you've drawn to this case and to statements such as the one that's presented in DX-239, does that predatory pricing theory have a basis in the economic literature?

A. Oh, yes. That's quite a popular topic in the economics literature. It's been empirically tested and examined with a variety of companies and it appears in any industrial organization textbook I believe.

Q. And where that paradigm of conduct, the predatory pricing paradigm, exists and there is what

appears to be a conscious decision to price below cost in the way that you've described, when that conduct paradigm exists, does it provide a basis for an economist to draw inferences about the exclusionary nature of the conduct?

A. Yes, it does. In fact, it's -- so my understanding of the requirement -- so that the economic analysis is if you meet two characteristics, you've priced below cost and you have a method of recouping the losses sustained while you were pricing below cost, then it is generally well-accepted that you can conclude that this was exclusionary conduct whose purpose was monopolization.

Now, I want to be clear actually in my answer that I'm giving the economic analysis version of that. I understand also that there's a parallel legal version, but I do not mean to speak to the law but only to the economic analysis side.

Q. And do you find that economic paradigm to be applicable in this case?

A. Well, with the exception that we are not -- the conduct that's being described was not predation, but yes, otherwise it is exactly parallel.

Q. And do your conclusions in this regard as to this element of your conclusion that Rambus' conduct is

exclusionary in an economic sense, are these conclusions independent from the earlier bases that you described for concluding that Rambus' challenged conduct is exclusionary, by which I'm referring to the misrepresentation element of your analysis and the analysis related to exclusion of alternative technologies?

A. That was quite a question. But yes, it is.

As I testified when we went through the assumptions, the conclusion here is -- requires that they knowingly engaged in this behavior and that they knew the risks. That's a factual matter that was not used in the -- that assumption was not used in the earlier analysis and hence is independent.

And I see this as a corroboration of the earlier analysis; that is, it's an independent means of reaching the same conclusion.

MR. ROYALL: Your Honor, I would guess that I have about forty minutes to go, and the very next topic is one that has again two provisional in camera slides.

If you wanted to break for lunch, my proposal would be to cover that as soon as we get back and then finish up. And again, I would estimate thirty to forty minutes.

JUDGE McGUIRE: Okay. Why don't we do that then.

It's 12:30. We will reconvene then at 1:45 after lunch.

Hearing in recess.

(Whereupon, at 12:28 p.m., a lunch recess was taken.)

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

(1:46 p.m.)

JUDGE McGUIRE: This hearing is now in order and in in camera session.

Again, I'll ask counsel to certify to the court that everyone at their table and everyone behind them is cleared to hear this in camera testimony.

MR. STONE: On behalf of respondent I can, Your Honor.

MR. ROYALL: And on behalf of complaint counsel I can as well.

JUDGE McGUIRE: All right. Thank you.

(The in camera testimony continued in Volume 36, Part 2, Pages 7631 through 7663, then resumed as follows.)

JUDGE McGUIRE: Okay. Mr. Royall, you may proceed.

MR. ROYALL: Thank you, Your Honor.

BY MR. ROYALL:

Q. Professor McAfee, we have now arrived at the fifth and final key economic question that you identified earlier, namely the question: What remedy, if any, is needed to restore competition/alleviate the anticompetitive effects of Rambus' conduct?

Have you reached conclusions relating to that

question?

A. I have.

Q. Before we get to the precise nature of your conclusions, let me ask you to explain if you could, as an economist, how do you go about assessing questions about remedies or appropriate remedies in an antitrust case?

A. Well, what an economist would refer to as the first best, that is to say, the most desirable approach to remedies would be to restore the world to what it would have been absent the anticompetitive conduct.

So the general idea is that you just want to undo the effects of the monopolization -- actually undo the monopoly and by undoing the monopoly will undo the effects of the monopolization and thereby undo the effects of everything else. That would be the first best.

I actually have a slide to illustrate or to summarize this.

Q. Is this the slide you're referring to?

A. It is.

Q. This will be DX-245.

And the point you just made, is that the same point that's being referenced here in the first bullet

of DX-245?

A. It is.

Q. What do you mean by the statement in the second bullet where you say, "As a practical matter, in this case the preferred remedy cannot be achieved"?

A. Well, in this case there have been, as we discussed, substantial investments and in fact almost a decade's worth of investments in these technologies and we discussed misdirection of investments in technologies.

A lot of things that are not going to be, as a practical matter, possible to reverse have been created by these specific investments, and that leads to the conclusion that the first best is not attainable, which I would say is actually the normal state of affairs, but there's no -- this case being no exception.

Q. When you say "the normal state of affairs," by that do you mean the normal state of affairs in an antitrust case?

A. In an antitrust case, yes.

Q. What do you mean when you say here in the first subbullet on DX-245 where you say, "Rambus' monopoly power is durable"? What do you mean by that and how does that relate to the issue of remedies?

A. Well, there's a sense in which that's

redundance since monopoly power, as I've defined it, is always durable. But Rambus has achieved monopoly power and that's durable. That's not going to go away because the JEDEC standards aren't going away, having been adopted by the marketplace.

Q. And how does that relate to your views on remedies?

A. That says it's not going to be possible to go back to 1992 and change the technologies that are embedded in SDRAM. And DDR SDRAM for that matter.

Q. Your next subbullet states, "The but-for world is now unattainable."

What do you mean by that and how does that relate to your conclusions on remedies?

A. The but-for world that we discussed, in particular the but-for world in which -- well, actually either of the two, when Rambus technology is not embedded in the JEDEC standards or when there is ex ante negotiation, neither of those worlds is available to us today, and there's no way to actually create those worlds at this time.

Q. Now, you mention in this second bullet in this slide, DX-245, you refer to some practical issues pertaining to remedies.

What, to be precise, what practical issues are

you referring to in that regard?

A. Well, three main ones which are presented on the subsequent slide.

Q. Let's go to the next one.

Is this the slide you're referring to?

A. It is.

Q. This will be DX-246. And you have entitled this slide Practical Limitations.

What do you mean by "practical limitations" in this context?

A. These are aspects of the world that are relevant to the attempt to undo the monopolization of Rambus. That is to say, the existence of an installed base of SDRAM and DDR and the devices and complementary devices have been developed, those already exist. Those investments have already been made. They're committed. There's no way to undo the existence of those investments today.

Q. You refer in the second bullet on this slide to DDR-II and you state that the DDR-II standard has been developed largely under the same assumptions as were used for SDRAM and DDR SDRAM.

First of all, let me ask you, what do you mean by that? What are you meaning to state by that?

A. So the DDR -- so that actually means two

things. One is that DDR-II development started building on DDR and at a time when it wasn't known that Rambus had intellectual property covering DDR or at least wasn't widely known.

The second thing is that DDR-II was and was intended to be an evolutionary outgrowth of DDR and as a consequence DDR-II is building on a product that contains Rambus intellectual property.

Q. And how do those --

MR. STONE: May we just be clear that as with yesterday that the witness is testifying to his assumptions here as opposed to facts that he just stated?

JUDGE McGUIRE: Okay. Mr. Royall, can you inject that into your questioning?

MR. ROYALL: Yes, Your Honor.

BY MR. ROYALL:

Q. What you just described in answer to my earlier question, Professor McAfee, was this your understanding as to the timing of the development of the DDR-II standard by JEDEC?

A. Yes, it is.

Q. And are you making assumptions about the facts in that regard?

A. Yes, I am. I was not a witness to the or a

participant in the development of DDR-II.

Q. Now, having made such assumptions, what, if any, economic conclusions do you make about the DDR-II standards development and implications of that for the question of remedies in this case?

A. Well, we've talked at some length about the economies associated with reusing existing technology in an evolutionary approach to the development of DRAM standards. And that evolutionary approach requires the DDR-II standard to build on the DDR standard, and that's just a restriction on any remedy in that if Rambus is allowed to assert its IP against DDR, then the DDR-II will have to build on some other foundation in order to avoid Rambus IP.

Q. The final point that you make on this slide, DX-246, refers to technological development in alternatives to Rambus' claimed technologies has been forgone. What do you mean by that?

A. As we discussed, for example, with asynchronous alternatives, the investments that might have otherwise arisen in asynchronous DRAM technologies were not fully exploited because SDRAM appeared to be a better alternative than it was or than was understood to be.

Q. How --

A. I think I said that exactly backward. Can I try again?

Q. Yes. If you would like to restate it.

A. To take, for example, asynchronous technologies, there were investments that would have otherwise occurred in asynchronous technologies that were not taken because SDRAM was believed to be a better alternative than it has proved to be because it was believed not to carry IP from Rambus.

Q. And how, if at all, does that point relate to your conclusions about remedies?

A. Well, that's water under the bridge. It's already been -- the time has already passed.

Q. In situations in which there are practical limitations of the sort that you've described, what, if anything, does economics teach in terms of the appropriate approach to remedies?

A. So there's a theory in economics known as the theory of the second best, and it suggests in this instance that the second best approach -- by the way, I have a slide for this as well.

Q. Is this the slide?

A. It is.

Q. This will be DX-247.

And let me just come back to what you were

saying earlier.

You were referring to the theory of the second best in economics. Can I ask you to explain what that theory is?

A. Well, the theory of the second best generally is when the first best is not available for some reason, it's to do the best you can given the constraints that are ruling out the first best, the first best being in some sense a theoretical optimal solution.

And so the theory of the second best suggests in this instance that if you can't undo the conduct, you should try to minimize the effects of the conduct.

Q. What do you mean in the second bullet point in DX-247 when you state, "The appropriate remedy to Rambus' conduct thus involves minimizing the marketplace harm associated with the anticompetitive behavior"?

A. So what I mean is in order to minimize or undo the effects of the conduct, the natural approach is, given that you can't just undo the conduct itself, is to try to eliminate or minimize the effects that conduct has had on the marketplace, that is, minimize the harm associated with the conduct.

Q. And have you, Professor McAfee, reached any

conclusions regarding what type of remedy or remedies, from the standpoint of economics, would be needed in order to achieve the remedies-related objective that you describe in this slide?

A. Yes, I have.

Q. And what conclusion have you reached in that regard?

A. I have actually a slide that summarizes the undoing of the effects.

Q. This would be DX-248.

Is this the slide you're referring to?

A. It is.

Q. And let me ask you if you could to explain your conclusions, and I would start with the first bullet where you state, "Rambus should be prohibited from enforcing against JEDEC-compliant DRAMs any patents filed (or based on filings) prior to June 18, 1996."

A. So let me say first that the June 18, 1996 is obviously a fact point and that what I'm referring to is that's part of an assumption that what should have been disclosed was patents or intellectual property that existed prior to that point, relevant intellectual property.

And the prohibition of enforcing is given that

the intellectual property would be unlikely to have been adopted in the standard under the hypothesis of disclosure, that is, in the but-for world, a way of undoing the effects of the harm that occurred is to make the standard to be royalty-free as it would have been in the but-for world or would have likely have been in the but-for world.

Q. And when you use the term "JEDEC-compliant DRAMs" here, by that are you meaning to refer to both SDRAM and DDR SDRAM compliant products?

A. Yes. And also to successive generations. The successive generations build on the existing DRAM.

Q. Do you have any view or conclusion as to whether the appropriate remedy in this case from the standpoint of economics should extend to DDR-II?

A. Yes. That being a successive and evolutionary development on DDR.

Q. And what basis do you have or what has caused you to conclude from the standpoint of economics that the remedy should extend to encompass DDR-II as well as SDRAM and DDR?

A. So again, given the likely but-for world, in the likely but-for world the DDR would not contain Rambus IP. JEDEC would then be building a DDR-II in the but-for world on a product base that did not

involve DDR.

If I can give an example, if the alternative that had been adopted over on-chip DLL were a vernier system or a "vernier" system, then JEDEC would be building on a base where they have learned about and fine-tuned and exploited the vernier system, and it's likely that the DDR-II would then incorporate the same vernier system and not on-chip DLL.

And so if the effect of undoing is to correct the same effect you need to enforce against -- you would need to prohibit the enforcement of the patents even against the successive generation.

I should say to be fair, at the point in which a revolutionary change, that is, a major redesign rather than an evolutionary step is taken, then it would be reasonable to in some sense start the clock over, although that's going to be a hard thing to define as a practical matter.

Q. When you use the term in the first bullet point of this slide "patents filed," by that are you meaning to refer to anything with respect to patent applications?

A. Yes. My understanding -- again, this is an assumption on my part, is that my understanding is that the JEDEC members were supposed to reveal or disclose

not just patents but patent applications, but that would be an assumption on my part.

I guess from an economic perspective the undoing of the content of the conduct would specify nonenforcement of any intellectual property that should have been disclosed, whatever that might be.

Q. The second bullet point states, "This remedy should extend both to U.S. and foreign patents."

A. Yes. This is a world market. The products which are produced using these technologies are a world market and the technologies themselves are a world market, and so to enforce the remedies selectively in one nation is not going to actually address the problem.

I should also state that it is my understanding that the U.S. is a net importer of DRAMs, and so if the patent enforcement still occurs outside, there would actually be harm to U.S. consumers in the long run.

Q. Have you considered as part of your economic analysis whether a remedy of the sort that you described that was limited to U.S. patents and no patents beyond that would be sufficient to address the anticompetitive effects of Rambus' conduct?

A. I do not believe it would. As I said, the U.S.

is a net importer and it's actually a relatively small -- it's a significant but small share of the entire world market, and so enforcement against the rest of the world would have a similar effect as enforcement against the entire world.

Q. In the final bullet point on this slide, DX-248, you state, "This remedy will restore competitive pricing in the relevant technology markets and mitigate other anticompetitive effects."

Could I ask you finally to explain what you mean by that statement.

A. Yes. This essentially puts right JEDEC's decision to incorporate this technology given that it had the belief -- that the members had the belief that there was no intellectual property attached to the standards.

And so in that sense it is an appropriate remedy in that it confirms the beliefs of the JEDEC members or the expectations of the JEDEC members that the standards they were defining were royalty-free.

MR. ROYALL: Your Honor, I have no further questions.

JUDGE McGUIRE: Just so I'm clear on this first point that you made here, sir, when you talk about any patents filed prior to June 18, I assume by that you

mean patent applications; is that correct, as opposed to patents that have been issued?

THE WITNESS: Yes. Well, actually what I'd like to say is that it's whatever should have been disclosed should not be enforced.

So I've -- what I've written here is conditional on the assumption that what's found is that it's patents and patent applications prior to Rambus' departure, but in fact the actual nature of my conclusion is whatever should have been disclosed should not be enforced.

JUDGE McGUIRE: Again, but for my question, when you're talking about patents filed, you're referring to any patent application?

THE WITNESS: Yes, I am.

JUDGE McGUIRE: Okay.

THE WITNESS: But to be fair, that is an assumption on my part.

JUDGE McGUIRE: Okay. Right. I just want to clarify that for the record.

BY MR. ROYALL:

Q. And if I could just follow up on that, when you say "patents filed," are you referring only to patent applications or to patents as well as patent applications?

A. Well, of course patents -- in order for patents to have issued prior to that date they must have been filed prior to that date, so it would include patents as well.

MR. ROYALL: Your Honor, I have no further questions at this time for Professor McAfee.

JUDGE McGUIRE: Thank you, Mr. Royall.

At this time we'll hear the cross-examination by respondent.

MR. STONE: Thank you, Your Honor.

CROSS-EXAMINATION

BY MR. STONE:

Q. Professor McAfee, how are you?

A. Good.

Q. Good.

Can we bring up DX-231.

This is a chart we looked at that you were shown by Mr. Royall earlier today; am I right?

A. It is.

Q. And one of the things you talk about in your first bullet point is that based on some factual assumptions you have made that Rambus' conduct, as you understand it based on those assumptions, has distorted JEDEC's standard-setting process by concealing material information; correct?

A. Yes.

Q. I want to ask you about the concealing part of that and the definition of exclusionary if I might.

It certainly is true, isn't it, that many companies and individuals conceal information?

A. It is true that many companies conceal information.

Q. A company, for example, that is very profitable might conceal the extent of its profits from others.

A. Well, I'm willing to reason with you that they might. Often companies are actually touting to the stock market that they're very profitable. In fact, what they tend to conceal is losses rather than profits.

Q. But a company, for example, that wants to discourage people from entering into the same line of business and competing with it might not want to make public how profitable that line of business is; correct?

A. Again, as an argument, it's a sensible argument. It is not actually in accord with my understanding of many factual situations. Normally companies conceal losses and are actually running off to the stock market to say how big the gains are,

although in principle what you say makes economic sense.

Q. And you're familiar with privately held as well as publicly held companies?

A. Yes, I am.

Q. And many privately held companies do not report whether they're making profits or losses; correct?

A. Yes, that's correct.

Q. And one reason companies that are privately held don't disclose the fact that they're in a line of business that is particularly profitable is because they don't want to do anything to encourage other people to enter that line of business and compete with them; isn't that right?

A. That's -- I can think of an example of that.

Q. And so it's not -- and the fact that by not disclosing the profits in an effort to discourage other people from entering into competition with it doesn't mean that the conduct is exclusionary, as you use the term in an economic sense, is it?

A. That a company doesn't disclose the profits that they make?

Q. Yes.

A. Is not exclusionary.

That -- I have to say I haven't really thought about this issue, but that appears to be a reasonable conclusion.

Q. The fact that a company may have made an invention which it thinks will have great value in the future but which it determines it wants to maintain as a trade secret and not disclose it to its competitors may discourage them from taking the preliminary steps necessary to build that product, but such conduct would not be exclusionary in an economic sense, would it?

A. I'm sorry. I had a little difficulty understanding that.

Q. Certainly. Let me step back.

Let's assume if we can as an economic question for you that a company has developed a new process of manufacturing that will allow it to produce product more cheaply than its competitors.

Can we assume that?

A. Yes.

Q. And let's further assume that that company would like to build a factory to employ that process and not let anybody know that it has a new factory using a cheaper process until they actually start producing product.

Can we add that to the assumption?

A. So just to make sure I'm clear, the hypothesis is they've invented what's known as a process innovation and it lowers their cost of manufacturing and they haven't told anybody about the process innovation because they want to wait until they've actually built the factory.

Q. Yes.

And that would give them an economic advantage if they can be the first to utilize this process. Correct?

A. That's correct.

Q. And in that scenario, the fact that they don't reveal the information is not something that in an economic sense you would consider to be exclusionary, is it?

A. No, it is not something that I would consider to be exclusionary.

Q. Now, the fact that a company applies for a patent on the process and chooses not to reveal the fact of that patent application or its contents is also not exclusionary, is it?

A. Well, that's a -- I would describe that as a very incomplete hypothetical.

Q. Okay.

A. So that is to say, I can think of circumstances where your hypothetical is true; that is to say, just concealing the existence of a patent is not by itself exclusionary.

Q. And in fact, the law recognizes that patent applications are to be kept confidential; correct?

MR. ROYALL: Objection, Your Honor. Calls for a legal conclusion.

MR. STONE: Let me withdraw it.

BY MR. STONE:

Q. As a matter of economics, you recognize that there are policy interests served in protecting patent applications from public disclosure, do you not?

A. Well, I'm aware that patent applications are generally kept secret in this country. I'm not actually aware of an academics debate on the value of keeping patent applications secret, and so I'm not as a matter of economic analysis aware of a conclusion of the kind that you described.

Q. As a matter of factual assumption or understanding on your part, isn't one of your assumptions or understandings that patent applications are kept secret?

A. It is my understanding, yes.

Q. So when you talk here about the conduct on

Rambus' part that you have assumed distorting JEDEC's standard-setting process by concealing material information, you have implicit in that statement more than just the fact that they didn't reveal certain information; isn't that right?

A. Well, I considered that I was very explicit about the assumptions that I was making in this, and I agree that I'm assuming that there was a material -- that material information, relevant information, should have been revealed and was not and -- but that's an assumption on my part, not a finding.

Q. And I want to explore the "should have been revealed" portion of your assumption if I might.

The "should have been revealed" portion of your assumption comes from something other than economics; true?

Let me rephrase it.

You're not saying that as a matter of economics it should have been disclosed?

A. No. I -- I'm happy actually to turn to my assumption and tell you -- it was definitely not as a matter of economics. It was an assumption that to comply with the rules.

Q. And that's what I want to get to.

So your assumption that what made the failure

to disclose exclusionary was that it was, based on your assumption, in violation of a rule?

A. Or a process, yes.

Q. Okay. And have you made any assumption one way or the other as to whether that rule or process is one that the antitrust laws should be employed to enforce?

MR. ROYALL: Objection, Your Honor. Calls for a legal conclusion.

MR. STONE: Let me rephrase.

JUDGE McGUIRE: Sustained.

BY MR. STONE:

Q. As a matter of economics, have you made any analysis one way or the other as to whether the underlying economic principles of antitrust law would be advanced by the particular rule that you have assumed?

MR. ROYALL: I would object as vague and ambiguous. I'm not sure what he means by "rule."

JUDGE McGUIRE: Can you restate on that, Mr. Stone? It is somewhat vague.

MR. STONE: Sure.

BY MR. STONE:

Q. You've told us there was a rule or process that you have assumed; correct?

A. I have.

Q. Okay. Is that rule or process that you have assumed something that as a matter of economic principles you feel advances the interest of antitrust?

A. Okay. So now I think I understand your question, and the -- I haven't done the kind of analysis that would let me answer that question fully.

I have some familiarity with the -- with -- while I have good familiarity with the standard-setting literature generally and the -- my understanding of the conclusions of that literature, which is not a literature I've personally contributed to, but I have some understanding -- I have a good understanding of I think -- is that standard-setting organizations generally walk a fine line in the antitrust world in the sense that there's a risk of -- there's a recognized risk of, what actually Adam Smith said, that when competitors get together it often ends in a conspiracy against the public.

So there's a fine line of the -- that these organizations walk.

On the other hand, there's a recognized --

JUDGE McGUIRE: All right, Mr. McAfee. I think you're getting somewhat far afield from the import of

the question. I'm going to ask you to sort of isolate your answer to comport more closely with what he was asking you. And I'm sorry to interrupt you, but I just think you're getting way too far out of the scope of the question.

THE WITNESS: So can I finish my sentence and then ask for a restatement of the question?

JUDGE McGUIRE: Okay. Go ahead.

THE WITNESS: There's a recognized benefit to standard-setting organizations, so in that sense there's a balance. I have not done the analysis necessary to apply that to JEDEC itself.

BY MR. STONE:

Q. Do you want the question back? I think in the end you --

A. Yes, I did ask for the question to be read back.

MR. STONE: Could I ask, Your Honor, that we have the question read back.

JUDGE McGUIRE: Yes.

Could we read the question back.

(The record was read as follows:)

"QUESTION: Is that rule or process that you have assumed something that as a matter of economic principles you feel advances the interest of

antitrust?"

THE WITNESS: Well, actually I thought I was being responsive to the question. That is, I was giving the --

JUDGE McGUIRE: You know, you might have been, but I just felt you were getting too far afield, so there's no point in arguing.

BY MR. STONE:

Q. Are you comfortable with the answer?

A. Yes.

Q. Okay. And similarly with respect to the portion of DX-231 and the first bullet that talks about misrepresenting, again, your conclusion that assumed conduct that you would say constitutes misrepresenting material information is exclusionary depends upon there being some independent duty not to engage in such a misrepresentation; is that correct?

A. I'm going to have to ask you to explain that.

Q. Certainly. Let me break it up.

You also have told us that based on assumptions you have made as to Rambus' conduct you concluded that there was some conduct which you would describe as misrepresentation which you concluded was exclusionary, as you defined that term; correct?

A. As I understand -- I think I assumed that there

was other conduct that was misrepresentations. And then based on that assumption, I found that the conduct would be exclusionary.

Q. And all misrepresentations even if they lead to competitive impacts are not necessarily exclusionary as you've defined that term in an economic sense, are they?

A. All misrepresentations --

Q. Let me see --

A. -- are not exclusionary? Is that the question you asked me?

Q. No. Let me see if I can make it clearer for you. It's undoubtedly my fault, so let me try again.

A misrepresentation is not always something that even if it has an impact on competition would be classified by you as exclusionary; isn't that right?

A. As stated --

MR. ROYALL: Your Honor, I was going to object to the compound nature of the question.

I think it may help if you can break that down. If he can answer it, that's fine, but it seemed compound and confusing to me.

JUDGE McGUIRE: Overruled. I'll hear the question.

If you can answer it, go ahead,

Professor McAfee.

THE WITNESS: Yes. It could be a misrepresentation could not be exclusionary, and I'd be happy to explain the circumstances under which a misrepresentation would not tend to be exclusionary.

BY MR. STONE:

Q. I think I'm fine where we are. Let me keep moving.

Let's go if we can to DX-232.

On the screen in front of you is DX-232, which is another chart you looked at this afternoon; correct?

A. That's correct.

Q. And in it you say, "Concealing or providing misleading information is exclusionary when equal or superior products are excluded."

I added the word "are" in there, but that's what you mean; correct?

A. Yes.

Q. And you told us earlier that if inferior products are excluded, that would not qualify as exclusionary conduct in an economic sense; correct?

A. That's correct.

Q. Okay. And when you say in the second bullet point that concealing or providing misleading

information prevents competition on the merits, you again are referring to prevents competition between equal or superior products and the one in question; correct?

A. Well, I would have said that statement is more generally true even though in terms of concluding that it's exclusionary, the relevant case would be equal or superior products.

Q. So for purposes of determining whether it's exclusionary conduct as you have defined the term in an economic sense, we need to look for whether or not there's been an impact on equal or superior products or competitors?

A. That's correct.

Q. Okay. Earlier today you talked a bit about risk taken or that you assumed was taken by Rambus. Do you recall that testimony?

A. I do.

Q. And you -- correct me if I have this wrong or oversimplified, but you assumed that Rambus' conduct represented a conscious taking of a risk?

A. I did assume that.

Q. Okay. And the risk you assumed that was being taken was the risk of not disclosing information which under a rule or process should have been disclosed?

A. Well, it's the consequences of that, so the risk is the consequences of that action.

Q. Okay. So let me see if I can restate it and see if I get it right.

So the risk that you assumed was that Rambus took the risk of losing the ability to enforce certain intellectual property as a result of not disclosing certain intellectual property in connection with certain rules and processes; is that right?

A. That's kind of a complicated question.

Q. Let me restate it.

You assumed that Rambus took a risk that it might lose the ability to enforce some patents; correct?

A. I did, yes.

Q. Okay. And you assumed, not making any factual conclusion yourself, you assumed that Rambus did that knowingly?

A. I did, yes.

Q. And you further -- then you concluded if those assumptions were correct that such conduct would be irrational, except if it was intended to achieve monopoly power; correct?

A. I think that actually overstates my testimony.

Q. Okay. You told us that the -- you referred to

"the only candidate purpose of which I'm aware." Do you recall that phrase?

A. That sounds like a phrase I said.

Q. Okay. So what was the only candidate purpose that you were referring to as a candidate purpose for taking such a risk?

A. That was the monopolization.

Q. Okay. Did you consider other purposes that might lead someone to take such a risk?

A. I did. But the reason for my phrasing as it was was I didn't find that -- this could be a failure of imagination on my part. I didn't consider the other alternatives that I -- of which I was aware, but admitting the possibility using the phrase that I used that there might be some other explanation which you might give me now.

Q. No. No, no. The assumption you made was that Rambus took the risk of losing the ability to enforce patents; correct?

A. That's correct.

Q. And the way in which you assumed they did that was by not disclosing patents that they should have disclosed; correct?

A. And the other misrepresentations but generally the behavior, yes, I'm assuming that that behavior

risked the patents so that they knew that.

Q. And they also would have known in your assumed scenario that the fact of nondisclosure was going to become known in the future; correct?

A. I don't know that I know that.

Q. Well, patents are public; correct?

A. Yes, patents are public.

Q. And you know that just as a matter of general common knowledge that you can go onto a Web site and find patents; correct?

A. I've done so.

Q. And so all the patents that issued ultimately to Rambus would be publicly available?

A. Eventually.

Q. And when they issued; correct?

A. Uh-huh.

Q. You need to answer audibly for the reporter.

A. Yes, they would become public when they issued.

Q. And that's not a -- that's information that you would assume people at Rambus also knew, that their patents when they issued would be publicly available; correct?

A. Yes, they would know that.

Q. And the patents that are involved in the

litigation you talked about in the course of this trial, those patents are public; correct?

A. The patents that have issued, yes.

Q. And so consistent with the assumptions you've made, a rational risk taker would have assumed that, well, everybody is going to find out about my failure to disclose these patents because someday they're going to issue and be public; correct?

A. I think they would know -- so in particular, if at any point they were being enforced against the JEDEC standard, then they would certainly be known.

Q. But they're public even if they're not being enforced?

A. That's correct.

Q. So your assumption is that Rambus took a risk of losing the ability to enforce its patents by not disclosing patents that it knew would issue in the future and be publicly known; correct?

A. I knew the patents -- they knew the patents would issue in the future and become publicly known.

Q. Yes.

So they knew their failure to disclose, in your assumed set of facts, would be discovered?

A. No. I don't think that follows because -- and I'm happy to explain.

Q. Well, let me ask it this way.

What you have assumed they should have done is disclosed information about their patents; correct?

A. Yes. And not misrepresent their intellectual property.

Q. I'm sorry. Did I interrupt you?

A. I don't know.

Q. Okay. And did you say and not misrepresent --

A. Their intellectual property.

Q. Okay. And the harm that you have told us in the course of this proceeding flows from that failure to disclose occurs only if it turns out that Rambus has patents which would be infringed by JEDEC-compliant parts; correct?

A. I'm sorry. I have to ask you to restate that. I just spaced out a little bit.

Q. That's okay.

The harm that you have told us flows from a failure to disclose occurs only if the patents read on or would be infringed by JEDEC-compliant parts?

A. That seems right, yes.

Q. Okay. So if Rambus had patent applications which you say it should have disclosed and knew it should have disclosed and took a risk of not disclosing them, the harm arising from any assumed nondisclosure

doesn't occur until the patents ultimately issue; correct?

A. Well, in fact the harm arises from the enforcement of the patents, so yes, it typically would not be until the patents issued.

Q. And the patents can't be enforced until they've issued; correct?

A. That's my understanding of patent law, but I'm not a patent attorney.

Q. So at the moment Rambus had an issued patent and sought to enforce it, it had to know that its previous failure to disclose, as you have assumed it, would be discovered?

A. No.

Q. Okay. Isn't it true that a patent shows on its cover when the patent was filed?

A. Yes, it is. Well, again, I am no expert in patents, but I have seen patents and they have dates on the cover for the application.

Q. Then I'm going to ask you to explain -- you offered this earlier and I thought I could short-circuit; it shows that I couldn't -- go ahead and explain why it is in your view that it would not be obvious once the patent issued that if there had been a duty to disclose that previously Rambus had failed to

comply with that duty.

A. Because my understanding of the duty to disclose is that it attaches to the JEDEC member, not to the organization as a whole, and so unless you can see Mr. Crisp's e-mails, you wouldn't discover the failure to disclose because you had to have knowledge that he was aware of the patents, that is, the member was aware of the patents rather than the company as a whole.

And there's a voluminous amount of the record associated with, for example, no requirement of patent searching. That is, it's not that you promise to give up your patents when you join the organization; it's that you have a good-faith duty to disclose your patents. That's my understanding of the rule.

And so just knowing that Rambus had intellectual property, you could never draw the conclusion that Rambus by itself -- from that fact you could never draw the conclusion of bad faith without knowing that the JEDEC member from Rambus was aware of those patents.

Q. Okay. So in your assumptions -- and this includes your assumption as to the scope of the duty to disclose at JEDEC -- the mere issuance of a patent wouldn't put you on notice that somebody had failed to

disclose it unless one of the named inventors on the patent was also the JEDEC representative?

A. That would certainly be -- is it possible that a named inventor forgot that they had invented something? I could conceive of that. Some of these people invent a lot of stuff. But otherwise, yes, you would expect a named inventor to be aware of the patent.

Q. Okay. And is it also your assumption that if the named inventor had in fact forgotten that the JEDEC rules would not require disclosure by that named inventor even if he was the JEDEC rep?

A. So again this is my understanding of the facts and the assumptions I've made. I haven't actually assumed anything about named inventors and haven't thought very extensively about that.

My understanding is -- and again, it's a finding of fact is what's at issue, but my understanding is the requirement is requirement essentially of good faith; that is, if you are aware of something that's material and relevant, you're supposed to disclose it, and if you fail to do that, you violated the process.

Q. Okay. So let me carry this one step further.

Going back to your assumed risk-taking on the

part of Rambus, should Rambus have known, as you've assumed the facts, that when their patents issued, which let's assume should have been disclosed, that at least people might be suspicious and curious as to whether or not Mr. Crisp knew about them?

MR. ROYALL: Your Honor, could I ask for some clarification of what patents are being referenced in these questions?

MR. STONE: Okay. That's fair.

BY MR. STONE:

Q. Have you made any factual assumption, Professor McAfee, as to what specific patents or applications Rambus should have disclosed to JEDEC?

A. I am assuming that it should have disclosed patents or patent applications with reference to all four of the technologies challenged in the case. If they shouldn't have disclosed on one of the technologies, then my finding of exclusionary conduct on that technology is no longer -- on that particular technology would no longer be reliable because I've assumed that they should have disclosed on that technology.

Q. Have you made any assumption as to the specific patent application numbers or identifiers for purposes of your work?

A. No, I have not.

Q. As part of the risk-taking that you've referred to, would you expect Rambus to have, had they actually been knowingly taking this risk, to have concerned themselves with the possibility that once the patents that you believe should have been disclosed were issued that people might inquire whether Mr. Crisp had known of those patents?

A. As a -- as human nature, so sort of somewhat outside of my economic reasoning, although human nature is actually part of the domain of economics, but it would be consistent with my understanding of human nature that people would at least be curious not so much when the patents issued but at the point that Rambus started suing them.

Q. Okay. Now, as part of your factual assumptions, did you assume that Mr. Crisp disclosed patents held by Rambus or the possibility of patents held by Rambus at a SyncLink meeting? Did you assume that occurred?

A. I'm aware of that as a factual matter. I don't -- I didn't assume it in any of my -- in any of the conclusions that you stated here today, but I am aware of that as a factual matter, that he disclosed the existence -- I must -- as I sit here today, I don't

remember whether it was patents or just the existence of intellectual property.

Q. Was it -- and let me ask this.

Was it important to your analysis for purposes of the opinions you've expressed here today one way or the other whether you have assumed or understood whether Mr. Crisp had provided a letter to JEDEC in which he discussed the possibility of Rambus intellectual property relating to SyncLink?

A. I'm sorry.

Q. Sure. Let me do it again.

Is it important for purposes of the opinions you've expressed here today and yesterday that Mr. Crisp provided a letter to JEDEC that discussed intellectual property that Rambus might possess that might bear on SyncLink?

A. I would agree that it's in principle important if it rose to the level of revealing the intellectual property to JEDEC itself. And that is the relevant intellectual property on the four technology markets. Since SyncLink used some of that technology and other technologies, it in principle could have done that, but it's not my understanding of the facts that it did do that.

Q. For purposes of the discussion you and I have

been having about the presumed risk, is it important to that discussion from your perspective forming opinions as to economic issues that Mr. Crisp would have been known by the other JEDEC participants to have made a statement about Rambus intellectual property?

A. Well, a statement about Rambus intellectual property is not very specific. If the -- if Mr. Crisp had revealed detailed knowledge of intellectual property which could then later be enforced against JEDEC members, that could actually reveal that they were in violation of the JEDEC process.

Q. Is it correct for purposes of the discussion we're having right now about risk that Mr. Crisp did reveal to JEDEC some level of knowledge about Rambus intellectual property by virtue of that letter, as you have assumed the facts?

MR. ROYALL: I was going to object, Your Honor. The question, although he threw in assumption at the end, he's asking the witness whether a certain factual proposition is correct.

MR. STONE: No, no. And I don't mean to. Let me rephrase it.

BY MR. STONE:

Q. I want you to assume that Mr. Crisp provided a

letter to JEDEC in which he expressed some awareness of Rambus intellectual property.

Can you assume that?

A. I can, yes.

Q. For purposes of the discussion you and I have been having about risk-taking, would it matter, in terms of whether or not people would be more than curious should patents later issue and be enforced, that the JEDEC representative had expressed at least some level of knowledge about Rambus patents at a JEDEC meeting?

A. I think "at some level of knowledge" is an inadequate description. I would describe this as being on a continuum. That is to say, if he revealed specific knowledge in a written document which could later be used against Rambus, that would actually enhance the risks very substantially.

On the other hand, vague generalities are not going to be much revelation at all. So I would describe this as on a continuum and it would matter the specific nature of the revelations.

Q. Okay. Let's pull up DX-239.

Now, you offered this --

A. Actually can I ask for a restroom break at the next -- I mean, it's not urgent. But the next

convenient --

MR. STONE: This is fine.

JUDGE McGUIRE: Let's take a break right now then. We'll go off the record for ten minutes.

(Recess)

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

MR. STONE: Thank you, Your Honor.

BY MR. STONE:

Q. Professor McAfee, right before we took the break I had asked to put up on the screen DX-239.

And this is a quotation from deposition testimony given by William Davidow that you referred to earlier today; correct?

A. That's correct.

Q. And you said a little bit about what this testimony, what he said, but is it correct that what Mr. Davidow said in his deposition as quoted here is that he could think of no rational motivation why Rambus or anyone else would jeopardize the value of their patents by participating in a process that might deprive them of the right to enforce those patents?

MR. ROYALL: Your Honor, I object to the question. Mr. Stone has just asked Professor McAfee for an interpretation of what Mr. Davidow meant by this

deposition testimony as opposed to what, if any, economic conclusions he draws from it.

JUDGE McGUIRE: Mr. Stone?

MR. STONE: Let me just -- I'll rephrase, Your Honor.

BY MR. STONE:

Q. When you withdrew certain economic conclusions from this testimony, did you understand the testimony to be that Mr. Davidow said he could think of no rational motivation for someone to engage in a process that would lead to them being unable to enforce their patents?

A. That is what I understood him to say.

Q. And then you did not understand him to say that the only rational motivation for doing so would be in order to monopolize, did you?

A. I did not understand him to be talking about monopolization.

Q. Okay. We can take that down. Thank you.

You also talked today in connection with this same line of questioning by Mr. Royall about mistakes; correct?

A. That's correct.

Q. And as a matter of economics theory, you recognize that information is not perfect; correct?

A. Generally information is imperfect.

Q. And so sometimes people not knowing full information may make mistakes?

A. I'm willing to allow that even people who have good information occasionally make mistakes. I consider that I cautioned my testimony on that matter with that caveat.

Q. Okay. And a mistake in this instance could be that someone didn't understand the rules in the same way you have assumed the rules?

A. That could be an example of a mistake.

Q. And it could be a mistake that you have assumed the rules incorrectly?

A. Well, it wouldn't be the same kind of mistake that we've been discussing. If it's my mistake as opposed to a mistake on the part of a Rambus employee.

Q. I don't disagree with that. But it could still be a mistake?

A. Well, I made an assumption. That assumption is either right or wrong. I don't -- in that sense I don't -- I mean, a mistaken assumption, as I testified, would lead to -- would generally lead to incorrect or conclusions that aren't applicable.

Q. Okay. And your assumption regarding a duty to disclose to JEDEC is different, is it not, than what

you read in the Federal Circuit's opinion about the Infineon case as to a duty to disclose at JEDEC?

MR. ROYALL: Your Honor, I object that this seems to be asking for a legal conclusion or at least an interpretation of a legal opinion.

MR. STONE: I'll withdraw it.

JUDGE McGUIRE: Sustained.

BY MR. STONE:

Q. Let's bring up DX-176 if we could.

I want to switch subjects, Professor McAfee, and ask you about commercial viability. I just want to start off making sure that we're on the same page.

You relied on others to determine whether a particular technology was technically feasible; correct?

A. That's correct.

Q. And then based upon the identification by others of technically feasible alternatives, you undertook to make a determination of commercial viability; is that right?

A. That's correct.

Q. Okay. And did you limit yourself in looking at commercially viable technologies to those which were equal or superior technically?

A. I limited myself to those that would be in the

marketplace. That could include technologies that were not exactly equal. And they in particular were slightly inferior.

Q. So when we talked earlier about exclusionary conduct, if exclusionary conduct resulted in eliminating from the marketplace or excluding from the marketplace certain inferior technologies, did you then use those for purposes of determining whether or not there had been any competitive injury?

A. When you say "inferior technologies," the commercial viability of the inferior -- inferiority of a technology depends on its price. It depends on what it costs. And so it's appropriate to include technologies which may be in some -- well, at the same price one might be inferior, but at a lower price it's actually superior. So it's in that sense that I included technologies which may at the same price be inferior.

Q. Okay. So for purposes of determining whether a technology is equal or superior, you have to do some analysis which combines both the technical feasibility and attributes of the technology along with its price; correct?

A. Well, it's a matter of constraining the price of a given technology, and so the alternative

technologies -- actually I've been assuming that the alternative technologies were actually freely available, with the exception, as I mentioned, of the Kentron technology, which in any case is a later technology, but...

Q. Okay. And the way in which economists in the antitrust context often examine alternatives is to use what you referred to as the SSNIP test; correct?

A. That's correct.

Q. And that is, you look at a small but significant nontransitory increase in price and determine what the elasticity is?

A. Of the market substitution, yes.

Q. And is there a usual price increase that is utilized in terms of determining what is a small but significant nontransitory increase?

A. Well, for physical products 5 to 10 percent is a common price increase. But that actually assumes that the products are already traded in volume before such price increase could be used. I would say in technology markets, I'm familiar with no such common price increase.

Q. Have you developed a particular price increase to utilize for purposes of your analysis that you presented here over the past two days?

A. I didn't because I didn't literally do a SSNIP test. I did a commercial viability test, which I described as being parallel. It's not literally an increase in price but rather a substitution question.

So it's parallel to that. But it's not exactly the same, so it doesn't have as a basis an increase in price.

Q. And in deciding how to compare technically inferior technologies with those that are superior, have you developed some formulation or quantification of how performance trades off with price or cost?

A. Well, I'm not really in a position to directly assess the cost/benefit of performance and costs associated with these technologies, so I have to rely, as it says on this slide, on others who have a better appreciation of the costs and benefits of those technologies, and so that's what I've relied on.

That is, I'm not in a position personally to evaluate the relative qualities of these technologies because they're very sophisticated technologies.

Q. And you're not qualified to comment on the cost or price of these technologies either, are you?

A. To comment on?

Q. Well, you've done no study of the cost or price of the various technologies, have you?

A. I would say that I've -- the price, as I said, with the competition of the Rambus technology that I assumed -- understand to have royalties attached to it, I've looked at the other technologies as -- and the Kentron technology as I mentioned, I've looked at the other technologies as being freely available. That is, I was not aware of any intellectual property or royalties that attach to them.

Q. Okay.

A. And so that answers the pricing aspect.

And then on the cost, I've actually -- and I should say, the testimony of the witnesses in this trial have very much spoken to the issues both of cost and performance of the technologies.

Q. Have you done any sort of an econometric analysis to determine the cost or price trade-offs for different levels of performance?

A. No. And nor do I think that econometric analysis is possible or appropriate in this circumstance.

Q. Let me ask about price.

May I get the chart, Your Honor?

JUDGE McGUIRE: Go ahead.

Actually, Mr. Stone, if you move that up a little more, I can see it better. That's fine.

BY MR. STONE:

Q. Could we, Professor McAfee, talk for a moment then about the price of the Rambus technology, if we could.

That price is a certain percentage of the average selling price of a DRAM; is that right?

MR. ROYALL: Your Honor, could I ask for clarification as to what Mr. Stone is referring to by the term "Rambus technology."

JUDGE McGUIRE: Mr. Stone?

BY MR. STONE:

Q. Well, let's talk about the four technologies that were in the yellow arrows with Rs on them. Okay?

Does that make sense to you, Professor McAfee?

A. I'm familiar with those technologies.

Q. Those would be the Rambus technologies covered by Rambus patents that relate to the four technology markets you've told us you've defined; correct?

A. Okay.

Q. And in figuring out what the price of those technologies are, would you take a certain percentage of the average selling price of a DRAM that incorporated those?

A. So my understanding of the Rambus contracts is that that's one component of the charges but that's not

the only component of the charges necessarily, but that's one component of the charges --

Q. Okay.

A. -- that Rambus assesses for its technologies.

Q. And the other component is sometimes there's a fixed fee or a flat fee or nonrecurring expenses paid?

A. There's some testimony of charges for various provision of other services, but -- but this is my understanding of the main charges, but there are other charges that have been referred to in the trial testimony.

Q. I'm trying to keep us from having to go back in camera, so if I am a bit vague and generalize, understand that's why. If we need to for your answer, we will.

A. Well, I was going to say alternatively you can ask me just to assume that those are the charges and I would be happy to do that as well.

Q. Let me just ask you, for our purposes, let me just ask you to assume that the price is a certain percentage of the price of the DRAM. Okay?

A. Okay.

Q. And without getting into specifics of what anybody pays for any particular DRAM under any particular license agreement, can we for the sake of

argument simply use 5 percent of the average selling price of the DRAM --

A. If you want.

Q. -- as our hypothetical?

A. We can.

Q. Now, have you looked at all at what, for a particular DRAM used in an ordinary PC that any one of us might buy for home use, what this turns out to be in dollars? Can you give us a rough ballpark?

MR. ROYALL: I object to the question as vague as to what you're referring to. Are these Rambus technologies? It's just a vague question.

JUDGE McGUIRE: Sustained. Mr. Stone --

MR. STONE: Certainly.

THE WITNESS: Are you asking me --

BY MR. STONE:

Q. No. I'm going to ask you another question.

A. Okay.

Q. Give me a rough number for the amount of money that would be paid to utilize Rambus technologies in a DDR SDRAM.

A. At 5 percent? Are we assuming 5 percent?

Q. Use 5 percent.

A. So it varies year to year, but it would be on the order of a billion dollars.

Q. No. Just for one. Just a DRAM. I'm going to have to sell my PC quick if that's what I'm paying.

A. I'm sorry. I thought you meant for the market as a whole.

Q. No. I'm trying to take us to -- what I'm trying to understand -- and let me not be convoluted about it, if I am being -- I just want to understand what the price impact is on a PC.

A. That's also something that actually there's been testimony on that in the trial and that's something that's varied pretty substantially over the last decade.

Q. Well, can you give us a ballpark, based on your work, of what the cost of the DRAM is that goes into an ordinary PC today?

A. A couple of hundred dollars -- well, it depends on what you mean by "an ordinary PC." I probably buy top-end PCs.

Q. Okay.

A. I think people -- so if you're buying a $200 PC, you're not spending more than, you know, $20 or $10 on DRAM. On the other hand, if you're buying a $2,000 PC, you're probably spending $200 or more on DRAM.

Q. A moment ago, Professor McAfee -- I just want

to try to clear up something in the transcript -- you said, didn't you, that the price impact on a PC is something that has varied pretty substantially?

A. That's my understanding, yes.

Q. Okay. Let's take -- I'm not going to spend too much time on this. Let's take a $600 PC, and your understanding is a $600 PC would have DRAM that cost the OEM about how much?

A. Again, it depends on the time. I don't know what DRAM is selling for today. But it might be, say, $50.

Q. Okay.

A. A hundred dollars. Again, this is something that's varied pretty substantially over the last decade.

Q. So that the cost of the Rambus technology to Rambus is what Rambus has paid of that -- for that DRAM under this hypothetical set of numbers is going to range from $2.50 to $5.00; correct?

MR. ROYALL: Your Honor, I object to the question as vague. It may have been unintentional, but Mr. Stone referred to the cost of Rambus technology to Rambus.

MR. STONE:

Q. I'm sorry. No, no. Let me rephrase it. Let

me rephrase it.

A. Okay.

Q. The cost to the OEM of the inclusion of Rambus technology in this particular DRAM is between two and a half and five dollars using these hypothetical set of numbers; is that right?

A. Well, in fact I see two errors in that, one of which is mine. I gave you a price for what I understood to be the modules actually, but Rambus earns its money on the DRAM, but not the module. But on the other hand, Rambus also gets royalties on the controllers, which I didn't give you a price for and nor do I know what they cost and -- at least off the top of my head, and so there would be other charges to Rambus as well, and so the number is both too high and too low or that is it has positive and negative errors associated with the overstatement of the cost of the DRAM and the understatement because of the lack of a module.

Q. We talked earlier -- we talked yesterday about the impact, if any, on consumers of the expectation of Rambus that it be paid for the use of its technology; correct?

A. We talked about -- which consumers are you referring to?

Q. The ultimate consumer, the user of the -- the purchaser of the PC.

A. We did talk -- yesterday or today?

Q. I think yesterday is when I objected, but maybe it was today.

A. Okay.

Q. One day or the other. Okay?

A. Uh-huh.

Q. And one of the issues that I wanted to ask you about was whether you have formed any opinion as an expert economist on whether there would be fewer PCs sold as the result of the payments to Rambus that we have assumed are at issue in this case.

MR. ROYALL: Is that a question, Your Honor?

MR. STONE: It is.

MR. ROYALL: It doesn't sound like it.

THE WITNESS: I think he said would there be fewer PCs sold. That is a question.

As I testified today, I don't think that there's been an impact on the DRAM prices as of today, and as a result there's no way to trace that, these effects, through to the final consumers.

I haven't really considered the controller market and whether there's been an impact on the controller market, but I expect that the analysis would

be similar, but I haven't actually personally done that analysis.

But with the respect to the DRAM itself, there's no mechanism by which such an impact would have been felt already. And as a result, I do not think that there would have been an effect on the final PC market as of today.

BY MR. STONE:

Q. Have you made any study of the elasticity of demand for PCs among consumers?

A. No.

Q. Have you made a study of the elasticity of demand for DRAM among OEMs?

A. I have not studied the elasticity of demand for OEMs.

Q. Could we bring back up DX-176.

I want to direct you to the bottom half of this chart where you say "serious consideration at JEDEC."

That was one of the factors you took into account, is it not, in your consideration of commercial viability?

A. It was.

Q. Now, the phrase "commercial viability," is that a phrase that you would find in the DOJ guidelines?

A. I don't recall that phrase in the Department of Justice guidelines.

Q. Or in any of the FTC's guidelines?

A. I don't recall offhand, but not to my knowledge.

Q. Is there any established literature in your field of industrial economics that describes the use of a commercial viability test to determine market substitutability?

A. I don't recall offhand. Not to my knowledge.

Q. Have you written any papers or articles yourself on that subject?

A. Well, I've written about the -- I've written several papers about antitrust evaluations. I didn't use the phrase "commercial viability" in those -- in those -- I needed a name for the technologies, though, is the reason for this.

Q. When you talked about serious consideration at JEDEC, you gave us, for each of the four technologies in question, you gave us selected quotes in your charts to people's views.

Is that a fair summary of what some of the charts showed?

A. Yes. A small -- not very much, yes.

Q. Was it important for purposes of determining

commercial viability that there be serious consideration given at JEDEC to a particular technology at a point in time where you had us, if you will, on the left side of the funnels, what I think is called ex ante?

A. That was certainly better -- the earlier or the more relevant the time period, the better the information is.

Q. Because one of the things you told us, isn't it, that when you go to a more recent point in time, people's knowledge about what was viable or feasible at earlier points in time might not be as good?

MR. ROYALL: Objection, Your Honor. I believe this misstates the witness' prior testimony.

THE WITNESS: My understanding --

JUDGE McGUIRE: Just a second. I've got to rule.

MR. STONE: Let me restate, Your Honor.

BY MR. STONE:

Q. Isn't it correct that in your view knowledge improves with time and it's hard to go back and remember exactly the state of knowledge at that earlier point in time?

MR. ROYALL: Objection. Vague.

JUDGE McGUIRE: Overruled. I'll hear the

question.

THE WITNESS: Actually I don't think I was referring to memory at the time in the statement I made. It was, rather, that the -- as the technology advances, what is feasible -- I'll explain this better if I give an example that's quite responsive.

But for example, we know how to put a lot more pins in today than we did in 1992, and as a result, adding pins seemed more feasible today than it probably would have in 1992. And so in that sense, yes, as the technology changes and we learn things, the comparisons change and that -- so the closer in time the consideration is that I can draw on to the relevant period, the better the data is.

Q. Okay. And for purposes of your economic analysis of commercial viability, you were looking, for the first two technology markets, at whether there was serious consideration at JEDEC in the 1992 time frame; is that right? And you told us yesterday 1992 meant 1991 to 1993.

A. Well, my attempt is to be relevant to the standard, and as I said, the lock-in is actually a continuum so that the time actually -- that is, lock-in is not something that happens at a particular day; it's something that happens in a continuous

fashion.

And so yes, 1991 to 1993 for SDRAM strikes me as the relevant period, but that doesn't rule out 1994 and 1995 as being relevant. And now, unfortunately, I've forgotten your question.

Q. That's okay. Let me -- so have I, so let me ask another one.

Is it correct then that for purposes of your opinion if alternatives were commercially viable for SDRAM with respect to the technology markets that are involved in the years 1994 and 1995 that would be pertinent for your analysis?

A. Yes, it would be pertinent. It would be not necessarily perfect information, but it would certainly be relevant information.

Q. And would it be pertinent for purposes of your analysis if alternatives were commercially viable in 2000 with respect to the two technology markets that relate to SDRAM?

A. It would depend on the nature -- are we talking about SDRAMs still?

Q. Yes, we are.

A. It would depend on the nature -- that is, if they had not been commercially viable in 1999, just became because of the technological advance

commercially viable in the year 2000, that would actually be a problem for the commercial viability during the relevant time period, so that if you found that they weren't commercially viable earlier than 2000, the fact that they became commercially viable in 2000 would not be much help.

Q. If they were given serious consideration by JEDEC in 2000, would that be evidence that they were thought to be commercially viable alternatives in 2000?

A. Well, it would certainly be evidence that they were thought to be commercially viable alternatives in 2000.

Q. Just as a matter of economics and understanding the costs of organizations operating, you wouldn't expect, consistent with economic principles, that JEDEC would spend a lot of time discussing technologies in the year 2000 if there was not a sense among at least some significant number of members that those technologies were commercially viable at that point in time?

A. Yes. I don't take it as a proof, but that actually is consistent with my understanding of JEDEC and of the market generally.

Q. Okay. With respect to DDR SDRAM, I want to

focus a little more carefully on what you consider to be the pertinent date for purposes of your analysis.

Yesterday I think you told us 1995; is that correct?

A. My recollection is that's around when the standard issued.

Q. Around when the standard issued? I'm sorry. I'm on DDR.

A. On DDR. '97. I've forgotten -- I've actually -- I may forget when the DDR standard issued, but I have it in my --

Q. Go ahead. Take a look at your chart.

A. '99 is when the DDR standard issued.

Q. And what's the pertinent date with respect to the DDR SDRAM for looking at whether or not there were commercially viable alternatives for purposes of the analysis that you've done?

A. Well, in respect to DDR, the changes to DDR could have come -- I mean, even a disclosure in 1998 might have led to a change in DDR. But from the perspective of the lawsuit, that is to say, given the allegations or my understanding of the allegations, the relevant period is when the disclosure should have occurred, which is earlier, so it would have been 1995 time frame.

Q. And have you -- what I'm trying to get to is: What have you assumed to be the date on which a disclosure should have been made as to DDR SDRAM?

A. Well, prior to 1996.

Q. And what have you based that on?

A. Well, it's my understanding of the alleged behavior; that is to say, it's my understanding of the allegations.

Q. Did you look at anything beyond the allegations in selecting that date for purposes of your analysis?

A. Well, there's certainly -- I've read a fair bit of information about -- that describes what patents and pending patents Rambus had and when it was applying for patents, and so on. Again, I'm not here to testify about what I read in those documents, but they don't undercut the hypothesis that Rambus had awareness of patents with respect to the two DDR technologies earlier than 1996.

Q. Let me see if I can rephrase. I don't think I'm being very clear. Let me ask it this way.

Have you made an assumption as to when JEDEC's work on DDR SDRAM officially began?

A. I don't know that I've explicitly made that assumption. It may be implicit in the assumption that

there was a duty to disclose or that the misrepresentations mattered, so that is to say -- that's outside of my testimony. So that is to say, my understanding is that if there was no work on it, the duty may not have established, but that's not for me to say one way or the other.

Q. Let me then ask it hypothetically and see.

If there was no duty to disclose unless work had begun on the standard and if work did not officially begin on the DDR SDRAM standard until after June of 1996, would you agree that under your analysis Rambus' assumed conduct was not exclusionary with respect to DDR SDRAM?

A. Not necessarily, but maybe. In the incompleteness of the hypothetical you referred to whether there were other misrepresentations, but again, these are -- you're questioning me about -- you're changing my hypothesis in the way of my assumption and trying to get me to reason about whether this change in this hypothesis leads to a violation of my assumption, and that's actually kind of outside of my general reasoning.

That is, I haven't concerned myself with the determination of did they have a duty to disclose other than I read a fair number of documents just so

that I was comfortable that there was actually a reasonable assumption to be made. But that is still an assumption as opposed to a conclusion that I'm testifying to.

Q. I didn't mean to get you to reason sort of outside the realm of area in which you've been doing your work. I'm mostly just trying to understand your assumptions, so let me see if I can phrase it slightly differently.

You have assumed with respect to DDR SDRAM that to the extent that work on DDR SDRAM is relevant to whether there was a duty to disclose that that work had commenced while Rambus was still a member of JEDEC; correct?

A. If it -- if I understand your question, which I take to be if work had not yet commenced or -- and the absence -- and there was no duty to disclose absent work and there was no issue of misrepresentation absent work on the standard, then there would be no duty to disclose, that seems logical to me, but that doesn't -- that just seems like another way of saying my assumption that there was a duty to disclose or a violation of the process was incorrect, and if that's true, then the conclusions I drew from that assumption would certainly fall away.

Q. Okay. With respect to commercial viability and determining whether or not a particular technology is treated as a good substitute, did you look for cost analyses, projected cost analyses of different technologies performed by market participants at any of the relevant time periods?

A. I didn't find any such cost analyses in the record. I did talk to participants in JEDEC who did not -- who sort of -- that wasn't the nature of the -- their description of what they did in their laboratories. That is, there weren't any spreadsheets for me to look at, and so that wasn't the kind of data that I understood to be available for my analysis.

Q. And did you look for whether there was any contemporaneous data that was -- I guess -- let me just be clear.

Did you review any contemporaneous data prepared at the time any alternative was considered where someone analyzed the relative cost and performance of one alternative versus another?

A. I didn't -- and there are statements in the JEDEC record that are qualitative about relative costs, but other than that, I'm not aware of any contemporaneous cost estimates.

Q. Let's look if we could at DX-129.

I want to direct your attention here to the small bullet point that says, "Excluded equally efficient or superior alternative technologies," if I might.

A. Uh-huh. Yes.

Q. Earlier today or -- let me phrase it this way.

Earlier in your testimony, you identified certain alternative technologies that you felt were within the technology markets that you defined; correct?

A. The commercially viable technologies.

Q. Yes.

Did you consider each of those technologies to be equally efficient or superior to the Rambus technology that was included within that same market?

A. When you add royalties to the Rambus technology, yes.

Q. So in each instance you were able to do a comparison of those other technologies and conclude that the Rambus royalties were such as to make the other technologies equally efficient or superior?

A. I'm sorry. I meant to say that I found them to be price-constraining against the Rambus technology, which is not quite the same thing as you've said, although it's actually closely related.

Q. What I want to ask about is this language and this has -- to an economist, the idea of equally efficient or superior alternative technologies has meaning; correct?

A. Yes.

Q. Because, as you discussed earlier today, if you exclude an inferior technology, that from the perspective of economics is -- does no harm; correct?

A. Well, generally is not harmful. It's not that there would never be circumstances under which it's harmful; it's that often it will not be harmful, but that's also the accepted definition of exclusionary.

Q. So what I want to ask about is, rather than the price-constraining technology market definition that we talked about earlier, whether you also made a determination as to which of the technologies included within each market were equally efficient or superior to the Rambus technology.

A. So my understanding of these technologies and also of the meaning of commercial viability is such that given intellectual property, the others -- one of the others, not -- I'm not sure I know which one -- but that one of the others would have been selected over the Rambus technology. I think we went through that logic today.

And the implication of that was that for JEDEC, given the disclosure, the others were -- actually I need to say likely. I left out the word "likely" in that. At least one of them was -- of the excluded technologies was equally efficient or superior, but I don't know necessarily which one.

Q. And are you saying that it is likely that at least one of them would have been equally efficient or superior? Is that how you wanted to put the word "likely" into your answer?

A. I'm happy with that method of putting the word "likely" in.

Q. And the comparison, the royalty comparison you're making for the Rambus technology, is -- can we put a dollar figure on the price of that technology? Is it -- can we select an average price for a DRAM and multiply it by some percent to understand what this is in dollar terms?

MR. ROYALL: Again, Your Honor, I object to the question as vague in that it doesn't define what Mr. Stone is referring to by the term "Rambus technology."

MR. STONE: Let me rephrase it.

BY MR. STONE:

Q. I'm going to use "Rambus technologies" for the

time being -- and I'll tell you if I change my definition -- to refer to the four Rambus technologies that were represented on a variety of your charts with yellow arrows, one each of which is included within the four technology markets you've earlier defined. Is that okay? Is that acceptable to you?

A. So to be clear, until you tell me otherwise, you are not talking about RDRAM.

Q. Until I tell you otherwise, I am not talking about RDRAM.

A. Nor any other technologies that Rambus may or may not own other than the four technologies in the complaint.

Q. Specifically, I'm talking about programmable CAS latency, programmable burst length, DLL/PLL on-chip, and the use of dual-edged clocking.

A. Okay.

Q. Okay?

Can you put a dollar figure in some fashion on the differential, dollar differential for a particular DRAM that you have assumed is the royalty differential for purposes of your performance-cost comparison?

MR. ROYALL: Objection. Vague as to time frame and as to what is meant by "a particular DRAM."

BY MR. STONE:

Q. Fine. Let's take, for example, a 128-meg DDR SDRAM. Can we do that?

A. Uh-huh.

Q. And that's a yes for the reporter?

A. Yes, it is. Sorry.

Q. Thank you.

For any point in time, when you were doing a comparison of alternative technologies and trying to decide if they were equally efficient or superior to the Rambus technologies, have you converted this royalty differential into dollars?

A. I have not.

Q. Okay. Look if you would at DX-177.

Here you talk about cost of the solution to DRAM manufacturers and others and performance benefits of the technology. Those are the middle two bullet points. Do you see those?

A. I do.

Q. Have you made any effort to quantify in any fashion, technically, economically, or in any other way, the performance benefits of the various technologies that you have been comparing to the Rambus technologies for purposes of determining whether they are equally efficient or superior?

A. I have created no such performance

comparison -- well, cost comparisons. I have talked about the relative merits, as I understand them -- again, this is my reading of others' testimony, but I haven't quantified those comparisons.

Q. Okay. Let's take the highlighting off of that and let's go the second bullet point where it says "IP royalties."

With respect to the various technologies that you have compared to the Rambus technologies to determine if they are equally efficient or superior, have you considered whether any of those other technologies are covered by intellectual property beyond Kentron?

A. I'm aware of no other intellectual property. It's my understanding from my reading of the record that there was no other intellectual property attached to them. It would matter to my conclusions if there were such intellectual property.

Q. How would it matter to your conclusions if there were such other intellectual property?

A. It could render -- it could in principle render a technology not commercially viable if it had attached to it intellectual property.

Q. Why is that?

A. Well, it's my understanding of the JEDEC

process that it has -- you can think of it as attaching a penalty. It's not an absolute bar, but it attaches a penalty to the presence of intellectual property.

And we spent a great amount of time during my direct testimony exploring my understanding of the reasons and economic motivations behind that preference. The short summary is that my understanding of the JEDEC process is that they would be leery and would need a -- I've forgotten now the exact phrase -- a well-justified reason before including technology that involved royalties and intellectual property, that is, patents, in the standard.

Q. As to -- let's assume that one of these other technologies is covered by a patent.

Can we assume that for purposes of these questions?

A. We can.

Q. If it is covered by a patent and JEDEC is aware that it's covered by the patent, have you for purposes of your analysis reached a conclusion as to whether or not JEDEC would include that technology among the alternatives it would consider?

MR. ROYALL: I object. It's an incomplete hypothetical.

JUDGE McGUIRE: Overruled. He can answer if he understands the question.

THE WITNESS: I have not explored the commercial viability of any of the market technologies, other than the Kentron one, with a patent attached to them, and if a patent is attached to it, it could in principle upset my conclusion that they were commercially viable.

BY MR. STONE:

Q. Have you --

A. That particular technology was commercially viable.

Q. I'm sorry. I stepped on your answer and I apologize.

Have you concluded that the Kentron technology is commercially viable?

A. It appears to be commercially viable.

Q. And you --

A. But as I said, royalties are a problem with that technology.

Q. But even though there are royalties associated with that technology, you think it remains commercially viable?

A. So it remains -- it's my understanding it remains commercially viable against a technology with

royalties. Against a technology without royalties, it may not be commercially viable. It is actually my understanding it hasn't been adopted by the market at this time.

Q. Many of the technologies that you have identified as commercially viable technologies have also not been adopted by the market; correct?

A. That's correct. Well, in this setting. I don't know one way or the other whether they've been adopted in some other setting. These technologies often apply to applications in specific integrated circuits and other places where one might apply the same technologies, but I haven't studied those markets.

Q. For purposes of your analysis of commercial viability and among the considerations that you took into account, does it make a difference if a technology is covered by a patent but the holder of the patent has agreed to provide a RAND letter?

A. If the holder of the patent doesn't provide a RAND letter, my conclusion is that the technology is not commercially viable, so not only is it important, it's necessary.

Q. Have you assumed -- because I understand this may be a factual issue -- have you assumed for your

purposes that JEDEC will not adopt technologies that are covered by patents where a RAND letter has not been provided?

A. I have assumed that.

Q. Have you also assumed that what JEDEC does is select the best performance-cost combination among the alternatives available to it for consideration?

A. This slide is supposed to set out the factors that I think -- the major factors which entered into that determination, and cost and performance are certainly present, but they are not the only two -- they are not the only factors I think that enter into the decision. And in particular, I would point to the final one, that every one of these technologies had problems to be solved, and so a perception of the magnitude of those problems would be relevant to the determination of which technologies should be selected, for example.

Q. And just so -- let me ask this hypothetically just so I'm understanding this.

For example, it might be that JEDEC was risk averse when it came to problems and they might choose a technology that might be a little bit inferior in terms of cost and performance if they thought there was less risk that the problems associated with that technology

could not be solved?

A. Let me be at least slightly pedantic but also true to my economic profession by saying, once you've introduced risk, you need to talk about expected costs and benefits rather than cost and performance, rather than cost and performance as if they were known. From an economic perspective, such a risk aversion may well be efficient.

Q. And did you make any assumption as to JEDEC's weighing of the problems it saw associated with each technology?

MR. ROYALL: Objection. Vague.

THE WITNESS: Yes. I would actually --

JUDGE McGUIRE: Well, hold on. Hold on.

THE WITNESS: I'm sorry.

JUDGE McGUIRE: When an attorney stands up and objects, I've got to rule before you answer.

Overruled.

You can answer the question now.

THE WITNESS: I have an understanding about how the decision-making and the deliberation of JEDEC proceeds. The economic model I used to understand JEDEC is what's known as the median voter model. That may not be -- I think I would want to temper the median voter model because in my understanding JEDEC actually

seeks more consensus than the median voter model requires; so that is to say, it is more of a consensus-driven organization than the median voter model.

In such a -- but starting with the median voter model, the -- actually I need to hear your question again now.

BY MR. STONE:

Q. My question is this: Have you assumed any particular way in which JEDEC dealt with addressing the problems of a particular technology?

A. Yes. So I have an understanding -- I would have to think a bit to trace through -- I've certainly assumed this consensus, that consensus is important to JEDEC. That's an answer to your question. Yes, I've assumed that JEDEC -- that consensus is important. It's not that JEDEC requires unanimity -- that is not my understanding -- but that it seeks -- it continues to deliver a -- when it is far from consensus.

Q. And in terms of the words I used earlier about risk averse, have you made any assumptions one way or the other about the level of risk aversion on the part of JEDEC given the model that you have used for thinking about that decision-making process?

A. So given the model that I've described, it

actually doesn't make any sense to talk about the risk aversion level of the body as a whole. The individual members have risk averse -- risk aversion levels, and to some extent the decision-making of the whole of the committee was then affected by the levels of risk aversion of the individual members.

It is -- but it's not the case that you can represent the whole as a -- by a set of risk averse preferences, if you'll accept a little bit of jargon from me.

Q. In coming up with any of your determinations as to commercial viability, can you give us an example of how you took into account your last bullet point, every technology had problems to be solved?

A. Yes. For example, in finding that doubling the clock speed was a substitute for dual-edged clocking, so that is using one edge of the clock and doubling the clock speed, it was important that a substantial fraction of the JEDEC membership, as I understand it, of the manufacturers, had problems producing the symmetric duty cycle required for dual-edged clocking. Now, it's not absolutely symmetric what's required; it's just symmetric.

So that is to say, there was a general concern that it was difficult -- a challenge to manufacture a

clock who has -- that is 50 percent up and 50 percent down or something close to that. It doesn't need to be exactly that. And that's a -- that -- so it's a challenge to manufacture such a clock.

It's also a challenge to deal with the electromagnetic interference associated with doubling the clock speed.

So the fact that both of those represented challenges that were considered at the time to be actually pretty serious, not every -- remember IBM knew how to produce the symmetric duty cycle clock pretty easily; other members did not. It mattered to my opinion, though, that there was a substantial number of JEDEC members who were unsure about both, about how they were going to implement both alternatives. And that's what -- that was important to my finding that doubling the clock speed was an alternative to dual-edged clocking.

Q. Okay. Let's look if we can at DX-144.

I'm sorry. Let's look at DX-132 first.

This was your chart of the DRAM industry overview that we looked at yesterday I believe; correct, Professor McAfee?

A. It appears to be, yes.

Q. And am I correct that technology providers,

that is, people who develop technology that may be useful to the DRAM industry, also include DRAM manufacturers?

A. DRAM manufacturers do generate technology.

Q. So in that sense at least between technology providers and manufacturers, there's also some vertical integration of those two functions?

A. There are some -- well, actually it is my understanding that all of the DRAM manufacturers generate technology and so all of them would be vertically integrated to -- it's my understanding. There may be some of the smaller players who don't produce very much.

Q. And are there other technology providers other than DRAM manufacturers and those like Rambus and Jazio that you've listed here?

A. Texas Instruments, for example.

Q. Okay.

A. They no longer manufacture DRAM, but they provide technology.

Q. And they would show up on this chart as well as a PC OEM and a server OEM, would they?

A. Texas Instruments? They certainly used to manufacture PCs, but I don't -- if they're manufacturing PCs today, I don't know about it.

Q. Okay. So -- and do the manufacturers of DRAM-related logic also provide technology?

MR. ROYALL: Objection. Vague as to what type of technology the question concerns.

JUDGE McGUIRE: Sustained.

BY MR. STONE:

Q. With respect to what's shown on your chart here as technology providers, based on your understanding and the assumptions you've made, do some of the manufacturers of DRAM-related logic that are also shown on this chart, DX-132, fall within the oval identified as technology providers?

A. I don't specifically know. I would expect Intel is a technology provider, for example, and it's also a chipset manufacturer or -- also a chipset manufacturer, so I would expect they are, but I don't actually know one way or the other for sure.

Q. Is it correct that a buyers cartel may arise in circumstances where you have a few large buyers, vertical integration and a high level of coordination?

A. This is a -- I'm going to ask you just to repeat the question so I make sure I have the question.

Q. Let me see if I can make it simpler.

In DX-132, there are people who are buying

technology as you've drawn this description of the DRAM industry; correct?

A. Yes.

Q. And included among the buyers of technology are the DRAM manufacturers; correct?

A. Yes.

Q. And if the DRAM manufacturers for purposes of buying technology were to act like a cartel, you might look to see whether the circumstances of their industry is susceptible to cartel behavior, might you not?

A. I am perfectly capable of doing such an investigation.

Q. Okay. And among -- and you've written about buyer behavior in articles you've published; correct?

A. Yes.

Q. And you wrote an article in the Texas Law Review on buyer power?

A. Yes.

Q. And among the characteristics you look for in a buyer cartel are that there's a few large buyers -- that's one factor you would look for; correct?

A. Well, the Texas Law Review paper has nothing to do with cartels.

Q. No. It just has to do with buyer power;

right?

A. It does have to do with buyer power but not with cartels.

Q. And now I'm jumping from --

A. I just wanted to make sure that you've changed the topic.

Q. I did.

A. I've also written on cartels, so -- but proceed.

JUDGE McGUIRE: Well, then you can answer this next question then.

BY MR. STONE:

Q. One of the factors you look for, if you're looking to see whether there might be a buyers cartel, is whether there are a few large buyers?

A. That certainly would be one of the ingredients to a buyer cartel.

Q. And it also is a factor that you would look for to see if they're vertically integrated; correct?

A. Vertical integration can contribute to -- vertical integration can make certain kinds of cartel behavior either more successful or more likely.

Q. And you also would look to see if there's a high level of coordination among the buyers; correct?

A. Now you've kind of switched gears on me.

Precisely what do you mean by "coordination"?

Q. Well, for example, isn't it the case that industry associations or consortia are often thought to provide the mechanism for buyer cartels to coordinate on the price they will pay?

A. Industry associations are what are known as a facilitating device. They help -- they facilitate, they make it more likely that a cartel, whether buyer or supplier cartel, can operate.

Q. And in your book, the Competitive Solutions book that we saw the cover of or the dust cover of on the text the other day or on the screen the other day, you wrote about the use of industry associations as a possible mechanism for a buyer cartel to operate; correct?

MR. ROYALL: Your Honor, if Mr. Stone intends to ask Professor McAfee about his book, I'd ask that he be presented with a copy and that I also be presented with a copy. I don't have a copy of the book present.

JUDGE McGUIRE: Can we make a copy of whatever passage you're looking at, Mr. Stone, or at least give them an opportunity to view it before we go into this line of inquiry?

MR. STONE: Can I just put it on the ELMO?

JUDGE McGUIRE: That would be fine. And then if they still want to examine it, I'll give them that opportunity.

MR. ROYALL: My only concern with this approach, Your Honor, is I don't know if Professor McAfee may need to look to other aspects of the book.

JUDGE McGUIRE: If he does, he'll be given -- if he has any questions on that, I'll be sure -- I'm sure and confident that he'll raise them.

THE WITNESS: You know, I have a jitter in the screen here that makes it hard to read, and this is actually coming out both blurry and jittery. So this is actually making me somewhat nauseous.

MR. STONE: May I approach?

JUDGE McGUIRE: Yes, you may.

BY MR. STONE:

Q. Let's do it this way. I'm going to direct your attention to the paragraph under the heading Industry Associations.

Is that something that you wrote?

A. It is.

MR. ROYALL: Your Honor, I now object because I don't have a copy of it.

JUDGE McGUIRE: Okay. Let's take two minutes

and you can both --

MR. STONE: I have a copy right here.

JUDGE McGUIRE: Oh, you have a copy.

MR. STONE: Of the page, not the book.

JUDGE McGUIRE: Okay. Let's still take two minutes so he can take a look at it and then the professor can take a look -- is it just that page you're going to inquire on?

MR. STONE: Just one paragraph.

JUDGE McGUIRE: Let's give them one minute to look through it and then you make your inquiry.

(Pause in the proceedings.)

Perhaps, if he hasn't already done so, at the end of the day he'll be happy to autograph that book for us.

MR. STONE: I will be certain to ask, Your Honor.

(Pause in the proceedings.)

JUDGE McGUIRE: Okay. Mr. Stone, you may proceed.

MR. STONE: Thank you.

BY MR. STONE:

Q. Mr. McAfee, directing your attention to page 138 of your book under the heading Industry Associations, is that a paragraph that you wrote?

A. Yes, it is.

Q. And do you agree with the statements set forth in that paragraph?

A. In the context of the entire chapter, yes, I do.

Q. Okay. Could you read the paragraph into the record not too fast for us, if you would be so kind.

A. "An industry association is an example of what is known as a facilitating device, which helps a cartel or a tacit collusion function. Industry associations provide a reason for executives to get together and learn how to know and trust each other. Industry associations perform studies that may suggest mutually beneficial strategies and dire consequences of a failure to cooperate. An industry association can be a vehicle for cooperative, build-the-market kind of advertising, or it can sponsor research projects that benefit the industry as a whole. Finally, industry associations lobby for beneficial legislation. Much of the work of industry associations is beneficial to customers -- improving the market and eliminating costly, ineffective regulation -- but an industry association also forges links between competitors and thus can be a vehicle for softening or eliminating price competition in the guise of rationalizing the

marketplace."

Q. Thank you.

In connection with the negotiations that you have presumed would occur either ex post or ex ante between Rambus on the one hand and DRAM manufacturers on the other hand, you told us earlier today that you would expect each of those negotiations to be one on one; correct?

A. That's my understanding, yes.

Q. You would not expect, would you, that the DRAM manufacturers would get together either through an industry association or otherwise to talk about a collective strategy that they would pursue in negotiating with Rambus?

A. So my -- when I said I expected them one on one, I was speaking in the context of JEDEC; that is, I was saying my understanding of JEDEC, that JEDEC does not provide a vehicle for collective negotiation.

Now, as to whether there was another vehicle available for collective negotiation I haven't actually considered.

Q. There were other -- in the course of the work you have done, you became aware of other collective gatherings of DRAM manufacturers, did you not?

A. I'm aware of -- well, of DRAM manufacturers?

Q. Let me ask it this way. Let me -- did you become aware of SyncLink?

A. I did become aware of SyncLink.

Q. Did you become aware of M9?

A. I didn't encounter M9 in my reading except from the trial testimony I think. That was the first -- that's the first time I recall encountering M9, is in the trial testimony.

Q. Did you become aware of ADT?

A. Yes.

Q. And did you become aware of AMI-2?

A. Yes.

Q. And in addition to M9, did you become aware of M11 and M14 through your reading of the trial testimony?

A. Yes. Sometime at the same points even.

Q. And you would not have expected, would you, for purposes of this hypothetical negotiation between Rambus and the DRAM manufacturers that through any of the groups we've just identified that the DRAM manufacturers would get together and agree on a joint strategy for dealing with Rambus in negotiations?

MR. ROYALL: I object to the question as vague inasmuch as I don't think it's clear what hypothetical negotiation he's referring to.

MR. STONE: I'll back up.

JUDGE McGUIRE: Just restate as to that portion.

BY MR. STONE:

Q. With respect to the hypothetical negotiation --

A. Can I interrupt and ask --

Q. May I approach, Your Honor?

Do you want me to take it back off your hands?

A. If you're not going to ask me further questions about it.

Q. Not at the moment. I'll be back for the autograph.

Professor McAfee, with respect to a hypothetical negotiation between Rambus and DRAM manufacturers, either ex ante or ex post, as to what they would pay for the Rambus technology, have you assumed that in advance of those negotiations there would be no meeting among the DRAM manufacturers and agreement upon a position they all should take in the negotiations?

A. I'm sorry. I was listening to the first part of your question, I started thinking, and now I've actually -- I missed part of the question.

Q. That's okay. Let me try it again.

I'm correct, am I not, that for portions of

your opinions that you've expressed here over the last two days that you've assumed a hypothetical negotiation between Rambus and DRAM manufacturers to determine the price they would pay for Rambus technology?

A. Well, I concluded that if Rambus signed a RAND letter, so we're in the but-for world analysis, if Rambus signed a RAND letter, and if JEDEC determined the inclusion of the technology was well-justified or that the technology was well-justified, that individual manufacturers would contact Rambus to get a sense of what the royalties that Rambus expected were. I didn't actually consider one way or the other whether that would be done individually or collectively. I don't think it upsets my opinion if it's done collectively.

Now, my understanding of the antitrust laws is that may or may not be a violation of antitrust laws, but certainly some kinds of collective action on the part of companies is a violation of the antitrust laws, but I don't think it actually matters to my opinion that it's individual.

Q. I want to ask you about economics, not antitrust law, if I can.

From an economic point of view, if all of the

purchasers, all of the buyers of a particular product or a technology agree on what they are willing to pay for it, they affect the negotiations as opposed to each of them negotiating individually and without coordination, do they not, as a matter of economics?

A. You know, I think -- I guess I feel like it's an oversimplification of what is a rich cartel theory, and in fact I have presented a lot of information in my book on this exact topic and also in other published -- at least one other published paper, and so I don't quite subscribe to that. It's not -- it's oversimplification, is the right description of it. That is to say, it's not wrong in principle, it's rather -- it's oversimplified. It requires additional hypotheses.

Q. Okay. Let me see if I can invite some additional information from you without having you rewrite the chapter here in the courtroom.

MR. ROYALL: Objection, Your Honor. I don't think that statement was necessary.

MR. STONE: No, no, no. I meant it -- it was not meant to be critical.

JUDGE McGUIRE: And it's not and the court takes it as such. Go ahead.

BY MR. STONE:

Q. Please, Professor McAfee, I meant no disrespect in that question.

Can you tell us, with as much as detail as you feel necessary to feel comfortable with the answer, what factors must be in place for you to agree with the statement that a buyers cartel acting cooperatively would have more market power in negotiating with a seller than if they each acted individually?

A. Well, it was actually the -- what's complicated in cartels is to get them to act cooperatively, and so if they -- if you want me to assume that they are acting cooperatively, then in fact I agree with the statement that they could affect the negotiations. But it's -- the challenge is actually to get a cartel to act cooperatively.

Q. Okay. And that's partly signaled by the heading on page 138 of your book that preceded this section I had you read which was Solutions to Tacit Cooperation Problems.

There are problems with tacit cooperation; correct?

A. In fact I think my recollection is I give 13 of them.

Q. Okay.

A. But I don't specifically remember the number.

Q. But for these purposes if we simply assume that there was collective action by all of the buyers of a particular commodity or a technology, they would have increased market power in negotiations with the seller than if they each acted individually?

A. If you add in cooperation. Collective action may not be sufficient to get cooperation. OPEC is a classic example of a cartel that has collective action but little, often little cooperation.

Q. An agreement not to include patented technology in a standard without the provision of a RAND letter would be an example of cooperation among the members of that organization, would it not?

MR. ROYALL: Objection. Incomplete hypothetical.

JUDGE McGUIRE: Sustained.

BY MR. STONE:

Q. You have assumed for purposes of your analysis that the JEDEC members have agreed through their adoption of the rules that they will not include patented technology in a JEDEC standard without first being provided with a RAND letter; correct?

A. That is my understanding of the JEDEC rules.

Q. Bring up if we could DX-144.

Directing your attention to DX-144 that's on

the screen before you, it lists three ways in which DRAM standards are set, through standard-setting organizations, private consortia and proprietary standards.

Do you see that?

A. I do.

Q. Are each of those what you would refer to as de jure standards?

A. I'm sorry. I'm blanking out on what the --

Q. Sure. Let me ask it differently.

A. No. But I should know the answer to this. I'm just blanking on what the -- it's the ones that aren't imposed by the government, is the -- all of them are the ones that aren't imposed by the government, but I don't remember if that's de jure or what the other one is.

JUDGE McGUIRE: De facto.

BY MR. STONE:

Q. Let me ask it differently.

A. I think these would all be de facto.

Q. Okay. It is also correct, is it not, that the marketplace itself by simply accepting a particular product can turn a product into a de facto standard?

A. That's correct.

Q. So in addition to standard-setting

organizations, private consortia, proprietary standards, we also could have widespread market acceptance?

A. So no, that's not quite my understanding. My understanding is these are the three means by which standards are proposed to the market and then the market chooses the standard from that; so that is to say, all of these are subject to a market test.

So that is to say, yes, inside the standard-setting organization they set their standard and propose it to the market, but they can't impose it in the sense that, for example, the Federal Communications Commission imposes standards on cellular communications. They make it a law. None of these organizations have that kind of authority.

Q. If a company starts manufacturing a product and other companies start manufacturing it as well and it catches on in the marketplace and soon accounts for a substantial volume of market share, would you consider that product to have identified a standard?

A. Yes.

Q. And it could do that --

A. If it is a standardized product, that is, if we're talking about something that embodies a standard -- a standard has characteristics attached to

it, but --

Q. When you use "proprietary standards" in your example on this demonstrative, could that also include within its ambit, as you use the term, a company that simply publishes a standard and says here's what we're going to make and anybody else who wants to make it can as well?

A. Yes. It would make the term "proprietary" somewhat of a misnomer. It would be a standard provided by a firm that was proprietary but offered on free terms, and so it's not exactly proprietary because it was given away free.

Q. Okay. When you referred to the RDRAM -- and I'm now using RDRAM distinct from Rambus technologies we've talked about earlier -- did you include it as the result of a proprietary standard?

A. Yes.

Q. And did you call it proprietary because it was a single company which developed the standard? That's part of the elements of proprietary?

A. And owned the rights to the practice of the standard.

Q. And let me go back then to slide DX-134.

With this background that we just covered, I'd like to talk for just a moment about your chart on the

basic economics of the DRAM industry if I can.

The large capital requirements, which is your first bullet point, was important for purposes of your analysis, was it not?

A. It was significant, yes.

Q. Now, one of the things you showed us earlier was the cost of a fabricating plant or fab; correct?

A. Yes.

Q. Now, the cost of a fabricating plant is not a cost that when the plant is built is limited to producing DDR SDRAM, is it?

A. It is not.

Q. For purposes of your analysis, have you assumed that a fabricating plant can produce various different kinds of semiconductor devices?

A. I am, yes.

Q. Okay. And when you talk about economies of scale, are you assuming that as the volume of production goes up, the marginal cost of producing the next unit goes down?

A. That's the meaning of economies of scale. I should say, as I testified, there are two kinds of economies of scale in this industry. There's the fact that the minimum efficient scale of the plant is very large, but there's also a network economy. That is to

say, as the industry gets larger, the average cost of production falls, and that's the related components as opposed to DRAM directly.

Q. I want to make sure I understand the network economies.

Tell us more about what you mean when you say "network economies."

A. So a network economy is anything where the -- it's a situation where increased use of a product either lowers its cost or enhances its value.

Q. So for example, in this case it's not a consideration that you took -- let me strike that.

I was concerned by the factors listed on this chart whether you were for purposes of your economic analysis assuming that DDR SDRAM in a computer was limited in terms of its ability to network with other computers. And you were not making that assumption, were you?

A. You mean in the sense of networking like routers and the like?

Q. Like networking to the Internet, like networking through a modem line.

A. No, no. That's a computer term. This is the economic term of a network externality.

Q. So the network externality here is that as

DRAMs become used in different applications, the price would be driven down even more, or the cost driven down even more?

A. Well, the total delivered cost of the product, so if you have to produce chipsets, the fixed costs associated with the chipsets are amortized over a larger volume, so that's -- it's not necessarily the cost of the DRAMs that are driven down, that's the minimum efficient scale aspect of DRAM production, which has been growing but is, you know, still -- the minimum efficient scale is still well less than the industry size, which is generally the relevant condition for economic analysis of economies of scale.

But it's the other components, the amortizing of the costs of the other components over a larger volume.

Q. And for purposes of your network externalities, you're not assuming that products have to use a particular form of DRAM in order to interface in any fashion with other products?

A. No. I think actually -- yes. So I'm agreeing with you. I'm not assuming that they need a particular form of DRAM.

Q. Let me ask you then about interoperability.

Have you -- this is an issue on which you've

made certain factual assumptions?

A. Yes.

Q. And have you assumed that different models of DRAM may require certain changes in the operating system -- certain changes in the rest of the system in order to operate?

A. To be useful, yes.

Q. Okay. And have you assumed that changes may be necessary in the motherboard, the chipset, the controller and the BIOS?

A. Yes.

Q. Have you assumed there's anything else in the chart that we looked at, DX-30, that would need to be changed as you changed versions of DRAM?

And we can bring up DX-30 if you want.

MR. ROYALL: That's what I was going to ask for the purposes of that question.

JUDGE McGUIRE: All right. Let's see it.

MR. STONE: DX-30. It was the hand-drawn chart. That's it. Perfect.

BY MR. STONE:

Q. Do you remember seeing this the other day?

A. I do.

Q. And you included a copy of it within your charts; correct?

A. I did.

Q. Referring you to DX-30, is there anything that you have assumed needs to be changed as the version of DRAM changes other than the chipset, the motherboard, the memory controller and the BIOS?

A. Yes.

Q. What else?

A. In particular, hard drives have DRAMs in them. Moreover, fax machines, printers and other devices have DRAMs in them. And the -- in order to use those DRAMs in that device, you would have to change components that are not listed on this chart but are present in those other devices.

If you are restricting it to within the PC, the only thing that I see that would have to be changed that contains DRAM is the hard drive, but there may be other components that contain DRAMs that I'm forgetting as I sit here today.

Q. And the use of the -- have you assumed that the use of the DRAM in a hard drive is independent of the use of the DRAM as it interfaces to the Northbridge chip in the chipset?

A. It is. The hard drive is just a plug-in device. It's self-contained.

Q. Okay. You can take that down and let's go back

to DX-134 if we could.

Let me ask you if I can about price sensitivity.

Is the factor that you've taken into account here in describing the basic economics of the DRAM industry that purchasers of DRAM are sensitive to the price of competing DRAM?

A. Yes.

Q. And when you refer to the price sensitivity on this chart, is that the nature in which you --

A. Can I clarify my previous answer? I answered too quickly.

Yes, although it's not all purchasers. It's a significant fraction, a substantial fraction of the purchasers.

Q. And are those the OEMs?

A. Oh, I was actually talking about the ultimate final consumer. The OEMs have -- inherit the preferences of the final consumer because that's their market, but it's the final consumer whose price sensitivity drives the price sensitivity of the OEMs.

Q. And have you done any quantitative studies to measure price sensitivity?

A. I have not quantified the price sensitivity of consumers.

Q. And finally let me ask you about the commodity nature of DRAM.

You, I think when being asked about this demonstrative earlier, you talked about the concept of backward compatibility? Do you recall that yesterday?

A. I certainly talked about backward compatibility, although I don't recall talking about it in the context of this particular slide.

Q. Well, I may be incorrect on that, and if I am, I apologize. Let me just ask you about backward compatibility.

Is it necessary, as you understand it, for the economics of the DRAM industry that DRAMs be backward compatible in the sense that a newer version can be used in connection with a motherboard, chipset, controller and BIOS that was utilized with an earlier version?

A. No, it's not generally necessary. Clearly that would be a benefit if it were true, but it's not generally necessary. In fact, it's rare.

Q. And when you used the term "backward compatible" in your testimony, what did you mean by that use of that term?

A. I'm referring to the reuse of components; that is to say, it refers to pieces or modules, a module

being a different use of the word "module" than is standard here, so let me not use that term -- pieces or subassemblies, components of the DRAM being the same in such a way that it actually reduces implementation costs and testing costs.

Q. So for example, if you could use the same core from one DRAM version to the next, that would be one of the examples of reusing prior components?

A. In principle, yes. I can't testify that that is an example, but in principle, certainly that's the kind of example I have in mind.

MR. STONE: Okay. Your Honor, if it was convenient with the court, now is a convenient time for me to break before I move to another subject, if you want to.

JUDGE McGUIRE: You mean break for the evening?

MR. STONE: Break for the evening.

JUDGE McGUIRE: Yes, that would be fine.

It's 5:00 then. We will take a break for the evening and I guess convene here -- it's already Friday -- tomorrow at 9:30 a.m.

MR. STONE: Thank you, Your Honor.

(Time noted: 5:00 p.m.)

C E R T I F I C A T I O N O F R E P O R T E R

DOCKET NUMBER: 9302

CASE TITLE: RAMBUS, INC.

DATE: June 26, 2003

I HEREBY CERTIFY that the transcript contained herein is a full and accurate transcript of the notes taken by me at the hearing on the above cause before the FEDERAL TRADE COMMISSION to the best of my knowledge and belief.

DATED: June 27, 2003

JOSETT F. HALL, RMR-CRR

C E R T I F I C A T I O N O F P R O O F R E A D E R

I HEREBY CERTIFY that I proofread the transcript for accuracy in spelling, hyphenation, punctuation and format.

DIANE QUADE