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FEDERAL TRADE COMMISSION

I N D E X (PUBLIC RECORD)

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UNITED STATES OF AMERICA

FEDERAL TRADE COMMISSION

In the Matter of:)

Rambus, Inc.) Docket No. 9302

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Wednesday, July 9, 2003

9:31 a.m.

TRIAL VOLUME 39

PART 1

PUBLIC RECORD

BEFORE THE HONORABLE STEPHEN J. McGUIRE

Chief Administrative Law Judge

Federal Trade Commission

600 Pennsylvania Avenue, N.W.

Washington, D.C.

Reported by: Josett F. Hall, RMR-CRR

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

JUDGE McGUIRE: Before we get started this morning, are there any housekeeping items we need to take up?

MR. ROYALL: The only thing I want to mention, Your Honor, is with respect to the in camera motion that Rambus filed.

JUDGE McGUIRE: That was one of the things I was going to take up.

MR. ROYALL: We don't have any objection.

JUDGE McGUIRE: Very good. That was my next question. Thank you, Mr. Royall.

Is there anything from respondents?

MR. STONE: I don't think so, Your Honor.

JUDGE McGUIRE: Then at this time you may call your first witness.

MR. STONE: Thank you, Your Honor.

At this time Rambus would call Dr. Mike Farmwald.

JUDGE McGUIRE: Sir, you may approach and you will be sworn in by the court reporter.

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Whereupon --

PAUL MICHAEL FARMWALD

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

DIRECT EXAMINATION

BY MR. STONE:

Q. Good morning, Dr. Farmwald.

A. Good morning.

Q. Would you state your full name for the record, please.

A. Paul Michael Farmwald.

Q. And where do you presently live?

A. Portola Valley, California.

Q. Where is that?

A. That's near the Stanford campus.

Q. And what do you currently do?

A. Somewhere between an inventor and an investor, I sort of do both.

Q. Have you at any time worked for Rambus?

A. Yes, I have.

Q. What was your initial relationship or involvement with Rambus?

A. It was originally my idea, and Mark Horowitz and I were the founders of the company.

Q. And do you have any current relationship with

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Rambus?

A. I'm still on the board of directors.

Q. And do you still own stock in the company?

A. Yes, I do.

Q. Let me ask you just for a little bit of background if I could.

Would you tell us where you were born.

A. Anderson, Indiana.

Q. And where did you go grow up?

A. It's a small town in northeastern Indiana. It's called Topeka, Indiana.

Q. And then where did you go to college?

A. Purdue University.

Q. When did you graduate from Purdue?

A. 1974.

Q. And how long were you there getting that degree?

A. Three years.

Q. And after you graduated from Purdue in 1974, what did you do next?

A. I went to Stanford University and was a graduate student in computer science there.

Q. Now, what did you get your degree in when you were at Purdue?

A. Mathematics.

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Q. And so you started at Stanford then in 1974?
A. Yes.
Q. And did you obtain a degree from Stanford?
A. Yes. A Ph.D. in computer science.
Q. And when did you get that?
A. 1981.
Q. And while you were at Stanford, did you work solely on getting your Ph.D. or did you do other things?
A. I did other things. I worked at Lawrence Livermore National Lab for actually most of the time I was a graduate student.
Q. And what did you do at Lawrence Livermore?
A. I joined a project there which was building a supercomputer. I ended up actually running the project in the end.
Q. Let me step back for a minute.
What's Lawrence Livermore, if you could take just a moment and tell us.
A. There's two large sort of national weapons laboratories. There's one in Los Alamos and there's one in Livermore, so this is the one in Livermore.
Q. And you said you were involved in a supercomputer project?
A. Yes.

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Q. What's a supercomputer?

A. To first order, it's a computer that costs more than a million dollars. It's sort of the largest, fastest computer you can build at a given point in time.

Q. And what was your involvement with that when you were at Lawrence Livermore?

A. I started out sort of as an engineer designing a piece of it and ended up co-running it with another gentleman.

Q. And what was the result of that project?

A. We built a series of three separate computers, three generations of computers.

Q. After you graduated from Stanford, what did you do?

A. Well, for a while I continued to work at Livermore for another four years after that. And then I started a company called FTL.

Q. And did FTL stand for something?

A. Yes, it did. It stood for Faster Than Light.

Q. What was that a reference to?

A. Well, when you build computers, the speed of light inside computers is one of the things that sort of limits their performance, so this was a little bit of a joke saying that we're going to build a computer

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saying that it's faster than anybody else's.

Q. So you started a company to do that?

A. Yes, I did.

Q. And who did you start that with?

A. Three people I knew that -- so three other colleagues and I started it basically.

Q. And what was the result of that company or that project?

A. We were acquired almost immediately just the three -- or the four of us total. We started to raise money and then somebody came along, a company called MIPS Computer Systems, and offered to buy us, so we were bought by them.

Q. And was a computer ultimately developed as a result of these efforts?

A. Yes, it was. It was the first of and probably maybe the only or maybe one of two ECL microprocessors.

Q. And what's ECL?

A. ECL is emitter coupled logic. Back then -- that's fifteen or more years ago -- there were two forms of logic that computers were built out of. One was called ECL, emitter coupled logic, which is very fast and very hot and very expensive, and CMOS, which is what all computers are built out of now, which was

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much slower and much lower power and much cheaper.

So we were building out of the fast, expensive set.

Q. In the course of this proceeding we've heard people talking about silicon, for example, and chips made out of a silicon substrate. Is that -- when you say "CMOS," is there a relationship there?

A. They're both -- ECL and CMOS are made out of silicon; it's just they're made in different ways.

Q. And what was the result of the project?

A. We built a computer and we sold quite a few of them. My recollection is we sold about a half a billion dollars worth of the computer systems through MIPS.

Q. Through MIPS?

A. Yeah.

Q. And what is MIPS?

A. MIPS was a computer company started by John Hennessey and some others to implement sort of the first commercial RISC microprocessor.

Q. We need to spend a little time on definition of terms.

Tell us what RISC is.

A. RISC is R-I-S-C. It stands for reduced instruction set computer.

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Q. And what does that mean?

A. The idea -- it was invented mostly by a gentleman at IBM named John Cocke, but then John Hennessey and another gentleman at Berkeley, whose name escapes me right now, pursued it further. And the idea is the -- if you build simpler instruction computers, you can make them run faster. It was a very successful idea.

Q. And whose idea was it ultimately to start FTL, the company you just described?

A. It was my idea. I convinced the other guys to do it.

Q. And then did you continue to work at MIPS after FTL was acquired?

A. Yes, I did.

Q. How long did you stay at MIPS?

A. I was there for roughly three years.

Q. And were any patents related to that project?

A. At least one patent that I can remember, yes.

Q. What did you do after MIPS?

A. I went to the University of Illinois for one year basically.

Q. And when was that that you went to the University of Illinois?

A. I believe it was 1988 .

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Q. And what caused you to go there?

A. A friend of mine, a very good friend of mine named Dave Kuck, was running a supercomputer project at the University of Illinois. It was mostly a large software project with a little bit of a hardware group attached to it. The hardware group was in trouble, so he convinced me to come and partly be a professor and partly try to fix the hardware group, to make it work basically.

Q. So that's what you did?

A. That's what I did.

Q. And how long did you stay there?

A. I was just there one year.

Q. And what was the -- what caused you to leave, and what happened with the project while you were there?

A. Well, several things. The main thing is my girlfriend decided she didn't want to move to Illinois, so that was the major factor.

The other factor was the hardware group. After I was there for a while, I decided that it was unfixable, and so I convinced Dr. Kuck to kill the project, to kill the hardware project.

Q. Did the rest of the project continue?

A. Oh, yeah. The software group was very

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successful. It's quite a famous project, so it was very successful.

Q. Did you teach while you were at Illinois?

A. Somewhat. Not very much. A little bit but not very much. Mostly I had students that I advised.

Q. Graduate students?

A. Graduate students, yes.

Q. And while you were there, did you begin work on what ultimately resulted in Rambus?

A. Yeah.

So while I was there and partly as a result of the fact that I sort of figured out fairly early on I wasn't going to stay, I started thinking about a new problem that I had realized was an issue while I was at MIPS. After MIPS bought us, I was assigned a specific task, and that was to design a backplane bus and the memory card that got plugged into the backplane bus.

Q. I'm going to interrupt you for a minute and if you could just take a second -- we've heard some testimony about this, but if you could explain what a backplane bus is, that would be helpful I think.

A. I'll try and do it visually.

If you -- the way computers used to be built back then -- this was sort of the middle to

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late '80s -- especially larger scale. This was a couple-hundred-thousand-dollars computer. It was a fairly expensive computer. It would be -- consist of fairly large cards, larger than this actually, so --

Q. So larger than a binder?

A. Larger than a binder. Not thicker. They'd be flat.

And they'd have a lot of chips on either one or both sides, and these would have a connector along one edge and the cards would slide into a rack, into another card that was at right angles, and along that card would be connectors.

So you would slide it in and it would plug in, and then the backplane bus was along the back edge so that each card could talk to all the other cards by going through the backplane bus. There would be a series of parallel wires on the back plane, which is how they communicated.

So I designed that bus and that card for that system.

Q. And tell us about -- was that a memory card?

A. A memory card, yes.

Q. And what did that consist of, the memory card? And this was at MIPS; right.

A. This was at MIPS, yeah.

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So we had built a very, very fast microprocessor for the time. My recollection is it ran at 80 million instructions per second, which is pretty fast for the time, not fast anymore, but back then it was.

So I had built a memory card that could actually feed the processor and because the DRAM chips -- DRAMs of course are the things at issue here. Back then the DRAM chips were so slow that it required, my best recollection is, 320 DRAM chips on a single card -- it was a very large card -- all running in parallel to feed a single processor and you couldn't do it with less than 320 memory chips. It needed that many minimum.

And that was a big problem because I knew that the next-generation processors were either going to -- were going to go up by a factor of two to four times faster and the memory chips weren't going to speed up by much.

Q. Let me interrupt you.

JUDGE McGUIRE: Good.

BY MR. STONE:

Q. I'll try to interrupt you and slow you down.

A. Sorry.

Q. That's okay.

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You said that processor speeds were going to go up by two to four times in the next generation.

A. Yes.

Q. Why is that?

A. It -- partly because it just happens. That's the way it is. There's a very famous law called Moore's law by Gordon Moore of Intel which says that historically and he predicts in the future that processor speeds will increase by a factor of four every three years, which is equivalent to saying a factor of two every 18 months. They're the same, same thing.

Q. Okay. And has that been true over some period of time?

A. It's been true for an incredibly long time. He made the prediction I think in the early '80s or late '70s and it's been true ever since then. It's still true even now.

Q. And so tell us again -- so you were thinking about Moore's law and then you --

A. Yes.

Q. And then you had an issue with respect to the memory card, and what did that lead you to conclude or visualize?

A. Well, that the bottleneck in the future was not

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going to be the processor; it was going to be the memory. Because within limits, you can just add more memory chips. You can -- you could take one processor chip and have ten or a hundred or a thousand memory chips all running in parallel to sort of feed the processor, but if you calculated the numbers going forward, the number of memory chips you would need was going to get incredibly large.

As I said, for our next generation that we were planning at MIPS, we would have needed a thousand memory chips running in parallel to feed the processor, and that's a minimum. It's an incredibly large number. It's basically not sustainable. You can't really build processors inexpensively if that was going to keep on.

Q. And did you sort of at the time do some analysis of this problem that led you to decide it was worthwhile to begin to try to think about solving it?

A. Yes, I did. I mean, I knew it was a big problem. So I just started thinking about how does one fix this.

Q. I used -- you were here for the opening statement and I used a chart that showed a performance gap. Do you recall that chart?

A. Yes, I do.

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Q. Did you do something like that back at the time?

A. Yes, I did.

Q. Could you try to recreate it for us if you wouldn't mind on the easel right behind you. There's some pens on the table.

A. I'd be happy to.

So I'm going to do a graph. And this is pretty much the way I did it back then.

So this is -- on one axis of the graph is time, and you know, back then it was sort of the late '80s, so I'll do it by every five years, so '85, '90, '95, 2000, 2005 .

And then the first thing you could plot, which is basically just Moore's law, which is the performance of processors, and back in sort of this time frame somewhere in here --

JUDGE McGUIRE: When you say "this," sir, we don't know what "this" is on the transcript, so try to state the date.

THE WITNESS: Okay. So in about -- about the time I was thinking about this was 1988 , so about right in here, a microprocessor, an Intel microprocessor, was about one MIPS, so I'll put that on the chart at one MIPS. That means one million

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instructions per second.

BY MR. STONE:

Q. And you put a dot at the intersection of 1988 and one MIPS?

A. That's from memory, and I really didn't go back, so I may be off by a little bit.

And what's happened now, if we look at 2003 , which is where we are now -- I'm going to do this on a scale. It's -- because it's an exponential it's hard to do, but we're at 3,000 MIPS now, so if I go out and buy the high-end Intel microprocessor, it runs at 3,000 MIPS, so we're 3,000 times faster now than we were back then.

And what's happened since then is it's went on an exponential curve. It sort of looks like this **(indicating)**. This is the kind of curve -- if you look every two years or every 18 months, the performance doubles.

Q. Label that curve if you would "processor speed."

A. Okay.

And this is Moore's law, by the way. That's a very famous law. Everybody accepts this. It's been happening -- there's a lot of argument whether it's going to keep on, but most people think it will for

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quite some time.

Q. So you drew for us now the processor speed curve.

What else did you think about at the time that you could sort of replicate for us if you would.

A. So then the next thing to think about or at least -- i mean, this is a very famous -- everybody knows about this one.

So what was somewhat more interesting is I was also thinking about -- you can plot in a similar curve over time the performance of individual DRAM chips.

So if I took an individual DRAM chip, they used to be fairly fast compared to the microprocessor back in the early '80s, but as time went on, they didn't improve in performance nearly as fast. They were increasing very slowly historically.

Q. So you've drawn a curve that runs from 1988 out to past 2005 ?

A. Exactly. And this is extrapolation, so this is sort of a dotted line. If I just took the curve, historical curve, and extrapolated it, it was also an exponential, but it was a much lower exponential than the processor curve.

Q. Label that curve for us if you would.

A. So that's memory performance.

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Q. Okay.

A. And the graphs I had done back then were fairly detailed. I mean, I'd actually done a lot of points and tried to do it fairly accurately.

But the interesting conclusion I drew from it, which is -- the details to some extent matter less than the fact that this ratio, the ratio -- if I take this number and divide it by this number --

Q. Because for the record we've got to make it clear, this number divided by this number --

JUDGE McGUIRE: You've got to -- go ahead, Mr. Stone.

BY MR. STONE:

Q. For any given point in time what you're saying is if I take the number that is on the CPU or the performance curve --

A. For processor speed.

Q. The processor speed curve?

A. And divide it by the memory performance, the individual chip memory performance, that tells me how many DRAMs I need to feed a single microprocessor.

Q. Okay.

A. It's just -- it's a number you can plot. That number becomes extremely large over time.

And then there was a third chart that I drew on

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the same thing over time.

Q. Why don't you draw that one --

A. And I will draw that. And that is the cost of a system.

So I'm doing it with another axis here of course. So this is dollars as compared to this performance. And that was the average cost of a computer system that was shipped at that time.

So back in the early '80s, the average cost of a system was probably $50,000. They were fairly expensive back then. And of course, over time it drops. You know, by 1990 PCs were starting to become popular, so the average cost of a system, you know, between expensive and cheap ones, was probably down into the $20,000 range, maybe ten to twenty thousand dollars, but it was dropping very rapidly, which was the interesting thing.

It was dropping -- and so now we're down to the point where the average cost of a computer system here in 2003 is about a thousand dollars. It's actually maybe even a little bit less than that because computers to me and to most people include not only big computers and PCs but games and things like that because those are really computers in the end, and so you blend them altogether and you get an

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average cost of a computer which is substantially less than a thousand dollars and it's going to keep going.

I mean, it's very clear -- again, this graph is -- has been a very regular graph. If you extend it into the future, the average cost of a computer system is going to go down to a hundred dollars or two hundred dollars in time.

Q. And I want you to label that line that you just drew "computer cost."

A. **(Witness complies.)**

Q. Now, we're going to mark if we can what you've just drawn as DX-251.

May I approach and do that, Your Honor?

JUDGE McGUIRE: Yes. Noted.

(DX Exhibit Number 251 was marked for identification.)

BY MR. STONE:

Q. So I've marked the chart that you've just drawn for us, Dr. Farmwald, as DX-251.

And can you explain, if you can use that chart as a reference as to what you were thinking back in 1988 , what that led you to see as a problem that you wanted to address.

A. So the obvious conclusion from this to me at

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the time was -- is -- this was inconsistent. If I looked at the cost of a -- the inherent cost of the DRAMs, just the DRAMs, it was going to be very expensive because I was going to take a very large number, which is the CPU speed, divide it by what appeared to be a fairly small number, which is the extrapolated performance of a DRAM, and that would say that you'd need thousands of DRAMs even to feed a very inexpensive microprocessor.

Okay. That's fine as long as computer systems are very expensive. You can have thousands of chips. It's just a cost issue. But I also knew that the average system was going to get very cheap, and so there was something broken. That couldn't work.

And so the obvious thing is that this curve of memory performance needed to be shifted so that it was on a much steeper slope, and so that's the problem I decided I wanted to work on.

Q. Okay. So if you'd resume the stand, that would be great.

Was it consistent with your prior experience that as you continued to design faster computers they were going to need more DRAMs.

A. Yes.

Q. And where had you had that experience?

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A. Well, in general, I had a background of designing large-scale computers, you know, supercomputers and other fast machines, so my whole history said that that was true.

Q. And had it been true in your experience at MIPS?

A. Yes. Absolutely.

Q. So back in the time having identified this problem that you've summarized for us here fairly quickly, what did you do then to try to address the problem?

A. I tried to think of how to make a DRAM faster.

Q. And I want to -- can I put DRAM speed in some context here?

A. Sure.

Q. Could I interrupt you for that.

When you say the speed of a DRAM, what do you mean, what do you refer to.

A. And I admit, I do use it -- there's two ways of looking at a DRAM's speed and I tend to think of one more than the other.

The performance I'm thinking about is the bandwidth of a DRAM, which is the number of bytes per second or bits per second that it can read or write, as compared to the other kind of speed is the time it

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takes to return the first bit of information. To me, that's much less important.

Q. Okay. So -- and tell us what a byte or a bit is or both.

A. A bit is a single -- you know, it's a yes or a no. It's the single smallest piece of information you can have.

Q. So a one or a zero?

A. A one or a zero, absolutely.

A byte -- in the early days a byte was a variable number of bits. Now it's become standardized. It's eight bits, so it's a 64-bit number now.

Q. And when you say 64 bits, what's that?

A. I'm sorry. It's an -- i apologize. It's an eight-bit number that can take one of 64 values. I'm sorry.

Q. And just to make sure we all understand, and probably this is elementary to everybody here, but if you're writing in binary with zeros and ones and you have a string of eight digits, one, zero, zero, one, one, eight of them, that gives you 64 combinations?

A. Yes. It's two to the number of bits.

Q. So then when you measure the bandwidth of a DRAM, when you think about the bandwidth, do you think

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of how many of those bits or how many of those bytes could be transferred out of the DRAM at a particular period of time?

A. Yes.

Q. And as you were thinking about this problem in 1988 , what was sort of the speed of DRAMs as you thought about it in bandwidth terms?

A. Roughly speaking, back then a DRAM could produce typically either a half or one byte every hundred nanoseconds.

MR. STONE: May I ask him to go back to the board.

JUDGE McGUIRE: Yes. Go ahead.

BY MR. STONE:

Q. Could you go back and flip to another sheet if you would.

And I want you to put a couple of definitions up there so we have them, and the first one I want you to do is you just said -- you used the phrase "nanosecond" and if you would write "nanosecond" and tell us what a nanosecond is.

A. It's usually abbreviated NS, but spelled out it's nanosecond. So it's a billionth of a second. And it's usually written 10^9 seconds.

Q. And what's a millionth of a second?

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A. So that's one microsecond. It's usually abbreviated microsecond. So it's a millionth of a second.

Q. I'm going to jump ahead here a second to some terms that I think are going to come up and ask you -- we've heard testimony about computer speeds talked about sometimes in terms of megahertz.

Is there a -- can you just define for us what a megahertz is.

A. A megahertz is -- it's a -- it's sort of an inverse of a microsecond. If I have a -- if I'm doing something every microsecond, then I'm doing it at a one-megahertz clock rate.

Q. If you were doing something at a nanosecond, every nanosecond, what would that translate to?

A. That's a gigahertz.

Q. And to put it in some context, PCs today like many of us have on the tables here, what speeds do they run at?

A. Most current big PCs run at one to three gigahertz, which is the same as -- well, it is the same as 1,000 to 3,000 megahertz.

Q. And back with the first computer you were building at MIPS and Faster Than Light, write down the Faster Than Light speed if you would.

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A. We were running at 80 megahertz.

Q. As compared to the 1,000 to 3,000 today?

A. That's correct.

Q. So DRAMs then in the 1988 time frame, just go ahead on this chart, if you would write out the speed at which in general terms you understood DRAMs to transfer information.

A. They cycled at roughly 100 nanoseconds, which is the same as 10 megahertz. This is .1 milliseconds, which is the same as 10 megahertz. And they typically produced one-half to one byte per cycle so that you could multiply the two together and so it typically ran at 5 to 10 megabytes per second per chip.

Q. And what did you think -- one more question.

In 1988 , what were you hoping to be able to get a DRAM to do as compared to what you then understood them to do?

A. Well, because I was a supercomputer designer, I mean, that was sort of my background -- the most famous supercomputer at the time was called a Cray I. It was a very famous, still somewhat a famous computer. It's a physically large machine. I couldn't -- it would take probably three of us to put our arms around it and it's six, seven feet tall. It's a big machine. It takes a hundred kilowatts of power. The entire memory

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system of that computer ran at 500 megabytes per second, so I sort of thought an interesting goal would be to have a DRAM chip that could run at the same speed as this giant supercomputer.

Q. So I want you to write "goal" at the bottom of this chart and write out "500 megabytes."

A. So that was our goal.

Q. Okay. You can resume the stand if you would.

Your Honor, could I approach and mark this DX-252, this chart?

JUDGE McGUIRE: Yes.

(DX Exhibit Number 252 was marked for identification.)

BY MR. STONE:

Q. Okay. Well, with this little tutorial for which we thank you and with your goal in mind, tell us if you can what it is that you then thought about how to address this problem.

A. Well, because of what I had just done at MIPS, I knew sort of the physics behind how backplane buses worked. I had gone into a lot of detail of making what was at the time a very, very fast backplane bus.

So I understood that sort of paradoxically the smaller I make the backplane, you know, if a backplane is really big, because of the way light works, it runs

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slow, and so the way to make a backplane bus that's really fast is to make it really tiny.

So at least conceptually somewhere along the line I made the leap of if I can make a DRAM chip that looks like a memory card, acts like a memory card, and plug it into a little, tiny backplane bus, instead of a big thing a little, tiny thing, that it has the chance at least of running very fast.

Q. What does light have to do with this?

A. In computers you use electrons to send signals from one point to another, and light travels at the speed of light of course, and electrons travel close to the speed of light, typically not quite but close. So typically they'll travel at maybe six-tenths or eight-tenths or nine-tenths of the speed of light, so to first order they're about the same thing.

So it's a -- i mean, it's pretty fast, but it's still, at the scales and the speeds we're talking about, it's a constraint because light typically travels about a nanosecond per foot, so you know, in about a foot it takes light one nanosecond, a billionth of a second, to go that distance.

MR. STONE: Your Honor, can he add that to the chart?

JUDGE McGUIRE: Sure. Go ahead.

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BY MR. STONE:

Q. Go back to DX-252 if you would and put how far light travels at a nanosecond. Put it on the one you have right there for me.

A. So I'll try and make roughly two marks.

So it takes light about one nanosecond to go roughly that far **(indicating)**.

Q. And write "light" underneath where you put one nanosecond.

Why was -- to go back to the question, so you mentioned light to us and you told us you wanted to make a smaller backplane, but what does the speed of light have to do with making it smaller.

A. Well, since electrons travel at almost but not quite the speed of light, you can think of it as the same issue. The smaller I can make it, the faster I can make it. It's for the same reason, because the electrons have to travel from one card or from one place and they have to travel through the wires and then go to the other place, and that's a distance and it takes a certain amount of time to do that.

Q. So the shorter the distance, the faster they can get there?

A. That's right.

Now, there's a lot of -- it's -- i'm

8085

simplifying it a lot. It turns out it's a lot more complicated than that because electrons don't travel quite so freely as photons do, and so there's some other issues that make them even slower in real life. But again, to first order, smaller is faster.

Q. So let me ask you then about size.

How big were DRAMs in the 1988 time frame when you were thinking about this problem.

A. How big physically?

Q. Yeah, how big physically.

A. You know, six-tenths of an inch tall, something like that. Something like that.

Q. And how big are they today?

A. A little bit bigger, not much bigger, about the same size, a little bit bigger. They have more pins now but about the same size.

Q. So if the size of them can stay roughly the same, what did this idea of having a smaller backplane -- what did that mean to you at the time you were thinking about it?

A. What I wanted to do instead of putting the DRAM chips on a card, instead of putting the DRAMs on a card and having to go from the chip, across the card, across the connector, through a backplane, onto to another card, across the card to another chip, I

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wanted to go directly from the chip directly onto another little card and directly to the next chip and have distances that were very tiny, you know, an inch or two instead of many, many, many inches or maybe even feet.

Q. So in your mind, what did that mean you had to do to make that happen?

A. To make that work, I had to have the functionality, the same intelligence of the entire large memory card. I had to be able to put it into a single DRAM chip.

Q. You told us earlier that the memory card for the computer that you designed at MIPS I think had 320 DRAMs more or less on it?

A. Yeah.

Q. Is that right?

A. That's right.

Q. What was your goal in terms of how many DRAMs it would take for that same computer if you were able to make your design work?

A. Well, I wanted to build a faster memory system with one chip, so I wanted a single chip to be faster than the entire 320-chip board.

Q. And when you say "a single chip," that would be like a single DRAM?

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A. A single DRAM chip, yes.

Q. So put this in a time context. You started thinking about this problem when?

A. 1988 .

Q. And how long did you sort of think about it on your own? I assume longer than it's taken you to describe this morning?

A. Yeah. I don't remember exact time scales. It was probably on the order of six months or so that I was thinking about the problem.

Q. And what ideas did you come up with then in a general sense if you would?

A. Well, I came up with the idea of a simplified bus protocol and a simplified bus controller that was plausibly simple enough to put on a DRAM. And then that leads to the next set of problems, is okay, you've made something that's now physically quite small, how do you make it run fast enough.

Just because the signals can propagate that fast doesn't mean that you can send that fast of signals; i.e., you have to have drivers and receivers and clocking and a whole bunch of other things that can also go that fast, and I started to think about those kinds of things.

Q. When you say "bus protocol," what do you mean

8088

by that?

A. Sort of a set of -- the -- it's the organization of the bits and the timing of the bits that specify, you know, so you can look at it and say, well, this is a read request and here's the address and essentially trying to figure out what I should do. It tells me whether I should read it or write it, where the address is, where the data is, and so on.

Q. Just -- we've heard this to some extent but just to refresh us, when you say "read" and "write" in the context of a DRAM, what do you mean?

A. A read of a DRAM is you want to tell the DRAM an address and it wants -- it will return the data at that address. A write is the opposite. You tell it an address and give it some data and it stores the data that you give it into that address.

Q. So you either say go get me what's at this address or go put this at that address?

A. Yes.

Q. And when you used the phrase earlier "bus controller," what did that mean?

A. That's the thing that interprets whatever the protocol is, so it actually looks at the bits in the request, the read or write command, and the address and figures out what to do with it, figures out whether

8089

it's a read or write and, you know, what it should do with the request.

Q. Did there come a time as you were thinking about how to solve the problem you described for us when you decided to interact or engage with others on that problem?

A. Yes. Fairly early on. I'm a computer architect probably more than anything else, so I think about how to put together computers, but I was quickly running into problems of, as I said, the drivers and the receivers and the clocking. That's more of a circuits problem and I'm not at all a circuits person. I know a little bit, maybe enough to be dangerous, but I'm certainly not an expert, so I decided to go back to California and approach some people I knew who I thought were the best circuit designers in the world to see what they thought.

Q. And when was that?

A. I can't tell you exactly. It was in the very late part of 1988 . And the reason I remember that is because it was cold and rainy, so I think it was in the winter of 1988 .

Q. And who did you contact?

A. Mark Horowitz and Mark Johnson.

Q. And what were their respective relationships

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with you at the time? How did you know them?

A. I had worked with both of them at MIPS. Mark Horowitz was a Stanford professor who had consulted to our project, the ECL project I mentioned, as a circuit designer. And Mark Johnson was a CMOS circuit designer who had worked on another project at MIPS. And I knew both of them, and in my view, they're the smartest guys I knew in circuits, so I wanted to talk to them.

Q. So this was sometime when it was, by California standards, cold and rainy?

A. Yes.

Q. And that was at the end of '88?

A. Yes.

Q. So did you meet with them?

A. Yes, I did. We met at a restaurant called Saint Michael's Alley.

Q. Is the restaurant still there?

A. I don't think it is. I think it's gone now.

JUDGE McGUIRE: So is that line of questioning, by the way.

MR. STONE: I understand.

BY MR. STONE:

Q. So what did you ask them or what did you tell them at this first meeting?

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A. I presented my ideas to them, both the protocol -- you know, the overall idea, what the problem was, and said we should go start a company. I also gave them my first-pass ideas on how to build circuits.

So I sort of tried to present them with a -- at least the beginnings of an idea as to how to go do this, and I said let's go start a company to do it.

Q. What was their reaction?

A. They both thought it was plausible but -- especially Mark Horowitz. And I've known him for a long time, and he calmed down when he got married, but up until then he was very -- every new idea that he'd see, his automatic first reaction is to point out every single flaw in it, and it can be sort of intimidating, and he proceeded to do that.

He told me especially that my circuit ideas were really stupid and couldn't possibly work. And so you know, again, he thought it was an interesting idea, but he thought that my specific implementation couldn't possibly work.

Q. And then did you have further communications with either or both of them?

A. Yeah. Actually the next day Mark called me back and said, Okay. Well, the ideas are pretty

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stupid, but I think I actually know how to fix them and make them work right, so it's not as totally stupid as I -- he thought. The first day he always hates it and the next day he always comes back and tells you how to make it work, so I expected that.

Q. So at that point was there interest on his part in working with you on this problem?

A. There was. Mark was not ready to go start a company. He was a professor at Stanford, didn't have tenure yet. I don't think he was at first all that interested in leaving.

Q. What about Mark Johnson?

A. I think he was even less interested in leaving. He was fairly happy at his job and at first at least certainly wasn't interested in starting a company.

Q. So at that point what did you do next?

A. Well, I worked on both of them. I basically got -- with some cajoling convinced both of them that if one would join, then the other -- you know, they'd do it together. If one did it, then the other one would.

And I finally got Mark Horowitz to agree that he'd take a year's leave or take a leave from Stanford and actually see if we could get this going. He didn't

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think we were going to make any money, but he thought it was an interesting project.

And then Mark Johnson decided not to join; he bailed out.

Q. But did Mark Horowitz continue on?

A. Yes, he did.

Q. So when about was this, how long after your first meeting?

A. Fairly -- i don't remember, but I think it was within a month or less of that.

Q. So was it then you and Mark Horowitz working together on the problem?

A. Yeah, we started working together.

Of course I had gone back to Illinois. I was still a professor there, and he was still of course a professor at Stanford. I had already told Illinois that I was leaving, and so I had to sort of finish out the year as did Mark, so Mark applied for a leave, and so we started doing a little bit of work on the phone but mostly waiting until we were done with our respective universities.

Q. So when was that that you finished up that work?

A. It was in the spring of, you know, late spring of 1989 .

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Q. And did the two of you then start working more regularly together?

A. Yes, we did. I moved back to California and started -- i'd mostly -- i lived in Berkeley at the time and Mark lived in I believe Menlo Park or Palo Alto, right at the boundary between the two, so I would come down and work at Mark's house mostly.

Q. Did you have offices?

A. Not at first. We actually would work in his house, either his living room or his kitchen.

Q. And did you -- in addition to working on the technical problem you described, you told us one of the things you wanted to do is start a company. Did you begin to think about that?

A. Yes.

Q. Can you -- let me -- i know you're going to take control here. I'm trying to hang onto whatever I can.

Did you at some point in time come up with sort of an idea or a model for a business that you wanted to start?

A. Actually I did. I had the model even when I presented it to Mark and Mark, so I had the model very early on as to what the business could be or should be.

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Q. Tell us if you would what your original business model or ideas were.

A. Well, when I thought about it, it very quickly came down that there was only one possible model in my view. We could -- you could build very, I thought, compelling parts using this idea, but DRAM fabrication plants are extremely expensive things. They -- my best recollection at the time they cost a half a billion dollars; now they cost two or three billion dollars. They're very expensive.

As a start-up company there was no chance whatsoever that anybody was going to give two, you know, ex-professors or two professors, you know, a billion dollars to build chips. So the only possible business model that made any sense was to patent it, convince others to build it, and charge them royalties.

Q. What did you do to move forward with that idea?

A. Well, Mark started doing a lot of -- most I'd say of the technical work, so I started talking to potential partners and customers and investors, so I started doing a lot of the business development.

Q. Who were, just in a general sense, who were potential customers?

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A. Well, you could think of it two ways. There's the DRAM companies who to some extent are your customers, but they're really in my view not the customers. The customers are the people who build -- who buy the DRAMs -- sorry -- who actually purchase and use the DRAMs. So those would mostly be computer companies.

At the time of course IBM was one of the largest computer companies, so -- and I had a very good friend, a gentleman named John Cocke, who was actually the inventor of RISC, who was an IBM fellow, who I sort of approached and told him about the idea.

Q. And you said he's an IBM fellow. Can you tell us just for a second what that means?

A. IBM, it's a big company and they have a management track for people who like to manage, but a long time ago they also developed a track for their best sort of thinkers, their best engineers and scientists, and so on, so if you don't want to be a manager, then you can become a fellow and it essentially gives you the sort of power and freedom that a senior manager would have.

Q. What role, if any, did he play?

A. He was very helpful. He introduced me -- he gave me encouragement. He liked the idea a lot, so he

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gave me a lot of encouragement. And he also introduced me to a friend of his named Andy Heller, who was also an IBM fellow but who had just quit IBM and gone to be a venture capitalist actually.

Q. So customers at the time -- you mentioned IBM at the time.

Were there other companies that you would have at the time thought of as potential customers for this.

A. Yes.

Q. Who were they?

A. Well, it's a large list. Intel obviously is a big customer. There was, you know, MIPS was a potential customer. Anybody who manufactured computers at the time would have been a potential customer.

Q. What about at the time who did you consider to be potential manufacturers of the product?

A. All of the DRAM makers. We from the very early stages wanted to -- we wanted this to be an open thing. We wanted to license it to everybody. We wanted everybody to manufacture the part.

So every DRAM manufacturer there was. Toshiba. NEC. Micron. IBM. It turns out IBM was, at the time at least, not only the largest consumer but the largest

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producer of DRAMs in the world.

Q. Not true today?

A. Not true today.

Q. What about then investors, the third group you mentioned? Who were sort of the investors you were thinking of in these early days?

A. Well, I didn't start out knowing that much about it. Through the FTL experience I had met with a couple of investors, and then of course John Cocke introduced me to his friend Andy Heller who was at Kleiner Perkins.

So for various reasons I approached Andy first.

Q. When you say Andy Heller was at Kleiner Perkins --

A. I should give the full name of it. It's called Kleiner Perkins Caufield and -- what was the last one? -- kP -- i can't remember the last one -- KPCB. It's a very large -- it's actually probably one of the largest venture capital firms in the world. It's a very famous company.

Q. What were you hoping these venture capital firms like Kleiner Perkins would do?

A. Well, I wanted them to get excited and give me money, and help, too, but mostly money.

Q. What was your plan as to how they would give

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you money to do this company?

A. It's the usual thing. You go in and show them what your idea is and tell them how great you are, and if they like you, they will typically start talking to you about how much money do you need and how much of the company can they own, so they put in a certain amount of money in exchange for a certain percent of the company.

Q. In this early 1990 time frame after you came back from California from your stint in Illinois, did you have conversations with companies in these various groups you've described other than just the ones you've mentioned with the fellow at IBM and Andy Heller?

A. Well, Andy brought me in to meet all the partners at Kleiner Perkins, so we had a series of meetings with Kleiner Perkins.

I also met with some other firms. I had had previous experience with Merrill Pickard Anderson and Eyre, which is another venture firm -- you can abbreviate it MPAE if you want -- and also another venture firm called Mohr Davidow.

Q. That's M-O-H-R?

A. M-O-H-R, comma, Davidow.

And I don't remember how I was introduced to

8100

them, but I talked to them, too.

Q. Would you prepare materials to show them? Would you give them things in writing?

A. Yes.

Q. I have a binder in front of you, and I'm just going to give the same binder if I can to the complaint counsel.

And turn to, if you would, what I hope is the first document in your binder, which is RX-15.

A. Okay.

Q. Directing your attention to what has earlier been marked and admitted as RX-15 -- you can bring it up on the screen if you could -- can you tell us what this document is?

A. It appears to be a draft of an early business plan, partly from the date and partly from the fact that there are large pieces of it which are really just outlines and not finished.

Q. You'll notice on the first page it has a date of June 26, 1989. Do you see that?

A. Yes.

Q. And then if you look to the second page, page 2 at the bottom, you'll see "draft" in the lower left corner, August 18, 1989. Do you see that?

A. Yes, I do.

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Q. Are those two dates around the time frame you were trying to put something like this together and having these meetings you've just told us about?

A. Yes.

Q. Going back to the first page of it, if you would, you have -- it says "RamBus Inc." down there, with a capital R and a capital B, and then an address in Berkeley. Do you see that?

A. Yes.

Q. Was there a company Rambus, Inc. in June or August of 1989 ?

A. No. We hadn't actually formed the company yet.

Q. But you'd picked a name for it?

A. We had picked a name, yes.

Q. And who picked the name?

A. I think I did. That's my memory anyway, that I did.

Q. And how did you come to settle on that name?

A. Well, we're a RAM. We were going to put a bus on a RAM, so that sort of came to mind, and I have a vague recollection that there was a very popular movie called Rambo, so Rambus sounded like Rambo, so it seemed cute.

Q. When you say "a RAM," why -- what's the

8102

relationship between RAM and DRAM?

A. Well, a RAM is a more general kind of DRAM. RAM means random access memory. It means you can read or write any arbitrary address with pretty much the same speed.

Q. And the address in Berkeley, what address was that?

A. That's my home address.

Q. So you didn't have an office at this point in time?

A. It appears not, no.

Q. I want you to turn if you would to the second page of this document, still RX-15, and look under the heading 1.2, which says "Rambus and RamStack product descriptions."

A. Yes.

Q. And then down there, there's three bullet points, and if you would, tell us what the first bullet point refers to.

A. It says "a highly optimized 8-bit bus and interface built into each DRAM and/or CPU chip."

This is back to what we wanted to do was to do a DRAM, to implement a DRAM that had more or less the functionality of a memory card in an older-style system, so it was a -- the bus and the interface is

8103

sort of a smart memory card.

Q. And are the bus and the interface different things as you used the terms here?

A. Yeah, actually they are. The bus in my view is the actual connections between the chips, and the interface is the part in the chip that talks to the bus.

Q. And tell us then what the second bullet point refers to where it says, "The ability to address individual chips and even individual memory arrays within a chip." What does that refer to?

A. Because each chip was like an independent memory card, that meant that when you made a request, it would go to a single chip, and so hence you had to be able to address any arbitrary chip because you needed to talk to all of them, so you could actually talk to any individual chip and it would return the full data bandwidth back.

Q. When you say "a memory card," tell us what the difference is between a memory card and just a DRAM.

A. A memory card is a collection of DRAM chips, anywhere from a few, although in these days it was typically a few hundred, it was large.

Q. And what was on that card besides just some number of DRAMs?

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A. A bunch of logic that would implement the controller and the bus interface. And those would be separate chips from the DRAMs.

Q. And you -- are you describing here that you wanted to put that logic and controller onto a DRAM itself?

A. Yes.

Q. Could you -- i'm going to ask you, with the court's permission, if you could draw one more picture for us, and flip to the next page in the pad if you would. And draw us just pictorially what a DRAM was like in the 1988 -1989 time frame and how you envisioned a DRAM looking to be like in the memory card.

A. So I'll take it a little bit -- one step even further maybe even a little bit.

If you look at an old-style memory card, you would have a bunch of DRAM chips on it, so I'll just draw one, and somewhere there would be a bunch of logic. This would be the bunch of chips. And these chips are not DRAMs. That would drive the address lines to the DRAM chip. This is to a single DRAM chip and then some data would come back to it or could be driven to it. This is typically one way or the other.

So essentially it was a fairly dumb thing.

8105

You would give an address, there would be a couple of lines that would say whether I wanted to read or write, and then you would either, you know, read the data and some stuff would come back or you would write it.

Q. I'll interrupt you for a second because I want you to put some labels on it before we go too far.

Write "memory card" on the big outside box.

A. **(Witness complies.)**

Q. And then write -- okay. Go ahead. And then write "DRAM."

A. Okay. I did actually.

Q. Oh, you did.

And then the other set of chips that the data goes back into, label those, if you would.

A. **(Witness complies.)**

Q. And how have you labeled those? Controller?

A. Controller, yes.

Q. Okay. So is there more then to your description of a memory card?

A. I was just going to say that's what happens with one DRAM chip.

Q. Start over, if you would, Dr. Farmwald.

A. You would replicate this same thing over and over again. You'd have another DRAM chip with either

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shared or different address lines going to it and some different -- generally different data lines coming back, and that would be replicated as many times as you needed to to fill up the card with DRAMs.

Q. Now, on the bottom half of this chart if you would draw what you were envisioning to be a DRAM that was like a memory card.

A. So I'll do it this way. Here's a single DRAM chip. What we wanted to do is -- inside the chip there's a piece of silicon, a dot -- it's the same thing in here -- that actually implements it, and then there's wires that come off of that to the pins in the chip, and what we wanted to do was put a little bit of logic on the DRAM chip itself.

So here's the core of the DRAM with all its logic. We wanted to put a little bit of logic along one edge and have drivers that directly drove the pins so that you could connect this chip to another chip that sits right beside it.

I'm not very good at drawing, but I'll try. It's like this **(indicating)**.

So this chip could talk to this, the next chip, which could talk to the next chip, which could talk to the next chip, but the whole thing would be really tiny.

8107

Q. So on that first chip you drew, label it "new DRAM."

A. Okay. Can I -- how about Rambus DRAM?

Q. Okay.

And then separately label the logic you described would be on that chip.

A. It's really tiny, so I'll draw an arrow to it.

Q. And you've written "controller" as the label?

A. Yeah.

Q. And did you think that that logic would be control logic as you showed us up on the memory card?

A. It had to be simplified. This -- because in order to make it fit on a single chip and not take up very much space, we had to simplify it drastically over what this logic was. But in essence it was the same thing; it was just simplified a lot.

Q. Okay. Thank you. If you would resume.

Could I approach to label that, Your Honor?

JUDGE McGUIRE: Yes.

MR. STONE: This will be DX-253.

(DX Exhibit Number 253 was marked for identification.)

BY MR. STONE:

Q. Taking you back, Dr. Farmwald, to the exhibit that is in front of you, which is RX-15, and asking

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you again to look at the second page, you've just talked a bit about that second bullet point, and I'd ask you now to look at the third bullet point, which says, "A very dense three-dimensional packaging scheme made practical only by the inclusion of the bus interface."

And can you tell us if you would what you were referring to there?

A. That's what I just described here where you stack the chips, essentially you just stack them on top of each other so that conceptually along at least one edge of all the chips is -- they talk to each other along some traces that go along one edge of the chips, so they can be stacked very tightly together.

Q. Turn if you would to the third page of RX-15.

And here you have a description under the heading 1.3, Market Analysis, that I'd like to ask you about for a moment.

You earlier told us a bit about your understanding of the cost of building a fab, I think you called it, and there's a reference in this first sentence to a DRAM fabrication plant. Is there some relationship between that and a fab?

A. Yes.

Q. What's that relationship?

8109

A. Fab and fabrication plant are the same thing, yeah. It's the factory in which you build chips themselves.

Q. And in this section here, Market Analysis, was this the type of description that you were trying to give to potential investors and others in this early time period?

A. Yes.

Q. I want to ask you to look at the second paragraph here, and you'll see at the bottom of the second paragraph there is a sentence which goes, "The assumption of a 50 percent penetration of the established DRAM market within five years is not unrealistic, in view of the standardized cookie-cutter approach in the industry."

Do you see that sentence.

A. Yes.

Q. Could you explain to us if you would what you meant by that sentence.

A. In many parts of the chip industry but especially the DRAM industry, whatever the most popular chip is becomes even more popular, because if one person is using it, then that makes it cheaper, so other people start to use it, which makes it even cheaper. So typically, it's been true for quite some

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time that whatever the most popular chip is, it has way more than 50 percent market share.

Q. And when you say "standardized cookie-cutter approach," we've heard a lot of testimony in this case about standards set by organizations like JEDEC. You've heard of JEDEC?

A. Yes.

Q. Were you referring here to standards like those set by JEDEC?

A. Absolutely not. Up to this point DRAMs had not been done by standards committees. It had been done by whatever the chip that came out that people started to use sort of became a standard just by sort of people adopting it. We thought our chip could become the standard just by virtue of people adopting it and using it.

Q. In the last sentence in this paragraph where it says, "DRAMs made by different vendors all share a common interface" -- do you see that reference?

A. Yes.

Q. What did you mean there by "common interface"?

A. It was more of a practical statement that because of this approach that people want to use -- if one part starts to become popular and common, then other manufacturers start to build the same part too,

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because that's what people are using, so things very quickly coalesce around whatever the popular thing is. It's a -- it's just a -- been a fact of life in the DRAM industry for quite a long time.

Q. And then in the last part of that sentence where it says, "New technologies generally are either adopted by everyone in the industry or by no one," what did you mean when you wrote that?

A. If a new technology is desirable and it starts to get adopted, then everyone picks it up very quickly. Conversely, if it's picked up only by a small number of people, then it tends to remain expensive and people generally stop using it at some point, so that's what I meant by either everyone or no one.

Q. And then turn if you would to page 9 of Exhibit RX-15.

And I want you to look under the heading Rambus Company Profile if you would.

The first paragraph, I want to direct your attention to the second half of that first paragraph that begins, "Unlike the chaotic situation today in the RISC microprocessor world." Do you see that sentence.

A. Yes.

Q. It then goes on to say, "This will be

8112

accomplished" -- well, let me go back.

The full sentence that I just started to read says, "Unlike the chaotic situation today in the RISC microprocessor world where competing families of products provide only slight differences in functionality, the patented Rambus technology still has the opportunity to establish a single high-performance DRAM standard."

What did you mean by that sentence.

A. We thought our ideas were sufficiently interesting and advanced and had a long enough life and solved a compelling enough problem that we could convince initially a few people and then from there everybody to use our interface and our ideas.

Q. You go on to say, "This will be accomplished by offering all interested DRAM and CPU vendors a sufficiently low licensing fee (2 percent) that it will not be worth their time and effort to attempt to circumvent or violate the patents."

What were you meaning to say there?

A. Well, again, we thought we had invented a pretty compelling idea. We were still working on the patents at this point in time in 1989 , we didn't file until 1990 , but we thought it was pretty significant.

We thought it was going to be pretty hard to

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implement. It was a pretty large leap forward. We were going from, you know, 5 or 10 megabytes per second per DRAM, which was the current state of the art, to 500 megabytes. It was a big leap. I mean, it was a factor of a hundred. It wasn't a factor of two or anything like that.

So we thought that between the complexity and the fact that we felt that our patents would be good even, though we hadn't filed them yet, that a smallish royalty would be palatable to people and that they would go for that.

Q. We've heard various people refer to your ideas in the course of this case as revolutionary. Would you agree or disagree with that characterization?

A. We think they probably were, yeah.

Q. They probably were?

A. In both the good and the bad sense, in the sense that they were revolutionary in that they were substantially different but also revolutionary in that a lot of people didn't like them, so...

Q. We've also heard some other developments in this industry described as evolutionary. Is that a term you have some understanding of?

A. Yes.

Q. And would you consider what you were doing as

8114

an evolutionary development in the DRAM industry or not?

A. No. I would say it's revolutionary.

Q. And what would you describe as something that was evolutionary?

A. Well, you could look at it from several different points of view. I think the simplest one is how much performance gain you got. If you go up by factors of two or four, that's probably evolutionary. And we went up by a factor of 500; I'd say that's revolutionary.

Q. You mentioned sort of the ideas you had which you thought were critical to your inventions.

Could you -- i'm not asking you to give us hundreds of patent claims here or anything like that and I'm sort of asking you in a nonpatent context, if I can, just as an inventor, if I might, to list for us if you would sort of those ideas.

If it's helpful to the court, maybe he can make a list on the chart of the ideas he felt were part of their original inventions, Your Honor?

JUDGE McGUIRE: Yes. Go ahead.

THE WITNESS: At least in my mind, I think about it in two different categories, so I'll sort of try and outline it that way.

8115

A bunch had to do with the idea of putting a bus protocol inside the DRAM, and so these are sort of more architecture-type things.

And this note has to do with registers, having a pipeline, block transfers, having a protocol at all actually.

So a bunch of things relating to what -- the idea of putting a simplified bus protocol inside a DRAM, because simplifying it was actually a pretty important thing. You couldn't just blindly take the same bus protocol that you'd use in a giant backplane bus and put it in a DRAM, so there had to be a lot of cleverness -- well, there had to be a lot of thinking -- let's put it that way -- to try to make it simple enough to put it inside the DRAM and yet fast and flexible, and so on and so forth.

I mean, there's -- i can -- if I think harder, I could come up with more, but there's a bunch of things relating to the bus protocol.

Q. I'm going to interrupt you for a second and ask you to just take a moment and tell us what, when you wrote "register" down --

A. Well, the fact that there are registers inside the DRAM, that that was something new at the time, that you could have control registers that you could read

8116

and write that were separate from the memory itself but that controlled the functionality of the DRAM or the interface itself.

So registers, you know, control registers.

Q. When you say "pipeline block transfer," what are you referring to there, if you could help us understand?

A. The concept here is that I can send the request -- i have a bunch of DRAMs. I have more than one DRAM connected potentially to this bus, so the CPU can send a request to one DRAM and, while that DRAM is thinking, it can send another request to a different DRAM and then go back to the first DRAM, get its data back, and then go to the second DRAM, get its data back.

So that's pipelining. You're sort of getting two things at once, is one way to think about it.

Q. When you say "block transfer," what does that mean?

A. The idea of pulling back instead of one byte at a time -- computers don't use one byte at a time. Computers use typically a cache line at a time, which is typically 128 or so bytes. It's a fairly large number. So why not just bring the whole block back at once. Instead of saying here's an address, give me the

8117

bytes, and here's an address plus one, give me the next byte, which is how the normal DRAMs worked at the time, why not just give me the whole block.

Q. And when you say you were going to put the protocol -- that the very idea of a protocol was something that you thought --

A. Exactly. Each issue was having a simple protocol, too. These things are part of the protocol. The protocol is sort of the more general thing of what these are subsets of.

Q. And was there a second part that you were going to --

A. Yes.

Q. -- describe?

What's -- let me ask you, Dr. Farmwald, slow down if you can and let me finish, please.

And if you would describe the second part of your ideas that were part of what you thought was the technology you were developing.

A. The other part had to do with the bus interface itself, or let's just call it the interface, the high-speed -- in fact, really the way I want to think about it is a high-speed interface. Because once you got a bus protocol, that doesn't necessarily mean it's going to work fast.

8118

Now, the other part of the coin is how do you make it run fast, because it's got to work together. The protocol allows you to have something that can run fast and the high-speed interface is what actually makes it run fast.

So the high-speed interface itself, it mostly has to do with circuits. And it's the bus -- well, just in general the driver -- i'm just going to call it the drivers and receivers.

The clocking, the use of DLLs -- in fact in my view one of the most significant things is the use of DLLs and PLLs to synchronize the clocks, the use of dual-edge clocks or using both edges of the clocks.

I'm sure there's more, but that's what I think of right now.

Q. Before I ask you to sit back down, could you tell us -- we heard a lot about the latter two on this list, but could you explain the drivers and receivers to us.

A. Yeah. This also generates a list of things. The drivers -- in order to send a signal from one chip to another, you have to sort of push the electrons, so the drivers are the things that push the electrons, you know, out through wires into the next chip, and the receivers are the things that sort of look at the

8119

electrons coming in.

So it's the things that, you know, drive and receive the signals. Those are circuits that need to run very fast in order to run at two nanoseconds. Typical delays at the time in CMOS were five nanoseconds or so, so in order to build drivers and receivers that could run at fractions of two nanoseconds -- you know, you can't -- they have to run faster than two nanoseconds to run at two nanoseconds -- required a lot of cleverness, mostly on Mark's part, not mine.

And also in order to do that we had to reduce signal swings. The normal CMOS signal levels at the time switched between zero and five volts, so a five-volt signal swing. We went down to a one-volt signal swing and we used current mode logic in determinated lines instead of the way normal things were done.

All of these were done for the purpose of making things run fast.

Q. I want to ask you more about that.

When you say the delays were five nanoseconds in CMOS at the time, what were you referring to.

A. The average time that it took to get from the -- if I take a gate, you know, maybe an and gate

8120

that says that both the inputs are high, then the outputs are high, the delay from when the signal comes into that gate to when it comes out could be typically five nanoseconds or so.

So that's a problem because if -- typically the gate delay is also the same as the slew time. Signals -- i can draw on the side here **(indicating)** --

Q. You said slew?

A. Yes. Slew rate.

The way you send a signal is you either have one voltage -- in this case it needs to be zero volts and five volts, so the signal volt will go from one level to another. It's a change. And normally you draw it as if it was instantaneous, but it's not. In fact, there's a time it takes to go from the low level to the high level. That's called the slew rate or the rise time. And that time is typically roughly the same as the gate delay.

So -- and that's a problem. Again, if this time, rise time, is of five nanoseconds and we want to design a bus that runs at two nanoseconds, that doesn't work. You have to fix that.

So Mark had to design drivers and receivers out of the same crummy logic that everybody else was using -- that was a key -- that ran much faster.

8121

Q. When you say "logic," what do you mean?

A. The gates. The gates themselves.

Q. And the gates are devices etched in silicon?

A. Exactly. Little devices etched in silicon, exactly. Sorry.

Q. I think that covers what I wanted you to write up there, if you could resume the stand.

Could I mark it, Your Honor.

JUDGE McGUIRE: Yes. That will be marked DX-254.

(DX Exhibit Number 254 was marked for identification.)

BY MR. STONE:

Q. Dr. Farmwald, I want to direct you now with this background back to RX-15 and back to page 9 where we were a moment ago and ask you again to try to stay slow in your responses here for me if you would. I want to direct your attention to the second and third paragraphs under that heading 3.1.

The first one talks about "Rambus technology provides several strong barriers to entry for potential competitors, the strongest of which are its patents and the overwhelming 'unfair' advantage its technology enjoys," and then it goes on from there.

Tell us if you would what you were referring

8122

to there when you were talking about barriers to entry.

A. We felt, still feel actually, that the ideas were very new and very interesting and that the patents themselves were going to be pretty broad because the ideas were new and had not been looked at before, and so a good, strong, broad patent is a good protection we felt.

We also felt that you can have broad patents on an idea that doesn't have any advantages. We also felt that the idea had advantages, that it was a lot faster, a lot denser, which means you pack it together tighter, a lot lower power and a lot cheaper than any other approach we knew of, so we thought all those things together was pretty compelling.

Q. Did you at the time -- and I'm talking now about this '88-89 time frame -- did you then give thought to whether there might be other ways, other than the ways you've described, to speed up the transfer of data from a DRAM?

A. Yes, we did.

Q. And did you think that there were or were not other ways of doing it than what you were doing?

A. We actually made an effort, Mark and I, to sit down and carefully think of all the possible ways we

8123

could of doing this, partly to make sure that our approach was the best one but also partly to understand all the different approaches that we could, so yes, we thought about that pretty carefully.

Q. And did you conclude that there were other ways of doing this thing overall than the way you had done it?

A. We concluded that at least some of these ideas in our view were absolutely necessary, and in fact we couldn't figure out a way around some of these ideas.

Q. Let me direct you to the next paragraph.

When you say Rambus -- it goes, "Furthermore, Rambus is not only stiff competition from a technical point of view," and then it goes on from there.

When you said "stiff competition from a technical point of view," what were you referring to there?

A. We thought the part had enormous technical advantages because it was faster mostly.

Q. Okay. And then you say in the next sentence, you say, "The DRAM industry's penchant for standardization combined with the Rambus marketing strategy of licensing all the major vendors make it extremely unlikely that any potential competitor would be able to gain critical mass enough to challenge an

8124

already established and ubiquitous Rambus chip."

Do you see that sentence.

A. Yes.

Q. When you said "potential competitor" in that sentence, what were you referring to?

A. An alternative interface, alternative high-speed interface.

Q. So a different design or --

A. A different design, a different idea.

Q. And when you talk about the penchant for standardization, is that what you described for us earlier or something different?

A. It's just what I've described earlier, that just because of the nature of the business, they all want to build the same part.

Q. And you also mentioned here the Rambus marketing strategy. Was there a strategy in 1989 ?

A. There was the beginnings of one.

Q. What was the beginnings of the strategy as you envisioned it then?

A. We were going to try and find customers for our parts, big customers, and we were going to try and license all the DRAM makers to build our part to supply those customers.

Q. Okay.

8125

JUDGE McGUIRE: I want to go back over part of that testimony so I'm clear.

When you're talking regarding the DRAM industry's penchant for standardization and your answer was "they all want to build the same part," but in that term, did you mean that it goes through a process by which it becomes an industry standard in the concept of, say, JEDEC, or are you talking about in other ways that I come up with the idea and everyone else just employs it or purchases it?

I mean, I think that term is important when you're talking about standardization.

I mean, how did you intend that in this plan?

THE WITNESS: We definitely intended it in the sense of de facto standards. We felt that the history of the DRAM industry was that whatever part somebody started to use that became popular, everybody else just started copying it.

So there was no standards process; it was just what happened.

JUDGE McGUIRE: So you're saying they could only copy it if they agreed to terms under -- and I assume these ideas are all under patents, so they would have to pay for that use under the patent?

THE WITNESS: That was our intent, yes.

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Because some of the previous -- if I could just add a little bit, the previous standard interface was called the RAS/CAS interface and it had not been patented.

So somebody came out with it and it became popular, everybody else started copying it, but there weren't any patents on it.

JUDGE McGUIRE: Well, I just have an interest in the term "standardization," but yet that's really not how you employed it. You're talking about a de facto standard.

THE WITNESS: Exactly. De facto standards, yes.

JUDGE McGUIRE: All right, Mr. Stone.

MR. STONE: Thank you, Your Honor.

BY MR. STONE:

Q. I ask if you would turn to page 19 of this same document, RX-15, Dr. Farmwald.

And this is under the heading Potential Risks and Problems, and if you can, tell us why you included this in the document, this section, why was this section there.

A. There's sort of a stylized way you do a business plan and having potential risks is something you always put into a business plan, you know, what the potential problems might be.

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Q. And what were the potential risks that you identified in the 1989 time frame?

A. As I said earlier, this appears to have been a draft, so this looks like more the beginnings of an outline. But at that time we seemed to have identified three things, which is -- one is somebody else doing pretty much the same thing that we just don't know about yet and that we couldn't know about until -- you know, we were going to be somewhat -- you know, we're only going to talk under NDA, so maybe they were only going to talk under NDA for a while.

Q. When you say "NDA" --

A. Nondisclosure agreement.

Q. Okay. Slow down a little bit if you would, but tell us on the second point here, Rambus must be established as a standard to effect large royalty payments, what did you mean by that, and again if you would focus on the issue of what you meant by "standard" in this context.

A. To us, and I still think of it that way, but certainly at the time, the standard is it's just the part that everybody uses. It's, you know, when you think of a memory chip, at that point you thought RAS/CAS interface. There was no standards body that had subdivided that. It was just that was it.

8128

So we wanted to become the new standard, the part that everybody used.

Q. And when you said here "large royalty payments," what did you have in mind in this time frame?

A. All along we wanted to have sort of single-digit -- lowish single-digit royalties. We thought that was reasonable and fair given sort of our contribution to the thing. But the DRAM market as a whole is very large.

So that's what we meant. It's a relatively small number times a fairly large market.

Q. What made you at the time in your mind think that a smallish single-digit or low single-digit number was fair in light of your contributions?

A. Well, there were two, maybe three ways of thinking about it. One is what others were charging for DRAM patent royalties.

At the time, my recollection was that TI was still charging in the range of 8 to 10 percent for royalties on DRAMs. It was a very large number. But they owned some pretty fundamental patents on the insides of DRAMs, too, so that seemed like an upward bound. It seemed like that's what we think they were charging but ours should be a little less than that.

8129

The other thing we thought about was if you try and charge too high a number, people will just be scared off. I mean, you know, you're trying to convince people to adopt your part, so you can't go in and just charge someone, you know, a completely obscene number. You have to charge something reasonable.

So all of those factors sort of said that, you know, small, you know, low single-digit numbers seemed fair.

Q. Okay. And the last point on this page 19 of Exhibit RX-15 where it says, "Will patent be enforceable and broad enough to stop imitators," why was that listed as a potential risk?

A. In the long run, no matter what, even if the numbers are small, even if the number is 2 or 3 percent, which in general is a fairly low number, if people can get out of paying, they will.

And so the patent has got to be pretty good. It's got to be, you know, both broad enough that it's difficult or impossible to get around and enforceable. It has to be legal and something that will hold up in court.

MR. STONE: Your Honor, I'm going to move to another exhibit. Would now be a convenient time for

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the court?

JUDGE McGUIRE: Let's do that. Let's take a ten-minute break and we'll return at that time.

(Recess)

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

MR. STONE: Thank you, Your Honor.

BY MR. STONE:

Q. Dr. Farmwald, I'd like you to turn if you would to your next document in your binder, which is Exhibit CX-1702.

And if you would, take a look at this document and then if you can tell us what it is.

A. I'm pretty sure it's my notes -- it's my handwriting. I know that. It's the notes from a Kleiner Perkins venture capital meeting, and I'm pretty sure it's not the first meeting that we had with them.

Q. And it has a date on the first page at the top. Do you see that? Is that the date of the meeting?

A. I believe so, yes.

Q. What date is that?

A. 8-28-89.

Q. And I want you if you would to turn all the way

8131

to the last page of this document, which is page 6, and tell us if you can whether page 6 of Exhibit 1702 is part of the same set of notes or different.

A. Actually it looks like it's an earlier set of notes because the date is different, so it looks like it was some months earlier, but it's with one of the people from Kleiner Perkins, Andy Heller, who was the gentleman I told you about before from -- ex-IBMer.

Q. So I want to direct you to just the first five pages if I can, leaving out page 6 of Exhibit 1702, CX-1702.

Does this appear to you to be notes you took at a meeting or in connection with a meeting.

A. Yes.

Q. If you'd look at the third page of Exhibit 1702, there's a series of names at the top.

Can you tell us what these names refer to?

A. Yes. These are various of the partners plus a lawyer who were at this meeting, John Doerr, Andy Heller, Bernie LaCruit and Roger Borovoy.

Q. And then in the names below that, we see your name, and what's the name just ahead of yours?

A. Jim Mannos, M-A-N-N-O-S.

Q. And what was his role or involvement at the time?

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A. He was initially being considered as a VP of marketing for Rambus, so he came along with me to some of the early meetings.

Q. Was he helping you at all?

A. He was helping me, yes.

Q. And then are the names at the top, the four names at the top, are those people who were there on behalf of Kleiner Perkins?

A. Yes.

Q. Can you give us just a little bit of background, who you understood John Doerr to be at the time, what was his role?

A. John Doerr is a senior partner at Kleiner Perkins, actually a very famous guy, started a lot of companies, one of the founders of Sun Microsystems, but very many companies.

Q. And Andy Heller, the next name, you told us who he was?

A. Yes.

Q. And the next name, Bernie -- how do you say that?

A. "Bernie LaCruit."

Q. What was his position at the time?

A. He was a partner. He had just joined not too long before this. I can't right now remember his

8133

background, but he was a really well-known guy, too. I just can't remember where he had come from before Kleiner Perkins.

Q. And then the last name you said was Roger Borovoy?

A. Yes.

Q. And was he at Kleiner Perkins?

A. He was not. He was an attorney and sort of associate of the firm.

Q. And did you know him by reputation or personally?

A. I did not know him personally. I knew him by reputation.

Q. What was his background as you understood it at the time?

A. He was Intel -- he had been Intel's attorney for quite a long time, so he's a very well-known guy because of that.

Q. Did you have an understanding as to why an attorney was at this meeting?

A. I believe that it was -- that's why I'm pretty sure this wasn't the first meeting. I believe we had had a first meeting and that they wanted to evaluate -- you know, the strength of any potential company built on these ideas depends on the strength of the ideas,

8134

and so I believe that they had hired Roger Borovoy to investigate how good the patents could be.

Q. Was he a patent attorney as you understood it at the time?

A. My understanding was yes.

Q. And staying if we can on page 3 of these notes, you've written "Roger begins" and then there's a discussion down below that.

What do these refer to?

A. So these are my notes of Roger's comments after having talked to us at some earlier meeting, so this was his feedback mostly to Kleiner Perkins but somewhat to us also.

Q. And what did he tell you at this meeting as best you can recreate from your notes if you would?

A. He thought -- the first point is he appeared to think that the packaging patent was the wrong approach.

Q. I'm going to interrupt you there if I can.

When you say "packaging patent," what was the reference to as you understood it at the time?

A. Again, this is from a long time ago, but my best recollection is that one of the patents I wanted to pursue was the idea of the stacked chips, being able to build a 3D stack of chips, and I think he thought

8135

that that was, although patentable, not probably the best approach.

Q. Again using these notes if they can help you recall, what else did he say after the comment about the packaging patent?

A. Let's see if I can read it.

He thinks that Rambus can get even more packaging patents, but much depends on getting a standard which depends on our patents. He thinks that there may be as many as ten to twenty patents which together give good coverage.

So he seemed -- i do remember that he was very positive. He thought we had a very significant idea that potentially had a lot of patents that could derive from it.

Q. And in these notes you underlined the word "standard." Do you see that?

A. Yes.

Q. And at this time was there any discussion of standards set by standard-setting organizations?

A. No.

Q. What was the discussion about standards at this meeting with Mr. Borovoy and the various partners from Kleiner Perkins?

A. We had to convince people to use this part and

8136

we had to convince enough people so that it became the most common part, it became the default part that people would use. That's our definition of standard. It's the standard part that people use.

Q. Look if you would a little further down in these notes. It says "Andy" and then there's an underlined phrase, something memory from IBM.

Do you see that?

A. Yes.

Q. What does that refer to?

A. I don't remember. I've -- i don't remember unfortunately.

Q. And then turn if you would to the next page.

And let's focus on the top half of the page maybe if we can.

Again, there's a reference to standard, of making the Rambus a standard, which is underlined, and then you go into "Jim discusses."

And if you would, take a look at those notes down to where it says "IBM" in the middle half of the page and tell us, if you can, using these notes as an aide, if they are, what was discussed in this portion of the meeting.

A. Well, we clearly needed some large consumer of DRAMs to choose us. I mean, that's how you became a

8137

standard at that point, is you got somebody big to use you in high volume.

So it actually says: "Get maker and user of DRAMs. IBM is top choice."

That's pretty clear. IBM at that point was both the largest producer and consumer of DRAMs in the world back then.

We also thought that Sony was important and we thought that video games were important as users of the chips.

Q. And what's the next line of the notes say?

A. Important issue is nailing down a few major users.

Q. And after that, what did you write?

A. Discussion of how to sell to IBM, high-end machines and workstations.

Q. And then beneath that it says "Motorola/Toshiba"; is that right?

A. Yes.

Q. And then what does it say next to those companies' names?

A. As partner.

Q. Do you recall what happened with respect to Kleiner Perkins following this meeting?

A. Immediately following this meeting they, mostly

8138

through Andy's help, we started to make -- to go into serious discussions with IBM as a customer.

Q. How did Andy help you in that regard?

A. Well, he had a huge number of contacts there given that he had just been an IBM fellow, plus he's a very outgoing, forceful character, so he knows everybody. So he pushed his contacts at IBM to talk to us.

Q. And did they?

A. Yes. But it took a little bit. IBM at that point -- again, IBM was by far the largest computer company in the world, and they had gotten a little bureaucratic and they wouldn't sign an NDA with a small company that they didn't know anything about.

So after a lot of -- i can remember this quite while. But after a lot of pushing back and forth, they hired a retired IBM fellow and I had to fly to Poughkeepsie, New York, and I sat in his backyard and I described Rambus to him. He then wrote a report to IBM, and then a few days later they actually agreed to sign an NDA with IBM instead of just with this guy.

Q. And that all started with Andy Heller's help?

A. Yes, that all started with Andy Heller.

Q. Let me ask you if you would to look at the next document in your binder, which is CX-1750. Take a

8139

moment to look at those if you would and if you can tell us what these notes are.

A. Bernie LaCruit -- so these are -- and Mark Bailey was another partner --

Q. Let me back you up.

Are these your handwritten notes.

A. This is my handwriting, yes.

Q. Okay. And what are they notes of?

A. Of a meeting about three weeks later with -- another Kleiner Perkins meeting.

Q. And who was the meeting with?

A. Again with Bernie LaCruit and with Mark Bailey.

Q. And the date on the document is September 18, 1989 ?

A. Yes.

Q. And is that the date the meeting occurred?

A. Yes.

Q. And what was discussed in this meeting?

A. It appears that they were giving us the feedback from a partners meeting, a Kleiner Perkins partners meeting where they all agreed whether they wanted to do the investment or not, and their feedback, which appeared to be mostly positive, that they liked the technology. There's some questions that they'd like to go further on. And they weren't quite ready to

8140

decide whether to invest yet or not.

Q. I want to direct you if I can to the middle of the first page where it says "key to success."

Do you see that language.

A. Yes.

Q. Key to discuss is establishing de facto standard?

A. Yes.

Q. What did you mean in your notes when you wrote down "defacto standard"?

A. This is of course their feedback to us, so I'm just taking notes from them, but I think it's pretty clear. We had to find a number of high-volume customers and high-volume producers to produce the part so that it became the part that everybody was using.

MR. STONE: Your Honor, at this time I'd like to offer CX-1750 into evidence.

JUDGE McGUIRE: Any objection?

MR. ROYALL: No objection.

JUDGE McGUIRE: Entered.

MR. STONE: Thank you, Your Honor.

(CX Exhibit Number 1750 was admitted into evidence.)

BY MR. STONE:

Q. Let me ask you to turn if you would to the next

8141

document, RX-82. And take a moment if you would to flip through it and just describe in general terms for us if you can what it is.

A. It's an early slide presentation that I believe we probably would have given to venture capitalists, to potential investors.

Q. Is this a document that you had Andy preparing at the time?

A. Yes.

Q. And on the cover I notice it has two names, Dr. Mark Horowitz and Dr. P. Michael Farmwald. That refers to you and Dr. Horowitz?

A. Yes.

Q. How would a document like this be used at a meeting with a venture capitalist?

A. This was before they had projectors that you connect to a computer, so you'd bring a stack of transparencies -- these would have been turned into transparencies -- and then you'd use an overhead projector to show it to them.

Q. And there's a date on the bottom of this document.

Is that roughly the time frame at which it was prepared.

A. Roughly, yes.

8142

Q. And there's some initials alongside the date. Do you see that?

A. Yes. JLM.

Q. To what does that refer?

A. Almost surely that refers to Jim Mannos.

Q. Who was helping at the time?

A. Who was helping, who was helping to edit some things.

Q. I want to ask you about a couple of the slides in Exhibit RX-82 if I can, and if you would, turn to page 6.

What does this slide depict or communicate?

A. It's a list of what we viewed as our overwhelming advantages for why we could win in the marketplace.

Q. And let me ask you about the last bullet point, the one that says, "Use existing DRAM fab technology and designs, only change the interface."

What was that meaning to refer to or what did you mean by that?

A. DRAM fabs tend to be specialized things. They're built specifically to build DRAMs and there's a history behind them.

So there's several different kinds of fabrication plants. There's ones that you use to

8143

build microprocessors, there's ones that you use to build DRAMs and other things, and they tend to be different.

So what we had to do was come up with an interface that was compatible with the processes that were used inside a DRAM fab and not with a CPU fab. CPU fabs tend to produce faster parts, but they also tend to be more expensive parts, so we couldn't use that kind of logic. We had to use DRAM kind of logic.

Q. Well, when you talk about an interface here, we've heard something in the course of this case -- and you may have heard it when you were here for the openings -- about a narrow bus or a narrow bus architecture. Was that what -- did you mean that when you said "interface"?

A. I meant the bus architecture, yes.

Q. Did you mean something that might be described as a narrow bus?

A. I don't think I ever thought about it as a narrow bus. We had a set of ideas that implemented a bus. Along the way we would pick implementation choices that made sense at the time.

So the first bus we picked was a 9-bit-wide bus because that's what we could fit on the edges of the chips that existed at the time. Later we went to

8144

wider buses because we could fit more pins on the chip.

Q. Was there anything about your ideas that you wrote up on the demonstrative we have up there, which I think is DX-254 -- were any of those ideas you wrote up there ones of using what might be called a narrow bus? And that's the chart behind you.

A. Generally not. A few of them allow narrower buses to work better, but I don't think they're at all specific to narrow buses.

Q. Let me ask you to turn to page 9 of RX-82 if you would.

Is this -- can you tell us what this page lists here?

A. It's a description of the first-generation Rambus interface.

Q. The second bullet point, "Uses a custom signal interface at 500 megahertz (two nanoseconds)," and then it has some bullet points under that, what did you mean to communicate here? And if you can compare it by the chart you drew, DX-254, that might be helpful.

A. I'm actually not sure I understood the question. Sorry.

Q. That's okay.

8145

Just tell us if you can what are the various points you meant to convey there in the second bullet point.

A. These had to do with the high-speed interface that I showed here **(indicating)**.

Q. On DX-254?

A. Yes.

So it's to some extent more or less the same points, maybe slightly different ordering. A very low voltage interface, which means low signal swing interface. Special drivers and of course receivers, too, to drive and receive that low signal swing interface.

Controlled impedance transmission lines. When I talked earlier about the speed of light, I did simplify things a little bit because it's a little bit more complicated than just how fast the electrons travel. It also has to do with how spread out the signals get. If the impedance isn't controlled, then what happens is I can launch a wave into it, but what happens is the wave will get spread out, which is essentially the same thing as the signal traveling slower, but it's very difficult to undo.

So by controlling the impedance you can keep the signal tighter, the rise times and the fall

8146

times --

Q. Is that something that falls in Mark Horowitz's area a little more than yours?

A. Yes.

Q. Okay. And then you have written there "pipeline transfers," and is that similar to or the same as "pipeline block transfer" that you wrote on DX-254?

A. Yes.

Q. And then let me ask you just one more question on this page.

Look if you would at the very last bullet point, the "allows block mode transfer," and at the very last bullet point under that where it says "1 to 128-byte-long blocks supported." What does that describe.

A. I'd mentioned this earlier. Typical computers don't want one byte at a time. Typically they want 64 or 128 bytes at a time.

So instead of sending the address, getting data, sending the address, getting data, it's better, we felt, to send the address and get a whole block of data, send one address and say now return the whole block of data back, all the words I want together, just do it all, but you need a controller to do that.

8147

That's the key observation.

Q. And earlier today when I asked you a question about bytes and you were doing 2^8 and what that multiplies out to, did you give me the wrong answer?

A. I made a mistake, yeah. I was a little nervous. 2^8 is 256. Sorry. I knew that.

Q. Turn if you would to page 17 of this same exhibit , RX-82.

A. To which page?

Q. Page 17.

This appears -- you have at the top Rambus and RISC, R-I-S-C.

What were you trying to communicate with this particular chart -- or slide?

A. As I mentioned earlier, RISC, which stands again for reduced instruction set computer, at this time was a very hot topic. The idea of RISC computers had come along about five years earlier. It had spread very widely. It was very popular. It was really changing the industry quite a lot.

But because of the way it spread -- it had been more or less invented at IBM, but he had sort of talked about it -- John had talked about it at various universities, and then they had sort of reinvented it and changed it, so there was a lot of different RISC

8148

versions, a lot of different computers that use RISC ideas, but no one company sort of pulled it altogether and did all the things in one place.

So we felt that Rambus' ideas were as revolutionary as RISC technology -- I still think that's true -- but that maybe there's an opportunity since we invented it within a single company that we could sort of not only patent it but sort of keep some control of it so it didn't go off into incompatible directions.

Q. And how did you at the time envision that you would keep that control so it didn't go off in incompatible directions?

A. Well, that there would be a Rambus standard that we would in cooperation with our partners specify but that we would sort of in some sense own. We would do it with partners. They would have feedback. They would be allowed to change things, but any change that would be made would be propagated to everybody. It wouldn't be custom. We wouldn't do custom versions of Rambus for each company, but rather we would take all the good ideas, put them together, and then everybody would use the same good ideas.

Q. Now, I want to jump ahead in time just a minute and ask you, does that idea of how you would prevent

8149

incompatibility -- is that something that Rambus was ultimately able to do?

A. Yes.

Q. And so how many different designs of Rambus DRAMs are out there?

A. Well, at each generation there's many different versions of the design, but they're all completely compatible. And we've had different generations of the design, which of course aren't compatible because, you know, you do -- the first-generation DRAMs had a certain performance level, 500 megabytes per second. The next generation, which were called direct RDRAMs, more than doubled that performance level, so they weren't compatible, but again they were standardized. There were a number of implementations, but they were all compatible with each other. And now of course we're working on the third generation.

Q. Okay. Let me ask you to turn to the next page in Exhibit RX-82, which is page 18.

What does this particular slide communicate?

A. It's pretty much the business model. It's how we make money. It's who our customers are. We sell directly to semiconductor companies and computer companies.

8150

Q. At this time what were you contemplating you would sell?

A. Technology and consulting essentially. We were selling the concept and the implementation of a DRAM interface standard to DRAM companies and to computer companies.

Q. And then the next bullet point, income is via, how did you contemplate then that you would earn income?

A. Well, we would sell designs, i.e., consulting. We would go work with the DRAM companies to implement the Rambus interface in their DRAMs and other products and they would pay us consulting fees, essentially pay for our engineers, and they would pay us royalties, ongoing royalties, for the use of that intellectual property that would be shipped with their products.

MR. STONE: Your Honor, at this time I'd like to offer Exhibit RX-82 into evidence.

JUDGE McGUIRE: Any objection?

MR. ROYALL: No objection.

JUDGE McGUIRE: Entered.

(RX Exhibit Number 82 was admitted into evidence.)

BY MR. STONE:

Q. Thank you.

8151

Turn if you would to the next document in your binder, which is RX-24.

Can you tell us what this document is.

A. Yeah. I remember it.

This is the nondisclosure agreement that we signed with IBM that was so painful to get.

Q. So this is what happened after the meeting in the gentleman's backyard that you described in Poughkeepsie?

A. Yes.

Q. Let me digress then for a moment -- your Honor, I'd also like to offer then RX-24, which is that letter agreement.

MR. ROYALL: No objection.

JUDGE McGUIRE: Entered.

(RX Exhibit Number 24 was admitted into evidence.)

BY MR. STONE:

Q. Let me go back then. You've told us about meetings with venture capitalists at Kleiner Perkins.

Did you meet with any other venture capitalists.

A. Yes.

Q. Who did you meet with next after Kleiner Perkins?

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A. I don't remember the order, but we met with two different firms. One was called Mohr Davidow and the other was called Merrill Pickard Anderson and Eyre.

Q. And do you remember who you met with at Mohr Davidow?

A. Yes. It was Bill Davidow, who was the named partner of the firm.

Q. Does he currently have a role in Rambus?

A. He's the chairman of the board of Rambus.

Q. Is his role one of a nonexecutive chairman where they don't operate the business day to day?

A. That's correct.

Q. Do you recall your first meeting with him?

A. Very well actually.

Q. Could you briefly relate that meeting to us if you would.

A. Yes. I don't remember how I was introduced to Bill, but I came in, and it was just me presenting, so I presented the plan, you know, something like what we saw before. It was probably fairly similar to that one, you know, slides basically, a few graphs.

And Bill is a smart guy and he used to be a very senior person at Intel before he became a venture capitalist, and so he was getting pretty excited. He really understood what we were doing, was very excited

8153

about it, which is, you know, you like that, when somebody likes your idea.

And I don't know. About two-thirds of the way through the presentation or so, Bill sort of -- if you've met Bill, he's got a -- you know, he's got a strong personality -- he sort of leans forward and said, You really need Intel to succeed, don't you? Because I had been talking a lot about IBM and how we had good contacts there, and so on, and I said, Yeah, but I don't know how to get to Intel.

Q. Why did you need -- why did you think at least you needed Intel at that time?

A. Well, they were at that point still, you know, relatively early in their history, but even at that point probably -- this is from memory -- probably 25 or 30 percent of the DRAMs in the world were connected to Intel microprocessors even at that early day. Of course now it's 95 percent of the world's DRAMs are connected. But it was clear that they were growing like crazy, so clearly they were very important.

Q. So what happened after he asked you if you needed Intel and you said, Yes, I think we do?

A. So we were sitting on opposite sides of a conference room table and so Bill sort of -- he had a chair with rollers on it and he slid the chair around

8154

and turned around, and there was a phone on a little table behind him and he dialed a number from memory -- I actually remember this -- he dialed a number from memory and said: Hi, Betty. Is Gordon in?

I had no idea what was going on.

So he said: Hi, Betty. Is Gordon in?

She says, Yeah, he's busy, but if you want me to interrupt, I will.

So she puts him through to someone named Gordon, and Bill is saying, I'm sitting here listening to someone who's telling me what I think is one of the most compelling ideas I've heard in a very long time and I want you to hear it.

So there was a little bit of discussion, and basically Gordon makes a change in his schedule so that we could come visit them the next day, and then Bill comes back and says, I've got you a meeting with Gordon Moore.

Q. And Gordon Moore was?

A. He's the founder of Intel. The guy who did Moore's law.

I was completely flabbergasted. That's why I remember the meeting so well, because I was completely flabbergasted that somebody could get a meeting that easily and quickly with Gordon Moore.

8155

Q. Did you meet with him the next day?
A. Yes.
Q. And what was his reaction?
A. Mark came along with me. This was obviously a pretty important meeting. And he was very positive. He -- i remember a lot about it. He had a comfort -- he had a cubicle -- intel is very egalitarian --
JUDGE McGUIRE: All right. Let's try to keep it to the answer. I don't need all this -- ultimately when I read 20,000 pages of this transcript, I could do without two or three other pages.
THE WITNESS: Sorry.
Anyway, Gordon -- we had a very good meeting with Gordon. He was very excited and he wanted Intel to work with Rambus.
BY MR. STONE:
Q. And ultimately did that come to pass?
A. Yes, it did. They signed an agreement within the next six to nine months.
Q. Did you -- you mentioned one other venture capital firm you met with. Who was that firm?
A. Merrill Pickard Anderson and Eyre.
Q. And ultimately was there an agreement among any of the venture capitalists to help with funding?
A. All three of them agreed to fund.

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Q. And what were the terms on which they funded?

A. They each took one-third. They invested $1.86 million and they each put in one-third of that, whatever that comes out to be, and they roughly all three of them together owned about 50 percent of the company.

Q. So they made an investment of money and they got about half of the company.

When did -- when was the company formed and the money paid and those kinds of things?

A. We shook hands in late '89, and since Mark and I weren't taking a salary, I don't think we actually closed officially and they gave us the money until I believe April of 1990 I believe.

Q. And did you -- were there any employees of the company before the time you got that funding?

A. We -- my recollection is that we took -- we actually closed the funding so that we could start paying our first employees, so I think the employees started soon after that.

Q. Who were the first employees?

A. Jim Gasbarro and Rick Barth.

Q. And what did they do?

A. Jim was sort of a packaging person. They were both good circuits guys, but Jim did a lot of the

8157

circuits and packaging and Rick did more architecture things, so to some extent Jim helped Mark and Rick helped me to some extent.

Q. And how long did you continue with the four of you?

A. We worked for quite a while. I don't remember when we hired the fifth person, but we worked together from then, you know.

Q. Let me ask you about -- ultimately was a patent filed with respect to your inventions and ideas?

A. Yes.

Q. And was a patent lawyer hired to help with that?

A. Yes, he was.

Q. Who was hired?

A. David Larwood did a lot of the work, who was Roger Borovoy's assistant.

So Roger was hired and then he assigned a gentleman named David Larwood to do most of the work.

Q. And Roger was the lawyer who had, earlier in your notes, had been helping Kleiner Perkins evaluate your ideas?

A. Yes.

Q. What role did you play in the initial patent

8158

application?

A. I certainly tried to help write it. I wasn't certainly at the time at all a patent expert, but I tried to help. Mark Horowitz did the bulk of the writing of the specification. I wrote pieces of it which he then rewrote. But I at least tried to help. And I -- so I generally tried to help with the writing.

Q. And the portions that you and he wrote were which portions of the application, if you can note as the description of the invention, the specification, the claims and a few other parts, which parts or all the parts did you and he try to write?

A. Again, mostly the specification. We very much focused on the specification.

Q. How long did that process take of the writing that you and he did?

A. My recollection is that we worked on it for at least six months, maybe longer. We spent a lot of time on the specification.

Now, of course this was in parallel with trying to figure out what the idea was. I mean, we were working on the idea at the same time we were writing the specification.

Q. As you were working on drafting the patent

8159

application, did you have a view on your own as to whether or not you were going to get a patent or patents as a result of that application?

A. Yes, I did. When I first had the idea, I did a lot of patent searching when I was at Illinois. They have a patent repository in Springfield, Illinois, so I would actually go there and do searches. And then when I came back, I continued doing searches at Sunnyvale at the patent repository.

So I felt I had a pretty good idea, I had done a pretty thorough review of the prior art, and I felt that we had some pretty significant new stuff that I hadn't seen before in the prior art.

Q. What did you do with the things that you found as a result of these searches?

A. Everything I found was given to the lawyers and was put into the patent, first patent application, as a list of prior art.

Q. Had you ever been involved in the actual drafting of any portion of a patent application before this?

A. I had been -- i had -- i had received two patents before that. In neither case had I written the patents. In both cases I described the idea to an attorney who then wrote it up, sent it back to me, and

8160

I then signed it.

    Q. Was this the first time you actually tried to write a portion yourself?

    A. Yes.

    Q. You mentioned David Larwood as somebody who worked with Mr. Borovoy?

    A. Yes.

    Q. What was his role in this original application as you observed it or understood it?

    A. He wrote the claims and sort of took the disclosure that primarily Mark had written -- i'm sorry -- the specification that primarily Mark had written and sort of, you know, made it into patentese a little bit, wrote claims, you know, did the things that made it into a patent.

    Q. I want to go back to something that you mentioned earlier, Dr. Farmwald, which was you mentioned you were trying to make contact with various companies in the business, potential customers, potential manufacturers. Do you recall that?

    A. Yes.

    Q. Would you generally give presentations to companies that you thought might be customers or manufacturers of this product?

    A. Yes. Roughly speaking, I would give a first

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presentation, make a first contact, and then if they were interested and wanted technical follow-up, Mark or Mark and I would go and do technical follow-up.

Q. Let me ask if you would to turn to what's next in your binder, which is RX-25, and I want to direct your attention if I can not to the first page of RX-25 but to the second page and the following pages of RX-25.

If you would, take a minute or two to just skim through pages 2 through 21 of RX-25 and then tell us if you can what the document is.

A. It appears to be a somewhat later presentation than the ones we looked at earlier, and it appears to be a presentation that we would have given to a potential partner or customer early on. It's got some technical detail but not a huge amount.

Q. So when you say "early on," do you mean early in the discussions with the customer or do you mean early in some other sense?

A. Early in discussions; i.e., this looks like one that we would give without an NDA because it doesn't contain much technical detail.

Q. And why was there -- why would you normally give so much information before you got an NDA, if I'm understanding the inference correctly?

8162

A. Mostly to protect our ideas. Certainly our attorneys were saying until you filed a patent you have to be very careful about things, so don't talk about technical details until you filed a patent, and even after that you still want to be somewhat protective because NDAs not only cover patentable ideas but, you know, sort of business ideas and partnerships and all kinds of things, so just generally you want to have some sort of mutual agreement to be -- to hold things in confidence.

Q. Okay. Look if you would all the way to page 15 of Exhibit RX-25.

This slide "Who Does Rambus Sell to?" is this essentially the same information that we saw in an earlier slide that you used with venture capitalists.

A. Yes. It's been added to a little bit, but it's essentially the same slide.

Q. And again, this one shows your income as coming from what sources?

A. The same, the same as before, consulting and royalties and license fees.

Q. Turn if you would to the next page, which is page 16 of RX-25.

The first bullet point under this heading Rambus Marketing Strategy says, "Work with one or two

8163

early adopters."

What were you communicating with that language or trying to communicate?

A. At this point in time we still hadn't signed up -- this was early in 1990 -- we still hadn't signed up any DRAM makers yet, so what we were looking for was one or two DRAM companies to sign up with us early, because there's more risk, and what we were saying is what we'd offer them if they'd sign up early.

Q. And in these meetings what were you saying you would offer to those who had signed up first?

A. What we offer the person in the slide is a first to market, a lead to the market, reduced royalties, and an opportunity to have some feedback into setting of the Rambus standards.

Q. And when you talked about Rambus standards there, what did you mean?

A. It was -- we viewed what we were doing as what -- it was going to become a standard. You know, it was the Rambus standard. It was the part everybody used. There was a specification. Everybody would implement that specification and they would all be compatible with each other, so they're standard parts you could interchange one for the other.

8164

Q. The next bullet point says, "Rambus will be very flexible."

What did you mean to communicate there.

A. If they wanted other things, we would be willing to talk about them.

Q. And the next major bullet point says, "Rambus should be made available to open market fairly early."

What were you meaning to communicate with the phrase "open market"?

A. Early in our discussions we had, some of the companies we talked to were interested but only if they could have exclusivity. Either, you know, we wouldn't -- you know, we'll buy it, but you can't let somebody else license it or it has to be -- or, you know -- they wanted some form of exclusion. And we had early on decided that that wouldn't work, that we needed -- although we could give some advantages to the people who signed up with us early, the advantages could not be excluding other people.

Q. And is that a concept that has remained in effect today?

A. Yes.

Q. You mentioned under there, "There is real value in having a world DRAM standard."

Do you see that bullet.

8165

A. Yes.

Q. And then there's two bullet points under that, the first one which is: Avoid the VHS/Betamax situation.

What did you mean by that.

A. Well, my recollection at the time -- of course this was -- videotapes were still very popular, and Sony had invented the Betamax, the first, you know, cassette tape-based video player, but they had decided that they wanted to make it a very high-profit part of their company that they owned, and so essentially they weren't willing to license it to other people.

The license terms were so high -- I don't remember, but I think it was in the dollars per cassette -- they were so high that it was essentially not a plausible licensing approach. They were telling people go away, we don't want to license you.

Q. How did you plan to avoid that?

A. Well, what happened then is because they told people they wouldn't license them, a consortium of people got together and formed an alternative called VHS which then in the end became the successful way to do it.

So our goal was to license it openly and fairly to everybody so everyone is on equal footing with a

8166

relatively low royalty, something that given the magnitude of what we invented was not considered unfair.

Q. Okay. Could you -- if the court will allow you to go to the board --

JUDGE McGUIRE: Go ahead.

BY MR. STONE:

Q. -- give us a list of the early companies or the companies that you met with in the early time frame as best you can recall today.

MR. ROYALL: Can I ask for some clarification on what you mean by "early time frame"?

BY MR. STONE:

Q. Certainly.

If you could just limit yourself to the 1989 through end of 1990 time frame as best you can.

A. Okay. So from memory -- and I'll probably miss a bunch -- clearly IBM, clearly Intel. I remember those extremely well. Toshiba, NEC, Matsushita, Mitsubishi and Fujitsu. And these were a trip that Mark and I took -- these I remember well because it was a trip -- the first trip that Mark and I ever took to Japan. We met with all these people.

Micron, Siemens, Motorola, Apple, Sun Microsystems, SGI.

8167

And I'm sure there are lots more, but that's all I can think of.

Q. Let me just ask you about a couple.

In this time frame do you recall whether or not you met with HP, Hewlett-Packard.

A. HP and Tandem also. Sorry. It was a long list. I think there's even more, but this is what I can remember now.

Q. Okay. Thank you.

Could I mark this as DX-255.

JUDGE McGUIRE: Yes. Right.

(DX Exhibit Number 255 was marked for identification.)

BY MR. STONE:

Q. So DX-255 is the list that you recall today of the companies you met with in this 1989 -1990 time frame?

A. Yes. I'm sure it's incomplete, but right now it's what I can remember.

Q. Let me ask you if you would then to turn to RX-63, which is the next document in your binder. Take a moment to look at that if you need to and tell us if you can what this document is.

A. After we hired our first employees and after we had filed a patent, we started writing the document

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that would permit both us and our partner companies to actually implement a Rambus interface or chip, and this is an early version of that document.

Q. And I want you to look at the fax line at the top of the first page.

Can you tell from that fax line who, if anyone, this document was sent to?

A. It was sent to an international number in Germany because it's got the 49 country code, so --

Q. What companies, if any, did you meet with in Germany?

A. The only one I ever remember is Siemens, so it was almost surely Siemens.

Q. Okay. And then look if you would at the next document in the book, which is RX-94.

And can you tell us what this document is.

A. This is a later version of that document, of that same technical document.

Q. Of the one we just looked at?

A. Yes.

Q. Let's go back to the one we just looked at if you would, RX-63.

What role did you have in preparing this document?

A. This is -- was primarily written by Rick Barth

8169

and Jim Gasbarro and Mark Horowitz. I had some moderate input into it and wrote pieces of it, but they were the primary owners of this document.

Q. And it has a date on it, you see at the bottom of the first page, of draft of May 7, 1990 .

Is that consistent with the time frame which you think this document was prepared as best you can recall today.

A. Yes.

Q. Going back if you would to RX-94, the one we were just looking at, was your role in the preparation of this document similar to the preceding document?

A. Yes, it was. It was probably decreasing somewhat in that we by now had more employees, so there were more people working on various aspects of the document.

Q. And what's the time frame for RX-94's preparation?

A. It's dated November 5, 1990 , which is consistent with the time frame that I would have put it in.

Q. Look if you would at the next document in your binder, which is RX-99.

Do you recognize this document?

A. It appears to be a letter that I sent to a

8170

Dr. -- or Mr. Horninger at Siemens.

Q. And it mentions in it, "I am sending a copy of the new Rambus specification."

Do you see that reference in the very first line.

A. Yes.

Q. When you talk in this letter about the Rambus specification, what are you referring to?

A. That's this document we were just looking at.

Q. And that was the RX-94?

A. Yeah. Either 9 -- well, 63 or 94, but there are different versions of the document.

Q. But that's what you referred to as the specification?

A. Yes.

Q. What was your intent as to what someone who received this specification could do with it?

A. Well, first of all, we would only send them a specification like this if they had signed a nondisclosure and they were pretty serious because this is -- this is the guts of what we were doing. This is very secret, important stuff to us.

So this would indicate that Siemens was pretty serious about wanting to partner with us and that we were following up to send them enough information to

8171

judge whether they really wanted to partner with us or not.

Q. Let me frame my question slightly differently.

If someone had this material, how -- how much information is in here? Could they build a product with it.

A. Pretty close, yeah. Yeah.

Q. So this was in a sense a blueprint, if you will, for the product that you were designing?

A. Yeah. It's not quite everything you need, but a person pretty smart -- any smart engineer could take this and do the rest of the work himself.

Q. And look if you would at the next document in your book, which is RX-130.

And is this a later version of the same Rambus specification or technical description that we just looked at two of.

A. Yes, it is.

Q. And is this one prepared in the April of 1991 time frame?

A. That's the date on it, yes.

Q. Okay. Let me skip through that thick document, which should feel like progress to us, and move if you would to RX-102, which is the next document in your binder.

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Can you describe for us what this document is?

A. It's a fax from Siemens to me at Rambus with a list of questions, a detailed list of questions that they wanted answered.

Q. And when was this document sent to you?

A. If I read their dating system correctly, I believe it's in December of 1990 .

Q. And it refers to a list of questions; is that right?

A. Yes.

Q. And if we turn to page 2 of RX-102, we'll see some questions beginning in the bottom half of the page that are referenced by reference to page numbers. Do you see that?

A. Yes.

Q. And have you had an opportunity before today to go back and try to figure out what the page number references were to and what document they were talking about?

A. Yeah. They appear to be consistent with one of the earlier technical descriptions, yes.

Q. Look at the just preceding one if you would, which is RX-130.

When I showed you these to look at earlier, is

8173

that the one you identified as the likely cross-reference?

A. I think so. I believe so.

Q. Do you want to take a moment and check one?

(Pause in the proceedings.)

I think I gave you a bum steer.

A. No, actually I don't think it's the right one. I think it's the earlier one.

Q. So look at RX-94 and see if it's that one. Good thing you're checking it.

A. Yeah, that one seems to fit better. So I think that's the right one.

Q. Okay. And this document that we're looking at, RX-102, if we can go back to the cover page, was the time frame of this document, which you said was December of 1990, consistent with the time frame of discussions with Siemens?

A. To the best of my recollection, yes.

MR. STONE: Your Honor, at this time we'd offer Exhibit RX-102.

JUDGE McGUIRE: Any objection?

MR. ROYALL: No objection.

JUDGE McGUIRE: Entered.

(RX Exhibit Number 102 was admitted into evidence.)

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BY MR. STONE:

Q. Thank you.

Did there come a time that some of the companies that you were meeting with ultimately agreed to sign licenses or other agreements with Rambus?

A. Yes.

Q. Do you recall which companies were the first ones?

A. My recollection is that Intel was the first one to sign an agreement and that the first DRAM company I believe was Toshiba. And then -- sorry -- then Fujitsu signed soon thereafter I believe.

Q. What time frame was that in, if you recall?

A. I think it was late '90.

Q. Let me ask you to look if you would at the next document in your binder, which is RX-1091.

Now, is this 1091 a document you prepared.

A. No.

Q. Do you know who did prepare it?

A. I believe -- I'm pretty sure actually that this was done by Geoff Tate as the first rewrite of the business plan that he did, and I don't remember whether it was done before he joined to convince himself to join or after, but I'm pretty sure it was done by Geoff.

8175

Q. And is this a document you had seen before this litigation in depositions and so on?

A. Yes.

Q. You saw it in the time frame --

A. I'm sure I did. I don't actually have a direct recollection of seeing it, but I'm sure I did, yes.

Q. Let me ask you a couple of questions about it if I can. Turn if you would to page 4 of Exhibit RX-1091.

And right under the heading Intellectual Property Protection, the first paragraph, if you'd take a moment and read it to yourself.

(Pause in the proceedings.)

Tell me when you're done.

A. Okay.

Q. It says in there, it says, "It has been reviewed by all partners."

Do you understand, did you understand then, what was meant by "partners".

A. Yes.

Q. What was meant by "partners"?

A. Partners were companies that we had signed agreements with to either one way or another use our intellectual property.

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Q. And look if you would at the bottom of this page under IC partnerships and continuing over to page 5 of Exhibit 1091 under that same heading.

Do these -- does this discussion of a page and a half summarize in a way consistent with your recollection the status of license agreements as of late 1990 .

A. Actually it does, yes. This seems consistent with my memory.

Q. Okay. How -- were any of the license agreements signed when the negotiations were handled just by you and Mark Horowitz or were others always involved by the time you got to license?

A. I don't believe that any of the licensing agreements were done by Mark and myself, so...

Q. And you mentioned Mr. Tate earlier. When did he join the company?

A. I don't remember. It was sometime in the middle of 1990 , but I don't remember the exact date.

Q. Do you recall whether he as opposed to you or Dr. Horowitz were involved in the licensing negotiations that led to something signed?

A. It was definitely Geoff that did it.

Q. Earlier you described to us your hope that you'd be able to have everyone agree to make a part

8177

that was the same regardless of who made it, if I'm fairly summarizing your testimony.

Do you know whether the early agreements that were signed had provisions in it that were intended to accomplish that goal.

A. Yes. We were very insistent that they would all agree to produce compatible parts.

Q. Were there any discussions with anyone to your knowledge about a desire to use the technology other than in a Rambus-designed part?

A. Yes, there were. My recollections from this time frame are not very specific about who asked for what, but almost everybody would ask for the ability to use certain ideas without being compatible.

Q. I want to ask about a specific conversation that I think you'd mentioned before, which was a conversation with a Mr. T.J. Rogers. Does that name ring a bell with you?

A. Yes, it does.

Q. And what was his position or involvement back in the 1989 -1990 time frame?

A. He still is actually head of Cypress Semiconductor, which is primarily an SRAM company.

Q. And SRAM is a static RAM?

A. A static RAM. They're faster but also way more

8178

expensive. Our interface is not appropriate for an SRAM.

Q. And did you have a meeting with Mr. Rogers?

A. Yes. Bill Davidow and I met with Mr. Rogers, yes.

Q. And was there a discussion in the course of the meeting with him about using Rambus technology other than in a Rambus part?

A. Yes, there was.

Q. And can you relate to us briefly what that discussion -- how that discussion went?

A. He's a very smart guy. He got what we were doing very quickly and thought it was very interesting but then sort of asked a blunt question which took me back. He basically said, Well, this is great, and you know, I like it and we might use it, but why would we pay you for it. We'll just do it and you can -- i said, Because we'd sue you. But he said, But we're a lot bigger than you are.

I mean, I was sort of flabbergasted by that.

Q. And when you said you would sue him, what was your thought as to what you would sue for at that time?

A. Patent infringement.

Q. Now, did you have any patents at that time?

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A. I think we did. I don't remember the exact date of the meeting, but I think we did.

Q. You had an issued patent by then?

A. Probably not, actually. Probably not.

Q. Okay.

A. I'm sorry. We definitely didn't have an issued patent.

Q. Had you filed?

A. No, I don't remember because I'd have to know the dates.

Q. Okay. Look if you would at the next -- well, let me just ask it this way.

What knowledge did you have of companies asking about using the technology other than in a Rambus-designed device?

A. My general recollection is that almost everybody asked about it. My specific recollections only occur somewhat later, more in the '92 time frame for specifics.

Q. What was -- did you have a standard response you gave to companies when they asked?

A. That we would license it for noncompatible uses, but they would have to pay a higher royalty than for a compatible usage.

Q. And why was that?

8180

A. Well, to me it seems like elementary business sense. If you can license a technology for incompatible uses and pay less, then why would you ever pay for compatible uses. Plus there's a huge economic incentive for us to be part of a partnership going forward, which means compatible usage. That means we get to participate, they tell us about their customers, we get to participate in future design improvements, things like that.

So there's a huge economic advantage in us being part of the process going forward.

Q. And to be part of the process you wanted them to be -- the process you referred to is compatible uses?

A. Compatible uses, yes.

Q. How many companies ultimately manufactured a Rambus-designed DRAM, if you know?

A. I don't know the exact number, but it's almost every DRAM company -- almost every company who built DRAMs eventually ended up building Rambus DRAMs.

Q. And did all of them or most of them take a license agreement with Rambus?

A. Yes. Yes, they did.

Q. At the early time period, the 1990 and maybe continuing on into '91 or '92, who did you perceive to

8181

be the customers who were ultimately going to use this Rambus-designed DRAM?

A. Obviously the microprocessor companies, which is primarily Intel. Our interest in IBM had cooled down over time, partly because IBM wasn't doing that well in that time frame and Intel was doing a lot better.

So Intel was clearly far and away our big customer.

We also were interested in the graphics chip companies, and we were very interested in the game companies, too, Nintendo and Sony and people like that.

Q. And which of those potential customers was sort of the first to come to fruition, if you recall?

A. The first big one to come to fruition was Nintendo, the Nintendo 64. Before that, we had some graphics cards that were built using our chips.

Q. And what was the Nintendo deal? What did they do? How did they become a customer?

A. They, working with Silicon Graphics, they built a game called the Nintendo 64, a game box, game platform, that used a Rambus technology both in the DRAM and in the microprocessor interface. It was very successful.

8182

Q. And so was that the first really big, noticeable customer for Rambus?

A. Yes.

Q. Did there come a time when Rambus decided to sort of share its ideas and its technology more broadly with the world?

A. Yes. We had a public event where we sort of told the world what we were doing.

Q. Have you -- you heard me refer to it probably in the opening as a coming-out party or something. Is that consistent with how you would describe it or would you choose different words?

A. No. I think that's fair.

Q. Take a look in your binder. I'm going to skip one document, but go if you would to RX-67. Take a moment to look at this if you'd like and then if you can tell us what this document is.

A. It's a press release that sort of describes the company, and I'm pretty sure it is the press release that we used for the announcement, the opening announcement of --

Q. And you'll notice the date on this is March 9, 1992?

A. Yes.

Q. Is that consistent with your recollection as to

8183

when the party was held in that time frame?

A. Yes.

Q. And if you would, look at the first couple of lines of this document.

It says, "Rambus, Inc., an innovative technology developer, made its formal debut this evening in the Silicon Valley and simultaneously in Tokyo."

Do you see that phrase.

A. Yes.

Q. Is that consistent with your recollection of what happened, that there was an event in Tokyo and an event in Silicon Valley?

A. Yes.

Q. Did you attend either of those events?

A. I attended the one in Silicon Valley. Yes.

Q. And where was that held?

A. It was a restaurant in Palo Alto -- a restaurant/hotel in Palo Alto.

Q. In Palo Alto?

A. In Palo Alto.

Q. And about how many other people attended?

A. My rough recollection, there was fifty to a hundred people there, something like that.

Q. I want to ask you about a couple of statements

8184

in this document if I can, RX-67, but first let me offer this into evidence.

JUDGE McGUIRE: Any objection?

MR. ROYALL: No objection.

JUDGE McGUIRE: Entered.

(RX Exhibit Number 67 was admitted into evidence.)

BY MR. STONE:

Q. Turn if you would to page 2 of RX-67, Dr. Farmwald. And I direct you to the second full paragraph in the bottom half of the page if we could.

You'll notice it says in the second sentence, "The first of these licensees to announce agreements are Fujitsu limited, NEC Corporation and Toshiba."

Do you see that reference there?

A. Yes.

Q. Is that consistent with your recollection, that those were the first three of the DRAM manufacturers?

A. Yes.

Q. Okay. And did they participate in any way, any of those companies, in this event in March of 1992?

A. Yeah. There were at least one and I thought two senior executives from Japanese companies there. I just don't remember which companies they were from. I

8185

think NEC, someone from NEC was there.

Q. And how did they participate?

A. They stood up with Geoff and said how wonderful Rambus is and how they were going to do great things to --

Q. When you say "Geoff" you mean Geoff Tate?

A. Yeah.

Q. Look if you would at the last sentence, the one that says, "The Rambus technology is a new open standard and is available for license by any IC company from Rambus, Inc."

Do you see that.

A. Yes.

Q. What does "IC" mean in that context?

A. Integrated circuit company.

Q. And by this time period would you describe the Rambus technology as a new open standard? Is that a word you would have used?

A. Yes.

Q. And what made it a standard by this point in time, March of 1992?

A. We had three companies all agreeing to build the part. We had one large customer, Intel, and we had some other customers -- nintendo actually started their project back in this time. It took about two years or

8186

more to get the project out.

So we had a number of customers building parts all using exactly the same interface, the same chip, from different vendors.

Q. At this point in time did you have any -- had you made any efforts to try to have an organization standardize the Rambus design or technology?

A. I actually don't remember. I don't think we did, but I certainly wasn't involved personally, so...

Q. Turn if you would to the next document, RX-81.

Tell us what this document is. Take a moment to look at it if you need to.

A. This is a marketing brochure with a little bit of technical stuff in it that sort of describes the company that we would have given out basically to anybody. You wouldn't have required a nondisclosure to see this document.

Q. And was this available at that March 1992 event we just talked about?

A. I believe so, yes.

Q. Let me ask you a few questions about this document if we can, and I want to turn your attention if I might to page 3 of RX-81.

And there's a small paragraph about a little more than half the way down that says, "Rambus, Inc. is

8187

fully protecting the intellectual property rights of its technology by filing basic, broad patents in all major industrial nations around the world."

Do you see that sentence?

A. Yes.

Q. Was that consistent with your understanding of what was going on with the patent application efforts at that time?

A. Absolutely.

Q. Was there anytime in any of the meetings where you said to any company anything inconsistent with that statement there?

A. Absolutely not.

Q. Again, if I can draw your attention to the next paragraph, the one that begins "Rambus, Inc. is aggressively pursuing" and ends with "Rambus technology is an open standard that Rambus will license to any IC company," take a moment and read that to yourself. I want to ask you whether that is an accurate description of Rambus' business practices in March of 1992.

A. Yes, it is. I think it's an accurate description of our business model from day one through today, but including 1992.

Q. Turn if you would to the next page, page 4 of

8188

Exhibit RX-81.

And there's a little chart in the middle of the page and above it is the heading The Memory Bottleneck.

Do you see those two references.

A. Yes.

Q. Is this sort of a simplified reference of the chart you drew for us earlier today?

A. Yes, it is.

Q. Then turn if you would to page 6. If I go too fast here, stop me.

At the bottom of the page, it says "The Elements of the Rambus Solution," and you'll see the second sentence says, "This solution is comprised of three main elements, the Rambus channel, the Rambus interface and the RDRAM."

And the next page has text associated with each of those headings, Rambus channel, Rambus interface and Rambus DRAM or RDRAM.

And what I want to ask you to do if you can, and you can use page 7 of the document if it's helpful to find the right descriptive language, describe for us what was meant by "Rambus channel," and then I'll ask you about Rambus interface and then RDRAM.

A. Okay. Well, the channel is what I referred to

8189

up here as the bus basically **(indicating)**. It's the connection between the chips as compared to the chips themselves, the DRAM chips themselves.

Q. And what was the Rambus interface?

A. The interface is the circuitry that sits either on the DRAM chip or on the CPU chip, say, that connects to the Rambus channel.

So it's what I referred to on that chart there as sort of the circuits **(indicating)**.

Q. And then what's the RDRAM?

A. That's the DRAM itself, the memory part of it.

Q. There's a description in this diagram here on the bottom of page 6, there's a reference to "master" and "slave" and then it says "engine" and "DRAM core."

Can you tell us what those refer to.

A. Yeah. The interface is common to all chips. Whether it's a DRAM or a CPU or a controller, it's the same interface, but the rest of the chip is different. And then the master has some additional logic because it has to be a little bit smarter, just called the Rambus master logic.

So there's a common interface. There's some extra stuff that goes -- that doesn't go in a DRAM; it goes outside the DRAM.

Q. Is what we see here on pages 6 and 7 a

8190

generalized description of the ideas that you listed for us earlier on one of the demonstratives as the ideas that in a nonpatent sense you viewed as what you'd invented?

A. Yeah. It's -- i'd say that's true. It's also somewhat more of a description of the first-generation RDRAM, too, so...

Q. And what changed from generation to generation of RDRAM?

A. We went wider. We changed the clocking a little bit. We went a lot faster. We made a lot of architectural changes to make it go faster.

Q. And tell us why you were narrow at first and then went wider, if you would.

A. It was an implementation issue. When we first started, the pins were fairly expensive and the die size of the DRAM was sort of a certain size. And these issues sort of led us to say, well, let's build a nine-bit-wide bus for the first generation.

Q. Then when you went wider, how much wider did you go in the next generation?

A. I believe we went to 16 bits wide for the next generation.

Q. Then look if you would to page 8. You can just stay on page 8. You'll see it goes on from there under

8191

the heading Rambus Technology Highlights.

Look if you would at the text on pages 8, 9 and 10, continuing on I guess to 11, those four pages, and then just tell us if you can if those four pages give a general and maybe not all that technical overview of what you considered to be the Rambus technology.

A. Yeah. I think it does, yes.

Q. Okay. And then finally, look if you would at page 15.

And again, is this sentence all by itself, the second sentence on the page, when it says, "The Rambus solution is an open standard there," tell us again if you can what that refers to and is it any different than what you told us earlier.

A. No, it's not. It's the same. It's available to anyone. We have standardized it. Anybody is available -- anybody is allowed to use it as long as they're willing to sign a license with us.

MR. STONE: Okay. Thank you.

Your Honor, I could sort of switch topics now. I can keep going or take a lunch break. It's your preference.

JUDGE McGUIRE: It's almost 12:30. I think it's a good time to break. Why don't we break and we'll convene again at 1:45. Very good.

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Hearing in recess.

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

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

(1:46 p.m.)

(DX Exhibit Number 256 was marked for identification.)

JUDGE McGUIRE: This hearing is now in order.

Mr. Stone, you may proceed with your questioning.

MR. STONE: Thank you, Your Honor. May I approach the easel?

JUDGE McGUIRE: Please.

BY MR. STONE:

Q. Dr. Farmwald, I've put up a chart that I've already labeled as DX-256, which is the next in order, and I just want to ask you about the various entries on it if I can.

We show a timeline here that has summer of 1988 Dr. Farmwald seeks a solution to the performance gap.

Is that consistent with your testimony.

A. Yes.

Q. And then late 1988 was the meeting at Saint Michael's Alley restaurant with Dr. Horowitz and Mark Johnson?

A. Yes.

Q. Then summer 1989 we've written "Rambus

8194

inventions take shape."

Is that a fair time frame for that.

A. Yeah. It was a period of time, but that's correct.

Q. And then the fall of 1989 we've shown here the meetings with Bill Davidow and Gordon Moore.

Is that consistent with your recollection.

A. Yes.

Q. You told us earlier there was a handshake deal for the funding with the venture capitalists. On this DX-256 I show that at December 1989 .

Is that correct.

A. I believe so.

Q. And then when was the original patent application filed, if you know?

A. I believe it was April 1990 .

Q. Okay. And you told us earlier that Rambus signs first technology licenses was in October of 1990 ; is that right?

A. It was either September or October, but yeah.

Q. And then March of 1992 was the public presentation?

A. Yes.

Q. Okay. And then I've shown also, and I want to ask you about this, 1989 to 1993 you were involved in

8195

seeking customers and licensees and providing technical descriptions of inventions to the DRAM industry.

Is that a fair characterization of the time period during which you engaged in that activity as you talked about earlier.

A. Yes. It tailed off definitely very much true from '89 to '90 to early '93. It probably tailed off in the middle of '93.

Q. I want to take this down.

And the technical descriptions that you would provide to people in the DRAM industry as you talked about earlier that showed particular interest I guess or you thought might become licensees, were examples of the technical descriptions what we looked at earlier as RX-63, 94 and 130?

A. Sorry. Could you say the number again.

Q. RX-63, RX-94 and RX-130.

A. Okay. Yes on 63. Yes on 94. And what was the last one?

Q. 130.

A. Yes.

Q. Okay. Now, as you described your activities beginning to tail off in 1993, what activities did you continue to be involved with with Rambus, if any, as

8196

your other activities there tailed off?

A. I stayed on the board of directors and I still spent some amount of time, you know, helping the company meet with customers, but it just -- it became much less.

Q. Was there ever a period of time when you would say you were involved in the management of Rambus?

A. Certainly in the first few years very actively and by '92 it was much less -- after Geoff came, Geoff was running the company, so it became much less so towards the end of it.

Q. And have you attended board meetings regularly?

A. Yes.

Q. How frequently would you say you've missed the meetings?

A. Oh, not more than at most one or two per year that I've missed, so I've -- i'm sure I've gone to 95 percent of the board meetings.

Q. Okay. What were the kinds of issues in the time frame of '92, '93 and '94 that were the focus of board meetings, if there was a particular focus of those meetings?

A. I'd say the primary focus was getting the first chips out and into the marketplace, so getting our

8197

first customers to actually get a shipped -- shipping product, which meant for us, you know, getting DRAMs that worked, getting the other interfaces that worked, so a lot of technical issues and of course signing up more customers.

Q. Did there come a time when the focus of discussions at board meetings began to change?

A. I'd say it was certainly in the latter part of the '90s certainly, yeah.

Q. What would you say was the focus as time went on?

A. It became -- they became more and more keeping Intel happy really more than anything else because Intel became such an important customer.

Q. Okay. Let me ask -- i'm going to walk you through some board minutes if I might and ask you about them, so let me ask you to turn to the first one in your book, which is RX-167.

Can you identify what this document RX-167 is.

A. It appears to be a board meeting from January of 1992.

Q. And these would be the minutes of the meeting?

A. Yes.

Q. Okay. Look if you would at the bottom of the first page under Engineering and Technology, and you'll

8198

see the very last sentence says, "Mr. Farmwald present status of the resubmission of U.S. patent."

Do you see that?

A. Yes.

Q. Do you recall that meeting?

A. I don't have a direct recollection of the meeting. I have a vague recollection that sometime in late '91 the first patent application came back from the examiner, who made us -- I think it's called a divisional. They made us split it up in a number of pieces and made us resubmit it as a number of separate patents, and I believe this is what this is referring to.

Q. What was your role in the resubmission of those divisional applications?

A. I was part of the process trying to figure out the strategy for the -- for what divisionals to apply for, and so on and so forth.

Q. At that point in time, late '91, early '92, did you have a sense -- did you have an understanding -- let me ask it that way -- as to whether the claims in the various applications were broad claims that cover what you described earlier in a general sense as your inventions?

A. Well, it's a long time ago and so my

8199

recollection is not very firm about it, but I believe at that point my general impression is that we had a fair bit of work to do to improve our claims at that period.

Q. Okay. Let me ask you to turn to the second page of Exhibit RX-167 if I can.

There's a heading 8.0, strategy, and it says, "The board had an open discussion of 1992 -94 business plan and strategy."

Do you see that.

A. Yes.

Q. Was that a subject that was talked about at board meetings from time to time, mainly a business plan and strategy?

A. Yeah. Geoff liked to bring it up at least once a year, sometimes more, to sort of have a discussion and an update to the business plan.

Q. Do you have any specific recollection of this meeting or what was discussed at this particular meeting?

A. No, I do not.

Q. Did there become a time when there was a discussion at board meetings of what was happening in the competitive marketplace?

A. Again, I don't have a very firm recollection,

8200

but yes, my general impression was yes.

Q. And do you have a recollection of what product or products were identified as the earliest of the competitive products to the Rambus-designed DRAM?

A. There were several parts that individual companies were coming out with. One of them was called a cache DRAM or something like that. And then there was of course the SDRAM itself.

Q. And did you have a sense in the early 1990s of what sort of a competitive threat SDRAM caused?

A. Well, again, I have a vague recollection of my feelings at the time, that I felt that SDRAM was a pretty incremental step. It was a pretty small advance in performance. They were sort of doubling, maybe a little bit more, maybe quadrupling the performance, maybe two to four Xs of the previous stuff, and since we had a hundred X'd the performance of that, I felt we had a pretty strong advantage.

I did realize that there were a lot of applications that two to four X was plenty good enough for, so I understood that there would be opportunities for both in the market.

Q. And when you say two to four X or a hundred X, you mean two to four times faster or a hundred times faster?

8201

A. Yes.

Q. Look if you would at -- let me first offer -- i think I should move in RX-167, the minutes of the January 4, 1992 board meeting.

MR. ROYALL: No objection.

JUDGE McGUIRE: Entered.

MR. STONE: Thank you.

(RX Exhibit Number 167 was admitted into evidence.)

BY MR. STONE:

Q. Let me ask you now to look at the next document in your binder, which is RX-543a (sic), if you would.

Do you recognize this document as a memo and plan that you received in June of 1992?

A. I don't have a direct recollection of it, but I think it's -- i think it's what it says it is, which is a business plan from 1992.

Q. The cover page, the first page of 543a, is that a -- i'm sorry. This is CX-543a.

Is the first page of that a type of memo that you would get from people at Rambus?

A. Yes.

Q. Okay. I just want to ask you a couple of questions about this document if I might. Turn if you

8202

would to page 15 of CX-543a.

Under the heading Synchronous DRAMs, take a moment if you would and read what's written on the bottom of page 15 and then over on to skim, if you would, page 16 and 17, all under that heading synchronous DRAMs, and I'll ask you some questions about it, if you'd just familiarize yourself with it.

(Pause in the proceedings.)

A. Okay. I've looked at it.

Q. Okay. Then let's go back to page 15 under the heading Synchronous DRAMs, if we could bring that up on the screen.

It says at the very first sentence, "For two-plus years a JEDEC committee has been working on the specifications for a synchronous DRAM."

And you told us earlier today you had some understanding what JEDEC was; correct.

A. Yes.

Q. Did you have any personal understanding, any personal knowledge of what went on at JEDEC meetings?

A. I certainly developed an understanding at some point in time. I can't tell you for sure as to when that was. It was probably around this time frame.

Q. Did you ever attend any meetings yourself?

A. No, I did not.

8203

Q. Did you ever read any minutes from a JEDEC meeting?

A. I do not remember ever reading any minutes from a JEDEC meeting.

Q. Did you have any understanding about what specifications are referred to here in this business plan on page 15 of CX-543a?

A. Only in a vague sense. I don't have any direct recollection of it.

Q. Okay. The next paragraph says: "A few companies (Samsung, Toshiba and TI) are already working on sync DRAMs with plans to introduce their products in late '92 through mid-'93."

Is that consistent with your recollection of what you understood at the time?

A. It's consistent. I don't remember exact dates, but I do remember that a number of companies were coming out with sync DRAMs in advance of a standard and they were incompatible. I do remember that.

Q. And they were incompatible?

A. They were incompatible, yes.

Q. Did you have an understanding in this time frame and does this business plan jog you one way or the other as to whether you thought synchronous DRAMs were a competitive threat to RDRAM in the mid to late

8204

1992 time frame?

A. Again, I don't have a direct recollection, but I do have a somewhat of a -- I think, you know, it's the same as now, is they were a small increase in performance. A lot of the market only needed a small increase in performance, and the market that only needed that small incremental performance boost would probably go with synchronous DRAMs and that we would get the rest of the market, and then the issue was how big is each piece of the market.

Q. Did the board have discussions of what to do to position RDRAM most positively or most favorably in competition with synchronous DRAM?

A. Again, I have no direct recollection of this, of this, of any specific meeting, but just in general we had often discussions about how to position ourselves versus not just SDRAMs but some other parts, too, yes.

Q. Okay. Let me ask you to look at the very bottom of page 16 of CX-543a if you would.

Down where it says "Our number one strategy," the very last sentence, do you see where it says: Our number one strategy to counter sync DRAMs therefore is to get our parts proven and in the marketplace -- or in the market.

8205

A. Yes.

Q. Do you have an understanding of what parts are referred to there when it says "our parts"?

A. The first-generation RDRAMs, yes.

Q. And in the mid-1992, end of 1992 time frame, were they in the market yet?

A. I don't believe they were. I think we were pretty close, but I don't think they actually shipped until later.

Q. And then turn if you would to the next page, page 17, and look at the top three paragraphs on this page if you would.

Let me ask you first about the one that begins "secondly." It says "to gain awareness in 1992 that the 18" and then it goes "Mbit" -- what does that mean.

A. I'm sorry. What page are you on?

Q. I'm on page 17.

A. Okay. Sorry. Okay. I see it.

Q. The very first line where it says "18 Mbit," what's that?

A. 18 megabit.

Q. And then what's that a measure of?

A. How much -- how many -- how much storage is inside the DRAM, how big is the DRAM.

8206

Q. Okay. And then it says "will have a die size equal to the 18-megabit sync DRAM."

Do you see that.

A. Yes.

Q. Did you have an understanding in 1992, the latter part of 1992, of whether or not there were die size differentials between RDRAM and sync DRAM?

A. Yes. It was a big issue that all of our customers would ask us, is how big is our part versus alternative parts, so it was always an issue that was asked of us and something we had to know.

Q. And did you have an understanding of what the difference was?

A. Again, it's vague. It's been a long time ago. But my recollection is that we expected to be on the order of the same size or maybe 5 percent larger, but a small number larger at most.

Q. Look if you would at the next paragraph where it says, "Our third strategy is to gain momentum rapidly in non-main memory markets where sync DRAMs are not an issue."

Do you know what that refers to at the time? Does that sentence have meaning to you.

A. Yes, it does. Because this was a very big issue, ongoing issue over many years.

8207

The "main memory customers" mostly refers to PCs and workstations where there's a fairly large number of DRAM chips in the system so that even though the individual parts are fairly slow, as I talked about earlier, you can essentially run a bunch of them in parallel to get reasonably high performance.

So the non-main memory markets are markets like game, game boxes. At that time high-definition television was a very big deal, so that was another big market we were looking at, where they didn't really need very much memory, but they needed a lot of performance, and we felt that was the perfect market for us.

Q. And finally I want to ask you about the last paragraph.

It says, "Finally, we believe that sync DRAMs infringe on some claims in our filed patents and that there are additional claims we can file for our patents that cover features of sync DRAMs."

Was this subject, whether there were claims in patent applications that were pending or whether there were claims that could be filed that would cover sync DRAMs, is that something you recall being discussed at board meetings from time to time?

A. I have no direct recollection, but I believe

8208

that it probably was discussed, yes.

Q. And were there points in time when you had understandings that there might be claims that covered --

A. We certainly in general thought that we had pretty broad claims and that they certainly might cover synchronous DRAMs.

Q. And were there other points in time where you thought you didn't have any claims that covered sync DRAM?

A. Well, certainly later on we were told that we did not in fact have claims that cover synchronous DRAMs. That was much later, though.

Q. Okay. Do you recall who told you that as best you recall it?

A. Oh, it's not a guess. It was Joel Karp. It was sometime after we hired Joel, he came back to us -- and I remember it well because I was sort of shocked and surprised -- but that our patent portfolio and claims were much weaker than we thought but that he thought he could go and improve them.

Q. Let me ask you to turn if you would -- well, let me ask you about one more sentence.

Look at the last sentence of that paragraph, which says: "Our action plan is to determine the

8209

exact claims and file the additional claims by the end of Q3/92. Then to advise sync DRAM manufacturers in Q4/92."

Do you see those two sentences.

A. Yes.

Q. Did that happen?

A. I can only assume that we did try and determine the exact claims, but we must not have done anything about it because we didn't actually get any claims and we certainly didn't advise the sync DRAM manufacturers in that time frame, so I'm only assuming we decided we didn't have claims at that point, but I don't have a direct memory.

Q. Okay. Look if you would at the next set of board minutes, which are CX- -- let me offer first this business plan, RX- -- i'm sorry -- cX-543a if I might.

MR. ROYALL: No objection, Your Honor.

JUDGE McGUIRE: Entered.

(CX Exhibit Number 543a was admitted into evidence.)

BY MR. STONE:

Q. Let me ask you now to turn to the next board minutes that are in your binder, CX-604. And I'm going to ask you about the first two pages of these, this document.

8210

Do you recognize these to be another set of board minutes from a meeting in June of 1992?

A. That's what they appear to be, yes.

Q. Look if you would on the bottom of the first page under the heading 6.0, Engineering and Technology. And the last sentence reads, "There was discussion of RDRAM versus SDRAM and VRAM on area/bit and system performance."

Does that sentence have meaning to you?

A. Yes. Again, I have no direct recollection of the -- of exactly what was said, but this was something that was brought up at many if not most board meetings, which was again our die size overheads, how big our dies were versus competitors, and also what is the system performance for various kinds of systems if you put our chips in versus other people's chips, and that was an ongoing process trying to figure those things out.

Q. When you say "system performance," what do you refer to?

A. If you put our chips into a PC system of a certain speed versus putting, say, SDRAMs into that same PC, what would be the relative system performance, how much faster would ours be than theirs.

8211

Q. And what's the reference to VRAM, if you know?

A. Video RAM? It was a specialty part used back then for graphics chips and it was actually -- we regarded it as one of our prime candidates for our chips.

Q. Turn if you would to the second page of CX-604.

Under the heading 9.0, Five-Year Business Plan, it says: "Mr. Tate led discussion of strategies and projections for the five-year plan. It was agreed to review and revise the plan every six months."

Do you have any specific recollection of a discussion of a five-year plan at this board meeting?

A. I do not.

Q. Do you know whether, from your recollection, there was a review of a five-year plan every six months at board meetings?

A. I don't believe we actually did it as often as that. I believe the intent was to do it that often, but I think it happened more like once a year or so.

Q. Turn if you would then to a business plan, which is CX-545, the next exhibit in order, if you would.

And you'll note that this is 1992-1997 on the cover and the date is September 1992.

8212

A. Yes.

Q. Okay. I'd like to ask you a few questions about this. Turn if you would to page 7.

At the bottom under the heading Patents and Intellectual Property, is it consistent with your understanding that by September of 1992, as it says in this document, the Rambus system was currently covered by 18 patents with over 300 claims.

A. I would emphasize the word "filed" in the United States because I don't think we had 18 patents issued. We had 18 patents filed at that point. I don't remember the exact number, but it's consistent with my recollection, yes.

Q. So that would be patent applications?

A. Patent applications, yes.

Q. Okay. And you'll notice the very last line of this says, "Rambus' patents are likely to have significant applications other than for the Rambus interface."

A. Yes.

Q. Was that your understanding in the September 1992 time frame?

A. Well, I can't again precisely remember what I thought, but I think it's something I thought all along, so yes, I'm sure I did think that.

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Q. And let me ask it this way.

Was it your understanding back in the '88-89 time frame that the inventions you made with Dr. Horowitz would have potential applications in a variety of different products or uses.

A. Yes. Very much so. And I never dropped the belief, which is why I think I believed it all the way through, so...

Q. Okay. If you would turn in this same document, CX-545, to the page 20.

And again you'll notice there's a heading in this plan that begins on the bottom of page 20, Synchronous DRAMs, and it continues on to the top of page 21. And I want to ask you about the statement on the top of page 21 if can.

The very first sentence says, "Sync DRAMs infringe claims in Rambus' filed patents and other claims that Rambus will file in updates later in 1992."

Do you see that statement there?

A. Yes.

Q. And is that the -- were your views on that the same as the views when we talked about the similar sentence earlier?

A. I believe that Rambus had broad patents. I

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can't tell you whether I knew enough specifically about sync DRAMs to know whether they actually infringed claims based in that time frame, so I just don't remember enough about what I knew about sync DRAMs.

Q. Is that something you ever made an effort to determine on your own?

A. No.

Q. Were at some point in time you told the claims -- there weren't claims that were being infringed by sync DRAMs?

A. That was later on. Yes.

Q. Look if you would at the next set of board minutes, CX-605.

And turn if you would to page 2 of CX-605.

Under Sales and Marketing, I want to just direct your attention to the last sentence in that paragraph if I might.

It says, "Mr. Mooring also reported on potential competition from JEDEC, sync DRAM and CDRAM."

Do you see those words there.

A. Yes.

Q. And is the sync DRAM that's referenced there the one that we've talked about in just the past few questions?

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A. Yes.

Q. What was the CDRAM?

A. That was the cache DRAM that I mentioned earlier. I believe it was by Mitsubishi. I believe it was by Mitsubishi, that they were trying to do another fast kind of part.

Q. And how did it do? Did it turn out to be a competitor?

A. It ended up dying. It didn't go anywhere.

Q. Okay. And there's a mention on page 3, if you turn to the next page, of something called the Rambus partners merger. Do you see that?

A. Yes.

Q. And can you just briefly tell us what the Rambus partners merger was all about?

A. Yeah. I remember this well.

When we first started the company, Bill Davidow wanted to own a larger piece of it as an investor, so he came up with a complicated arrangement where Mark and I got a certain percentage of the royalties off the top directly, so we owned some of the royalties directly and we owned a piece of the company. And then when Geoff Tate came, he was not at all happy with this arrangement and after a year or two convinced us to undo the arrangement, so we sold it back to the

8216

company.

Q. So it all got undone?

A. It got undone, yes.

Q. Look if you would at the next board minutes, which are CX-606, dated October 22, 1992.

And let me ask you to turn to the second page of this document.

I want to ask you about the heading under Sales and Marketing.

And let me ask you, was there a general pattern that board meetings followed at Rambus during the time frame 1992, 1993, 1994 .

A. Yeah. I'd say that most of the board meeting was like a status report on the engineering and sales efforts, so between Allen Roberts, who would talk about engineering, status and schedules, and Dave Mooring, they would -- their two discussions would consume an awful lot of the board meeting.

Q. So here under Sales and Marketing, let me ask you to take a look at that one, and I want to draw your attention to the second half of that paragraph, which has in it "Mr. Crisp reported on the SDRAM status at JEDEC, the Rambus patent strategy and system-level difficulties with SDRAMs."

Do you see that sentence.

8217

A. Yes.

Q. Now, do you have any direct recollection of that discussion?

A. I do not.

Q. And do you have any recollection of a discussion about Rambus patent strategy at this stage?

A. I don't have any direct recollections of it, no.

Q. Okay. In this time frame, '92 to even '93, do you have any recollection of discussions of patent strategies?

A. Only in the vague sense that I thought our portfolio should be pretty good and that we should work harder on it, but I don't have any specific recollections.

Q. Okay. Was there any discussion at this meeting about anything to do with JEDEC's rules, policies, anything like that?

A. Absolutely not. I would have remembered that. No, there was not.

Q. Do you recall at any point in time ever being told that there was a JEDEC patent policy?

A. Not until the year 2000 when the first lawsuit, so I had never heard of it before that.

Q. Was there any discussion at a board meeting

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prior to 2000 of whether Rambus should disclose anything to JEDEC that it had not disclosed?

A. Definitely not at any board meeting that I attended.

Q. And did anyone ever discuss in your presence or at a board meeting anything about let's not tell JEDEC something that maybe we should or maybe we don't have to, but maybe we shouldn't anyway tell them?

A. I'm sure I would have remembered and I don't. Again, the reason I'm so certain of this is it came to me as a complete surprise in the year 2000 when I was first told it was an issue. I was just flabbergasted, so...

Q. Were you involved in any way in Rambus' decision to terminate or not renew its JEDEC membership?

A. Not directly. I remember -- i don't really remember much about it. I remember not -- i didn't think -- i thought it was a waste of our time being there, but I don't remember being directly involved in it.

Q. Let me go back to the minutes, CX-606, and ask you to look at the next sentence on page 2, the one that says, "Mr. Mooring then spoke on Rambus versus sync positioning, potential competition from the IEEE

8219

RamLink strategy, staffing and marketing communications."

Do you see that sentence.

A. Yes.

Q. What was IEEE RamLink?

A. I remember a lot more about that than I do about synchronous DRAMs.

RamLink was a project started soon after Rambus started talking to customers to, in my view, directly compete with Rambus. They were trying to use the same ideas to do something that seemed very similar to Rambus, and I was pretty indignant about it, which is why I remember it so strongly.

Q. How did you first learn about it?

A. I don't remember the exact time frame. It was probably sometime in 1992. I was basically told, you know, these guys are going around claiming they've got something that's just as good as Rambus but that doesn't involve any royalties, and I remember being pretty unhappy about such claims.

Q. Did you ever meet with anybody from RamLink?

A. Yes, I did.

Q. And let me ask you to look at the next document, which is CX-681.

Are you identified as the recipient of this

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e-mail?

A. Yes. I'm the only recipient of the e-mail, yes.

Q. Okay. And does this help you put in time when you had a meeting with anyone from RamLink?

A. Yeah. And it's consistent with my direct recollection that it was in late 1992. I didn't remember exactly when, so this puts it after October of 1992. But I do remember having a meeting with several people from the SyncLink group at their request and in a Hewlett-Packard office on Page Hill Road.

Q. And do you recall who attended that meeting besides yourself?

A. Well, Dave Mooring was there certainly. I think that Gustafson was there. I don't really remember who else was there.

Q. You'll notice it mentions in the third paragraph down the name Wigger?

A. Hans Wiggers, yeah.

Q. Do you know if he was there?

A. I don't really remember for certain whether he was there or not.

Q. Do you recall --

A. I also vaguely remember a gentleman named James was there, too, but it's -- i can't sort it out.

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Q. Do you recall anything that was said at the meeting?

A. Yes. It started out as a discussion. It was their meeting. They asked for it. And it started out as a discussion that maybe we should try and cooperate instead of compete, which we were of course not at all in favor of. We were way ahead of them. We had a part working and they had barely started.

And then it turned out what they really wanted to talk about is they were concerned that what they are doing potentially violated Rambus intellectual property and that they wanted to know whether we'd consider giving them a license.

Q. And did you respond?

A. Yes, we did. We told them that we would certainly consider it, and there was a sort of general discussion about sort of general terms, and my recollection is it became quickly apparent that we were pretty far off and that we just weren't going to be able to reach an agreement.

Q. When you say "we," was there someone who attended besides you from Rambus?

A. Dave Mooring.

Q. Okay. And did anything ultimately come of those discussions with RamLink?

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A. No. They went nowhere. We decided it was a waste of time, and in fact we pretty much decided that RamLink was going to die if we just left it alone, so -- and that's in fact what happened.

Q. Okay. Did you have any further interactions with RamLink after that?

A. None that I can remember, no. I certainly never attended any of their regular meetings.

Q. Okay. Look if you would at the next in your binder, which is another set of minutes, CX-607.

Now, I'm making a big jump in time here to 1996. And I just want to ask you about whether in this time frame, 1996, you recall any discussions about a company or a product known as MoSys.

A. Again, I can't tell you exactly when it occurred, but I do remember some discussions about MoSys, yes.

Q. And what did you know about -- was that a company?

A. Yes, it was.

Q. And do you know who founded that company?

A. Yes, I do. It was a guy named Wing Leung who used to work for Rambus and who left, and we considered him sort of a friend and he had assured us that he was going to go do something noncompetitive, and then we

8223

find out a little while later that in fact he was doing something directly competitive, so we were pretty upset.

Q. And what was the product or what was he doing that you considered competitive?

A. They were doing an extremely -- a very high-speed -- i guess I'd call it sort of a cache DRAM, but they had their own version of a high-speed DRAM.

Q. And was there a dispute that arose with them?

A. We felt that it was directly violating or infringing on Rambus intellectual property.

Q. And was that dispute resolved?

A. Yes, it was. I can't tell you the details of when, but I do remember that they in the end agreed. We settled out of court. They gave us some stock in the company. And I don't remember any more details than that at this point.

Q. Okay. Here in these minutes that I asked you to turn to, CX-607, I want to ask you to look at the bottom of page 2 of CX-607, and there's a reference there to "Mr. Tate discussed strategy for the company's intellectual property, including a review and broadening of key patent claims in current applications and analysis of," and carrying over to the next page, "potential infringement of the company's issued

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patents."

Now, do you have a recollection from this time frame what was being discussed in terms of the potential infringement?

A. I don't have a direct recollection, and I hesitate to point out, but at this board meeting I was actually absent, so -- that's on the first page. So I don't have a direct recollection of it, no.

Q. Okay. Well, look if you would -- I think you maybe were absent from the next set of minutes. I'm not sure.

Yeah. Look if you would at CX-608, which are the next in order, and these again I think are minutes of a meeting you were absent from, but I want you to look at the second page of CX-608.

And independent of the board meeting, you'll notice it says there "status of negotiations with Intel and recent actions by MoSys" under the heading Business Development.

Do you see those references?

A. Yes.

Q. In this time frame, April of 1996 or mid-'96, whatever you best recall, do you have a recollection of the status of negotiations with Intel?

A. I don't really have a firm recollection. I

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know that the history between Rambus and Intel had lots of ups and downs, but if you'd ask me to graph those ups and downs, I don't think I can do it.

Q. And does the reference to MoSys in this particular set of minutes help you place in time when that dispute with MoSys that you mentioned earlier arose?

A. It helps somewhat. I mean, it seems consistent with my memory that the dispute with MoSys was sometime in '96 or '97, but I don't still know the exact date.

Q. Did there come a time when Rambus went from being a privately held company to one that was publicly held?

A. Yes. We went public I believe in May of 1997.

Q. And why was that done?

A. Things were going well with Intel. The first products that had shipped had gone very well. The company was profitable. It seemed like a good time to go public and raise some more money. It's always -- you know, it's always good to have more money in the bank.

Q. Let me ask you about a completely different subject then at this time. Let me ask you about your retention of documents if I can, Dr. Farmwald.

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Did you ever at any point in time from 1988 through today ever make any effort to go through Rambus-related documents and discard any of a particular group of those documents.

A. No, I did not.

Q. Have you made an effort to keep all the documents from that time period all the way up until today?

A. I have kept everything that I have, yeah.

Q. Has anything ever been lost?

A. To my knowledge, I lost -- a hard drive once that had some e-mail crashed and that's -- i don't even know when it happened. That's all that I can ever think of that was lost.

Q. Other than that, is it your best recollection today that everything you ever wrote or received that related to Rambus you would still have?

A. I certainly think I have everything. I mean, of course things could have gotten accidentally lost, but certainly no deliberate attempt was done.

I also had some early models that I built, little physical models, and they got lost somewhere along the way, but I can't -- i'd like to find them, but I can't find them anymore, so...

Q. And so all of your Rambus-related documents,

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have you at some time or another turned them over to lawyers for Rambus?

A. Yes. I've turned everything over.

Q. Okay. I want to ask you about Intel and I want to ask you to turn to CX-1022 if you would.

And before we do that, if I could offer into evidence CX-608, the minutes from April of 1996.

JUDGE McGUIRE: Any objection?

I don't think he heard me.

MR. ROYALL: I'm sorry, Your Honor.

JUDGE McGUIRE: Any objection to CX- --

MR. ROYALL: No objection.

JUDGE McGUIRE: -- 608?

MR. ROYALL: No objection.

JUDGE McGUIRE: Entered.

(CX Exhibit Number 608 was admitted into evidence.)

BY MR. STONE:

Q. Turn if you would to CX-1022. And I neglected to include it in the binder and let me hand up a copy -- if I might approach, Your Honor?

JUDGE McGUIRE: Yes.

BY MR. STONE:

Q. -- a copy of CX-1016.

I'm going to ask you about 1022 first if I

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might, Dr. Farmwald, and try to put this all in context.

So if you'd turn to the second page of CX-1022, and about a third of the way down an e-mail message begins "From: Mike Farmwald" and then it continues from there I think to the end of page 3 of CX-1022. But take a look.

Is the portion of this document CX-1022 beginning on the second page and continuing to the end of the third page that has the little carets in the margin, is that an e-mail you wrote.

A. I'm certain it is, yes.

Q. What were you writing about?

A. I was responding to an e-mail from Geoff Tate, which you've just gave me a copy of it.

Q. And the e-mail you were responding to from Mr. Tate is CX-1016?

A. Yes.

Q. What was the issue, if you remember it?

A. Well, as I mentioned earlier, we've had ups and downs with Intel, and Intel came to us in this time frame, which is April of '96 -- '98 -- sorry -- april of '98 -- yeah, I thought it was later than that -- so April of 1998 and basically threatened us. They wanted to -- they were threatening us with doing

8229

their own next-generation DRAM unless we basically did a list of things that they wanted, including giving up royalties.

Q. Including what?

A. Including giving up royalties.

Q. And how did you react to it?

A. I was extremely angry.

First of all, I thought that Intel was bluffing. I felt that they knew that they couldn't get around our patents and that this was totally a bluff, and in fact they had -- this is their standard way of doing it, sort of threaten to completely destroy you, and after you've gotten over the panic, then they tell you what they really want, so I was pretty upset.

Q. And is the e-mail that you wrote, the second half of CX-1022, an expression of your reaction to that Intel proposal?

A. Yes, it is.

Q. Ultimately was some resolution of that issue arrived at?

A. Yeah. We negotiated with Intel and it took a while, but they eventually came around and the relationship got patched up and they were friendly again, so we didn't give in.

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Q. Let me ask you then to turn to CX-613, which is another set of board minutes, if we could, and these are dated March 4, 1998.

This is a meeting you attended, according to the minutes; is that right.

A. Yes.

Q. There's a mention in the quorum section, there's a mention of Avtar Saini of Intel Corporation being in attendance?

A. Yes.

Q. Do you know him?

A. Yes. I met him.

Q. And why was someone from Intel in attendance, if you know?

A. To the best of my recollection, I don't remember at what point it got added to the contract, but at some point Intel wanted attendance rights at Rambus board meetings.

Q. And so from time to time did they exercise those rights?

A. Yes, they did.

Q. And who was it who usually attended?

A. I remember Avtar. I also remember Pat Gelsinger occasionally attended, too. There may be more, but those are the only two I can remember

8231

now.

Q. Let me ask you about these minutes, CX-613. Turn if you would to the second page of them. I want to direct your attention to the bottom two items under Intellectual Property and General.

Under Intellectual Property, it says, "At this point Joel Karp joined the meeting and updated the directors on the company's strategic licensing and litigation strategy."

Do you see that.

A. Yes.

Q. Now, do you remember specifically any discussion by Mr. Karp at this particular meeting?

A. I don't remember whether it was at this particular meeting or not, but I do remember a discussion from Joel Karp soon after he joined the company, relatively soon after he joined the company.

Q. And what was the substance of that discussion as best you recall it?

A. It was surprising to me, very surprising to me. He felt that our portfolio of -- our patents portfolio, issued patent portfolio with claims, was much weaker than we thought it was and that there were a lot of unnecessary restrictions but that he felt that given a year or two he could vastly improve it, but it was

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going to take that long.

Q. Do you recall any discussion of a litigation strategy in this time frame?

A. I don't really. I believe -- i mean, I have a vague recollection that we were starting to know enough about DDR that we felt very strongly that we either had or could get patents on DDR, and I have a vague recollection about some discussion of SDRAM.

Q. Under general, it says, "Mr. Tate discussed a potential issue which had arisen between the company and one of its patent firms, Townsend, Townsend & Crew."

Do you recall that issue.

A. I recall an issue. I don't know whether it's the one specified here.

Q. Tell us the issue you recall about Townsend, Townsend & Crew if you can.

A. I remember two that were related that came more or less at the same time.

We were getting more and more unhappy with them, partly because Joel felt that they weren't doing a good job, and also I think the thing that sort of -- you know, the straw that broke the camel's back was that we found out that they had taken on a new client which was one of the -- it was SyncLink or one of the

8233

competitor products they had taken on as a client, which we felt was unacceptable.

Q. And was that an issue that ultimately was resolved?

A. I believe we fired them. That's my recollection.

Q. Okay. Look if you would at the next set of board minutes, CX-615, dated May 21, 1998.

Is this a meeting you attended, according to the list of directors present.

A. Yes.

Q. And look if you would at the second page under Intellectual Property, where it says, "Mr. Karp reviewed the status of the conflict of interest involving one of the company's patent firms."

And then it says, "In addition, he summarized the company's strategic licensing plans, new patents, and the results of his review of potential weaknesses in the company's intellectual property portfolio."

Do you see that reference.

A. Yes.

Q. Is it consistent with your recollection that it was in this time frame that Mr. Karp gave the presentation that you earlier described of some weaknesses in the portfolio?

8234

A. Yes. I think it's quite likely that this may have been the board meeting where -- that I'm remembering, yes.

Q. Did there at some point in this time frame or later begin to be board discussions about strategic patent licensing?

A. I do remember those things occurring. I can't give you firm dates, but I think it was in the very late '90s, yes.

Q. And who was Rambus thinking of licensing when there's a reference to strategic licensing?

A. Well, a number of companies had been approaching us all along about nonconforming uses of Rambus, noncompatible uses of Rambus, so I believe we were starting to take it more seriously that that's something that we should consider pretty seriously.

Intel was also pushing us pretty hard that they wanted a license to Rambus technology for nonconforming uses and we had to take them very seriously.

Q. And when you say "nonconforming uses," what do you mean?

A. Something that wouldn't have been compatible with one of the Rambus generations.

Q. And were there products that you knew of that

8235

were considered nonconforming that people wanted licenses for?

A. I don't remember any specifics. I know that MoSys, we settled that dispute by agreeing to license them.

I knew that we felt that DDR was probably going to infringe. I mean, there wasn't a spec. The DDR spec didn't come out until much later. I remember myself feeling quite strongly that DDR infringed or would infringe.

I don't really remember any other things.

Q. Okay. And do you recall at some point board discussions about licensing companies with respect to DDR?

A. Yes. I remember more and more towards the end of the '90s, yes.

MR. STONE: Okay. At this time I'd like to offer Exhibit CX-615.

MR. ROYALL: No objection.

JUDGE McGUIRE: Entered.

(CX Exhibit Number 615 was admitted into evidence.)

BY MR. STONE:

Q. Let me ask you to turn to the next minutes in your binder, CX-616, dated July 9, 1998.

8236

And you'll note again under the quorum that it shows you as present.

A. Yes.

Q. And it shows Mr. Avtar Saini of Intel present? Do you see that?

A. Yes.

Q. Was there a practice or a general method by which the agenda of board meetings in the 1998 time frame occurred?

A. Well, certainly with respect to the Intel representative, I do remember that generally we'd have a part of the board meeting that was sort of okay for Intel to see and part, because it involved competitors to Intel, that we'd do without Intel there.

Q. And did you get reports from various people at board meetings in the 1998 time frame?

A. Yes.

Q. And who would report at board meetings?

A. You know, generally the -- engineering would report engineering status and marketing would report marketing status. Those are the two big ones that took most of the time.

And I believe at this point that Joel Karp had come in as the intellectual property -- head of intellectual property. He was starting to report

8237

independently at that point on intellectual property issues.

Q. If you look at the first page of CX-656, you'll see under finance, "Mr. Harmon summarized the results."

A. Yes.

Q. What was Mr. Harmon's position at the time, if you know?

A. He was the CFO. Okay. I do remember those two. We were a public company at that point and so obviously the finances were important. It's just that since I'm more of an engineer, I didn't pay as much attention to those as other things.

MR. STONE: Can I also move in Exhibit CX-656?

MR. ROYALL: No objection.

JUDGE McGUIRE: Entered.

(CX Exhibit Number 656 was admitted into evidence.)

BY MR. STONE:

Q. Let me ask you to look at the next board minutes, CX-622, if you would, July 14, 1999 .

Is this again, according to the minutes, a meeting you attended.

A. Yes.

Q. And look if you would at the second page of

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CX-622 under Intellectual Property where it says, "Mr. Karp reviewed the company's strategic portfolio of current IP and plans for an additional strategic portfolio for extending the life of Rambus IP."

Do you see all that.

A. Yes.

Q. Do you have any specific recollection of anything to do with plans for an additional strategic portfolio for extending the life of Rambus IP?

A. Again, I can't -- my recollection is not as to whether it happened at this meeting or not, but I do have -- after Joel started, he really stirred things up. He really did a good review of the patents. He observed that there were a lot of weaknesses that could be repaired and a lot of new patents that could be filed and he was very actively working on that.

So I do remember that, yes.

Q. Okay. Let me ask you to turn -- let me first offer in evidence Exhibit CX-622.

MR. ROYALL: No objection.

JUDGE McGUIRE: Entered.

(CX Exhibit Number 622 was admitted into evidence.)

BY MR. STONE:

Q. I then ask you to turn to the last document in

8239

your binder, Mr. Farmwald, which is CX-623.

Are these minutes of a board of directors meeting from October 14, 1999 .

A. Yes.

Q. Let me ask you to turn if you would to page 4.

Again I'm going to direct you to just one of the many topics of this meeting, to the one headed Intellectual Property where it says, Mr. Karp reviewed strategic -- i'm sorry. I misread that -- "Mr. Karp reviewed various strategic IP issues including target selection and a negotiation timeline."

Do you recall a discussion at this specific board meeting of those topics.

A. I don't recall this specific board meeting. I recall a general discussion of such topics.

Q. Tell us if you can what you recall of a discussion of those general topics in this time frame if you can.

A. I remember that towards the very end of the 1990s we had decided that -- he had been there for a while, Joel had been there for a while, he felt that he had in fact fixed up our patent portfolio and that we now had issued claims that in fact did read on I believe both DDR and SDRAMs and that he was going to go off and try and license those things to various

8240

companies and that the target selection was what is the first company that we wanted to go approach about these things.

Q. Was there a discussion and a decision by the board as to a policy as to how you hoped to license these companies?

A. I'm sure there was. I actually -- i don't really remember exactly what it was, so I can't say I remember.

Q. Let me see if I can jog you at all as to any specifics.

Do you recall any discussion of let's license some but not others.

A. Oh, absolutely -- I'm sorry. I thought you were talking about the terms of it. No, no. We've always -- the same as the Rambus license themselves. We always were going to offer the same license to everybody on pretty much the same terms.

Q. And do you recall being involved in discussions as to whether the rate for DDR would be less than, the same as or greater than the rate for Rambus DRAM?

A. Well, I do remember that quite strongly because I felt very strongly about it. The rate for noncompatible for DDR had to be higher, in my view, for

8241

compatible uses.

Q. Was that ultimately the board's decision as well?

A. Yes.

Q. What was the basis for your view? Why did you think that?

A. Well, again, there are two real strong reasons. One is this issue of whether we're part of the process. If they're using compatible parts, then it's a partnership. We're working with them. We get feedback. We get information. We get to work with customers.

If it's noncompatible, they just write us a check. We don't know what's going on. We don't know what's going on in the future. There's no partnership there, and so we don't have any of the fringe benefits of being a partnership.

The other one is, again, in my view the very simple one is if I can buy a noncompatible license and do something that's competitive and pay less, then why would I ever buy the compatible license, so it seemed very simple to me.

Q. So there was an incentive to encourage people, as part of this, to encourage people to stay with RDRAM?

8242

A. Yes.

Q. Did the company offer licenses to manufacturers of SDRAM and DDR?

A. Yes. We offered it to everybody.

Q. And to your knowledge, were they all offered the same terms?

A. To my knowledge, they were more or less the same terms. I think there were some minor tweaks, but I think they were basically all the same.

Q. Did everybody take a license?

A. A lot of people did, not everybody. Three people didn't.

Q. And was there litigation with any of the ones who didn't?

A. Yes, there was litigation. Well, there's an issue -- there was litigation with Hitachi, but they settled before it actually got to litigation. And there of course later on was litigation with Infineon, Hynix and Micron.

Q. And do you know whether Hitachi paid more than other licensees or not?

A. It's my understanding that they did. My recollection is that they did pay a little bit higher as sort of a penalty for fighting basically.

MR. STONE: I have no further questions. Thank

8243

you very much, Dr. Farmwald.

JUDGE McGUIRE: Why don't we take a short break, ten minutes, and we'll come back with cross-examination.

We're in recess.

MR. ROYALL: Thank you.

(Recess)

JUDGE McGUIRE: At this time you may begin your cross-examination, Mr. Royall.

MR. ROYALL: Thank you, Your Honor.

CROSS-EXAMINATION BY MR. ROYALL:

Q. Good afternoon, Dr. Farmwald.

Now, just to make it clear, am I right that you are no longer involved in the day-to-day management of Rambus.

A. That's correct.

Q. And you ceased being involved in the day-to-day management of Rambus sometime in the 1993 time frame?

A. That's correct.

Q. But you have continued to be active as a member of Rambus' board of directors from the time that the company was founded through today; is that right?

8244

A. Yes.

Q. And you continue to own a significant number of shares in the company; is that right?

A. Yes.

Q. And is it somewhere in the range of four million shares?

A. A little bit less but pretty close, yeah.

Q. Now, let's talk for a moment about the original technical concept that you described to Professor Horowitz back in the late 1980s.

And actually I think I have a document I want to ask you about in connection with that.

May I approach, Your Honor?

JUDGE McGUIRE: Yes.

BY MR. ROYALL:

Q. Dr. Farmwald, I've just handed you a document that's been marked for identification as CX-1757.

Do you recognize these to be handwritten notes that you prepared?

A. It's my handwriting, yes.

Q. And directing your attention to page 2 of CX-1757, do you see about halfway down there's a reference to, if I'm reading your handwriting correctly, six measures of DRAM utility?

A. Yes.

8245

Q. And it looks like there's a list of six measures that's crossed out and then there's another list down at the bottom.

Do you see what I'm referring to at the bottom of the second page.

A. Yes.

JUDGE McGUIRE: Is that in camera?

MR. STONE: I believe it's in camera, Your Honor. If we could just take it off the screen for a second.

JUDGE McGUIRE: Yes. Let's clear this up before we go ahead.

(Pause in the proceedings.)

If there's any doubt about it, let's treat it as in camera.

MR. STONE: Give me one minute.

JUDGE McGUIRE: Certainly.

Let's go off the record for a moment.

(Discussion off the record.)

JUDGE McGUIRE: Mr. Stone?

MR. STONE: If it was on our list correctly or in error, it does not need to be treated in in camera in either event.

JUDGE McGUIRE: So that resolved it.

MR. STONE: So if it was granted that status,

8246

we would withdraw it.

JUDGE McGUIRE: All right. Very good.

Mr. Royall, you may proceed.

MR. ROYALL: Thank you.

BY MR. ROYALL:

Q. Going back to page 2 of CX-1757, do you see the list of six points at the bottom, bottom of the page?

A. Yes, I do.

Q. And this is a list that you made of various measures of DRAM utility; is that right?

A. Yes.

Q. And one of the items, the third item on the list, is bandwidth. Do you see that?

A. Yes.

Q. And am I right that bandwidth simply refers to the speed the data is passed in and out of a DRAM?

A. That's correct.

Q. And in developing the Rambus technology, am I correct that your primary focus was on addressing the bandwidth issue?

A. I'd say that's reasonably fair. Bandwidth was a major consideration. Getting the maximum bandwidth consistent with other things such as a low price and low power and other things, yes.

8247

Q. And just above "bandwidth" on this same list of six measures of DRAM utility is the word "latency." Do you see that?

A. Yes.

Q. And am I correct that latency relates to the time it takes to get data out of a DRAM after making a request?

A. Yes.

Q. And in developing the Rambus technology you were not attempting to change the latency of DRAMs; is that right?

A. We felt that the latency of DRAMs was sort of inherent in the way they were built and there wasn't much we could do about it. We tried to make it as low as we could, but there wasn't any knobs that we could turn to make it much better.

If I could just comment, I don't know if it matters, but this is actually not a document that was shown to Mark as part of Rambus. This is an outline of a talk that I gave at a supercomputer conference about supercomputers.

Q. Yeah, I understand.

A. Okay.

Q. Now, when you first formed Rambus, it was your view that the company should not attempt to actually

8248

build the DRAM products that you designed; is that right?

A. I would have loved to have built them. I felt that there was no way that we could raise enough money to build them.

Q. And even back in the early 1990s it was your understanding that a DRAM fab would cost somewhere on the order of a billion dollars to construct?

A. Yes.

Q. So the decision was made back then that Rambus would primarily be in the business of licensing its technology to others as opposed to manufacturing semiconductor devices itself?

A. I felt that that was the only possible business model, yes.

Q. And am I right, Dr. Farmwald, that Rambus has throughout its entire history had essentially a royalty-based business model?

A. Royalty and consulting fees, yes.

Q. Would you agree that royalties are Rambus' lifeblood?

A. Yes.

Q. And that's been true since the company was started?

A. Absolutely.

8249

Q. When you and Dr. Horowitz founded Rambus, you understood that semiconductor manufacturers generally don't like to pay royalties, didn't you?

A. They don't like to pay unless they have to, yes, that's correct.

Q. And am I right that you also knew that in order for Rambus to succeed with a royalty-based business model, the company would need to have patents over its technology?

A. Yes.

Q. And you worked with Professor Horowitz in drafting the original Rambus patent application filed in April 1990 ; is that right?

A. Yes, I did.

Q. And that application is sometimes referred to as the '898 application?

A. I believe that's correct, yes.

MR. ROYALL: May I approach, Your Honor?

JUDGE McGUIRE: Yes.

BY MR. ROYALL:

Q. I've just handed you a document that's been marked for identification as CX-1451.

Do you recognize this.

A. It appears to be the first patent we filed.

Q. Am I right that this is a copy of the

8250

'898 application?

A. I think so. I'm going to have to read it more carefully to say that for a hundred percent certainty, but it looks like it is. It's certainly labeled that way.

Q. Yeah, if you'll look on the first page, you'll see a list of numbers ending with the last three digits 898?

A. Yes.

Q. Do you see that?

A. Yes. It's confusing because it's also crossed out and got another label, but yes, it looks like that's what it is.

Q. Now, let's take a minute if we could. Mr. Stone had asked you some general questions about the portions of the original Rambus patent application that you, as opposed to Professor Horowitz, had written. Let's see if we can break down what are some of the different parts of this document.

If you'll turn with me to page 3 of CX-1451, do you see the heading Background of the Invention.

A. Yes.

Q. And so from this page on to page 5, the top of page 5, that's just a general background discussion relating to the Rambus inventions that were discussed

8251

in this patent application; right?

A. I think so, yeah.

Q. And then starting on page 5 and continuing on to page 9, this is a discussion of the prior art that you talked about earlier in response to Mr. Stone's questions; is that right?

A. At least some of it is. I certainly gave all of the prior art that I could find to David Larwood who then incorporated it into this patent.

Q. So that that section of the patent application was written by the attorney Mr. Larwood?

A. Yes.

Q. Based on your input?

A. Partly on my input. I don't know how much he did on his own.

Q. And then continuing on page 9, do you see the title Summary of Invention?

A. Yes.

Q. And then continuing there through -- that section ends on page 12, the top of page 12.

So that section from page 9 to page 12, that is a description or summary of your basic -- the basic inventions that are the subject of this patent application.

A. A basic summary, yes.

8252

Q. And then on page 12 there is, continuing to 13, there is a description of certain drawings or figures that are attached at the back of the application; is that right?

A. Yes.

Q. And starting then on page 13 and continuing through to I believe it's page 63, this is the detailed technical description of your inventions; is that right?

A. Yes.

Q. And then the claims of the patent or patent application, then they begin on page 64; is that right?

A. Yes.

Q. And in total, the '898 application contained 150 claims?

A. I'd have to check, but that sounds about right.

Q. If you'll look on page 125, I think that's the last page of claims and the last claim is number 150.

Do you see that?

A. Yes.

Q. Now, let's go back to the background section starting on page 3.

The first sentence under the heading Background

8253

of the Invention starts by talking about how semiconductor computer memories have traditionally been designed and structured.

Do you see that language.

A. Yes.

Q. And that's the subject of this first -- the entire first paragraph under the heading Background of the Invention. I'll give you a moment to look at that.

A. More or less true, yes.

Q. And am I right that the reason for this discussion, that is, the discussion of how semiconductor computer memories have traditionally been designed and structured, the reason for beginning this section with that discussion is to provide context for explaining how your inventions differed from traditional DRAM designs --

A. I think that's fair.

Q. -- is that right?

And then turning to the next page, page 4, you'll see the first full paragraph has the sentence -- the first sentence is: "To understand the concept of the present invention it is helpful to review the architecture of conventional memory devices."

Do you see that.

8254

A. Yes.

Q. And am I right that the point that's being made there is the same point that I just covered with you, that in this application you were not only presenting your inventions but you were contrasting them by comparison to traditional memory devices? Is that right?

A. We were trying to sort of outline, yes, the current state of memory devices, yes.

Q. Now, there is a reference in the next paragraph on page 4, the bottom paragraph, to a figure 1. Do you see that?

A. Yes.

Q. And let's go to figure 1, which is on page 129.

On the top of the page, page 129, do you see the figure there identified as figure 1.

A. Okay. I found it.

Q. And that what's being depicted in that figure is not the Rambus DRAM design but rather the general way in which traditional DRAMs were designed; is that right?

A. Well, not quite. What that is is a picture of what -- how the inside of a DRAM works. It turns out it's the inside of both a conventional as well as a Rambus DRAM, the internal -- the internal core array,

8255

how it works, how it works with bit lines, so basically right.

Q. And so the Rambus invention did not change that internal core?

A. We changed it a little bit, which we outline in this document, the core. Actually we changed it a fair bit, but yeah.

Q. Let's go back to -- let's go to page 9 of CX-1451, and this is the page that has the heading Summary of Invention and it's the beginning of that section of the patent application. Do you see that?

A. Yes.

Q. And the first sentence under that heading starts with the words "the present invention." Do you see that?

A. Yes.

Q. And the first point that's made here is that your invention, quote, includes a memory subsystem comprising at least two semiconductor devices, including at least one memory device connected in parallel to a bus. Let me stop there.

Do you see that language.

A. Yes.

Q. And am I right that what this is saying is that the invention, your invention and Dr. Horowitz's

8256

invention, includes at least one memory chip, another semiconductor device and a bus connecting them?

A. I would say -- well, again, in the end, there were many inventions in here, but one of the principal things we did, that is true, yes.

Q. And by the term "bus" here, how would you -- you may have defined the term earlier, but could you define it again, what you mean by the term "bus."

A. Yeah. To me a bus is a bunch of parallel lines, one or more connections that multiple devices can connect to in parallel, so that's the general form of a bus. And it can be anywhere from a couple of lines to many, many, many lines.

Q. And focusing on this same sentence, it's a long sentence, but that same sentence on page 9 of CX-1451, the language continues with the words "where the bus includes a plurality of bus lines for carrying substantially all address, data and control information needed by said memory devices."

Do you see that.

A. Yes.

Q. And am I right that what this is saying is that in the memory subsystem being described here the same bus would be able to carry all of the different types of information that are needed by the memory

8257

device?

MR. STONE: Your Honor, if I might object, my concern is here that the construction of claims in regard to a patent is the subject, as you know, of Markman hearings held where legal conclusions are ultimately framed by the district court, and in this instance some of the aspects of this particular application have been construed by the Federal Circuit, and I'm concerned as a result that the witness is being asked for legal conclusions and being asked to opine on claim construction issues, which I don't think are part of this case, rather than just what was the nature of his invention, so I have a concern that this is invading the province of a Markman hearing.

JUDGE McGUIRE: Mr. Royall, response?

MR. ROYALL: Your Honor, I have no intention of asking the witness about the claims in the patent. The claims are a separate section and that his point would only have bearing, if at all, on the claims in the patent application. All I'm asking the witness about is the description of the technology and I think that's highly relevant and it in fact is something that was raised in Mr. Stone's direct.

MR. STONE: And Your Honor, if I could just respond, that the specification and the rest of the

8258

language of the application is all part of what the court considers in a Markman hearing in construing the claim language, and I avoided the application for the reason that I didn't want to convert this proceeding into a patent infringement Markman hearing and tried to stay on the general technology.

To the extent this language sheds light on the witness' earlier descriptions of the technology, I don't mean to object to it in that sense, but I am concerned that we're going to get --

JUDGE McGUIRE: Then let's just keep it just to the technology, and to the extent that you're calling for any questions of law, then I'm not going to go into that inquiry, Mr. Royall.

MR. ROYALL: Your Honor, I have absolutely no intention -- I hope nothing I've asked suggests otherwise -- to ask about any issues of law.

JUDGE McGUIRE: I'm just saying that now that it's clearly defined as to how far you're going to be able to go on this, let's just keep that in mind.

And I'll also caution the same of the witness, to keep your answers purely on your own personal knowledge and not get into any opinions of law in that.

MR. ROYALL: Thank you, Your Honor.

8259

BY MR. ROYALL:

Q. And Dr. Farmwald, am I right you are a named inventor on this application, the '898 application?

A. Yes, I am.

Q. And just to be clear, when I'm asking you questions, I'm only asking you questions based on your own personal knowledge as a named inventor here, and I certainly don't want to ask you any -- ask for any legal conclusions.

A. Okay.

Q. Now, going back to that same first sentence under the heading Summary of Invention, page 9 of CX-1451, I believe I was pointing out to you the language that states "where the bus includes a plurality of bus lines for carrying substantially all address, data and control information needed by said memory devices."

Do you see that.

A. Yes.

Q. And am I right that what this is saying is that in the memory subsystem being described here the same bus would be able to carry all of the different types of information that are needed by the memory device?

A. If I take the -- all of the lines that connect

8260

all of the DRAMs together and call them a bus, then the answer is yes, so yes.

Q. And am I right that that concept, the concept of one bus carrying various types of data, is sometimes referred to as multiplexing?

A. No. I would say that's a different concept actually. I'm sorry. I would not agree that that's the same concept.

Q. How would you -- well --

A. A bus doesn't necessarily need to be multiplexed. There are buses and there are multiplexed buses, but to me a bus doesn't automatically mean multiplexed.

If I could make a specific example, you could have a bus that has a separate address, a separate data and separate control lines and you would never need to multiplex any of the lines and that's still a bus. In fact, that's how normal DRAMs work really.

Q. But am I right that the bus that you were describing in this patent application was a multiplexed bus?

A. I don't think -- i mean, it's been a long time since I looked at this document, so I would hate to make a flat statement like that. Certainly this description right here doesn't talk about a multiplexed

8261

bus.

Q. All right. Well, maybe I can help you then. If you look at the bottom sentence on page 9, CX-1451, the last sentence carrying over to the next page, page 10, do you see the words "the new bus"?

A. Yes.

Q. Okay. And then if you turn to the next page, then there the first word is "includes." Do you see that?

A. Yes.

Q. And then it mentions a couple things that it includes, but then skipping over that, then it says "and multiplexed address, data and control signals."

Do you see that.

A. Yes.

Q. So the new bus that you were describing in this patent application was one that included multiplexed address, data and control signals; is that right?

A. Certainly in the preferred implementation we did multiplex the address lines, I agree with that.

Q. And am I right that we touched earlier on the idea that in this patent application you were distinguishing your inventions from traditional DRAM designs, and am I right that this is one area of

8262

distinction, that is, by comparison to traditional DRAM designs in this time frame in the early 1990s, it was a distinguishing factor that the DRAM system that you were explaining in this patent application had multiplexed address, data and control signals?

A. I'm not sure I completely understand the question, but I believe, if you're saying is this the distinction between DRAMs --

Q. Is it a distinction between your invention and traditional DRAM designs?

A. I would not make it so clear-cut. Especially if I looked at the next sentence which says persons skilled in the art will recognize that 16 bus data lines or other numbers of bus data lines can be used to implement the teachings of this invention, so the fact that in the preferred implementation which was narrow it's multiplexed, what we explicitly say is that you can use -- the preferred implementation that we described in this patent is multiplexed, what we explicitly say is that wider buses could be used to implement teaching this invention, so I'm not sure that I would make that distinction.

Q. Just to follow up on that last answer, you said the preferred implementation in this patent application was narrow and multiplexed; is that right?

8263

A. It says so right here, yes, in a preferred implementation or in -- not in the but in a preferred implementation eight bus data lines and an address valid line, i.e., a ninth bit, carry address, data and control information for memory addresses up to 40 bits wide.

Q. And the word "narrow" in this context is a reference to the bus, that is, a narrow bus; is that right?

A. Well, I used the word "narrow," yes.

Q. And so that when you use the word -- the term "narrow bus" you're referring to the narrow bus that was used in the preferred implementation of the Rambus inventions as set forth in the '898 application?

A. Well, it says "in a preferred implementation," but the answer is yes.

Q. Now, going back -- well, strike that.

Let me ask you to turn to page 43 of CX-1451.

Are you with me --

A. Yes.

Q. -- on page 43?

The last paragraph on that page, the second sentence states, "By using a narrow, multiplexed (time-shared) bus."

Do you see that.

8264

A. Yes.

Q. And is that -- that's a reference to the narrow, multiplexed bus that's used in the preferred implementation?

A. Yes. In a preferred implementation.

Q. In a preferred implementation?

A. Yes.

Q. Was there more than one preferred implementation discussed in this patent application?

A. I don't remember. But we certainly described wider -- and we said explicitly, as I just pointed out earlier, that wider ones worked, were feasible, so I don't remember. It's been a long time since I looked at this.

Q. And you say you described it explicitly in the patent application?

A. Well, I just -- where I just pointed it out to you.

Q. I'm sorry. I missed that. Where was that?

A. Back where we just were.

Q. On pages 9 and 10?

A. Yeah.

Q. Oh, I see. This is on page 10 where it says "in a preferred implementation"?

A. Right. The next sentence actually says that

8265

persons skilled in the art -- i have to find it.

Q. Now, going back to the question I asked earlier, was there more than one preferred implementation of the Rambus inventions set forth in this patent application?

A. I don't remember.

Q. Now, going back to page 9 and continuing with some of the language of this very long first sentence under the heading Summary of Invention, do you see the language that -- it's one of the many parentheticals in this sentence -- "where the control information," do you see that?

This is on the first long sentence under Summary of invention on page 9.

A. Yes.

Q. So it says "where the control information includes device-select information," and then skipping further down, it says "and the bus carries device-select information without the need for separate device-select lines connected directly to individual devices."

Do you see that.

A. Yes.

Q. Now, am I right that this, what's being described here, is something that serves to distinguish

8266

the Rambus invention from traditional DRAMs which used separate device-select lines?

A. Well, again, I'm not sure whether I'm being asked for a legal opinion or not, but --

Q. No, you're not.

A. So it's sort of confusing to me. Basically the summary is describing a preferred implementation for which that's true. That's at least my understanding from reading that right now. Maybe I'm reading it wrong, so...

Q. Well, let me ask you to go back to page 3 of CX-1451, and you'll recall that under the heading Background of the Invention you agreed that this first full paragraph is essentially a description of the traditional design and structure of semiconductor computer memories.

And then if you'll look down to the third line from the bottom on page 3, do you see that there's a reference to use of a separate device-select line for each needed device? Do you see that?

A. Yes.

Q. So what is being described here is the fact that in traditional DRAM designs there was a separate device-select line for each needed device; is that right?

8267

A. That's how -- what it says the current memory systems use, yes.

Q. And then turning back to page 9, the language that I was asking you about a moment ago , and now we're going from your description in the patent application of the traditional DRAM design to your description in a summary form of the Rambus invention.

A. Uh-huh.

Q. And you say there that the bus carries device-select information without the need for separate device-select lines connected directly to individual devices.

Do you see that.

A. Yes, I do see it.

Q. So am I right that this is -- this is one of perhaps several areas in which the Rambus invention differed from traditional DRAM designs?

A. Well, I think what you're asking me -- i'm still trying to understand the question. I think what you're asking me is is everything in this invention dependent upon that feature, and it seems to me that's a legal opinion. I would say no, but -- but -- so I'm not sure exactly what question you're asking me still.

Q. Well, again, I'm not asking you for any legal

8268

opinions, because I understand you're a named inventor on this patent application and you said that you contributed to the writing of the patent application earlier.

A. Right.

Q. And I'm just asking -- and the patent application describes your inventions?

A. Yes.

Q. So I'm just asking you about the nature of these inventions and how do they differ from traditional DRAMs.

A. Right. So again, I'm still having trouble with the question, but I think there are a lot of different inventions in here which are completely independent of each other.

If I understand the essence of your question, and maybe I understand it wrong, I admit, but it seems to me you're asking me as is any device, for instance, that has a separate device select not under this invention, that seems to me to be a legal opinion and --

JUDGE McGUIRE: Then don't answer it if you think it's a --

THE WITNESS: Okay. Well, then that's what I'm trying to understand.

8269

BY MR. ROYALL:

Q. That is not what I'm asking you. I am simply -- I pointed out from the beginning of the patent application where you described the traditional DRAM designs as having separate device-select lines, and then I'm pointing you to language in which when you describe the Rambus design you say that the bus carries the device-select information without the need for separate device-select lines, and all I'm asking you is: Is this a way in which your invention differed from traditional DRAM designs? Because you didn't need separate device-select lines, that information was --

JUDGE McGUIRE: Okay. Can you answer that question, Dr. Farmwald?

THE WITNESS: I think so.

JUDGE McGUIRE: I mean from your personal knowledge.

THE WITNESS: From my personal knowledge. I think -- here's the thing that's confusing me, if I could just say. The problem is when you say "the invention" here. You've said that I believe several times.

BY MR. ROYALL:

Q. Well, that same sentence begins with the words

8270

"the present invention."

A. I understand. But in my mind I'm asking --

JUDGE McGUIRE: Take it, though, from the context of that paragraph.

THE WITNESS: Right.

JUDGE McGUIRE: If you can. And perhaps that will help you understand the import of the question.

THE WITNESS: I think that is one of the inventions of this, one of the things that was invented or described -- one of the inventions described in this patent, in this description, is a bus, a way of connecting DRAMs together that does not involve chip-select information. I think that is one of the inventions.

BY MR. ROYALL:

Q. And in that -- is that a respect in which the Rambus invention as a whole or the Rambus DRAM design differed from traditional DRAM design?

A. That would not be my view, but now I think now you're asking for a legal opinion again, so that's what's confusing me.

Q. I'm not asking you --

A. Well, my view is that it would not but --

Q. So traditional DRAM designs at this point also carried the device-select information over the bus?

8271

A. No. But that wasn't your question. You said -- well, maybe you should repeat the question because --

Q. Well, I'll -- let me read the question back.

And is that a respect in which the Rambus invention as a whole or the Rambus DRAM differed from traditional DRAM design.

A. That is one of the things that I believe we invented, yes.

Q. Okay. Now, the same very long sentence goes on to say "where the bus includes a plurality of bus lines."

Do you see that language? It's actually -- it's actually earlier up in the --

A. Yes, I see it.

Q. I'm sorry. I've already covered that point.

The language that I wanted to point out now is the language that I skipped over a moment ago where it says "and the bus has substantially fewer bus lines than the number of bits in a single address."

Do you see that.

A. Yes.

Q. And am I right that what's being described there, the idea that the bus that is part of your invention has substantially fewer bus lines than the

8272

number of bits in a single address, that is another way in which your invention, the Rambus memory subsystem that's being described here, differs from traditional DRAM designs?

A. That's less clear to me because in the traditional RAS/CAS interface the normal address bus that you send into that, the address lines, it's a bus, that has -- because of the way it works, you send half the address bits at first and then in the second cycle you send the other half of the address bits. That also has fewer address lines than it has address bits.

So I'm not sure that that in fact is a distinguishing characteristic of our invention.

Q. But just to be clear, is it not your understanding that traditional DRAMs -- and by that I mean the sorts of traditional DRAMs that are described in the background of the invention section in the '898 application -- is it not your understanding that those traditional DRAMs had more lines than the number of bits in an address?

A. No. It had fewer. No. That's the whole RAS/CAS interface. That's how it worked. You send half the bits in the first cycle and half the bits in in the second cycle, so it in fact did have fewer address lines than address bits.

8273

Q. So this is not a --

A. I don't think this is a distinguishing factor in my view. Again, you're asking for my personal view, not a legal conclusion.

Q. Let's go to page 10, the top of the page, the first full sentence which I think we've focused on a moment ago. This is the sentence that refers to a preferred implementation. Do you see that?

A. Yes.

Q. And let me ask you to turn again to the figures at the back of the document, page 131.

And there are two figures here, figures 4 and figures 5.

A. I'm sorry. What page are we looking at?

Q. Page 131.

A. Okay. Okay.

Q. If you could hold your finger on that page and then turn back because I want to compare that, this, to the language on page 10, if you're able to do that.

A. Yes.

Q. The sentence that I was pointing out says, "In a preferred implementation, eight bus data lines and an address valid bus line carry address, data and control information for memory addresses up to 40 bits wide."

8274

Do you see that language.

A. Yes.

Q. And then turning back to page 131, am I right that the two figures on this page, figures 4 and 5, are depicting that preferred implementation, by which I mean an implementation that has eight bus data lines and an address valid bus line?

A. Yes.

Q. And focusing on the top figure, that is --

A. Although, if I could just point out, it's a very minor point, but it really is nine data lines because the address is actually used in all nine of the lines. It's a minor -- it's a --

Q. Okay. Focusing then on figure 4, at the top on the right-hand side, there's the word "cycle." Do you see that?

A. Yes.

Q. And then below that are numbers 0 through 5. Do you see that?

A. Yes.

Q. And are those numbers references to clock cycles?

A. The zero -- whether they're odd or even are references to clock cycles. Past that point it's a reference to the beginning of the packet. But yes,

8275

that's right.

Q. And am I correct that the rows corresponding with those numbers refer to information that's being transmitted over the bus with each successive clock cycle?

A. Yes.

Q. And am I right that what's being depicted here is the format of a request packet?

A. Yes.

Q. And the six rows together comprise the entire request packet; is that right?

A. Yes. It's the address, the data and the control information. Well, actually -- sorry -- this is just address and control. There's no data in this one.

Q. The Rambus DRAM technology is a packetized technology. Is that a term that's sometimes used to describe the technology, "packetized"?

A. I think that's fair.

Q. And am I right that the use of packets in this way is another manner in which the Rambus technology differs from traditional DRAM memory design?

A. I believe it was one of the inventions that we disclosed in here, yes.

Q. Now, finally, let's go to page 129 and

8276

specifically the bottom of page 129, which is figure 3.

A. Okay.

Q. Am I right that what figure 3 depicts is the physical packaging of the preferred embodiment?

A. Yes.

Q. And on the far right, the flat box with the pins sticking out of it, is that the memory controller?

A. It's a CPU or memory controller, yes.

Q. Okay. And then the black line to the left of that, is that depicting the bus?

A. Yes. In the original -- if we had a better copy, you could see a bunch of individual lines going through it. They got smeared together in the copy.

Q. And then the vertically stacked devices that look like dominoes to the left of that, are those separate DRAM chips?

A. Yes.

Q. And they're all connected along one side to the bus --

A. Yes.

Q. -- is that right?

And am I right that this type of packaging of a memory subsystem is something that was significantly different from traditional -- the way that DRAMs were

8277

packaged.

A. That was one of the subjects of this invention, yes.

Q. You may set that document aside if you'd like.

Now, in the early 1990s I think you've testified that Rambus met with a number of companies seeking to interest other companies in licensing its technology; is that right.

A. Yes.

Q. And specifically am I right that what Rambus was seeking to license were rights to its technology for use in developing Rambus DRAMs or products that would be compatible with Rambus DRAMs?

A. That was what we were trying to license, yes.

Q. And you were personally involved in a number of presentations to various companies that occurred in that early -- late 1989 through the early '90s time period; right?

A. Yes.

Q. And I believe the DX behind you, which I think is DX-255, this is your listing of the companies that you recall meeting with in at least the '89 to '90 time period; is that right?

A. Yes. That's partial. I'm sure there's others I'm forgetting, but yes.

8278

Q. And whenever you met with these companies to discuss Rambus' technology, am I right that these discussions took place subject to nondisclosure agreements?

A. Almost always yes. Yeah.

Q. And Rambus was always careful about securing nondisclosure agreements before disclosing any proprietary details about its technology?

A. Certainly before we got the patents we were very careful and my best recollection is we were pretty careful afterwards, too.

Q. Now, let me show you another document.

May I approach, Your Honor?

JUDGE McGUIRE: Yes.

BY MR. ROYALL:

Q. I have just handed you what's been marked for identification as CX-1283. And I think you may have seen a similar document earlier.

Do you recognize this.

A. Yes, I do.

Q. And am I right that this is a document that you had some role in preparing?

A. Yes, I did.

Q. And am I right that this document is typical of the types of presentation materials that you used when

8279

you went out and tried to market the Rambus DRAM technology to potential business partners in the early time period of Rambus' work?

A. Yes. In the very early time period this is typical. This is from 9-89, so yes, this is an early version of such a document, yes.

Q. If I could ask you to turn to page 4 of CX-1283.

This is the page with the heading Rambus motivation. Do you see that.

A. Yes.

Q. And then you refer to about halfway down do you see the reference to current solutions?

A. Yes.

Q. And that's a reference to current or conventional DRAMs; is that right?

A. It's actually a reference to current memory systems that use DRAMs, but yes.

Q. And below the reference to current solutions, do you see the words "very wide"?

A. Yes.

Q. Is that a reference to the width of the buses used in conventional DRAMs?

A. No. That's a reference to the width of the bus used on the memory card.

8280

Q. Okay. Let me ask you this. By comparison to conventional DRAMs, was the bus -- well, strike that.

The first generation of the Rambus technology incorporated a narrow bus design; is that right.

A. The first generation did, yeah.

Q. Let's go to page 6 of CX-1283.

This has the heading What Does Rambus Offer? Do you see that.

A. Yes.

Q. And then on the bottom of the page, you see the language "Use existing DRAM fab technology and design, only change the interface."

Do you see that.

A. Yes.

Q. I think Mr. Stone may have asked you about this same language, but I just wanted to touch on it briefly again.

Am I right that Rambus' idea was not to change the core of the DRAM itself but to change the interface connecting the DRAM to other components.

A. That's pretty close. It's not quite true.

We had to make minor changes to the core, but we couldn't make major ones because that was too big of a leap, so it's close.

Q. Let's go to page 9.

8281

And this is the slide with the title Rambus interface. Do you see that?

A. Yes.

Q. And the first bullet says, "Uses only a single (eight-bit) bus to interface to DRAMs."

Do you see that.

A. Yes.

Q. And am I right that what's being described there -- is this essentially the same as the preferred implementation in the '898 application?

A. I'm not sure it's exactly the same, but it's basically the same, yes.

Q. Well, the --

A. I.e., there were minor changes made. They occurred at different points in time. Minor changes were probably made between them, but it's basically the same.

Q. We talked earlier about the preferred implementation which had, depending on how you looked at it, an eight or nine --

A. Exactly.

Q. -- bit-wide bus?

A. Right. That's why I said minor changes because I think we went from eight to nine bits, so...

Q. So when -- in this early time period when you

8282

and others associated with Rambus were going out to meet with other companies to market your ideas, am I right that you were telling other companies that part of your concept was this eight-bit multiplexed bus?

A. We were describing the first chip that we proposed to build, yes.

Q. Well, and the interface that you were telling these companies that they should build as a partner with Rambus was an interface to this eight-bit multiplexed bus?

A. That's correct. We were describing the first implementation of Rambus technology in it, yes, that's right.

Q. Now, going back to page 7 of CX-1283, this is the slide with the heading Rambus versus conventional DRAMs.

A. I'm sorry. What page?

Q. That's page 7.

A. Oh, sorry. I found it.

Q. And what this slide is doing is just drawing some comparisons or some contrasts between conventional DRAM and Rambus DRAM; is that right?

A. In this case it's a conventional -- it's a system built with conventional DRAMs or a system built with Rambus, but yes. This is a system description.

8283

Q. And am I right that when you, in this early time period, when you would meet with other companies, in describing your inventions, you would not only describe your inventions, the Rambus DRAM design, but you would also explain how they -- your inventions contrasted or differed from conventional DRAM design?

A. My hesitation is the use of the word "inventions." We were describing a Rambus implementation, so I'm not sure we put it in the context of inventions, but we were describing what the first-generation Rambus interface and parts would look like as compared to what a memory system built with conventional DRAMs would look like, yes.

Q. And going to the next page, page 8 of CX-1283, this is the slide with the heading current DRAMs?

A. Yes.

Q. And below that, the first bullet refers to current DRAM interface. Do you see that?

A. Yes.

Q. And you described the current DRAM interface below that as having three sets of lines, a set of address lines, a set of data lines and a set of control lines; is that right?

A. Yes.

Q. And am I right that Rambus' idea was to

8284

replace the three separate lines with one multiplexed bus?

A. That was one of our ideas, yes.

Q. And then the bullet point referring to control lines, there's a parenthetical reference to something called -- there are three terms, RAS, CAS and WE?

A. Yes. Write enable.

Q. Write enable?

And those were control signals used by the conventional DRAM bus architecture that -- well, let me stop there. Am I right that those are control signals that were used by conventional DRAM bus architectures?

A. Yes.

Q. And Rambus' multiplexed bus design didn't use these types of control signals; is that right?

A. That's correct.

Q. And that's something that you did away with as part of the move to a multiplexed bus design?

A. Yes.

Q. And let's go to page 13.

And do you recognize the picture here to be essentially the same picture as what we saw in I think it was figure 3 to the '898 patent application.

A. Yes.

8285

Q. So this is a depiction of the packaging of the first-generation Rambus design?

A. Yes. But let me just explain something. This was a picture of the packaging of the first-generation DRAM as of early -- late '89, early '90s. In fact we never actually shipped parts that looked like this. We actually packaged them quite differently, so that's -- the first-generation DRAM that actually shipped did not look like this at all. They were laid down flat.

So I just want to make that clear.

MR. ROYALL: Well, Your Honor, I would offer CX-1283 at this time.

JUDGE McGUIRE: Objection?

MR. STONE: No objection.

JUDGE McGUIRE: Entered.

(CX Exhibit Number 1283 was admitted into evidence.)

MR. ROYALL: And I believe I may also need to offer the notes that we touched on earlier, CX-1757.

MR. STONE: No objection.

JUDGE McGUIRE: Entered.

(CX Exhibit Number 1757 was admitted into evidence.)

BY MR. ROYALL:

Q. Am I right, Dr. Farmwald, that it's your

8286

recollection that during at least some of the early licensing discussions that Rambus had with other companies, that during those discussions Rambus showed a copy of its original patent application to some of these other companies?

A. Yes. I can't tell you specifically who we gave it to other than -- i don't have any direct recollection, but I do remember we gave it out, yes.

Q. Do you recall that Toshiba was one of the companies that Rambus disclosed its original patent application to?

A. I'm fairly certain that that's true, yes.

Q. And you don't recall specifically other companies?

A. I don't specifically recall when and where we handed it to them, but I'm pretty certain that we did, yes.

Q. And when you disclosed or --

A. That was a patent application, just to make it clear, because we didn't have an issued patent.

Q. Well, it was the same patent application that we discussed --

A. Exactly. The '898 patent application.

Q. And when you disclosed that patent application to Toshiba and potentially other companies that you

8287

don't remember now, am I right that you did not discuss with them the scope of Rambus' patent claims?

A. I did not. I can't say for certain whether anybody else in the company did or did not.

Q. Well, if there were such discussions, you were not involved in them?

A. If there were such discussions, I certainly don't remember them.

Q. And you said --

A. Actually could I just clarify that?

I have some vague recollection again of people asking us about -- and I don't remember the time frame, unfortunately -- as to whether they could use specific ideas but in a noncompatible form. I just don't remember when and who it was, so just to clarify my answer.

Q. Let me ask you about your testimony earlier in the day.

I believe you said that it was your general recollection that in at least some meetings with other companies in this early time period that some other companies asked about the potential to use Rambus inventions in noncompatible uses --

A. Yes.

Q. -- is that right?

8288

A. Yes.

Q. But you don't recall the specifics?

A. The only specific one that I have a clear recollection of is the RamLink meeting that we discussed earlier today.

Q. So besides that meeting, you can't tell us today the name of any particular company that you recall raising this issue of use of Rambus inventions in noncompatible use?

A. I cannot give any names or dates, no.

Q. And are you aware of any documentation in Rambus that would record or document any such discussions?

A. Not -- certainly not in the early years of the company, no, I'm not aware of anything.

Q. Now, putting aside whether you can remember actual names of companies that raised issues, let me ask you this: Do you have any specific recollection of a specific noncompatible use that a company discussed with Rambus in these early --

A. In the early years.

Other than the RamLink, no, not right now. Again, "early years" meaning pre-1993? '92?

Q. Well, would it make a difference to your answer?

8289

A. The only ones I can remember occurred in the later '90s.

Q. And you testified about that earlier?

A. DDR I testified.

Q. And the MoSys --

A. The MoSys.

Q. -- one example?

A. Yeah.

Q. And am I right that you do not recall talking with Toshiba or any other company about any specific alternative approach to implementing high-speed DRAM interfaces that would be blocked by Rambus patents?

A. I have no specific recollections of any such.

Q. Am I right that in meeting with potential business partners, in talking with them about Rambus' interface technology, you did not think that it would be in Rambus' interest to talk about alternative approaches for achieving high-speed DRAM interface?

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

Q. Yeah, let me restate that.

A. Yeah.

Q. Am I correct that it was your view that in meeting with other companies to talk to them about the Rambus interface technology and to encourage them to implement it and to license it that you did not believe

8290

that in that context it would be in Rambus' interest to talk about alternative approaches for achieving the same types of performance?

A. Well, my best recollection is that I didn't think at that time in the early -- in '89 and '90 that there were any alternatives to what Rambus was doing. Nobody else was proposing anything that early on. They started later to propose alternatives, but in the early time frame I don't think there was anything else other than the current interface. That's my recollection. Maybe I'm wrong, but...

So I don't remember thinking about it much one way or the other is what I'm saying.

Q. Let's go back briefly to CX-1283, which are the slides with the title Rambus. And if I could ask you to turn to page 17.

A. Yes.

Q. Mr. Stone asked you about this page, but I don't think he asked you about the third principal bullet point at the bottom -- I could be mistaken , but -- "Rambus can still be protected and standardized."

Do you see that.

A. Yes.

Q. By the word "protected" here were you

8291

referring to patents or patented -- patenting the technology?

A. I believe that's what I was referring to, yes.

Q. And the term -- by the term "standardized" here --

A. It's more than just patents, by the way. It's -- there's technical know-how other than patents, but mostly patents, yes, so...

Q. Okay. And by use of the term "standardized" here you're referring to the idea of making Rambus' technology a high-volume standard?

A. Yes. A de facto standard, a part that people used in high volumes.

MR. ROYALL: Okay. May I approach, Your Honor?

JUDGE McGUIRE: Yes.

BY MR. ROYALL:

Q. Dr. Farmwald, I've just handed you a document that's been marked for identification as CX-1754, and do you recognize these to be copies of your own handwritten notes?

A. I've glanced through the first four or five, and they all seem to be my notes, yes.

Q. And just so the record is clear -- I don't want to misrepresent anything -- if you'll look at page 27,

8292

you'll see that there's a copy of what appears to be a phone message?

A. Yes.

Q. And then there are a couple of pages embedded in here, pages 22 through 24, which clearly do not appear to be your handwritten notes. It's some typed material of some sort. Do you see that?

A. Yes.

Q. But the remainder of this exhibit is comprised of your handwritten notes; is that right?

A. Let me just flip through to make sure.

(Pause in the proceedings.)

Yeah, I don't think -- yeah, 22 through 24 have some notes on them which probably are in my handwriting. They're small enough -- but everything else looks like my handwriting.

Q. I just have I believe one thing to ask you about in this document.

If you'll turn to page 7 of CX-1754, these are the -- this is the page with the date that appears at the top 9-18 or September 18, '89. Do you see that.

A. Yes.

Q. And then there's a -- well, let me -- strike that.

Let me ask you, do you recognize these to be

8293

notes of meetings from a meeting that you had with the venture capitalists that you were talking about earlier today?

A. Yes. Bernie LaCruit and Mark Bailey were partners at Kleiner Perkins, yes.

Q. And about halfway down the page on page 7 is the reference or are the words "Key to success is establishing de facto standard."

A. Yes.

Q. Do you see that?

A. Yes.

Q. And is that -- was that your own thought or were you taking down the thoughts of someone else in this meeting or do you recall?

A. I don't recall, but just from the way I write things, that looks like I was taking notes from somebody else's comment. So I'm pretty sure that it's somebody else's statement.

Q. And am I right that you agreed that establishing Rambus technology as a de facto standard was key to the company's success?

A. Absolutely. Yes.

MR. ROYALL: Oh, Your Honor, at this point I would offer CX-1754.

MR. STONE: No objection.

8294

JUDGE McGUIRE: Entered.

(CX Exhibit Number 1754 was admitted into evidence.)

MR. ROYALL: May I approach, Your Honor?

JUDGE McGUIRE: Yes.

BY MR. ROYALL:

Q. I've just handed you a document that's been marked for identification as CX-570. I think you saw earlier today another version of the same document. Do you recall that?

A. Yes.

Q. And am I right that this is a document that you drafted in conjunction with Jim Mannos?

A. Yes. It's a very early draft of a business plan. Yes.

Q. Let's go -- if you could turn with me to page 3.

Now, on page 3, the second full paragraph under the heading Market Analysis, I think -- i believe this is a paragraph that Mr. Stone had asked you about earlier, and I wanted to draw your attention to the references in that paragraph to 50 percent penetration.

A. Yes.

Q. And am I right that in this very early

8295

business plan that is reflected in this document that you were projecting that Rambus might be able to obtain for its technology a penetration or a market share of roughly 50 percent in the DRAM industry?

A. We hoped to do at least 50 percent, yeah.

Q. And at this time period you believed that achieving a 50 percent market penetration was not unrealistic; is that right?

A. That's correct.

Q. And this relates to what you explained earlier about when you were describing what you meant by the language in this same paragraph referring to the standardized cookie-cutter approach in the DRAM industry?

A. Yes. They all used the same parts, yes.

Q. Let me ask you to turn to page 9 of this document, CX-570.

Under heading 3.1, Rambus Company Profile, the first paragraph, the second to last sentence says, "The DRAM market is already highly sensitized to the concept of standardization as most of today's DRAM chips are interchangeable amongst the various vendors."

A. Yes.

Q. And then it states, "Rambus is simply a logical extension of this policy."

8296

Do you see that.

A. Yes.

Q. And when you say here that Rambus is simply a logical extension of this policy, am I right that you're referring to the concept that Rambus DRAMs produced by different manufacturers would be compatible and interchangeable with one another?

A. Yes.

Q. And is it your understanding that that kind of product compatibility and interchangeability is important in the DRAM industry?

A. It's very important to the DRAM customers, yes.

Q. And is it important in part because DRAM purchasers generally prefer to work with multiple suppliers?

A. Yes.

Q. And on that same page just above the language that I've pointed out there's a reference -- i'm picking up midsentence, but there's a reference about three or four lines up from that same sentence to the patented Rambus technology still has the opportunity.

Do you see that.

A. Yes.

Q. It says: "The patented Rambus technology still

8297

has the opportunity to establish a single high-performance DRAM standard. This will be accomplished by offering all interested DRAM and CPU vendors a sufficiently low licensing fee (2 percent) that it will not be worth their time and effort to attempt to circumvent or violate the patents."

Do you see that.

A. Yes.

Q. And am I right that at this point in time you recognized that charging too high a royalty rate could motivate DRAM makers to more aggressively seek to work around Rambus' patents?

A. Yes. And to come up with all kinds of alternatives, yes.

Q. So the idea was to charge a royalty that you believed was low enough by comparison to the value of your technology that it would not encourage efforts by other companies to work around Rambus' patents; is that right?

A. Two issues. It's not just to work around the patents, but there's the initial adoption phase when you're trying to convince a company to use your product; i.e., it's not a standard yet. Nobody is using it. You have to offer them a low enough incentive to come in and partner with you.

8298

So it's a combination of those two things, but yes.

Q. And if I could ask you to turn to page 15 of this same document.

At the bottom of the page do you see the reference, the heading Barriers to Entry.

A. Yes.

Q. And the last point under that heading says: Low enough royalties to discourage rolling on your own.

Do you see that.

A. Rolling your own.

Q. Or rolling your own?

A. Right.

Q. And is that a reference to the same concept that we were just discussing from the earlier phase?

A. Yeah. This is of course an early draft of a business plan before we even filed patents, so we weren't quite sure how strong our patents were, so -- but yes, that is.

Q. And by the term "rolling your own" are you referring to the potential of other companies to develop alternative or competing technologies?

A. Yes.

MR. ROYALL: Your Honor, I would offer at this

8299

time CX-570.

MR. STONE: No objection.

JUDGE McGUIRE: Entered.

MR. ROYALL: Thank you.

(CX Exhibit Number 570 was admitted into evidence.)

MR. ROYALL: May I approach?

JUDGE McGUIRE: Yes.

BY MR. ROYALL:

Q. Dr. Farmwald, I've just handed you a document that's been marked for identification as CX-1282.

Am I right that this again is a document that you took part in preparing?

A. Yes.

Q. And am I right that this is another version of the types of slides that Rambus would share with potential business partners in the late 1980s and early 1990s time period?

A. Well, this specific one is -- you can tell by just looking at the end of it. This was one that was aimed at venture capitalists and that was one we shared with potential investors in the company because at the back there's pro forma balance sheets and things like that, so this would not be shared with partners but rather with investors.

8300

Q. With investors. Okay.

And turning -- if you could turn with me to page 5 of CX-1282, this is the slide with the title The Solution: Rambus.

Do you see that.

A. Yes.

Q. And below that it states, "How to solve this problem and make a lot of money at the same time."

Do you see that.

A. Yes.

Q. And am I right that the problem that's being referred to here is the so-called memory bottleneck problem?

A. Yes.

Q. And the bottom bullet on this same page states, "Make this interface the standard for all memory parts and charge a small (2-3 percent) royalty on all DRAMs and CPUs."

Do you see that.

A. Yes.

Q. And do you know why here the royalty being referred to is 2 to 3 percent as opposed to the 2 percent figure we saw in the earlier document?

A. Well, these are all very early documents. This was mostly Jim Mannos and myself and we didn't really

8301

have a good feel as to what the right numbers were, so there was no firmness in the numbers at all at this point.

Q. Am I right that at this point in time there was some uncertainty within Rambus as to whether a royalty in this range would be sustainable?

A. No. I think the issue was -- personally my recollection is the issue is the other way, could we charge a higher royalty or not, but remember at this point in the company the company was just Mark and myself and a part-time person, Jim Mannos, so I mean, there wasn't much of a company at this point.

Q. Well, let me ask you to turn to page 27, which is a slide with the title risks.

And do you see the bottom of the three principal bullet points states, "Income depends mostly on royalties"? Do you see that.

A. Yes.

Q. And below that, it says, "Will DRAM and CPU manufacturers pay 2-3 percent?"

Do you see that.

A. Yes.

Q. So am I right that you recognized at this point in time that there was some risk that even a royalty in this range, which this document characterizes as a

8302

small royalty, would be perceived by DRAM and CPU manufacturers as being too high?

A. Yes. Especially when you're asking for the royalty up front before you've even started work with them. The issue in many of these deals is you're trying to convince them to build something new and you want them to pay a royalty for it and that's always an issue, yes.

Q. Move on to another document.

May I approach, Your Honor?

JUDGE McGUIRE: Go ahead.

BY MR. ROYALL:

Q. I've just handed you, Dr. Farmwald, a document that's been marked for identification as CX-535. And again, I believe this is a document that you may have seen earlier today or at least a version of this document. Do you recall that?

A. Actually it looks different from the one I saw earlier today, so I can't say right now whether it's -- how similar it is.

Q. Well, do you recognize this document?

A. Let me look at it just for a second here.

(Pause in the proceedings.)

Vaguely, yes. I don't remember directly having seen it before, but it looks like a document from the

8303

time frame that's listed here, from November of 1990 . I believe it is what it says it is, so...

Q. You believe it is what it says it is, meaning it's a Rambus business plan from November 1990 ?

A. Yes.

Q. And do you know whether this is a business plan that was drafted by Geoff Tate?

A. I think it is. If you want, I can compare it to the other one that I remember a little bit more about to see if it's identical. It may be just printed in a different format.

Q. Just so the record is clear, the other document that Mr. Stone showed you was RX-1091. It does have a different date. It's November 15, 1990 as opposed to November 1, so maybe that other document is just a later version.

A. Let me see.

Yeah, there's a lot of differences between the two documents. I have a better recollection of seeing the one dated November 15, which I think is a later version. This is probably a draft, but I don't -- i can't say that for certain.

Q. Let me -- i can ask you about this other, the other document, since you have a better recollection of it, RX-1091.

8304

Do you have that.

A. Yes, I do.

Q. If you could turn to page 2 of that document, RX-1091.

And if I could focus your attention on the fourth paragraph beginning with the word "publicly."

A. Yes.

Q. And about halfway down that paragraph, do you see the sentence that states, "Create a clear impression in the mind of decision makers at IC companies, systems companies and major users that Rambus technology is revolutionary" -- let me stop there.

Do you see that.

A. Yes, I do.

Q. Is it correct or isn't it correct that Rambus in this time period was seeking to create the impression that its technology was revolutionary?

A. I believe so, yes.

Q. And am I right that you did not want Rambus' potential customers or business partners to perceive your technology as just being an incremental or evolutionary step beyond conventional DRAM devices?

A. That's correct.

Q. You wanted customers to perceive Rambus'

8305

technology as a significant leap forward or a revolutionary advance; is that right?

A. Yes.

Q. And why did you want Rambus' technology to be perceived in that way?

A. We thought it was a revolutionary leap forward. We thought we had done something nobody else had.

MR. ROYALL: May I approach, Your Honor?

JUDGE McGUIRE: Yes.

BY MR. ROYALL:

Q. Dr. Farmwald, I've just handed you a document that's been marked for identification as CX-635. I believe you may have been asked about this same document earlier today.

Do you recognize this to be -- well, the first page, do you recognize that to be the agenda for a Rambus board meeting in March 1992?

A. That's what it appears to be. I have no direct recollection, but I'm sure that's what it is, yes.

Q. And attached starting at page 2 are the minutes of the January 1992 or January 24, 1992 board meeting; is that right?

A. Yes.

8306

Q. And it notes that you were in attendance at that meeting?

A. Yes.

Q. And am I right that as a member of Rambus' board you regard attendance at board meetings to be one of your primary responsibilities?

A. Yes.

Q. And I think you said earlier that you try if at all possible to make it?

A. Yes.

Q. You do occasionally miss meetings; is that right?

A. Yeah.

Q. When you --

A. I'm probably going to miss one tomorrow actually, so...

Q. In those instances in which you for whatever reason are forced to miss a Rambus board meeting, do you make an effort to understand what was discussed or decided at the meeting that you missed?

A. Generally no. In fact I'd say almost always no, because if it's an important issue, somebody will call me and specifically bring it up, so generally no.

Q. If you miss a board meeting, do you make an effort to review the minutes of that board meeting?

8307

A. No, I don't.

Q. No?

In this document, CX-635, in the portion of the document that's the minutes of the January 1992 meeting, on page 3, do you see the heading strategy.

A. Yes.

Q. And under that heading it states, "The board had an open discussion of 1992-94 business plan and strategy."

Do you see that.

A. Yes.

MR. ROYALL: May I approach, Your Honor?

JUDGE McGUIRE: Go ahead.

BY MR. ROYALL:

Q. I've just handed you a document that's been marked for identification as CX-542.

And am I right that this is a copy of a draft business plan that was distributed by Geoff Tate on January 12, 1992?

A. That's what it appears to be. I don't remember it directly, but that's what it looks like.

Q. And you would have received this document; is that right?

A. Probably.

Q. And referring back to the document we were

8308

discussing a moment ago and specifically the language on page 3 of CX-635 where it refers to the board having an open discussion of the 1992 to '94 business plan and strategy, do you have any reason to doubt that this document, CX-542, was the same business plan, 1992 to '94 business plan and strategy that's referred to on the third page of CX-635?

A. Well, I'm skeptical that it was exactly this document since it is a draft and Geoff is a pretty thorough guy, so my guess is that the one that was discussed was actually some follow-on to this, but pretty close I'm sure is true.

Q. Now, I'm referring back to CX-542. If I could ask you to turn to page 2. Under heading 3, General Strategy to Achieve Our 50 Percent by '97 Mission, do you see that?

A. Yes.

Q. And the first sentence of that heading states, "We must establish Rambus as a successful volume standard as our number one priority technically and commercially."

Do you see that.

A. Yes.

Q. And is it the case that establishing its technology as a standard was Rambus' number one

8309

priority in this time period?

A. Yes. As a de facto volume standard, yes.

Q. You can set that aside if you would.

Your Honor, I would like to offer CX-542 and also CX-635.

MR. STONE: No objection to either document.

JUDGE McGUIRE: Then both will be entered at this time.

(CX Exhibit Number 542 was admitted into evidence.)

(CX Exhibit Number 635 was admitted into evidence.)

BY MR. ROYALL:

Q. Dr. Farmwald, am I right that at some point in the early 1990s you learned that JEDEC was developing standards relating to synchronous DRAMs?

A. Yes.

Q. Do you recall when you first learned of that?

A. I do not unfortunately.

MR. ROYALL: May I approach, Your Honor?

JUDGE McGUIRE: Yes.

BY MR. ROYALL:

Q. I've just handed you a document that's been marked as CX-671.

Am I right that this is an e-mail that was sent

8310

by Geoff Tate on December 18, 1991 and it was sent to you and to a number of others listed at the top of the document?

A. Yes.

Q. Do you recall receiving this e-mail?

A. I don't. But I'm sure I did.

Q. In the second paragraph of CX-671, under the heading synchronous DRAM, the document notes that a gentleman referred to as Shima-san of Toshiba, quote, sees no standard for sync DRAMs now, end quote.

And then it states, "I think his point is that now at JEDEC there is little agreement on pinout, organization, pin functions," and I'll stop there.

Do you see that.

A. Yes, I do.

Q. Does this document help to refresh your recollection as to when you first learned about JEDEC's work on synchronous DRAM standards?

A. It unfortunately doesn't help. I mean, it sounds like it was by 1991 , but I don't have any direct recollection.

Q. Was it possibly earlier than this date?

A. Possibly earlier than this.

Q. Towards the bottom of the first page of CX-671, the document states -- do you see that it's a

8311

one-sentence paragraph that says "Thinks we should"? Do you see that?

A. Yes.

Q. "Thinks we should develop a plan before announcement to take Rambus to JEDEC after announcement," do you see that?

A. Yes.

Q. And I can give you a moment to review this for context if you'd like, but my question is: Do you understand the term "announcement" being referred to here to be a reference to a public announcement of Rambus' DRAM technology?

A. I don't have a direct recollection, but I believe this is talking about the announcement that we had in March of 1992, which is about four -- three or four months after this, so it sounds plausible.

Q. So that was something that Rambus was planning in the late '91, early '92 time frame?

A. Yes, it would have been. Well, the announcement would have been planned, yes.

Q. Right.

And then it refers here to the prospect of taking Rambus to JEDEC.

Do you understand that to be a reference to the idea of proposing that JEDEC establish Rambus' DRAM

8312

technology as a standard?

A. That's how I would interpret it, yes.

Q. And am I right that in the early '90s Rambus did in fact approach JEDEC about the possibility of standardizing Rambus DRAMs?

A. I don't have a very clear recollection. I have a vague recollection that we tried but that we were told we couldn't, but I don't -- it's -- it's a very -- it's not a direct recollection. It's not at all a direct recollection.

MR. ROYALL: One moment, Your Honor.

(Pause in the proceedings.)

BY MR. ROYALL:

Q. Now, you said that you have a vague recollection that we tried but that we were told we couldn't?

A. Yeah, but the trouble is it's mixed up with documents that I've seen recently, so it is -- it's a pretty much useless recollection unfortunately.

Q. And when you say that you have a recollection that we tried, what you're saying is that you have a recollection that Rambus tried to get JEDEC to standardize its technology not as a de facto standard but as an organizationally adopted standard?

A. I don't really remember what we proposed to

8313

JEDEC unfortunately.

Q. But you do recall that Rambus did approach JEDEC relating to the idea of standardizing its technology, you have at least a vague recollection of that?

A. I have an extremely vague recollection that some discussions were made and that basically we got -- it's so vague that it's useless. I don't really have any firm recollection of what happened.

Q. Well, am I right that you do recall that when Rambus approached JEDEC about the potential of standardizing its technology that JEDEC or certain JEDEC participants gave the feedback that they felt that Rambus DRAMs were too big a leap or too revolutionary for JEDEC?

A. No. Unfortunately I don't recall what they said, who said it or -- unfortunately I just -- my recollection is useless. I just don't remember.

Q. Let me see if I can refresh your recollection.

May I approach, Your Honor?

JUDGE McGUIRE: Go ahead.

BY MR. ROYALL:

Q. What I've just handed you, Dr. Farmwald, is the transcript of the deposition that I took of you in this case in January of this year, and let me ask you to

8314

turn to page 73.

And do you see starting at line 9 -- let me just read this -- i asked the question to you: "What specifically do you recall in terms of feedback from JEDEC or JEDEC participants about the possibility of considering Rambus DRAMs as a standard?"

And your answer was: "Nothing specific, but the main feedback was it was considered too big a leap, that it was too revolutionary, that they wanted evolutionary approaches and that SDRAMs were perfectly fine for the next generation, but that's a vague recollection. You know, I can't tell you specific words or who said it or anything like that."

Do you see that.

A. Yes, I do.

Q. Now, understanding this is certainly perfectly consistent with what you've said about having vague recollections, but does this help refresh your recollection that Rambus did receive feedback from JEDEC about the possibility of standardizing Rambus technology, and your vague recollection in any event is that the feedback was along the lines of what you described here, that Rambus technology was too revolutionary for JEDEC?

A. My only recollections -- and I think the

8315

keyword here are JEDEC or JEDEC participants -- is that we got -- and this is so vague, I mean, it's unfortunately a fairly useless recollection -- is that we got feedback from someone. It was indirect. It wasn't to me. It was to somebody else who passed it on to me that the general feeling was that our stuff was too big a leap for them to accept. But it's so vague, it's pretty useless. I just don't remember who, when, who said it. I don't remember if it was JEDEC or somebody else. I just don't remember.

Q. Am I right that you understood that the interface that JEDEC was developing for synchronous DRAMs in the early 1990 s was a RAS/CAS-style interface, the type of RAS/CAS interface that had been used in earlier generations of DRAM?

A. It was evolutionary to the RAS/CAS interface, yes.

I wouldn't actually call it -- in my definition it isn't a RAS/CAS interface, but it's built on top of a RAS/CAS interface, yes.

MR. ROYALL: May I approach, Your Honor?

JUDGE McGUIRE: Yes.

BY MR. ROYALL:

Q. I've just handed you a document that's been marked for identification as CX-670.

8316

This is a -- you can see from the language at the very top of the first page -- a trip report relating to a JEDEC meeting in early December 1991 , and then if you look at the second page, the e-mail ends with the name Billy. Do you see that?

A. Yes.

Q. And then turning back to the first page, the top of the page, it -- there's the reference "to," colon, and then it says "everyone."

Do you see that.

A. Yes.

Q. Am I correct that this is an e-mail from Billy Garrett that you would have received in this time frame, December 1991 ?

A. I believe it is an e-mail from Billy Garrett and I believe I probably would have received it, yes.

Q. Now, turning to the second page of CX-670, do you see the numbered item 4 that starts in the second line?

A. I'm sorry. Oh, at the very end.

Q. Yeah. It's on the top.

A. Yes, I see it.

Q. The top of the page.

Now, in that sentence Mr. Garrett reporting on this JEDEC meeting from December 1991 states:

8317

"Everyone seems to be very RAS/CAS centered in their thinking. Most proposals are incremental additions to existing DRAMs."

Do you see that.

A. Yes.

Q. So is that consistent with your understanding of the type of DRAM interface that JEDEC was developing in the early 1990s, one that was very RAS/CAS centered?

A. Well, this is a long time before the SDRAM interface was finalized, so this was very early in the process. This is December 1991 . It's not inconsistent with my recollection. I just don't have much of a recollection of what happened when. So it's not inconsistent.

Q. Am I right that the type of interface that Rambus had developed was radically different from a RAS/CAS-style interface?

A. Well, yes and no. We hid -- dRAMs internally still do something conceptually like RAS and CAS. We hid the RAS and CAS from the user, but in essence the answer to your question is yes. It's not a RAS/CAS interface.

MR. ROYALL: May I approach, Your Honor?

JUDGE McGUIRE: Yes.

8318

BY MR. ROYALL:

Q. Dr. Farmwald, I've just handed you a document that's been marked as CX-1302.

Do you recognize this to be a presentation relating to Rambus' 1992 to '97 business plan.

A. That's what it appears to be.

Q. Now, if I could ask you to turn to page 7, which has the -- it's a slide with the title Unique Intellectual Property Franchise. Do you see that?

A. Yes.

Q. And the third bullet down states, "They," which I take to be a reference to the Rambus patents that are discussed or filed patents that are discussed in the first bullet point, "They are broad and fundamental because the Rambus system solution is so radically different from the 1970s RAS/CAS DRAM interface."

Do you see that.

A. Yes.

Q. Do you have any reason to disagree with that statement?

A. No.

Q. So the Rambus interface, the interface that was described in the Rambus patent applications, was radically different from the traditional RAS/CAS

8319

interface used in conventional DRAMs; is that right?

A. Yes.

MR. ROYALL: Okay. May I approach, Your Honor?

JUDGE McGUIRE: Go ahead.

BY MR. ROYALL:

Q. Now, I've just handed you a document marked CX-604, and do you recognize this to be a copy of the minutes from the June 25, 1992 Rambus board meeting?

A. Yes.

Q. And you were present at this board meeting; is that right?

A. It appears I was. I don't have a direct recollection of the meeting, but yes.

Q. And turning to page 2, heading 9.0, which reads "Five-Year Business Plan," do you see that?

A. Yes.

Q. And below that it states, "Mr. Tate led discussion of strategies and projections for the five-year plan."

Do you see that.

A. Yes.

MR. ROYALL: May I approach, Your Honor?

JUDGE McGUIRE: Yes.

BY MR. ROYALL:

Q. I've just handed you a document marked CX-543.

8320

This is I believe the same document that Mr. Stone showed you earlier. Do you recognize that?

A. Yes. It looks like the same document, yes.

Q. And this is something that you received from Mr. Tate in mid-June 1992; is that right?

A. I think so, yes.

Q. And there's a cover memo and then the business plan attached to it, but in the cover memo on the first page, the last line of text states, "Please read before the board meeting."

Do you see that.

A. Yes.

Q. Do you have any reason to doubt that this is the same five-year business plan that was referred to in the minutes from the June 25, 1992 board meeting that we reviewed just a moment ago, CX-604?

A. Given the dates, I think it's extremely likely that it is alike.

Q. Okay. And so am I right that you had a copy of this business plan roughly a week before that June 25, 1992 board meeting?

A. Yes.

Q. And on the first page of CX-543 it states, Mr. Tate's memo in the second line or second sentence states, "This is a complete rewrite of our business

8321

plan with inputs from all of the executives of Rambus, Inc."

Do you see that.

A. Yes.

Q. And you were one of the executives that had input on this business plan; is that right?

A. I don't remember whether I actually gave any input, but I would have been one of the executives, yes.

Q. Well, have you ever known Mr. Tate to be less than accurate in communicating with Rambus' board?

A. Well, I'm not sure -- the fact that I hadn't given any input I don't think would be inaccurate with this statement, but I don't remember whether I gave any input, is all I said. I just don't know, so --

Q. Well, he said in his memo to yourself and other board members that this was a complete rewrite of our business plans with inputs from all of the executives, but what you're saying is you just don't recall --

A. I just don't recall whether I gave any feedback at all.

Q. Now, if I could ask you to turn to page 8 of CX-543.

Your Honor, I understand we're having some kind

8322

of computer problem and I suggest --

JUDGE McGUIRE: Are you having problems again?

MS. MANNING: Not with the real-time.

JUDGE McGUIRE: With the transcription?

MS. MANNING: No. With the --

JUDGE McGUIRE: Well, let's take a break and see if we can't resolve that. Maybe it's a good time to take a break anyway. Let's take a five-minute break.

MS. MANNING: Thank you, Your Honor.

(Recess)

JUDGE McGUIRE: Mr. Royall, you may proceed.

MR. ROYALL: Thank you, Your Honor.

BY MR. ROYALL:

Q. Dr. Farmwald, if I could ask you to turn to page 8 of CX-543. And I would focus your attention on the heading Phase 1: Critical Mass Priming the Pump. Do you see that?

A. Yes.

Q. And there are numbered paragraphs below that and the last numbered paragraph on that page, paragraph 5, at the bottom of the page, states in the first sentence, "Rambus technology is so much faster than its competitors that there is a strong skepticism 'it's too good to be true -- show me' attitude."

8323

Do you see that.

A. Yes.

Q. It's correct, isn't it, that in the early 1990s companies that were learning about Rambus' technology for the first time were expressing skepticism about whether Rambus' technology could actually achieve the performance levels that were being claimed?

A. Yeah. They didn't -- a lot of people didn't think we could make it run as fast as we claimed.

Q. And am I right that an obstacle that Rambus was encountering in this time period was the perception among some potential customers that Rambus' technology was risky?

A. I think that's fair. If I can say that risky meant that it wouldn't work in the time frame we were claiming, yes.

Q. Let me ask you to turn to page 12 of the same document.

And I'd focus your attention on the heading Perception of Risk. Do you see that?

A. Yes.

Q. And again there is a reference here to customers having the initial response that Rambus' performance claims were too good to be true, and then it states, "The number one obstacle is to show them,"

8324

referring to customers, I assume, "that it does work."

Do you see that.

A. Yes.

Q. So the strategy -- am I right that the strategy for dealing with customers that perceived Rambus' technology to be risky was to demonstrate that it would perform as billed?

A. Yes.

Q. And putting aside risks or perceived risks of Rambus technology not working, wasn't another obstacle for Rambus in this time period the fact that some customers felt that they simply did not need the levels of performance that Rambus was promising?

A. For some customers that was true, yes.

Q. In the early 1990s when Rambus was just getting started, am I right that it was your view that Rambus' technology was somewhat ahead of its time?

A. Yes. Certainly in the sense that the bulk of the market in '89 or '90 didn't need that much performance but that in five or ten years it would, so the answer is yes.

Q. And am I right that some of Rambus' customers or potential customers expressed the view that they thought that Rambus' technology in this time period was ahead of its time?

8325

A. I'm sure that's true. I don't have any specific recollections of who said what, but I'm sure that was true.

Q. Do you recall in the early '90s potential customers expressing the view that they could design the next generation of their products without the need for the performance levels that Rambus was promising?

A. Certainly I remember certain customers that said that, especially in particular customers like Sun Microsystems who were designing fairly big machines with lots of DRAM chips. They felt they didn't need -- since they had so many DRAMs, they felt they could use a lot lower-performance DRAMs.

Q. And am I right that another obstacle that Rambus was facing in this time period was resistance to its royalty-based business model?

A. Bluntly, that's not my recollection, that the royalties weren't the issue. The issue was how badly do I need this. But it's a -- i don't have a firm recollection one way or the other. I don't -- i don't have any recollection that was a big issue, so...

Q. Let me ask you to turn to page 14 in this document.

And I would focus your attention on the heading Resistance to Business Model. Do you see

8326

that?

A. I'm sorry. I'm on the wrong page.

Q. I'm sorry. Page 14.

A. Yes, I see it.

Q. So under the heading Resistance to Business Model, the first sentence states, "A few systems companies and IC companies have had a very negative reaction to our business model."

Do you see that.

A. Yes.

Q. And just so we're clear, can you explain to us what a systems company is?

A. A systems company is, again, someone like Sun Microsystems, Dell, who -- they don't build any great circuits, they don't build DRAMs, they buy them from other people and put them into boxes and sell them to their customers.

Q. And what is an IC company or an integrated circuit company? Is that a DRAM manufacturer or does it refer to something else?

A. DRAM -- well, generally it refers to -- it could refer to a DRAM company, but generally it refers to the company that makes either the graphics chip, the CPU chip or the controller chip, whatever. But it also could refer to the DRAM company.

8327

Q. Continuing in that same paragraph, it states: "Some believe that it is not fair that we are wanting to charge a royalty on ICs that incorporate our technology. Others believe that our royalty will make ICs incorporating our technology too expensive."

Do you see that.

A. Yes.

Q. Does this refresh your recollection that negative reaction to Rambus' business model was in fact a significant issue in this time period?

A. It was significant to a few customers. It doesn't -- it doesn't give me any specific recollections of it.

But let me just emphasize that this was not talking about the DRAMs; this is talking about the non-DRAM chips. That's what "ICs" in this context is referring to. I do remember that.

Q. So the negative reactions to Rambus' business model that are being described here, these are negative reactions by companies other than DRAM manufacturers?

A. That's from reading this. I don't have a direct recollection, but from reading this that's what it appears to say, yes.

Q. And in the same paragraph, the last sentence

8328

states, "Two specific examples are Sun and" -- I'm not sure I can pronounce this correctly -- "Tseng"?

A. Tseng Laboratories.

Q. Tseng?

You're familiar with those companies.

A. Yes, I am.

Q. And neither of these are DRAM manufacturers?

A. That's correct. Actually neither of them are IC -- well, Tseng was a graphics company and Sun Microsystems is a systems company.

Q. Now, let's take a look at the next section in this business plan on the bottom of page 14 of CX-543. The section has the title Competitive Solutions. Do you see that?

A. Yes.

Q. And if you turn to the next page, page 15, you'll see that one of the competitive technologies that's discussed here is synchronous DRAMs. Do you see that about halfway down on the page 15?

A. Yes.

Q. Is it correct that at this point in time Rambus perceived synchronous DRAMs as the primary competitive threat to Rambus' technology?

A. That's not my recollection. My recollection is that in fact we regarded our market as more the markets

8329

where people wanted ultimate performance, so that was more like high-end graphics chips or high-end game machines, so my recollection is in fact we didn't regard synchronous DRAMs as our primary competition. But that's a -- it's a vague memory.

Q. Let me ask you if you can dig out from your pile of exhibits there this document which I showed you earlier, CX-1302 **(indicating)**.

A. Okay. I've got it.

Q. And let me -- this is the presentation slides for the Rambus business plan 1992 to '97.

Let me ask you to turn to page 18, which has the heading Competitive Risks. Do you see that.

A. Yes.

Q. And under the heading Competitive Risks the only technology that's listed is synchronous DRAMs. Do you see that?

A. Yes.

Q. Does that refresh your recollection that in this time period synchronous DRAMs were perceived within Rambus as being the principal competitive threat to its technology?

A. No. It actually -- i still believe -- at least -- i can only tell you my own opinion. I don't remember what the company opinion was. But I didn't

8330

regard synchronous DRAMs in this time period as our principal threat, so that's my recollection.

Q. So if you had prepared these slides, you would have --

A. These are not my slides.

Q. Well, if you had prepared them, you would have listed some other technology --

A. Yes.

Q. -- as --

A. I would have listed VRAMs and some other higher-performance DRAMs as things -- i was -- i mean, I was more looking -- i mean, basically yes, DRAMs and things like that would have been more -- synchronous DRAMs was a competitor, but you specifically asked me whether it was the major competitor, and that's the part I'm not sure I would agree with, so...

Q. Let's go back -- well, before I -- i believe you said earlier that despite the fact that synchronous DRAMs were a more modest extension from the performance of the earlier-generation products that for many customers that level of performance was sufficient for their needs; right?

A. Absolutely true, yes.

Q. And in that sense, despite the fact that synchronous DRAMs didn't reach the bandwidth levels

8331

that Rambus was promising, they were still a formidable competitor in the marketplace; is that right?

A. Right. Yes, that's true.

Q. Now, let's go back to CX-543, the June '92 business plan.

And still focusing on page 15, under the heading Synchronous DRAMs, the first sentence states: "For about two-plus years a JEDEC committee has been working on the specification for a synchronous DRAM. No standard has yet been approved by JEDEC. Our expectation is a standard will not be reached until end of '92 at the earliest."

Do you see that.

A. Yes.

Q. And by this point in time you were already aware that JEDEC was working on synchronous DRAM standards; is that right?

A. I'm sure I was, yes.

Q. And then further down on the same page it states, "A synchronous DRAM is an incremental extension of page mode DRAMs."

Do you see that.

A. Yes.

Q. And is that consistent with your understanding

8332

of the nature of synchronous DRAMs in this time period?

A. Yes.

Q. Let's turn to page 16.

You recall that earlier I asked you whether -- i believe I asked you whether you understood that the interface that JEDEC was developing in the early 1990s was a RAS/CAS interface? Do you recall that.

A. Yes, you did ask that.

Q. And I thought that you were somewhat hesitant in agreeing to that?

A. There's a difference between a page mode DRAM and a RAS/CAS DRAM. That's quite a different thing.

So I agree that it's very much an extension of a page mode DRAM. RAS/CAS I could quibble a little bit more. In the end my answer is yes, but I'll quibble a lit bit more about it, so --

Q. Well, let me point you to some language on this page, page 16, the third paragraph up from the bottom of the page, the first sentence states, "Sync DRAMs are an incremental improvement on the 20-year-old RAS/CAS interface."

Do you see that.

A. Yes.

Q. And then it goes on to state, "The old

8333

interface is running out of gas, but all customers are familiar with it and understand it, so there will be a tendency to try the sync DRAM approach to see if it will meet their needs rather than moving to a completely new interface (Rambus) with the need to have to do a lot of learning and rearchitecting of their system/chip."

Do you see that.

A. Yes.

Q. Now, focusing on the first sentence there, does that refresh your recollection as to the fact that the sync DRAMs were being developed based on a RAS/CAS interface?

A. Well, I still don't fully agree with it. In fact, I would interpret this I think differently than you do.

I interpret this as that sync DRAMs are an incremental performance improvement on the 20-year-old RAS/CAS interface, which I completely agree with that. I would quibble some about whether it's an incremental improvement on the RAS/CAS interface because I don't consider it to be a RAS/CAS interface. But it's a quibble. I'm not arguing strongly with your statement.

Q. Okay. Now, focusing on the rest of the

8334

language that I read a moment ago, this language speaks of a tendency on the part of DRAM customers to want to work with the technology that they were familiar with and understood; right?

A. Yes.

Q. Am I right that Rambus was concerned in this time period that that sort of tendency among DRAM customers or purchasers might inhibit its ability to move the industry to a new, more revolutionary interface?

A. Yes. We realized that unless you needed the performance of Rambus, you wouldn't move unless you had to. So I agree with that.

Q. And that's because of the costs of moving to a new interface?

A. That's one element, yes.

Q. Are there other elements?

A. Well, moving from RAS/CAS to SDRAM had costs, too, so -- but that's the major one, yeah.

Q. Now, turning to page 17, I want to focus you on some language that Mr. Stone focused you on earlier, the paragraph beginning "finally" at the top of the page.

It says, that sentence, first sentence, says, "Finally, we believe that sync DRAMs infringe on some

8335

claims in our filed patents and that there are additional claims we can file for our patents that cover features of sync DRAMs."

Do you see that.

A. Yes.

Q. Now, what I want to ask you about now is what knowledge you have about Rambus' efforts to develop patent claims covering features of synchronous DRAMs.

And before I go further on that, let me establish a couple of things.

Am I right that during the early 1990s you had certainly some direct involvement in patent prosecution, the patent prosecution process or the patent process on behalf of Rambus?

A. Yeah. Certainly during 1990 and part of '91 I did. I don't specifically remember how much I had, but yes.

Q. And am I right that in the early 1990s you had interactions with Rambus' outside patent lawyers relating to efforts to supplement and broaden Rambus patents?

A. Certainly in the very early '90s I definitely did, yes. I don't remember having too many past about 1991 or so. I just don't remember.

MR. ROYALL: May I approach, Your Honor?

8336

JUDGE McGUIRE: Go ahead.

BY MR. ROYALL:

Q. Just to expedite this, Dr. Farmwald, I've handed you a collection of about -- I think it's five documents. And part of what I want to do is see if I can refresh your recollection as to the time period during which you were corresponding with lawyers relating to patent issues.

You said that -- you had recalled in the very early '90s I think that you had some interaction with Rambus' outside patent lawyers.

The first document that you should have here in this stack is CX-1936, and do you recognize this, the first page of this, to be a fax cover sheet, a fax sent to you by Lester Vincent, a lawyer at the firm Blakely Sokoloff.

A. That's what it appears to be. I don't have any direct recollection of it, but it appears to be that.

Q. And Mr. Vincent, you understood that he was outside patent counsel to Rambus at this time?

A. Yes. Lester Vincent was our outside patent counsel, yes.

Q. And let's go to the next document, CX-1938.

And do you recognize this to be a February 19,

8337

1992 letter that was sent to you by Mr. Vincent.

A. Yes.

Q. Relating to patent issues?

A. That's what it appears to be. Again, I have no direct recollection of it, but that's what it appears to be.

Q. And then going to the next document, CX-682, do you recognize this to be an e-mail that was sent to you by or from Richard Crisp in November 1992?

A. Yes. That's what it appears to be. Again, I have no recollection of it -- or there's a mention of an MIT patent. I don't remember that either.

Q. Well, what this e-mail relates to is a meeting -- it says: "Lester will be here at 2 p.m. thursday. Let's talk about the claims we want to add and look for the supporting documentation."

Do you see that.

A. Yes.

Q. So just pausing for a moment on this document, does this refresh your recollection that you continued to be involved in efforts to add new claims to Rambus' patents or patent applications at least into the late 1992 time period?

A. I just don't remember. It's -- i'm not arguing that it's -- i'm not saying it's not true. I just

8338

don't remember.

Q. And this document doesn't help refresh your recollection?

A. It doesn't. I don't remember it.

Q. Let's go to the next document, CX-1950.

Do you recognize this to be a letter, another letter sent to you in the November 1992 time period from Lester Vincent relating to patent issues.

A. That's what it appears to be, yes.

MR. ROYALL: I believe, Your Honor, that all of the documents I've just gone through with the exception of one are already in evidence, but I would offer CX-1950.

MR. STONE: No objection.

JUDGE McGUIRE: Entered.

(CX Exhibit Number 1950 was admitted into evidence.)

BY MR. ROYALL:

Q. Am I right, Dr. Farmwald, that in addition to corresponding with Rambus' patent lawyers from time to time that you also from time to time had conversations with the patent lawyers relating to patent issues, Rambus patent issues?

A. I don't remember. I'm sure I did. I just don't remember.

8339

Q. Let me ask you to look at the next exhibit, CX-1937. And I'll represent to you that this is a copy of an attorney billing record from the Blakely Sokoloff firm that was sent to Rambus, and let me ask you to turn to page 2.

And do you see in the narrative description there that there are references to teleconference with Mike Farmwald concerning arranging meeting, and it says: "Prepare for meeting with Mike Farmwald concerning office action. Meeting with Mike Farmwald concerning amendment, divisional applications and prior art, including travel from meeting. Teleconference with Mike Farmwald concerning amendment. Conference with Mike Farmwald concerning draft amendment. Teleconference with Mike Farmwald concerning revisions to amendment."

Do you see all that.

A. Yes, I do.

Q. Does that refresh your recollection that at least as of this time period, that in early 1992, you were having conversations with Rambus' outside patent lawyers relating to patent issues?

A. Again, I believe it's probably true. I just don't have any direct recollection of it.

Q. Am I correct that in the 1992 time frame you

8340

were generally aware that Rambus was seeking to develop patent claims covering features in SDRAMs?

A. I have no recollection of that.

(Thunder)

JUDGE McGUIRE: I have to comment. You're being told to wind it up.

No. I'm kidding.

MR. ROYALL: Your Honor, if there's a preference to end earlier before we all get rained on, I'm happy to do that or I can go on to 5:30.

JUDGE McGUIRE: I think we should go on to 5:30.

MR. ROYALL: May I approach?

JUDGE McGUIRE: Yes.

BY MR. ROYALL:

Q. Dr. Farmwald, I've just handed you a dominant that's been marked as CX-606, and do you recognize this to be a copy of the minutes from the October 22, 1992 Rambus board meeting?

A. That's what it appears to be, yes.

Q. And you were present for this meeting; is that right?

A. That's what it says, yes.

Q. And on page 2, if I could ask you to turn there, under the heading Sales and Marketing, do you

8341

see the sentence about, oh, eight or nine lines down where it says, "Mr. Crisp reported on the SDRAM status at JEDEC, the Rambus patent strategy and system-level difficulties with SDRAMs"? Do you see that?

A. Yes.

Q. Does that refresh your recollection that in this time period in 1992 Rambus was seeking to develop patent claims covering features in SDRAMs?

A. It doesn't. I don't remember anything about this meeting. I'm not -- you could take it that way. I'm not sure -- but I could also take it that Richard had taken over the Rambus patent strategy in general, but I'm not sure -- I could take it either way, but no, I don't have any direct recollection of it.

MR. ROYALL: May I approach?

JUDGE McGUIRE: Yes.

BY MR. ROYALL:

Q. I've just handed you another document marked CX-686, and do you recognize this to be a copy of a February 1993 e-mail sent by Richard Crisp on which you were copied?

A. Yes.

Q. And the subject line refers to patent stuff? Do you see that?

A. Yes.

8342

Q. And then in the text of the e-mail there's a reference to claims which were under consideration for addition to the original patent. Do you see that?

A. Yes.

Q. And then there are four numbered items below that, DRAM with programmable access latency, DRAM with multiple open rows -- the fourth one is DRAM using PLL/DLL circuit to reduce input buffer skews. Do you see all that?

A. Yes.

Q. Were you aware that some or all of these claims were being developed in this time period for the purpose of covering features in synchronous DRAMs?

A. I don't remember that, no. I just don't have any recall.

MR. ROYALL: May I approach, Your Honor?

JUDGE McGUIRE: Go ahead.

BY MR. ROYALL:

Q. I've just handed you another document, Dr. Farmwald, marked CX-702.

Do you recognize this to be an e-mail from June 1992 sent by Mr. Fred Ware to you and to others within Rambus?

A. That's what it appears to be.

MR. STONE: I believe counsel misspoke. I

8343

think it's June 1993.

MR. ROYALL: Oh, did I say 1992? I meant 1993.

THE WITNESS: Yeah.

BY MR. ROYALL:

Q. You do recognize it to be an e-mail that was sent to you in that time period?

A. Well, I don't recognize the e-mail, but it appears to be an e-mail that I was copied on, yes.

Q. Well, you weren't copied on, you were -- your name -- you were one of the persons --

A. It was sent to me.

Q. And the subject line is patent claim status. Do you see that?

A. Yes.

Q. Do you have any doubt that you received this e-mail?

A. I probably did, yes.

Q. And Mr. Ware, the author of this e-mail, he was an engineer at Rambus; is that right?

A. Yes.

Q. And he's someone that you interacted with on occasion relating to patent issues; is that right?

A. I'm sure I did. I don't have any direct recollection of it, but I'm sure I did.

8344

Q. And in the first paragraph of this e-mail Mr. Ware states: "I spoke with Lester Vincent and Tom Lee (the other one) on the phone yesterday. The current status of the additional claims that we want to file on the original (P001) patent follows. I haven't received their paperwork, so I don't know the exact titles of these claims."

Do you see that.

A. Yes.

Q. And then below that there are six numbered paragraphs. Do you see that?

A. Yes.

Q. And the first paragraph, do you see that parenthetical with -- i'm sorry.

In the very first paragraph of the e-mail do you see the parenthetical "P001".

A. I'm sorry?

Q. Well, I'm sorry. I noted that there were six numbered paragraphs and now I'm coming back to the first paragraph in the e-mail.

A. Okay. Yes.

Q. And do you see in that paragraph there is a parenthetical reference to P001?

A. Yes.

Q. Do you see that?

8345

And do you understand that to be a reference to the original Rambus patent application, the '898 application.

A. I think it's a reasonable inference. I don't remember, but I think it's a good inference.

Q. And then the first numbered paragraph refers to writable configuration register permitting programmable CAS latency, and then it says: "This claim has been written up and filed. This is directed against SDRAMs."

Do you see that.

A. Yes.

Q. Were you aware that in this time period, June 1993, that Rambus had pending patent claims relating to programmable CAS latency?

A. I have no recollection. And at this time I was basically off working on starting a new company called Chromatic. I would not have been paying too much attention to this anymore. I don't remember, but I suspect at this point I wasn't really paying much attention.

Q. Well, does this refresh your recollection at all as to --

A. No, it does not.

Q. -- the extent to which Rambus was seeking to

8346

file patent claims directed at SDRAMs in this time period?

A. No, it does not.

Q. Am I right that you were aware at this time that JEDEC was considering the idea of incorporating programmable latency, a programmable latency feature in the SDRAM standards?

A. I have no idea what I knew at the time.

Q. Let me ask you if you could pull out from your exhibit pile the Billy Garrett trip report from December 1991 that's CX-670.

A. I found it.

Q. And we briefly touched on this earlier, but let me ask you to focus on the first page of this document.

And do you see where it refers in about fifteen lines down from the top on the first page of CX-670 to NEC and then it says "Howard Sussman"?

A. Okay. I've found it.

Q. And then after that it says, "Howard has been pushing the definition of synchronous DRAMs."

Do you see that.

A. Yes.

Q. And then there's a list of numbered items below that and the second item says, "Latency should be

8347

programmable."

Do you see that.

A. Yes.

Q. Does that refresh your recollection that you were aware that JEDEC in this time period was considering the idea of incorporating a programmable latency feature in the SDRAM standards?

A. No, it doesn't. I don't -- i may have known. I just don't remember.

Q. Let's go back to CX-702, the document we were discussing earlier.

The third numbered paragraph in that document states "DRAM with PLL clock generation" and then it says: "This claim is partially written up. They need to finish it up and file it. They are not waiting for anything from us. This is directed against future SDRAMs and RamLink."

Do you see that.

A. Yes.

Q. Were you aware in this time period that Rambus was working on patent claims relating to the use of PLLs on DRAM?

A. I don't remember specifically at this time frame. I do remember that I felt that we had very strong patent coverage over PLLs/DLLs and that someday

8348

other DRAMs would have to use them and that in specific RamLink was going to use them and that was one of the reasons that we told them at the RamLink meeting that we felt they were violating our patents.

So with respect to RamLink, I do have a recollection.

Q. Well, does this language and in particular the language "this is directed against future SDRAMs" --

A. That doesn't --

Q. Well, let me finish.

A. Sorry.

Q. Does that language refresh your recollection that in this time period Rambus was filing patent claims directed against SDRAMs or future SDRAMs?

A. Well, certainly not against SDRAMs because SDRAMs don't use PLLs, but -- so the answer is no, it doesn't change my recollection at all.

I do recall, as I said, that specifically with respect to RamLink and I don't remember the time frame -- or this e-mail but that I felt that they were violating our intellectual property on the usage of PLLs/DLLs, specifically RamLink.

Q. By the way, just to be clear on this, am I right that in your view PLLs and DLLs are basically the same thing?

8349

A. From my point of view as a systems architect I think they're fairly similar. Circuit designers disagree. But I think they're similar.

Q. And on the subject of PLLs, am I right that in the 1990 or early 1990s time frame PLLs were very difficult things to design?

A. They were very difficult things to design on a DRAM. They were very difficult. Some people at this point in time roughly, early '90s, felt that we couldn't do it, that it was impossible.

MR. ROYALL: May I approach, Your Honor?

JUDGE McGUIRE: Yes.

BY MR. ROYALL:

Q. Dr. Farmwald, I've just handed you another document marked CX-1957 I believe.

And do you recognize this to be a letter sent to you by Lester Vincent, Rambus' outside patent counsel, in April 1993?

A. I believe that that's what it is. I don't remember the letter.

Q. And the letter refers to enclosing draft preliminary amendments for the above-referenced patent applications. Do you see that?

A. Yes.

Q. And then there are three patent applications

8350

that are referred to above that. Do you see that?

A. Yes.

Q. And do you see that each of these three patent applications is identified with a different reference number?

A. Yes.

Q. And the first application that's listed here, the '692 application, it's identified with a reference number P007D. Do you see that?

A. Yes.

MR. ROYALL: May I approach, Your Honor?

JUDGE McGUIRE: Yes.

BY MR. ROYALL:

Q. I've just handed you another document, CX-1959. And I think you'll see that this is another copy of the same e-mail to you and others from Fred Ware dated June 18, 1993, but this version has some handwriting on it.

First of all, do you recognize the handwriting on this document.

A. It's not mine. I don't know whose it is, but it's not mine.

Q. Let me focus your attention on the third numbered paragraph. This is the paragraph that relates to patent claims on DRAM with PLL clock generation. Do

8351

you see that?

A. Yes.

Q. And do you see that in the handwriting in the left margin beside that refers to P007?

A. Yes.

Q. And then if you look back at the earlier exhibit, 1957, this is Mr. Vincent's letter to you in April of 1993. Again, the '692 application that he wrote to you about that he was attaching preliminary amendments for, that has the reference number ending with P007D. Do you see that?

A. Yes, I see that.

Q. Okay. Does seeing the same reference number written on this copy of Mr. Ware's e-mail and Mr. Vincent's letter to you from April 1993, does that help in any way to refresh your recollection in terms of your awareness that Rambus in this time period was developing patent claims directed at SDRAMs?

A. Well, no, it does not refresh my memory, but I will point out that this is not directed at SDRAMs from reading these own documents that you've just showed me, so --

Q. Well, the PLL clock generation claim --

A. PLLs are not used in SDRAMs, so --

Q. It says "future SDRAMs."

8352

A. They're not used in -- well, fine. They're not used in SDRAMs, so they're used in RamLink, so...

Q. But in any event, seeing these, these documents --

A. It does not refresh my memory, no.

Q. -- doesn't help refresh your recollection?

A. No.

Q. Now, one last document and I'll be done. Is that all right?

May I approach?

JUDGE McGUIRE: Go ahead.

BY MR. ROYALL:

Q. Now, I've just handed you a document that's been marked as CX-745, and as you can see, the first page has a handwritten note or is a handwritten note, and then it attaches some correspondence, and I'll represent to you that the handwritten note here is a note that was written by Allen Roberts, Rambus' vice president of engineering.

And the text states: "This is Lester's attempt to write the claim for the most/SDRAM defense. Please comment."

Do you see that --

A. Yes.

Q. -- handwritten language?

8353

And then if you turn to the next page --

A. I'm not sure that it says "most," but I can't actually read it.

Q. I'll represent to you that that's what it says.

If you turn to the next page, page 2 of CX-745, this is a letter to Mr. Roberts from Lester Vincent dated August 1, 1994 . Do you see that.

A. Yes.

Q. And you are copied on this letter. Do you see your name?

A. I see that at the bottom, yes.

Q. I'm sorry. I said it was from Lester Vincent. It's from Lester Vincent's law firm and the name is Scott Griffin, who I presume was a colleague of Mr. Vincent's.

A. I don't know who Scott Griffin is, but...

Q. Now, does seeing this correspondence copied to you from August 1994 attached to a handwritten note from Allen Roberts in which he refers to Lester's attempts to write the claim for the most/SDRAM defense, does that in any way refresh your recollection as to the fact that Rambus in this time period was seeking to develop claims to cover features in SDRAMs?

8354

A. No, it doesn't.

MR. STONE: Your Honor, I object to the use of the handwritten note which --

JUDGE McGUIRE: Sustained.

THE WITNESS: It --

JUDGE McGUIRE: He doesn't know what the handwritten note is. I'm not sure if that's the context of your question, but --

MR. ROYALL: I'm just asking if it refreshes his recollection. I'm not asking him to vouch for what the note is.

JUDGE McGUIRE: All right. You can answer that question.

THE WITNESS: It doesn't. It doesn't remind me of anything. I don't recall this.

In fact, I'll say I think it's unlikely that I saw or paid any attention to it since I had essentially ceased to become a Rambus employee in August of 1993 and this is August of 1994 .

BY MR. ROYALL:

Q. Just to be clear, when you say that you're not sure or you doubt that you saw it or paid attention to it, are you referring to the letter on which you were copied?

A. Certainly both, the handwritten note or the

8355

letter, either one.

MR. ROYALL: Your Honor, I'm happy to stop there for today and finish up in the morning.

JUDGE McGUIRE: Okay. Very good. Then we'll adjourn for the evening and convene tomorrow morning at 9:30. Thank you.

(Time noted: 5:34 p.m.)

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C E R T I F I C A T I O N   O F   R E P O R T E R

DOCKET NUMBER: 9302

CASE TITLE: RAMBUS, INC.

DATE: July 9, 2003

I HEREBY CERTIFY that the transcript contained herein is a full and accurate transcript of the notes taken by me at the hearing on the above cause before the FEDERAL TRADE COMMISSION to the best of my knowledge and belief.

DATED: July 10, 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