

1 UNITED STATES PATENT AND TRADEMARK OFFICE

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3  
4 BEFORE THE PATENT TRIAL AND APPEAL BOARD

5 -----

6 INTEL CORPORATION,

7 Petitioner,

8 v.

9 PACT XPP SCHWEIZ AG,

10 Patent Owner.

11 -----

12 PTAB Case No. IPR2020-00535

13 Patent No. 8,312,301

14 -----

15  
16 REMOTE VIDEOCONFERENCED AND

17  
18 VIDEOTAPED DEPOSITION OF

19  
20 WILLIAM MANGIONE-SMITH, PhD

21  
22  
23 DATE TAKEN: JANUARY 15, 2021

24 REPORTED BY: PAUL J. FREDERICKSON, CSR

25 JOB NO. 4417239

Page 1

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Patent No. 8,312,301

14

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17

Remote Videoconferenced and

18

Videotaped Deposition of WILLIAM

19

MANGIONE-SMITH, PhD, the witness herein,

20

at 9:06 a.m., pursuant to notice, reported

21

by certified court reporter Paul J.

22

Frederickson, CSR. All parties appeared

23

remotely and the witness was sworn

24

remotely.

25

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A P P E A R A N C E S

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3         Videographer

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I N D E X

WILLIAM MANGIONE-SMITH, PhD

By Mr. Brown: 9

Request for information: None

Request for documents: None

INDEX TO EXHIBITS

EXHIBIT 1 16

US Patent 6,141,762

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Declaration of William Mangione-Smith, PhD

EXHIBIT 4 137

US Patent 6,535,798

EXHIBIT 5

147

Advanced Configuration and Power  
Interface Specification, 12-22-96,  
INTEL - 1014

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JANUARY 15, 2021

[9:06 a.m. Pacific Time.]

THE VIDEOGRAPHER: All right. 09:05:55

One moment, please. 09:05:57

Here we go. 09:06:15

I have a couple of devices, so 09:06:24  
just bear with me. 09:06:25

Good morning. We're going on 09:06:31  
the record at 9:06 a.m. Pacific 09:06:33  
Standard Time on January 15, 2021. 09:06:37

Quick reminder that the 09:06:40  
microphones on these devices are 09:06:43  
sensitive. They will pick up 09:06:44  
whispering and private conversations, 09:06:46  
sometimes cellular interference. So 09:06:48  
if you could turn off all cell phones 09:06:50  
or simply move them away from your 09:06:52  
viewing device. 09:06:54

Audio and video recording 09:06:55  
continue to take place unless all 09:06:57  
parties agree to go off the record. 09:06:59

This is media unit number 1 in 09:07:01

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1 the video-recorded deposition of 09:07:03  
2 William Mangione-Smith taken by 09:07:05  
3 counsel for the defendants in the 09:07:07  
4 matter entitled PACT XPP Schweiz AG 09:07:09  
5 versus Intel Corp. filed in the United 09:07:14  
6 States District Court for the District 09:07:18  
7 of Delaware, case number 09:07:19  
8 1:19-cv-01006-JDW. 09:07:22  
9 This deposition is taking place 09:07:27  
10 using remote counsel technology. 09:07:28  
11 My name is Fritz Sperberg from 09:07:31  
12 the firm of Veritext Legal Solutions. 09:07:33  
13 I'm the videographer. The court 09:07:35  
14 reporter is Paul Frederickson, also of 09:07:37  
15 Veritext. 09:07:39  
16 We're not related to any party 09:07:40  
17 in this action, nor are we financially 09:07:42  
18 interested in the outcome. 09:07:44  
19 Counsel, please now identify 09:07:46  
20 yourselves and state your affiliations 09:07:47  
21 for the record. And if there are any 09:07:49  
22 objections, please state them at the 09:07:53  
23 time of your appearance, beginning 09:07:54  
24 with our noticing attorney. 09:07:55  
25 MR. BROWN: This is Brandon 09:07:58

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1 Brown of Kirkland & Ellis for Intel 09:07:59  
2 Corporation, the petitioner. 09:08:01  
3 And with me is also Kyle Calhoun 09:08:03  
4 and Sarah Mikosz, also of Kirkland & 09:08:05  
5 Ellis. 09:08:09  
6 MR. LI: This is Ziyong Li at 09:08:09  
7 Quinn Emanuel for patent owner PACT 09:08:13  
8 XPP. 09:08:16  
9 And just for the record, this 09:08:16  
10 deposition is for the IPR purpose only 09:08:17  
11 and is not for the district court 09:08:19  
12 case. 09:08:21  
13 THE VIDEOGRAPHER: My mistake. 09:08:24  
14 Thank you. 09:08:25  
15 MR. BROWN: Just so you have it, 09:08:25  
16 the case number is IPR2020-00535. 09:08:26  
17 THE VIDEOGRAPHER: Thank you. 09:08:35  
18 09:08:51  
19 WILLIAM MANGIONE-SMITH 09:08:51  
20 being duly sworn on oath, was 09:08:51  
21 examined and testified 09:08:51  
22 as follows: 09:08:51  
23 EXAMINATION 09:08:51  
24 BY MR. BROWN: 09:08:54  
25 Q. Good morning. 09:08:54

1	A. Good morning.	09:08:58
---	------------------	----------

2	Q.	My name is Brandon Brown. I'm	09:08:59
---	----	-------------------------------	----------

3 | an attorney with Kirkland & Ellis for Intel, 09:09:01

4	as you heard.	09:09:04
---	---------------	----------

5 | Would you please state your full 09:09:04

6	name for the record?	09:09:06
---	----------------------	----------

7	A. Certainly. William Henry	09:09:06
---	-----------------------------	----------

8	Mangione-Smith.	09:09:10
---	-----------------	----------

9	Q. And what is your address,	09:09:11
---	------------------------------	----------

10	Mr. Mangione-Smith?	09:09:15
----	---------------------	----------

11	A.	4146 - 118th Avenue Northeast.	09:09:16
----	----	--------------------------------	----------

12	And that's in Kirkland, Washington 98033.	09:09:20
----	---	----------

13	Q. And is that where you are right	09:09:26
----	------------------------------------	----------

14	now?	09:09:28
----	------	----------

15	A. It is.	09:09:28
----	-----------	----------

16 Q. I called you Mr. Mangione-Smith. 09:09:30

17 Would you prefer Dr. Mangione-Smith or Mr.? 09:09:33

18	A. We usually go with doctor for	09:09:36
----	----------------------------------	----------

19 such proceedings, so why don't we do that? 09:09:39

20	Q. You've got it. No problem.	09:09:42
----	-------------------------------	----------

21	So have you done a deposition	09:09:45
----	-------------------------------	----------

22 during the COVID pandemic before? 09:09:48

23	A. This is at least my third and	09:09:52
----	----------------------------------	----------

24	maybe my fourth.	09:09:54
----	------------------	----------

25	Q. Okay. All right.	09:09:55
----	---------------------	----------

1                   So I don't think any of these                   09:09:57  
2       questions will seem new to you then, but let           09:09:58  
3       me do some preliminary questions.                   09:10:01  
4                   Is there anybody else in the               09:10:03  
5       room there with you?                               09:10:04  
6           A.       No, there is not.                       09:10:07  
7           Q.       Okay.                                   09:10:07  
8                   And are you in communication           09:10:09  
9       with anybody else right now over text or,           09:10:10  
10      you know, email or anything like that?           09:10:14  
11      A.       No, I am not.                               09:10:16  
12      Q.       Okay.                                   09:10:17  
13                   And can you agree that you won't       09:10:18  
14      have contact with Mr. Li during the course       09:10:20  
15      of this deposition except -- you know, at       09:10:24  
16      least while the deposition is live?               09:10:26  
17      A.       Other than obviously what's               09:10:31  
18      through the video that's being recorded. I       09:10:33  
19      will -- I certainly would agree that I'll       09:10:35  
20      have no side-channel conversations of any       09:10:38  
21      sort with him.                                   09:10:40  
22      Q.       Perfect. Thank you.                       09:10:42  
23                   And is there anything open on           09:10:44  
24      your computer other than the -- the Exhibit       09:10:45  
25      Share window and this Zoom window?               09:10:48

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1           A.     Open right now is my email           09:10:52  
2     because I was looking at it before we got       09:10:54  
3     on.   09:10:56  
4           Q.     Okay.                               09:10:56  
5           A.     That's the only --                 09:10:59  
6           Q.     Are you going to --                09:10:59  
7           A.     That's the only other thing.       09:11:00  
8                   I'm sorry, I stepped over you.    09:11:01  
9           Q.     No problem.                        09:11:03  
10                   Are you going to leave that open  09:11:03  
11     during the course of your deposition?         09:11:05  
12           A.     No, I imagine as soon as we go    09:11:06  
13     to deposition -- the exhibits -- in fact        09:11:08  
14     I'll just switch to that now.   There.   I've   09:11:11  
15     got the exhibits page up.                       09:11:13  
16           Q.     Great.   Okay.                    09:11:15  
17                   And so you've been deposed        09:11:17  
18     remotely a few times before.   How many times  09:11:19  
19     total have you been deposed, including         09:11:21  
20     remote and in person?                           09:11:22  
21           A.     Are you referring to matters or   09:11:25  
22     days?    09:11:27  
23           Q.     That's a good question.   How     09:11:29  
24     about days?                                     09:11:31  
25           A.     I don't know.   Certainly at       09:11:34

1     least 20.   So I could go back and likely                   09:11:35  
2     figure it out more precisely but quite a                   09:11:40  
3     few.   09:11:42  
4             Q.       Got it.   All right.                       09:11:44  
5                   Well, then, so you already know           09:11:45  
6     all the regular rules that apply in person               09:11:47  
7     also apply here.   We have to avoid talking             09:11:50  
8     over each other.   You understand that;                 09:11:52  
9     right?   09:11:54  
10            A.       Yes, sir.                                   09:11:54  
11            Q.       Yeah.                                       09:11:57  
12                   And you also know, I'm sure,               09:11:57  
13     that if you don't understand my question you           09:12:00  
14     should ask me to clarify it.   Can we agree             09:12:02  
15     to that?   09:12:04  
16            A.       Yes.   09:12:04  
17            Q.       And can we agree that if you             09:12:07  
18     answer my question we can assume that you             09:12:09  
19     understood it?   09:12:10  
20            A.       That seems like a reasonable             09:12:13  
21     assumption.   09:12:15  
22            Q.       Great.                                       09:12:17  
23                   And of course if you need a                 09:12:18  
24     break at any point, feel free to do so.                 09:12:19  
25     Just please don't ask for a break when a                 09:12:21

1 question is pending. Okay? 09:12:24

2 A. Yes. 09:12:24

3 Q. Great. 09:12:28

4 Is there any reason why you 09:12:28

5 can't give full and complete testimony 09:12:29

6 today? 09:12:32

7 A. Not that I'm aware of, no. 09:12:33

8 Q. Are you on any medications or 09:12:36

9 experiencing anything else that might affect 09:12:38

10 your memory or your testimony? 09:12:40

11 A. No. 09:12:40

12 Q. Okay. 09:12:40

13 And you understand that we're 09:12:45

14 here for the declaration that you submitted 09:12:46

15 for the inter partes review of the '301 09:12:48

16 patent; right? 09:12:52

17 A. Yes, sir. 09:12:53

18 Q. Did you write that declaration? 09:12:55

19 A. I did write that declaration, 09:12:58

20 and it's got -- it contains my opinions on 09:13:00

21 the matter, or at least many of my opinions 09:13:04

22 on the matter. 09:13:06

23 Q. Okay. 09:13:06

24 And did you ever see or have you 09:13:08

25 ever seen the patent owner's response that 09:13:10



1 the technology. I want to mark as 09:14:16  
2 Exhibit 1, this will be our practice run to 09:14:19  
3 see if this works, the Nicol reference, 09:14:21  
4 patent number 6,141,762. That should show 09:14:23  
5 up in just a minute or so. 09:14:28  
6 [Deposition Exhibit 1 marked for 09:14:28  
7 identification.] 09:14:28  
8 BY MR. BROWN: 09:14:28  
9 Q. While we're waiting for it, is 09:14:34  
10 that how you pronounce this reference name? 09:14:36  
11 Or are we going to pronounce it something 09:14:39  
12 different? 09:14:41  
13 A. Yeah. I mean, are there 09:14:41  
14 alternatives that people have thrown around? 09:14:42  
15 "Nicol" is -- sort of looks reasonable to 09:14:44  
16 me. That's the only one I've heard people 09:14:46  
17 say. 09:14:48  
18 Q. Yeah. Okay. Well, we've had a 09:14:49  
19 few alternatives here internally, but I'm 09:14:52  
20 not going to say them because then we might 09:14:55  
21 adopt one of those. 09:14:57  
22 A. Got it. 09:14:58  
23 With my last name, as you might 09:14:58  
24 imagine, I'm sympathetic. It's 09:15:00  
25 pronounced -- I pronounce it different ways. 09:15:03



1 Q. Okay. It should be up there 09:15:05  
2 now. 09:15:16  
3 A. Yeah, I'm doing the screen 09:15:18  
4 refresh. There we go. Okay. 09:15:19  
5 [Pause.] 09:15:48  
6 A. All right. I am with you. 09:15:48  
7 Q. Great. 09:15:50  
8 And you've reviewed Exhibit 1 09:15:50  
9 before; correct? 09:15:52  
10 A. Yes, I have. 09:15:54  
11 Q. Okay. 09:15:55  
12 And do you know who Mr. Nicol 09:15:56  
13 is? 09:15:59  
14 A. I don't believe so. We may have 09:16:01  
15 crossed paths in the past, but the name 09:16:03  
16 doesn't ring a bell. 09:16:08  
17 Q. And how about Mr. Kanwar Singh? 09:16:11  
18 Do you know Mr. Singh? 09:16:16  
19 A. Same thing. 09:16:18  
20 Q. So let's -- I want to take you 09:16:18  
21 to column 2, the "Summary of the Invention" 09:16:24  
22 and just ask some preliminary questions. 09:16:30  
23 A. All right. 09:16:33  
24 Q. You see there on line 17 right 09:16:35  
25 under the heading "Summary of the 09:16:39

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1     Invention," Nicol explains that one of the     09:16:41  
2     intentions of the patent is for [as read]:     09:16:44  
3             "Improved performance of     09:16:48  
4     multi-processor chips which is achieved by     09:16:50  
5     dynamically controlling the processing load     09:16:52  
6     of chips and controlling, with significantly     09:16:56  
7     greater than on/off granularity, the     09:16:57  
8     operating voltages of those chips so as to     09:17:00  
9     minimize overall power consumption."     09:17:03  
10             Do you see that?     09:17:05  
11             A.     Yes, I see that.     09:17:06  
12             Q.     Do you agree that a person of     09:17:07  
13     ordinary skill reviewing Nicol would     09:17:08  
14     understand that Nicol is teaching how to     09:17:10  
15     dynamically control the processing load of     09:17:14  
16     chips and their voltages so as to minimize     09:17:17  
17     overall power consumption?     09:17:20  
18             MR. LI:   Objection, form.     09:17:24  
19             A.     I would agree that to a person     09:17:25  
20     of ordinary skill in the art, yes, Nicol is     09:17:27  
21     directed towards managing a load on a     09:17:32  
22     multiprocessor system and the voltage in     09:17:37  
23     order to -- in order to reduce overall power     09:17:40  
24     consumption.   It's -- it -- it doesn't     09:17:48  
25     minimize overall power consumption, but     09:17:54

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1     that's a phrase that even technical people a     09:17:56  
2     lot of times would say.     09:17:58

3             Q.     And what's the distinction     09:18:03  
4     you're raising between -- behind whether or     09:18:04  
5     not it minimizes power, overall power     09:18:06  
6     consumption, or it's doing something else?     09:18:09

7             A.     "Minimize" means minimal. We     09:18:10  
8     don't really know what the minimal possible     09:18:13  
9     power consumption is. But its goal is     09:18:15  
10    clearly to try to reduce it and thus reach     09:18:18  
11    an improved system.     09:18:21

12            Q.     Got it. Okay.     09:18:24

13                   And then the summary goes on,     09:18:27  
14    and my question is going to be do you agree     09:18:30  
15    that Mr. -- that Nicol also teaches to a     09:18:32  
16    person of ordinary skill in the art that     09:18:35  
17    there is a controller in his invention that     09:18:37  
18    will allocate tasks to the individual     09:18:41  
19    processors in order to equalize the     09:18:43  
20    processing load among the chips?     09:18:46

21                   MR. LI: Objection, form.     09:18:49

22            A.     My recollection is that Nicol     09:18:51  
23    discloses multiple embodiments, and in one     09:18:55  
24    of them there clearly is a controller that     09:18:58  
25    is responsible for assigning various tasks     09:19:02

1 while the system is operating. 09:19:06

2 Q. Okay. 09:19:08

3 You are saying that there is 09:19:10

4 only -- well, I guess we'll get into that. 09:19:11

5 Okay. 09:19:20

6 And so do you agree that Nicol 09:19:21

7 teaches a person of ordinary skill that it 09:19:24

8 should equalize the processing load among 09:19:26

9 the chips in order to then lower the clock 09:19:29

10 frequency of those chips to as low a level 09:19:34

11 as possible while assuring proper operation? 09:19:36

12 MR. LI: Objection, form. 09:19:39

13 A. No. It states that it's doing 09:19:51

14 that, but in my review of the technology, 09:19:52

15 I'm not sure that it actually illustrates 09:19:55

16 equalizing the processing load. 09:19:58

17 Q. Your testimony is that Nicol 09:20:05

18 doesn't describe equalizing processing load 09:20:08

19 among it's PE? 09:20:12

20 MR. LI: Objection, form. 09:20:14

21 A. It may use that term. From a 09:20:15

22 practical point of view in almost all 09:20:18

23 real-world situations it's going to be 09:20:24

24 difficult if not impossible to actually 09:20:28

25 equalize the processing load. 09:20:29

1                   And, for example, in the first                   09:20:34  
2           system that he discusses where all of the                   09:20:39  
3           PEs operate at the same voltage, there                   09:20:42  
4           really is likely not much that you can do to                   09:20:45  
5           optimize -- I'm sorry, to equalize.   You                   09:20:49  
6           pick a processor, which I -- the one you                   09:20:52  
7           pick, which has got the highest tent pole,                   09:20:55  
8           the most computation required, and then the                   09:20:58  
9           rest just shake out as they do.   There is no                   09:21:01  
10          opportunity to equalize the load, no real                   09:21:05  
11          benefit to equalize, trying to equalize the                   09:21:07  
12          load among the other ones.                   09:21:10

13               Q.       Got it.                   09:21:17

14                   And so do you disagree, then --                   09:21:18  
15          I understand what you're saying about                   09:21:19  
16          equalize.   Are you disagreeing, then, that                   09:21:21  
17          Nicol teaches to equalize as best as it                   09:21:23  
18          possibly can among its PEs?   I understand                   09:21:28  
19          you're saying you can't perfectly equalize,                   09:21:31  
20          but you would agree that Nicol describes                   09:21:33  
21          equalizing as best as it can among the PEs?                   09:21:36

22                   MR. LI:   Objection, form.                   09:21:40

23               A.       No, that's -- that's not a word                   09:21:43  
24          I would use to describe it.                   09:21:44

25               Q.       How would -- sorry, go ahead.                   09:21:49

1           A.     Well, I -- I guess I'll just           09:21:50  
2     leave it with that. I would not say that it   09:21:52  
3     discloses equalizing the processing load.       09:21:56  
4     It may actually say that later on in the       09:21:59  
5     rest of the detailed description. As we sit   09:22:04  
6     here, I don't recall. But given that it's       09:22:06  
7     mentioned here, it wouldn't surprise me if     09:22:08  
8     that word is used. But my understanding of     09:22:10  
9     the techniques that are actually disclosed,     09:22:12  
10    they're not directed at equalizing the           09:22:16  
11    processing load as I understand that            09:22:19  
12    concept.    09:22:21  
13           Q.     Okay.                             09:22:22  
14                   How do you understand the           09:22:26  
15    concept of what Nicol is doing to distribute   09:22:27  
16    tasks among the PEs?                             09:22:30  
17           A.     Well, my understanding is that,   09:22:36  
18    as I said, Nicol discloses two different       09:22:39  
19    embodiments, two different systems. One in     09:22:42  
20    which all of the PEs operate at the same       09:22:45  
21    voltage and clock speed, which -- which can   09:22:50  
22    be changed based on the situation. And a       09:22:52  
23    second one where each PE operates at its own   09:22:55  
24    voltage and clock speed, which again can be     09:23:00  
25    varied based on demands at execution time.     09:23:04

1                   So then it says that you divide                   09:23:10  
2   up tasks among the PEs and whichever PE --                   09:23:12  
3   and in the discussion of the task                   09:23:22  
4   distribution, they're focused on tasks with                   09:23:25  
5   known resource demands, time demands, time                   09:23:29  
6   limits. So -- and that's many applications,                   09:23:34  
7   like "realtime tasks" we would oftentimes                   09:23:38  
8   call them. But it's certainly not all sorts                   09:23:41  
9   of computation tasks.                   09:23:43  
10                   So it divides these up in some                   09:23:47  
11   manner among the PEs and then it figures out                   09:23:50  
12   based on that knowledge which PE is the most                   09:23:54  
13   heavily loaded, which one has, you know,                   09:23:59  
14   the -- the most critical time demands. It                   09:24:02  
15   sets the voltage -- well, based on that it                   09:24:05  
16   determines the clock frequency needed to                   09:24:09  
17   meet that performance goal, and then based                   09:24:11  
18   on that it determines the voltage needed to                   09:24:13  
19   support that clock frequency, and then it                   09:24:17  
20   sets all of the PEs to operate under that                   09:24:19  
21   condition.                   09:24:22  
22                   The -- in essence the                   09:24:24  
23   distribution of the tasks among the other                   09:24:26  
24   noncritical PEs from a performance point of                   09:24:29  
25   view is largely immaterial.                   09:24:33

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1 Q. Okay. Let me unpack that a bit. 09:24:34  
2 So you mentioned that there are 09:24:40  
3 two embodiments and you were referring to, I 09:24:41  
4 think, the figure 2 embodiment and the 09:24:47  
5 figure 4 embodiment; right? 09:24:50  
6 A. Yes, sir. 09:24:51  
7 Q. Yeah. 09:24:52  
8 And are those the only two 09:24:52  
9 embodiments, in your opinion, in Nicol? 09:24:55  
10 A. I believe those are the only two 09:24:59  
11 embody -- well, those are the foundational 09:25:02  
12 embodiments that I've discussed and that he 09:25:05  
13 discusses in detail. 09:25:08  
14 Q. Okay. 09:25:12  
15 And would you agree there are 09:25:12  
16 other embodiments in Nicol as well other 09:25:13  
17 than figure 2 and figure 4? 09:25:15  
18 A. Perhaps. You would have to 09:25:18  
19 point me to them. I have certainly focused 09:25:19  
20 on 2 and 4. 09:25:21  
21 Q. Okay. 09:25:22  
22 So sitting here right now, from 09:25:24  
23 your preparation and drafting your 09:25:27  
24 declaration, you aren't sure if there are 09:25:28  
25 others beyond 2 and 4? 09:25:31



1           A.     Well, there's also a question in     09:25:32  
2     my mind from a legal point of view, and as     09:25:34  
3     you're aware I'm not a lawyer, what     09:25:38  
4     constitutes a disclosed embodiment.     09:25:40  
5                 So I don't know, for example, if     09:25:44  
6     one short hypothetical sentence that says,     09:25:50  
7     "Oh, yes, you could do this as well,"     09:25:54  
8     without any explanation for how this     09:25:57  
9     hypothetical thing would be achieved or any     09:26:01  
10    details of its structure, whether that     09:26:02  
11    constitutes a disclosed embodiment or not.     09:26:06  
12    Or whether to be an embodiment there has to     09:26:09  
13    be some level of detail.     09:26:11  
14           Q.     Got it.     09:26:16  
15                 Let me take you, then, to     09:26:22  
16    column 3 at line 10 through 20. This is the     09:26:24  
17    paragraph that begins:     09:26:33  
18                 "In the Figure 2 arrangement, in     09:26:34  
19    accordance with the principles disclosed     09:26:36  
20    herein...."     09:26:38  
21                 Do you see that?     09:26:38  
22           A.     Yes, I do.     09:26:40  
23           Q.     Okay.     09:26:40  
24                 I'm going to take you to the     09:26:43  
25    last sentence of that paragraph, and     09:26:44

1 obviously feel free to review anything you 09:26:45  
2 need to. But it explains that: 09:26:47  
3 "The intermediate goal, of 09:26:50  
4 course, is to maximize the parallelism and 09:26:52  
5 to evenly distribute the load presented to 09:26:55  
6 the Figure 2 system among all the PE's." 09:26:58  
7 Do you see that? 09:27:00  
8 A. I do. 09:27:01  
9 Q. Okay. 09:27:02  
10 And so Nicol there is teaching 09:27:05  
11 that it needs to maximize the parallelism 09:27:06  
12 and evenly distribute the load among those 09:27:10  
13 PEs in figure 2; correct? 09:27:14  
14 A. No. 09:27:16  
15 MR. LI: Objection, form. 09:27:17  
16 BY MR. BROWN: 09:27:17  
17 Q. What did I get wrong? 09:27:20  
18 A. You said "teaching." He's -- 09:27:21  
19 they're stating that this is a goal. And, 09:27:24  
20 frankly, I -- as an engineer I don't 09:27:29  
21 understand why they would adopt that as a 09:27:32  
22 goal. But I can understand that that's what 09:27:35  
23 they were attempting to accomplish. 09:27:39  
24 I don't -- 09:27:41  
25 Q. Okay. Got it. 09:27:41

1           A.       I'm not sure that they actually       09:27:43  
2       disclosed techniques that are directed       09:27:44  
3       towards that goal, but I'm sure we'll get to       09:27:46  
4       that.       09:27:50  
5           Q.       Okay.       09:27:50  
6                    So let's -- we'll get the       09:27:51  
7       language right. You will agree that it was       09:27:54  
8       the goal -- withdrawn. Let me say it       09:27:57  
9       differently.       09:27:59  
10                   You agree that it was the       09:28:00  
11       intention of Nicol to evenly distribute       09:28:01  
12       tasks among all available processors;       09:28:03  
13       correct?       09:28:06  
14                   MR. LI: Objection, form.       09:28:07  
15           A.       They do say that an intermediate       09:28:09  
16       goal is to maximize the parallelism and to       09:28:15  
17       evenly distribute the load presented to the       09:28:18  
18       figure 2 system among all of the PEs.       09:28:22  
19           Q.       And so you agree with me that it       09:28:27  
20       was Nicol's intention to evenly distribute       09:28:31  
21       tasks among all available processors;       09:28:33  
22       correct?       09:28:35  
23                   MR. LI: Objection, form.       09:28:36  
24           A.       My recollection is that's the       09:28:39  
25       same question I just answered. So I       09:28:41

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1 would -- if there is some distinction that 09:28:43  
2 you want to make, I'll be happy to focus on 09:28:45  
3 that. But otherwise I would prefer to just 09:28:47  
4 stand on my previous answer. 09:28:49  
5 Q. I don't know if the answer to my 09:28:52  
6 question is yes or no from your previous 09:28:53  
7 answer. That's why I'm asking it. 09:28:55  
8 A. Okay. 09:28:59  
9 Q. And I'll ask it. 09:29:00  
10 Do you agree with the statement 09:29:02  
11 that Nicol's intention is to evenly 09:29:03  
12 distribute tasks among all available 09:29:08  
13 processors? 09:29:10  
14 MR. LI: Objection, form. 09:29:11  
15 A. I would agree that in this 09:29:14  
16 passage that you've directed me to they do 09:29:17  
17 say that "The intermediate goal is to" -- 09:29:19  
18 and then there is some other elements, blah 09:29:21  
19 blah blah -- "evenly distribute the load 09:29:23  
20 presented among all of the PE's." 09:29:27  
21 Q. And let me take you down to the 09:29:32  
22 end of column 3 in Exhibit 1. At line 66 of 09:29:34  
23 column 3, you see that it says: 09:29:41  
24 "Hence, the operating system of 09:29:44  
25 PE 100 needs to ascertain the required 09:29:46

1 completion time, divide the collection of 09:29:49  
2 tasks as evenly as possible (in terms of 09:29:53  
3 neither processing time), and consider the 09:29:55  
4 PE with the tasks that required the most 09:29:59  
5 time to carry out, and adjust the clock 09:30:01  
6 frequency to ensure that the most heavily 09:30:04  
7 loaded PE carries out its assigned tasks 09:30:06  
8 within the required completion time." 09:30:09  
9 Do you see that sentence? 09:30:12  
10 A. Yes, I do. 09:30:13  
11 Q. So you would agree that Nicol is 09:30:14  
12 explicit in how tasks are to be allocated in 09:30:16  
13 that it says you: 09:30:22  
14 "...divide the collection of 09:30:24  
15 tasks as evenly as possible (in terms of 09:30:25  
16 needed processing time)...." 09:30:28  
17 Correct? 09:30:30  
18 A. I -- 09:30:31  
19 MR. LI: Objection, form. 09:30:32  
20 A. I agree that they state that 09:30:33  
21 that's a goal. That goal is difficult to 09:30:35  
22 achieve. In fact, it's notoriously 09:30:40  
23 difficult to achieve. And I haven't seen 09:30:44  
24 any disclosure in Nicol that actually makes 09:30:47  
25 it feasible. 09:30:50

1           Q.     But they are -- Nicol -- you           09:30:53  
2     would agree at least that Nicol is explicit       09:30:55  
3     in describing how it believes tasks should       09:30:57  
4     be allocated. We can agree on that; right?       09:30:59  
5           MR. LI: Objection, form.           09:31:02  
6           A.     I would agree that it's their       09:31:04  
7     goal. They believe tasks should -- they       09:31:06  
8     would prefer tasks are evenly distributed.       09:31:10  
9           Q.     So as I think you sort of           09:31:13  
10    started off with earlier, if we look at in       09:31:23  
11    column 3 at line 38, 39, there's a sentence       09:31:26  
12    there that reads:           09:31:36  
13           "Of course, it is unlikely that       09:31:38  
14    an application can be perfectly divided into       09:31:40  
15    two equal load task streams and,           09:31:42  
16    therefore...."           09:31:45  
17           And then it goes on.           09:31:46  
18           And I think you're -- what           09:31:47  
19    you're saying is similar to that statement,       09:31:49  
20    that it is difficult to divide up a number       09:31:51  
21    of tasks perfectly among the PEs. Is that       09:31:55  
22    fair?           09:31:59  
23           MR. LI: Objection, form.           09:32:01  
24           A.     I'm -- yes, but I'm -- but I'm       09:32:03  
25    saying something a little bit more.           09:32:07

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1                   What they're describing here is           09:32:09  
2     a solution to something called the                   09:32:11  
3     bin-packing problem. And it -- the                   09:32:15  
4     bin-packing problem is known to have a               09:32:19  
5     computational complexity called "NP                   09:32:22  
6     complete." N-P complete. Which means we've       09:32:27  
7     never found an algorithm that can                   09:32:32  
8     efficiently solve that problem, and we               09:32:34  
9     believe -- "we" as computer scientists or           09:32:37  
10    computer people believe that it can't be              09:32:40  
11    solved efficiently with any sort of                   09:32:44  
12    conventional known computing technology.            09:32:48  
13                   So it's not just that, yeah,            09:32:51  
14    this is a very difficult problem. It's that           09:32:53  
15    it's -- it's a foundationally difficult               09:32:57  
16    problem.    09:32:59  
17            Q.     And by bin packing, just to            09:33:01  
18    unpack that, sorry to reuse the word, you're        09:33:04  
19    referring to figuring out exactly how to              09:33:07  
20    distribute work among a multiprocessor                09:33:10  
21    system; right? That's what you mean by bin            09:33:14  
22    packing?    09:33:17  
23            A.     In essence or at least in this           09:33:17  
24    application. Yes, I would say that. That's           09:33:20  
25    not a bad characterization.                            09:33:23

1           Q.     And the challenge that you're           09:33:26  
2     describing is that even today here in 2021       09:33:27  
3     we still don't know how to do that with         09:33:32  
4     perfect efficiency; right?                       09:33:35  
5                 MR. LI:   Objection, form.           09:33:38  
6           A.     I say that it's worse than that.    09:33:44  
7     We only know how to do it with very bad         09:33:46  
8     efficiency.   But I want to be clear.   In       09:33:49  
9     essence, what I'm talking about is different    09:33:53  
10    from this specific passage in Nicol that         09:33:55  
11    you're referring to where they sort of say,     09:34:00  
12    "I have an application.   I'm going to divide    09:34:02  
13    it up into two parts."                           09:34:04  
14                 I'm talking about once you've       09:34:06  
15    got all the constituent parts, then the           09:34:08  
16    question is will you start out by saying,        09:34:11  
17    "My clock speed can be 100 megahertz or          09:34:14  
18    120 megahertz or 130 megahertz on four PEs"?   09:34:19  
19                 And you're going to start with       09:34:24  
20    the lowest, 100, and say, "Well, can I           09:34:25  
21    assign all these tasks to my available PEs       09:34:28  
22    and have them done in 100."                     09:34:30  
23                 And if the answer is no, then        09:34:35  
24    you try it again with 120 or 130.               09:34:36  
25                 So that's the bin-packing           09:34:39



1 problem, where the clock speed would set the 09:34:41  
2 size of the bin and then the question is can 09:34:43  
3 you pack all these tasks into that size? 09:34:45  
4 Q. Got it. 09:34:50  
5 You're saying it's a combination 09:34:51  
6 of load and frequency. So there's -- it's 09:34:53  
7 sort of defining that right balance? 09:34:55  
8 A. Yes. 09:34:59  
9 Q. Got it. 09:35:00  
10 And so even though, you know, 09:35:02  
11 still today this hasn't been solved to 09:35:03  
12 anywhere near what computer science would 09:35:05  
13 prefer, you would agree that that hasn't 09:35:08  
14 prevented folks from still attempting to do 09:35:11  
15 their best to distribute work among PEs, 09:35:16  
16 right, or among any processing element, not 09:35:22  
17 just Nicol? 09:35:25  
18 A. Yeah. 09:35:26  
19 MR. LI: Objection, foundation. 09:35:26  
20 A. I'm not suggesting that task 09:35:30  
21 scheduling isn't done across 09:35:32  
22 multiprocessors. It is. And I'm not 09:35:34  
23 suggesting that task scheduling where 09:35:36  
24 there's a realtime deadline isn't done. It 09:35:40  
25 is. You know, and I'm not saying there 09:35:43

1 hasn't been great improvement on the 09:35:48  
2 algorithms for task scheduling over the past 09:35:50  
3 40 years. There has been. 09:35:54  
4 It's just these hard terms like 09:35:56  
5 "equal." Well, equal is a goal. We don't 09:36:00  
6 expect to get there. Equal load. 09:36:03  
7 Or, you know, like we had -- I 09:36:07  
8 think it was "minimal" before. Well, 09:36:09  
9 minimal is a goal. I don't even know what 09:36:11  
10 minimal is for some of these systems because 09:36:15  
11 it -- and I'm not being facetious. It's a 09:36:17  
12 very difficult concept to define. But I 09:36:20  
13 can -- I know when I've reduced the power 09:36:26  
14 consumption. So -- so that's what they're 09:36:29  
15 shooting for. 09:36:31  
16 Q. Got it. 09:36:33  
17 So what Nicol is -- I'm 09:36:34  
18 understanding. It's -- Nicol is shooting 09:36:36  
19 for as even of a distribution as possible, 09:36:40  
20 but you're saying everybody knows they're 09:36:43  
21 not going to get there perfectly or anywhere 09:36:45  
22 near perfect; right? 09:36:47  
23 A. Yes. And on top of that I'm 09:36:49  
24 saying I don't understand why that would be 09:36:51  
25 their goal. But that's really a separate 09:36:53

1 issue. They -- they've stated that that's 09:36:55  
2 their goal. 09:36:58

3 Q. Right. Right. Yeah, we'll 09:36:58  
4 come -- we'll put a pin in that. 09:37:02

5 I understand -- I heard your 09:37:04  
6 tent pole point, and we can come back to 09:37:05  
7 that. I understand that's an opinion you 09:37:08  
8 have. 09:37:10

9 So, you know, going back to, you 09:37:15  
10 know, your own personal work when you were a 09:37:17  
11 professor at, say, UCLA from 1995 to 2005, 09:37:19  
12 you were aware of operating systems having 09:37:24  
13 schedulers that attempted to distribute 09:37:30  
14 tasks in an efficient way; right? 09:37:32

15 A. Yes, I was aware of task 09:37:38  
16 schedulers, realtime task schedulers, and 09:37:41  
17 various heuristics that attempted to improve 09:37:44  
18 their performance. 09:37:50

19 Q. And so in the late '90 time -- 09:37:51  
20 withdrawn. 09:37:52

21 In the late '90s having a task 09:37:53  
22 scheduler was something that was known to 09:37:55  
23 people of ordinary skill in the art; right? 09:38:00

24 MR. LI: Objection, form. 09:38:03

25 A. Yes. Task scheduling was known, 09:38:06

1 and task scheduling under different sorts of 09:38:14  
2 constraints like realtime or not realtime or 09:38:17  
3 mixed task requirements was known. 09:38:20

4 Q. So let me take you then -- we've 09:38:31  
5 been talking about the two embodiments, and 09:38:32  
6 so let's talk about the figure 2 embodiment 09:38:33  
7 in a little bit more detail. And if you 09:38:36  
8 want to pull up figure 2, which is on -- 09:38:38  
9 what is it? -- the third page of -- I'm 09:38:44  
10 sorry, the second page of Exhibit 1, or if 09:38:46  
11 you want to go to the text that's fine as 09:38:50  
12 well, but I'm going to ask some specific 09:38:52  
13 questions about it. 09:38:54

14 A. All right. I'm there. 09:38:57

15 Q. So -- and for clarification, my 09:38:59  
16 questions are going to be about what Nicol 09:39:03  
17 actually describes to do and not -- not 09:39:05  
18 your -- your ideas about why that might not 09:39:10  
19 make sense or why you might disagree with 09:39:13  
20 it. Okay? 09:39:16

21 A. Understood. Yep. 09:39:17

22 Q. So in figure 2, you know, 09:39:18  
23 we've -- when -- when something -- let's say 09:39:21  
24 we have four PEs in figure 2, as shown 09:39:24  
25 there, and we have four tasks, each of 09:39:28

1     varying difficulties.  Does that -- can I     09:39:33  
2     use those phrases?  Does that make sense to     09:39:36  
3     you?  Or should I use a different word?     09:39:38  
4             A.     Yes.  No, that makes sense.     09:39:40  
5             Q.     Okay.     09:39:41  
6                     And so it's impossible to evenly     09:39:42  
7     load in figure 2.     09:39:44  
8                     What would figure 2 -- what does     09:39:48  
9     Nicol teach you should try to do in figure 2     09:39:50  
10    to distribute the work when it's not     09:39:53  
11    possible to completely equalize it?     09:39:55  
12                     MR. LI:  Objection, form,     09:40:00  
13    foundation.     09:40:00  
14             A.     So Nicol teaches that -- in the     09:40:02  
15    elements that I've reviewed, that what you     09:40:07  
16    do is you assign tasks and you figure out     09:40:11  
17    which PE is most heavily loaded, and then     09:40:14  
18    you set the voltage and clock frequency off     09:40:20  
19    of that.     09:40:21  
20                     In the case that you're     09:40:22  
21    referring to, if there are only four tasks,     09:40:23  
22    presumably one could assign one to each of     09:40:26  
23    the PEs.  And then if they were each -- I     09:40:30  
24    think you mentioned it -- tasks where you     09:40:33  
25    knew what the -- what the deadlines were,     09:40:36

1 then you would know which one was in essence 09:40:39  
2 the most heavily loaded and could go 09:40:42  
3 forward. 09:40:45  
4 To be honest with you, we could 09:40:46  
5 certainly look at the details of whatever 09:40:48  
6 scheduling algorithm is disclosed in Nicol, 09:40:52  
7 but I don't recall that -- I don't recall me 09:40:54  
8 commenting on it or that being in part of 09:40:58  
9 the declaration or petition that I responded 09:41:00  
10 to. But we can certainly look at that 09:41:06  
11 further if you wish. 09:41:08  
12 Q. Sure. 09:41:09  
13 And so just to continue with the 09:41:10  
14 hypothetical. If we were looking at the 09:41:12  
15 figure 2 embodiment and now instead of four 09:41:15  
16 tasks we had eight tasks of varying 09:41:19  
17 difficulty. 09:41:21  
18 A. Uh-huh. 09:41:21  
19 Q. What does Nicol teach you should 09:41:21  
20 try to do to distribute those eight tasks 09:41:23  
21 among the four PEs? 09:41:26  
22 MR. LI: Objection, form, 09:41:29  
23 foundation. 09:41:30  
24 A. I don't recall commenting on 09:41:34  
25 that. If there is some particular part of 09:41:36

1 my declaration that you would like to point 09:41:39  
2 me to review or a particular part of Nicol 09:41:40  
3 that you would like me to review, I can 09:41:45  
4 certainly do that. 09:41:48  
5 My understanding of what Nicol 09:41:49  
6 really discloses is fundamentally a hardware 09:41:52  
7 platform, and then some discussion of, "Oh, 09:41:56  
8 we can use this." And then there is some 09:41:59  
9 loose discussion of scheduling under various 09:42:01  
10 circumstances, for example. But not much 09:42:04  
11 detail at all. 09:42:06  
12 Q. Right. Understood. 09:42:06  
13 But as we've been talking about 09:42:10  
14 earlier, in a situation that I just 09:42:11  
15 described, let's say eight tasks to be 09:42:15  
16 distributed among the four PEs, what Nicol 09:42:17  
17 at least states as his intention is that you 09:42:20  
18 should distribute that work as evenly as 09:42:24  
19 possible as you can across those four PEs. 09:42:25  
20 Fair? 09:42:29  
21 MR. LI: Objection, form, 09:42:32  
22 foundation. 09:42:33  
23 A. That's a goal. I don't recall 09:42:33  
24 any -- reviewing or commenting on any 09:42:36  
25 disclosure in Nicol that discusses how that 09:42:38





1 PEs sharing a clock that makes it 09:44:03  
2 advantageous to distribute the work as 09:44:07  
3 evenly as possible? 09:44:09  
4 MR. LI: Objection, form. 09:44:10  
5 A. Well, they -- they believe, I 09:44:16  
6 think, that that will allow them to 09:44:20  
7 minimize -- based on their statements in the 09:44:22  
8 summary of the invention, to minimize the 09:44:25  
9 power consumption. 09:44:27  
10 Q. So what Nicol is saying they 09:44:33  
11 believe -- or withdrawn. 09:44:39  
12 Yeah. So Nicol believes that 09:44:48  
13 when you have these PEs sharing a clock, if 09:44:50  
14 you try -- if you distribute the work as 09:44:58  
15 evenly as possible, that can allow you to 09:45:00  
16 reduce or minimize your power consumption; 09:45:05  
17 right? 09:45:07  
18 MR. LI: Objection, form. 09:45:09  
19 A. I believe that their goal is to 09:45:12  
20 try to evenly distribute the tasks so that 09:45:15  
21 in essence they're lowering that tent pole 09:45:21  
22 that I talked about or making the bin as low 09:45:24  
23 as possible to achieve all of their 09:45:27  
24 performance demands. 09:45:31  
25 Q. And by -- because now somebody 09:45:34

1 really miss -- a transcript is not going to 09:45:38  
2 have any idea what you mean by "tent pole," 09:45:41  
3 so let me expand on that a little bit. 09:45:42  
4 So what you're saying is by 09:45:44  
5 lowering the tent pole you're referring to 09:45:47  
6 reducing -- how to say this? Withdrawn. 09:45:53  
7 By lowering the tent pole, 09:46:00  
8 you're referring to that if you evenly 09:46:03  
9 distribute as best as you can across the 09:46:06  
10 PEs, the highest frequency that's necessary 09:46:09  
11 will be as low as possible in that 09:46:12  
12 embodiment? 09:46:17  
13 A. Yes. That's my intention. And 09:46:20  
14 I'm sorry, I thought maybe I vaguely 09:46:21  
15 referred to tent pole previously. I thought 09:46:23  
16 I had mentioned it. But also I'm throwing 09:46:26  
17 out too many different analogies probably 09:46:29  
18 between the bin and the tent pole. 09:46:34  
19 But, yeah, in essence you want 09:46:35  
20 to -- you want to be able to ideally just 09:46:38  
21 barely meet your performance deadlines 09:46:43  
22 because then you're running the clock as low 09:46:46  
23 as possible and -- and consequently can 09:46:48  
24 lower the voltage as much as possible and 09:46:55  
25 still achieve your performance demands. 09:46:57

1           Q.     And the reason that that's           09:47:02  
2     important in figure 2 is because your -- all   09:47:06  
3     of these PEs are sharing that same frequency   09:47:12  
4     and voltage. And so if you raise that tent    09:47:15  
5     pole, you're going to have more inefficiency   09:47:18  
6     in the system than if you were able to        09:47:23  
7     evenly distribute and lower the tent pole?    09:47:25

8           A.     I think that's right.            09:47:31

9                   For example, if you -- we've got   09:47:34  
10    four PEs here -- and maybe this is getting    09:47:36  
11    to part of your point. If you've only got    09:47:39  
12    three tasks, you assign them to three        09:47:42  
13    different PEs, the fourth one has nothing to   09:47:45  
14    do and it's still getting clocked at the       09:47:48  
15    same frequency as all the other ones. It's    09:47:51  
16    not very -- the tasks aren't very evenly      09:47:55  
17    distributed, but maybe they're as evenly       09:47:58  
18    distributed as possible.                        09:48:00

19           Q.     Got it. Okay.                   09:48:05

20                   Now, if we -- we talk about the   09:48:20  
21    other embodiment that you were -- that you    09:48:23  
22    mentioned earlier, the figure 4 embodiment,   09:48:26  
23    how does figure 4 -- let's start with some    09:48:33  
24    basics to frame this.                           09:48:35

25                   How does figure 4 differ -- how   09:48:36

1 does the figure 4 embodiment differ from the 09:48:39  
2 figure 2 embodiment? 09:48:41

3 A. So figure 4 differs in a number 09:48:44  
4 of ways. Let's focus first on my 09:48:46  
5 understanding of the embodiment as opposed 09:48:54  
6 to just the figure. 09:48:56

7 Each one of the PEs here has its 09:48:59  
8 own localized power supply and clock 09:49:02  
9 frequency. So they can all operate 09:49:06  
10 independently. In essence, if we think of, 09:49:09  
11 you know, that one of them can be running at 09:49:14  
12 100 megahertz, and if the second PE only 09:49:15  
13 needs to run at 33 megahertz, maybe its 09:49:19  
14 clock would be set to 40 so that the 09:49:22  
15 frequency was as close as possible. 09:49:25

16 So the power supplies in the 09:49:28  
17 figure shows that DC-to-DC converter and a 09:49:31  
18 separate calibration unit and separate PLLs, 09:49:35  
19 phase-locked loop, for each of these PEs. 09:49:39  
20 That is all new, different from the figure 2 09:49:42  
21 embodiment. 09:49:46

22 In addition, there is a level 09:49:48  
23 converter shown in figure 4 which in 09:49:51  
24 figure 2 it's called "level shifter." It's 09:49:57  
25 the same block. 09:50:00

1                   And then as well, there is an                   09:50:03  
2           asynchronous -- what's called an                   09:50:05  
3           asynchronous communication network.   In           09:50:08  
4           essence, the -- that implements a                   09:50:12  
5           synchronizer because two different blocks           09:50:15  
6           are running at different clock frequencies.   09:50:18  
7                   It's my understanding that such           09:50:23  
8           a synchronizer, while not shown in figure 2,   09:50:24  
9           would also be necessary.                   09:50:27  
10           Q.       Why would a synchronizer be           09:50:35  
11           necessary in figure 2?                   09:50:37  
12                   A.       Well, in figure 2 there is           09:50:39  
13           communications between the various PEs used   09:50:42  
14           for computation, 101, 102, 103, 104, and           09:50:47  
15           then the separate PE, 100.   And from the           09:50:51  
16           discussion it's -- the written description,   09:50:57  
17           I believe it's clear that PE 100 is           09:51:02  
18           anticipated to be running on its own clock       09:51:06  
19           frequency.   So its clock is different from       09:51:08  
20           the others.                   09:51:11  
21                   And the other aspect is when           09:51:13  
22           you -- whenever you have a level shifter,       09:51:17  
23           that's used to equalize voltage           09:51:19  
24           differentials.   And in these sorts of           09:51:23  
25           digital systems, when you have voltage           09:51:26

1 differentials you almost always have clock 09:51:29  
2 speed differences. 09:51:30  
3 So you almost -- in my 09:51:32  
4 experience rarely do you see a level shifter 09:51:35  
5 without some sort of synchronization 09:51:39  
6 circuit. 09:51:43  
7 Q. Got it. 09:51:44  
8 And just to go with that a 09:51:45  
9 little bit more, you said the PEs 101, 102, 09:51:47  
10 103, 104, 100 are all communicating with 09:51:50  
11 each other. Would you -- when -- here's the 09:51:53  
12 actual question. 09:52:03  
13 When PEs 101, 102, 103 and 104 09:52:03  
14 are communicating amongst each other, do you 09:52:07  
15 need a synchronizer for that or do they only 09:52:09  
16 need the synchronizer when they then also 09:52:12  
17 talk to PE 100? 09:52:15  
18 MR. LI: Objection, form, 09:52:17  
19 foundation. 09:52:17  
20 A. Yeah, I don't recall if I said 09:52:21  
21 that they were all communicating amongst 09:52:23  
22 each other. The level shifter is there to 09:52:25  
23 do voltage equalization between the PEs 101 09:52:28  
24 through 104 and the PE 100. There is -- 09:52:36  
25 it's clear to me from the written 09:52:42

1 description that the application for 09:52:48  
2 figure 2 anticipates communications back to 09:52:50  
3 the PE 100 from the various computation PEs. 09:52:53  
4 Q. And does it also include 09:52:58  
5 computation -- or communications between the 09:53:00  
6 comp- -- what you're calling the computation 09:53:03  
7 PEs? 09:53:06  
8 MR. LI: Objection, form. 09:53:07  
9 A. I don't -- I don't recall if 09:53:08  
10 there is much in any way of discussion of 09:53:10  
11 direct communications. But if there's 09:53:14  
12 something in the -- if there's something 09:53:17  
13 that you would like to point me to, I would 09:53:21  
14 be happy to consider that. 09:53:24  
15 In the case of communications 09:53:25  
16 among the PEs, there is a whole world of 09:53:32  
17 scheduling aspects, scheduling issues, that 09:53:34  
18 would have to be addressed because one task 09:53:36  
19 is now dependent upon another. None of 09:53:38  
20 which are discussed in Nicol. 09:53:42  
21 Q. Okay. 09:53:47  
22 Let's -- so we were talking 09:53:47  
23 about figure 4. And we'll come back to that 09:53:50  
24 point but I want to say with where we were. 09:53:53  
25 We were on figure 4. And if I understand it 09:53:56

1 right, your -- your view of figure 4 is that 09:53:59  
2 each of the PEs is tied to its own voltage 09:54:04  
3 supply and its own clock. Right? 09:54:07  
4 A. Yes, that's my understanding of 09:54:10  
5 figure 4 with the possible exception of a 09:54:14  
6 controller at the bottom left, which is not 09:54:19  
7 well labeled. And my understanding is that 09:54:23  
8 it's another PE. It is in figure 2, but 09:54:27  
9 it's not clear where its power supply and 09:54:31  
10 clock frequency comes from. 09:54:34  
11 Q. Yeah. 09:54:35  
12 And so figure 4, you know, 09:54:36  
13 teaches that when you -- at least from 09:54:40  
14 Nicol's intention, that when you have 09:54:43  
15 multiple PEs and you've given them each 09:54:45  
16 their own clocks, you are able to adjust 09:54:47  
17 those clocks based on the individual PE's 09:54:50  
18 workload; right? 09:54:53  
19 A. Yes, that's my understanding. 09:54:58  
20 They will do some -- apply some scheduling 09:54:59  
21 algorithm, assign tasks to each PE, figure 09:55:03  
22 out what its completion time is, and then 09:55:06  
23 try to set the clock frequency and voltage 09:55:09  
24 to just meet that and not go above it any 09:55:13  
25 more than they have to. And that's done per 09:55:18



1 PE, as you said. 09:55:22

2 Q. And how does that change the way 09:55:23

3 that workload is distributed in figure 4 09:55:26

4 versus in figure 2? 09:55:28

5 MR. LI: Objection, form, 09:55:33

6 foundation. 09:55:34

7 A. I don't know. There's not much 09:55:36

8 description at all in Nicol of how the 09:55:38

9 workload is distributed. There is 09:55:40

10 discussion of once it's distributed, this is 09:55:44

11 how you would advantageously use the current 09:55:47

12 distribution. 09:55:51

13 I -- my recollection is I looked 09:55:57

14 at various parts for discussion of the 09:55:59

15 specific scheduling algorithms. I don't 09:56:01

16 think I commented on them in my declaration 09:56:03

17 because I don't think I found much of any 09:56:05

18 detail. But if there is some part in the 09:56:07

19 written description you want to point me to, 09:56:09

20 I would be happy to review that. 09:56:12

21 Q. Well, we spent a lot of time 09:56:14

22 earlier talking about how figure 2 have -- 09:56:16

23 you know, is optimized by distributing work 09:56:21

24 as evenly as possible. Is that idea that 09:56:27

25 you have to -- idea of distributing work as 09:56:31

1 evenly as possible something that also 09:56:33  
2 applies to figure 4? 09:56:35  
3 MR. LI: Objection, form. 09:56:41  
4 A. I don't recall if Nicol 09:56:42  
5 mentioned that in the context of figure 4. 09:56:45  
6 They -- that may be a stated goal that they 09:56:47  
7 have as well. It may not be. 09:56:50  
8 Q. Well, as a person of ordinary 09:56:54  
9 skill, you know, would you look at the 09:56:55  
10 figure 4 embodiment and description and 09:56:58  
11 think that you still had to distribute work 09:57:00  
12 as evenly as possible or would you think 09:57:02  
13 that that wouldn't be necessary? 09:57:04  
14 MR. LI: Objection, form. 09:57:07  
15 A. I would think that it would 09:57:11  
16 depend on the rest of the system. There are 09:57:12  
17 cases where it makes sen- -- and by cases I 09:57:14  
18 mean, for example, the type of workload and 09:57:20  
19 the particular semiconductor technology 09:57:22  
20 we're dealing with, which has changed over 09:57:24  
21 time and impacts these issues and the 09:57:26  
22 efficiency of the various power supplies. 09:57:29  
23 So there are cases where it 09:57:32  
24 would be desirable to sort of get the 09:57:35  
25 frequencies as equalized as possible and 09:57:39

1 consequently as low as possible, although 09:57:43  
2 they may be different. 09:57:45  
3 But there are certainly 09:57:46  
4 situations where it's more desirable to, for 09:57:48  
5 example, maybe utilize one PE until you've 09:57:52  
6 consumed all of its processing capability 09:57:55  
7 and then start to schedule to a second one. 09:57:57  
8 There's no universal best approach 09:58:01  
9 independent of a lot of other system 09:58:06  
10 factors. 09:58:08  
11 Q. And so what are -- let's just 09:58:08  
12 kind of explore that. What are the factors 09:58:10  
13 that would cause a person of ordinary skill 09:58:14  
14 in the art to think that you wouldn't want 09:58:15  
15 to distribute tasks evenly on figure 4? 09:58:19  
16 What sort of things would affect that? 09:58:21  
17 A. Well, I can give some examples. 09:58:26  
18 This will not be a complete list. 09:58:28  
19 But, for example, there is an 09:58:32  
20 odd, odd to me, phenomenon in semiconductors 09:58:33  
21 that has only emerged, I believe, over the 09:58:44  
22 last decade or so which says when you -- 09:58:47  
23 there are situations where you can reduce 09:58:51  
24 the voltage and increase the available clock 09:58:53  
25 frequency. And that's dependent on 09:58:58

1 temperature relationships and the specific 09:59:01  
2 semiconductor processes. 09:59:04  
3 I don't think that those -- the 09:59:06  
4 issue I'm thinking of was present back at 09:59:07  
5 the time of invention. 09:59:10  
6 Also it could be the case -- and 09:59:13  
7 the power supplies and the DC-to-DC 09:59:16  
8 converter here that we've got will have a 09:59:18  
9 rated efficiency. So your efficiency might 09:59:21  
10 be 70 percent, which means if 100 units of 09:59:25  
11 power come into the chip for the -- for 09:59:31  
12 PE 1, the DC-to-DC converter will waste 30 09:59:34  
13 units of that power. 09:59:38  
14 Now, that efficiency will vary 09:59:39  
15 over the voltage range. It may be flat for 09:59:42  
16 a very large range. It may increase 09:59:45  
17 dramatically as you get to a high-level 09:59:49  
18 voltage and increase dramatically as you get 09:59:53  
19 to a low-level voltage. 09:59:55  
20 So there will be cases where -- 09:59:56  
21 this is why I was suggesting it. There will 09:59:59  
22 be systems that are built that will achieve 10:00:03  
23 better power consumption utilization 10:00:07  
24 efficiency by attempting to fully utilize 10:00:11  
25 one PE before activating a second one. 10:00:16

1                   And that's not an uncommon                   10:00:19  
2           approach at all. And obviously it makes the           10:00:21  
3           scheduling problem trivial.                           10:00:23  
4           Q.       Right. Right.                               10:00:25  
5                   And is that -- and the systems               10:00:31  
6           that you're describing there utilize --               10:00:52  
7           fully utilize one PE before activating a               10:00:56  
8           second one. That system isn't described               10:00:59  
9           anywhere in Nicol, is it?                             10:01:03  
10           A.       I don't recall Nicol going into               10:01:12  
11           any great useful detail on how to schedule           10:01:14  
12           for figure 4. So that sort of system is               10:01:17  
13           certainly enabled by figure 4 as much as any           10:01:19  
14           other scheduling algorithm. Well, not any               10:01:22  
15           other but most other scheduling algorithms,           10:01:25  
16           particularly of the sort that we've                   10:01:28  
17           generally been discussing.                           10:01:31  
18           Q.       Okay.                                       10:01:31  
19                   So that's -- and -- well, I want               10:01:33  
20           to now talk about what I think is called in           10:01:38  
21           the patent the middle-ground embodiment. Do           10:01:43  
22           you know what I'm talking about?                     10:01:46  
23           A.       I believe so. Could you point               10:01:48  
24           me to the specific location?                           10:01:49  
25           Q.       Yeah, for sure.                               10:01:54

1                   So it's -- Exhibit 1, column 6,           10:01:55  
2           line 66 is -- is where it starts some of           10:01:59  
3           that discussion. It goes on to column 7.           10:02:05  
4           A.       Yes, I see that.                   10:02:11  
5           Q.       Okay.                           10:02:18  
6                   And so what is the middle-ground       10:02:21  
7           embodiment described in Nicol?               10:02:23  
8           A.       Well, the middle ground is the       10:02:29  
9           PEs of a multiprocessor chip are divided       10:02:31  
10          into groups, and each group of PEs are       10:02:35  
11          arranged to operate from their own           10:02:40  
12          controlled supply voltage.                   10:02:43  
13          Q.       So it's sort of a -- well, why       10:02:47  
14          is it called "middle ground"? What's your       10:02:50  
15          understanding of why that word was used       10:02:53  
16          here?                                       10:02:55  
17                   MR. LI: Object to form.               10:02:57  
18          A.       I couldn't -- obviously don't       10:02:58  
19          know what the inventors were thinking or the   10:03:01  
20          drafter. However, it has some elements of       10:03:03  
21          figure 2's system and some elements of       10:03:09  
22          figure 4's system, and how close it is or       10:03:12  
23          how different it is is very difficult to say   10:03:17  
24          because it is so underspecified.               10:03:20  
25          Q.       And so when you say it has some       10:03:25

1 aspects of figure 2, you know, at least one 10:03:27  
2 of the aspects that's disclosed is that some 10:03:29  
3 of the PEs will be sharing a clock and 10:03:32  
4 voltage supply; right? 10:03:36  
5 MR. LI: Objection, form. 10:03:39  
6 A. Yes. It says: 10:03:41  
7 "...each group of PEs can be 10:03:42  
8 arranged to operate from its own controlled 10:03:43  
9 supply voltage." 10:03:46  
10 Q. And then one of the ideas that 10:03:49  
11 it -- or one of the concepts that overlaps 10:03:50  
12 with figure 4 is that now you have multiple 10:03:53  
13 groups that can have their own voltage 10:03:57  
14 control like figure 4 does with individual 10:04:01  
15 PEs; right? 10:04:04  
16 MR. LI: Objection, form. 10:04:06  
17 A. No, I wouldn't necessarily say 10:04:09  
18 that. There is -- there is a lot that's not 10:04:12  
19 well specified here. 10:04:17  
20 Q. What is the overlap -- or what 10:04:23  
21 are the elements of the figure 4 system that 10:04:27  
22 you see in the middle-ground embodiment? 10:04:29  
23 A. Well, there is constitution of 10:04:37  
24 PEs that can be arranged to operate from its 10:04:39  
25 own controlled supply voltage. It's saying 10:04:42

1     that they're grouped in some way such that     10:04:44  
2     they operate together in some way that is     10:04:49  
3     not -- where that operation characteristics     10:04:56  
4     are not shared presumably with other PEs     10:04:59  
5     that are not in the same group.     10:05:02  
6             Q.     Okay.     Got it.     10:05:15  
7                     And so, you know, we've spent     10:05:17  
8     some time talking about how work would be     10:05:21  
9     distributed.     I understand your position     10:05:24  
10     that there is no specific scheduler or     10:05:26  
11     algorithm described in Nicol.     10:05:31  
12                     To a person of ordinary skill in     10:05:36  
13     the art, how would work be distributed in     10:05:38  
14     the middle-ground embodiment that's     10:05:41  
15     described?     10:05:45  
16                     MR. LI:     Objection, form,     10:05:46  
17     foundation.     10:05:47  
18             A.     The system is too underspecified     10:05:52  
19     for me to answer that.     For example, it's     10:05:56  
20     not clear within groups if the operating     10:05:58  
21     frequency of the different PEs can vary or     10:06:04  
22     not.     10:06:06  
23                     Also, you know, in Nicol some of     10:06:08  
24     the tasks have completion deadlines, have     10:06:13  
25     realtime characteristics, and some don't.     10:06:18

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1 And there is no discussion of how to combine 10:06:21  
2 those two different kinds of tasks in the 10:06:24  
3 scheduler, and there's a wide range of 10:06:26  
4 options. There are many things that could 10:06:28  
5 be done. 10:06:30  
6 Q. Got it. Okay. 10:06:39  
7 So let's make some assumptions 10:06:43  
8 about the type of -- type of tasks and the 10:06:45  
9 way that the PEs are working. Let's 10:06:53  
10 assume -- just based on the two things that 10:06:55  
11 you just raised. 10:06:57  
12 So let's assume that the clock 10:06:58  
13 frequency is set in groups but can't then be 10:07:03  
14 individually changed at a PE level. So its 10:07:12  
15 frequency is set on a group level. Does 10:07:17  
16 that make sense? 10:07:20  
17 A. Sure. So the -- 10:07:22  
18 MR. LI: Objection. 10:07:23  
19 A. -- the groups share a power 10:07:25  
20 supply and a common DC-to-DC converter and a 10:07:27  
21 common PLL. 10:07:33  
22 Q. Right. 10:07:37  
23 A. Okay. Okay. So we'll add those 10:07:37  
24 characteristics to the description of their 10:07:39  
25 middle ground. I'm with you. 10:07:40

1 Q. And that's like how figure 2 10:07:42  
2 works; right? 10:07:44  
3 MR. LI: Objection, form, 10:07:46  
4 foundation. 10:07:46  
5 A. It's got a lot of similarities 10:07:50  
6 to figure 2, yes. 10:07:51  
7 Q. And then -- and so if we make 10:07:57  
8 that assumption, does that -- does that help 10:07:59  
9 a person of ordinary skill decide how best 10:08:04  
10 to distribute other work in the 10:08:08  
11 middle-ground embodiment? 10:08:11  
12 MR. LI: Objection, form. 10:08:13  
13 A. It certainly reduces the number 10:08:19  
14 of unknowns. So I guess I would say it 10:08:21  
15 helps them. But there are still many 10:08:24  
16 unresolved issues. It's not -- it's not -- 10:08:29  
17 there is no clear path for what's the best 10:08:32  
18 or preferential way to distribute tasks. 10:08:35  
19 Q. What if we take into account -- 10:08:40  
20 withdrawn. 10:08:41  
21 What if a person of ordinary 10:08:42  
22 skill takes into account Nicol's goal of 10:08:43  
23 minimizing overall power consumption? How 10:08:46  
24 would a person of ordinary skill then 10:08:52  
25 approach distributing work among the 10:08:54

1 middle-ground embodiment? 10:08:57

2 MR. LI: Objection, form, 10:08:59

3 foundation. 10:08:59

4 A. Well, Nicol discusses, for 10:09:05

5 example, taking tasks and breaking them up 10:09:07

6 into different parts and taking one task and 10:09:09

7 breaking it up into two. Preferentially 10:09:12

8 breaking them in half but acknowledges that 10:09:16

9 that may not be possible. 10:09:18

10 Are you suggesting that these 10:09:20

11 breaks can be done evenly in your 10:09:23

12 hypothetical? 10:09:26

13 Q. Sure. We can -- we can make 10:09:32

14 that assumption. 10:09:34

15 A. Okay. 10:09:35

16 Should I assume that there is 10:09:37

17 communications between the two parts and 10:09:41

18 thus a timing dependence, or are they fully 10:09:43

19 independent? 10:09:47

20 Q. Are -- both of those 10:09:50

21 circumstances are possible at the time of 10:09:52

22 Nicol's patent; right? 10:09:57

23 A. Yes, I agree, yeah. 10:10:00

24 Q. So why don't we take whichever 10:10:01

25 one you think will make the analysis 10:10:02

1 simpler? 10:10:05

2 A. Should I assume that there is a 10:10:05

3 cost for communications among PEs or that 10:10:12

4 it's free? 10:10:17

5 For example, it's not clear to 10:10:18

6 me in figure 2 that when -- actually, I 10:10:20

7 think all of the discussion in figure 2 10:10:26

8 anticipates that with regards to scheduling 10:10:28

9 that there is no communications between the 10:10:32

10 tasks on PEs. 10:10:37

11 However, if you have one task 10:10:39

12 and you break it up, there is almost always 10:10:41

13 a dependence between them, so there will 10:10:44

14 almost always be some communication. I 10:10:46

15 guess the point I'm getting at is there's 10:10:49

16 still far too many under -- it's an 10:10:52

17 under-specified problem. 10:10:56

18 Q. I gotcha. Okay. So let me just 10:10:57

19 try to understand that last problem. 10:10:59

20 You're saying that in the 10:11:01

21 instances that Nicol described, so you have 10:11:02

22 to take one task and try to break it up into 10:11:05

23 multiple subtasks to divide across multiple 10:11:08

24 PEs, there's almost always going to have to 10:11:11

25 be communication between those individual 10:11:13

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1 PEs about what they're working on; right? 10:11:15

2 MR. LI: Objection, form. 10:11:18

3 A. Yeah. Only because in general 10:11:20

4 if the two subtasks are completely separate 10:11:25

5 they probably would have been their own 10:11:28

6 separate tasks to begin with. That's my 10:11:30

7 reasoning there. 10:11:33

8 I don't recall -- yeah, so I'll 10:11:35

9 stay with that. 10:11:37

10 Q. What's an example of that kind 10:11:53

11 of -- yeah. What's an example of that kind 10:11:55

12 of task where you're going to have to have 10:11:59

13 communication from one of the PEs to the 10:12:01

14 other about that sort of -- about their 10:12:03

15 individual parts of that task? 10:12:06

16 MR. LI: Objection, form, 10:12:09

17 foundation. 10:12:10

18 A. Sure. So any sort of two-step 10:12:13

19 mathematical expression where you evaluate 10:12:19

20 one function and take its output and then 10:12:21

21 feed it as an input to the second function. 10:12:24

22 Those functions could be very short if 10:12:27

23 they're just simple expressions. You know, 10:12:31

24 X plus Y. But if they're matrix operations 10:12:35

25 they could be quite complex and require a 10:12:38

1 long period of computation. In which case 10:12:41  
2 it may be beneficial to run one part on one 10:12:43  
3 PE and then pass the results through the 10:12:49  
4 controller and then back to the second PE 10:12:51  
5 and run the second part. 10:12:54

6 At the end of the day, it's 10:12:57  
7 not -- when Nicol talks about these 10:13:02  
8 operations, my recollection is he's almost 10:13:07  
9 always saying, for example, if you have one 10:13:10  
10 task that needs to run at 100 megahertz and 10:13:14  
11 you can break it up into two parts, maybe 10:13:17  
12 one that runs at 60 and one that runs at 40, 10:13:20  
13 then you put those an two separate PEs and 10:13:23  
14 you can run it at 60. 10:13:26

15 It's clear in that situation 10:13:29  
16 they -- they can't communicate. So that 10:13:31  
17 would have to be an example that I referred 10:13:34  
18 to where somebody put two tasks together 10:13:38  
19 that really didn't need to be put together 10:13:40  
20 at all. 10:13:43

21 THE WITNESS: And can I ask 10:13:49  
22 whenever you get to a convenient 10:13:51  
23 break -- I'm in no particular hurry, 10:13:53  
24 but we've gone for about an hour. 10:13:55

25 MR. BROWN: Yeah, now is a 10:13:57

1	perfectly fine time to take a break.	10:13:58
2	Do you want to come back in ten	10:14:00
3	minutes? Is that enough or, do you	10:14:02
4	need more time?	10:14:03
5	THE WITNESS: Perfect.	10:14:04
6	MR. BROWN: All right great.	10:14:05
7	THE VIDEOGRAPHER: Off the	10:14:06
8	record. The time is 10:14.	10:14:07
9	[Recess at 10:14 a.m. Pacific	10:14:09
10	Time.]	10:14:44
11	[Resuming at 10:29 a.m. Pacific	10:14:45
12	Time.]	10:14:48
13	THE VIDEOGRAPHER: And here we	10:29:02
14	go.	10:29:03
15	We're back on the record at	10:29:03
16	10:29.	10:29:07
17	Go ahead.	10:29:07
18	MR. BROWN: Thank you.	10:29:09
19	EXAMINATION CONTINUING	10:29:10
20	BY MR. BROWN:	10:29:10
21	Q. Welcome back, Doctor.	10:29:10
22	A. Thank you.	10:29:12
23	Q. Did you -- did you speak with	10:29:13
24	Mr. Li during the break?	10:29:15
25	A. I spoke with no one, not even my	10:29:17

1	wife.	10:29:19
2	Q. Okay.	10:29:20
3	You are allowed to do that	10:29:22
4	unless she happens to have patent expertise.	10:29:23
5	A. Okay.	10:29:26
6	I -- I did tweet but not related	10:29:29
7	to the case.	10:29:32
8	Q. You tweeted in the last ten	10:29:35
9	minutes?	10:29:36
10	A. Yeah. There's a new Nicolas	10:29:38
11	Cage movie coming out that actually looks	10:29:40
12	really interesting, and a friend commented	10:29:42
13	on it.	10:29:45
14	Q. Okay. I'm sure one of our	10:29:45
15	talented associates on the call is pulling	10:29:51
16	up that tweet.	10:29:52
17	All right. So we were talking	10:29:55
18	about the middle-ground approach in Nicol,	10:29:59
19	and we were discussing how a person of	10:30:03
20	ordinary skill in the art would know to	10:30:05
21	distribute tasks in that embodiment. And,	10:30:07
22	you know, I was thinking I might be able to	10:30:14
23	try make this a little simpler and lay out	10:30:16
24	some -- some parameters so we can have the	10:30:19
25	discussion.	10:30:21

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1                   So what if we assume that                   10:30:22  
2       there's a middle-ground embodiment of Nicol       10:30:26  
3       that has four PEs? And its two groups of       10:30:28  
4       two. So two of the PEs are grouped together       10:30:32  
5       with one common voltage supply and clock and       10:30:35  
6       then the other two are also grouped       10:30:38  
7       together. Does that make sense?       10:30:40  
8           A.       It does.       10:30:42  
9                   MR. LI: Objection, form,       10:30:43  
10          foundation.       10:30:45  
11       BY MR. BROWN:       10:30:45  
12           Q.       And that's kind of a hybrid       10:30:46  
13       between figure 2 and figure 4; right?       10:30:48  
14           A.       In some sense, yeah. But I       10:30:52  
15       think maybe a closer hybrid would be if you       10:30:55  
16       threw in one PE that operated totally on its       10:30:57  
17       own, but I'm with you. It certainly is       10:31:00  
18       within the realm of middle-ground systems, I       10:31:02  
19       think, that's covered by that one sentence.       10:31:07  
20           Q.       Okay.       10:31:09  
21                   So then let's -- let's talk       10:31:12  
22       about how we distribute work in that       10:31:15  
23       circumstance, how a person of ordinary skill       10:31:17  
24       at the time would distribute work.       10:31:19  
25                   And let's make the work simple.       10:31:21

1 Let's assume that we have only four tasks to 10:31:23  
2 complete and none of them are dependent on 10:31:27  
3 each other. So we don't have to worry about 10:31:30  
4 that communication point we talked about. 10:31:32  
5 And two of them are very heavy loaded, very 10:31:34  
6 significant, a lot of work. Two of them are 10:31:39  
7 very light loads. 10:31:42  
8 Does that terminology work for 10:31:44  
9 you? 10:31:46  
10 A. Yes, I understand. 10:31:47  
11 Q. And that's certainly a type of 10:31:50  
12 scenario that could come up at the time of 10:31:52  
13 the invention; right? 10:31:53  
14 A. Yes. 10:31:53  
15 Q. So in that circumstance how 10:31:58  
16 would a person of ordinary skill, having 10:32:00  
17 read Nicol and being cognizant of at least 10:32:01  
18 its intention, think would be the best way 10:32:05  
19 to distribute the work of those four tasks 10:32:10  
20 among our two groups of two PEs? 10:32:13  
21 MR. LI: Objection, form, 10:32:16  
22 foundation. 10:32:17  
23 A. To be honest with you, I -- I 10:32:20  
24 don't know. I can't put myself back in the 10:32:22  
25 time of the invention with the information 10:32:25



1                   In most cases -- I think you                   10:33:51  
2       said there is two groups of four and there's       10:33:53  
3       four tasks and the four tasks are                   10:33:56  
4       independent -- I would say it -- you're           10:33:59  
5       going to have one of the groups at least           10:34:03  
6       operating. Probably you would assign one       10:34:06  
7       task to each one of the PEs. That's a           10:34:08  
8       pretty common paradigm example you put in       10:34:14  
9       front of me, but there's not much of a           10:34:17  
10      scheduling problem to face in that sort of a   10:34:19  
11      situation.   10:34:22

12           Q.       Okay. So we will come back to       10:34:26  
13      some of those points, but let me follow up       10:34:32  
14      first on your last sort of -- last couple       10:34:34  
15      sentences there.                                   10:34:37

16                   So you are agreeing that a           10:34:38  
17      person of ordinary skill would probably look   10:34:42  
18      at the situation of two groups of two and       10:34:46  
19      say, "I'm going to assign one task, one of       10:34:48  
20      my four tasks, to each of those PEs."           10:34:52  
21      Right?   10:34:54

22                   MR. LI: Objection, form.           10:34:57

23           A.       Given four tasks and two groups   10:35:00  
24      of four PEs, it's not clear to me why there   10:35:02  
25      would be any benefit to using both groups or   10:35:07

1     doing -- or assigning two tasks to any PE.           10:35:13  
2     You would probably pick one group and assign       10:35:17  
3     one task to each one of the four PEs and be       10:35:20  
4     done with it.                                       10:35:23  
5             Q.       I see.                               10:35:23  
6                     So --                                 10:35:26  
7             A.       Go ahead.                           10:35:26  
8             Q.       I'm sorry, go ahead.               10:35:27  
9             A.       I was just going to say, I mean,   10:35:28  
10     as I suggested before, there may be a             10:35:30  
11     benefit to using multiple groups. There may       10:35:32  
12     be a cost hit as soon as you turn one on. I       10:35:36  
13     just don't know.                                   10:35:39  
14             Q.       Yeah. Okay.                        10:35:41  
15                     So, you know, I heard you say       10:35:42  
16     earlier and now you said it again, so I           10:35:44  
17     realize that you didn't just misspeak. My         10:35:46  
18     hypothetical was two groups of two PEs each.       10:35:48  
19             A.       Oh, sorry about that.               10:35:52  
20             Q.       No, no, no. No problem. So         10:35:53  
21     let's -- which I think might clear up one of       10:35:55  
22     your points here.                                   10:35:58  
23                     So if you have two groups of two    10:35:59  
24     PEs, and we'll make them homogeneous; right?       10:36:01  
25     We'll make them just all the same PE.             10:36:01



1 But they -- they certainly might decide to 10:37:03  
2 assign one task to each one of the four PEs 10:37:06  
3 in two different groups. 10:37:09  
4 Q. And so now the question I have 10:37:12  
5 is how are they going to decide which of the 10:37:14  
6 PEs to assign the specific task to? And so 10:37:17  
7 if we have -- 10:37:22  
8 MR. LI: Objection. 10:37:23  
9 Sorry, go ahead. 10:37:27  
10 BY MR. BROWN: 10:37:28  
11 Q. He already doesn't like where 10:37:29  
12 I'm going with the question. 10:37:31  
13 So if -- if we've got two PEs, 10:37:33  
14 two groups of two PEs, and we've got two 10:37:36  
15 very hard tasks and two very easy tasks, is 10:37:39  
16 a person of ordinary skill in the art going 10:37:44  
17 to -- well, is one possibility that a person 10:37:46  
18 of ordinary skill in the art is going to 10:37:50  
19 say, "I should give the hard tasks to the 10:37:52  
20 two PEs in one group and the easy tasks to 10:37:56  
21 the two PEs in the other group so that I can 10:37:59  
22 clock the groups according to the difficulty 10:38:03  
23 of the task"? 10:38:06  
24 A. I think depending on -- 10:38:08  
25 MR. LI: Objection, form, 10:38:10

1 foundation. 10:38:11

2 A. -- other factors that are 10:38:12

3 underspecified one could certainly reach 10:38:15

4 that conclusion. 10:38:17

5 As I was trying to suggest 10:38:18

6 before, I can also easily imagine where a 10:38:19

7 more power-efficient solution would be to 10:38:24

8 assign a heavy task and a small task to, you 10:38:26

9 know, the two PEs in one group and just turn 10:38:30

10 the power off or greatly reduce it in the 10:38:33

11 other one. 10:38:36

12 Q. Right, right. 10:38:37

13 A. But it certainly could be the 10:38:38

14 case that you would divide the two heavy 10:38:39

15 ones and the two light ones into two 10:38:41

16 different groups. 10:38:44

17 Q. Yeah, it -- a lot of these 10:38:45

18 things depend on, you know, the specific 10:38:47

19 task, the specific time requirements, the 10:38:50

20 specific efficiency of the system; right? 10:38:53

21 A. Right. And those task 10:38:56

22 assignments that you suggested, they may be 10:38:58

23 the right choice. Right in terms of 10:39:01

24 achieving the goal of reducing power as much 10:39:05

25 as possible. 10:39:07



1           Even if they're not the right           10:39:09  
2     choice, they may be -- that may be a           10:39:11  
3     reasonable scheduling algorithm given the           10:39:16  
4     overall goals of the system. I mean, at the           10:39:18  
5     end of the day obviously you want to           10:39:20  
6     schedule tasks as quickly as possible, and           10:39:21  
7     that is also a consideration. You don't           10:39:23  
8     want the algorithm to be too complicated           10:39:25  
9     such that you shoot yourself in the foot.           10:39:29  
10           Q.     Got it. Got it. Okay.           10:39:32  
11                   And then, you know -- that all           10:39:34  
12     makes sense. And the reason that at least           10:39:37  
13     one -- one justification for why a person of           10:39:41  
14     ordinary skill might choose to assign the           10:39:44  
15     heavy task to one group and the light task           10:39:47  
16     to another would be to -- to sort of follow           10:39:49  
17     that same tent pole problem that we were           10:39:54  
18     talking about in figure 2 that we want to --           10:39:57  
19     we don't want to have a tent pole that's           10:39:59  
20     higher than it needs to be for each of those           10:40:02  
21     groups; right?           10:40:04  
22                   MR. LI: Objection, form.           10:40:07  
23           A.     Right. You would be attempting           10:40:12  
24     to reduce the size of the bin between -- for           10:40:14  
25     each group. Or the -- or the height of the           10:40:19

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1 tent pole. Bring the ceiling down as close 10:40:21  
2 as possible. 10:40:24  
3 Q. Okay. I got it. We are start 10:40:31  
4 starting to really mix metaphors now, but I 10:40:34  
5 think -- 10:40:36  
6 A. I know. I'm sorry about that. 10:40:36  
7 Q. No, I think -- I think we're -- 10:40:38  
8 I think it's -- I think that makes sense. 10:40:41  
9 So basically, you know, at the 10:40:43  
10 end of the day a person of ordinary skill in 10:40:46  
11 the art looking at this middle-ground 10:40:48  
12 embodiment in the two groups of two PEs that 10:40:51  
13 we've discussed would understand that, you 10:40:53  
14 know, he would be reasonably capable of 10:40:59  
15 assigning the tasks in the way that we've 10:41:01  
16 been discussing. That's fair? 10:41:03  
17 MR. LI: Objection, form, 10:41:06  
18 foundation. 10:41:07  
19 A. You could certainly end up with 10:41:09  
20 tasks assigned in that way using a wide 10:41:11  
21 range of algorithms or optimization calls. 10:41:14  
22 Q. And those are -- those are, 10:41:18  
23 like, scheduling algorithms that you're 10:41:20  
24 talking about? 10:41:22  
25 A. Yes. 10:41:22

1           Q.     And a lot of those -- and           10:41:24  
2     those -- you know, many of those were known   10:41:26  
3     at the time of Nicol's invention already;       10:41:28  
4     right?   10:41:31

5           A.     Yeah. As I -- as I think we       10:41:32  
6     discussed earlier, there's -- at the time of   10:41:34  
7     invention there were -- the task-scheduling   10:41:38  
8     problem was well known. There were hundreds   10:41:42  
9     of solutions and different implementations     10:41:46  
10    to achieve different specific goals.           10:41:50

11          Q.     And that scheduler is typically   10:41:57  
12    part of the operating system on a computer      10:42:00  
13    system; right?                                   10:42:03

14                 MR. LI: Objection, form.           10:42:08

15          A.     Yes, that's typically part of     10:42:09  
16    the operating system.                           10:42:10

17          Q.     And that's all in software;       10:42:12  
18    right?   10:42:14

19          A.     That's --                           10:42:18

20                 MR. LI: Objection, form.           10:42:19

21          A.     -- almost -- well, it's usually   10:42:21  
22    in software. It's almost always in            10:42:22  
23    software. In this case I read Nicol to          10:42:27  
24    really be focused on DSP applications,         10:42:29  
25    digital signal processing. Lots of realtime    10:42:34

1 tasks. 10:42:38

2 Even in that context I would say 10:42:41

3 software schedulers are the most common 10:42:43

4 approach. But it's more common to have 10:42:46

5 hardware task schedulers in that domain than 10:42:51

6 any other computing domain that occurs to me 10:42:54

7 as I sit here. 10:42:58

8 Q. And Nicol discloses -- Nicol 10:43:00

9 discloses that it has a realtime operating 10:43:04

10 system operating on one of the PEs; right? 10:43:05

11 I can -- 10:43:05

12 MR. LI: Objection, form. 10:43:10

13 A. Yeah. I think that's probably 10:43:12

14 in column 3 you're thinking of. It says: 10:43:14

15 "...the applications that need 10:43:17

16 to be processed are mapped to the N PEs 10:43:18

17 under the control real time operating 10:43:23

18 systems executed on PE 100." 10:43:25

19 Yes. 10:43:27

20 Q. And so this -- at least in that 10:43:29

21 embodiment Nicol is suggesting using a 10:43:31

22 software realtime operating system with a 10:43:34

23 software scheduler? 10:43:36

24 MR. LI: Objection, form. 10:43:39

25 A. Yeah, absolutely. I was just 10:43:40

1 pointing out that hardware schedulers are 10:43:42  
2 almost impossible to build and almost never 10:43:45  
3 used in most computing systems. This is the 10:43:47  
4 one domain that possibly lends itself to it. 10:43:50  
5 But I wasn't suggesting that Nicol discloses 10:43:53  
6 that. 10:43:57  
7 Q. Okay. Got it. 10:43:57  
8 Got it. Okay. 10:43:59  
9 So let me switch gears and talk 10:44:02  
10 about claim -- I want to talk about that 10:44:08  
11 claim language. 10:44:16  
12 Let me mark the '301 patent so 10:44:17  
13 you have it in front of you. 10:44:19  
14 [Deposition Exhibit 2 marked for 10:44:19  
15 identification.] 10:44:31  
16 A. Do we know if -- with the first 10:44:31  
17 exhibit I did a refresh and it took a while 10:44:34  
18 for the stuff. Should the exhibit just pop 10:44:37  
19 up, do we think, once -- once it's loaded? 10:44:41  
20 Q. My anticipation of what I've 10:44:45  
21 seen is that there's a refresh timer, but it 10:44:48  
22 might not be as fast as you want. 10:44:51  
23 A. Fair enough. I might as well 10:44:53  
24 just hit "refresh." 10:44:55  
25 Q. Yeah. 10:44:56

1	[Pause.]	10:45:03
2	Q. Okay. It looks like it's up	10:45:03
3	now.	10:45:05
4	A. All right. It's there. Let me	10:45:13
5	download it and we'll get going.	10:45:14
6	[Pause.]	10:45:27
7	A. All right.	10:45:28
8	Q. Okay.	10:45:28
9	Exhibit 2 is US Patent	10:45:29
10	8,312,301.	10:45:32
11	You've obviously read the '301	10:45:35
12	patent before; right?	10:45:38
13	A. Yes, sir.	10:45:39
14	Q. Okay.	10:45:40
15	Let me take you to claim 3.	10:45:41
16	This is on column 15, if that's helpful.	10:45:44
17	A. All right. I'm there.	10:45:56
18	Q. And I want to take you right in	10:46:00
19	the preamble there. It says [as read]:	10:46:01
20	"There's a method for operating	10:46:06
21	a system having a plurality of data	10:46:07
22	processing elements adapted for programmably	10:46:10
23	processing sequences...."	10:46:14
24	Do you see that?	10:46:15
25	A. I do.	10:46:17

1 Q. What does -- what does 10:46:19  
2 "programmably processing sequences" mean? 10:46:22  
3 MR. LI: Objection, form. 10:46:26  
4 A. I don't recall if there was an 10:46:28  
5 offer for claim construction on this. I 10:46:29  
6 could go back and check or you could remind 10:46:32  
7 me if that's not inappropriate. 10:46:36  
8 Q. So I don't think that you 10:46:44  
9 offered a specific construction for this but 10:46:49  
10 you did opine on it. So I'm trying to 10:46:52  
11 understand what -- I'm assuming that means 10:46:54  
12 you were using the plain and ordinary 10:46:56  
13 meaning of it. And so my question is really 10:46:58  
14 what's -- what is the plain and ordinary 10:47:00  
15 meaning of that term? 10:47:02  
16 A. Fair enough. 10:47:03  
17 MR. LI: Objection, form. 10:47:04  
18 A. Could you bring up my 10:47:06  
19 declaration as an exhibit, please? 10:47:08  
20 Q. No problem. It will be -- let's 10:47:10  
21 make that Exhibit 3. 10:47:11  
22 [Deposition Exhibit 3 marked for 10:47:16  
23 identification.] 10:47:19  
24 MR. BROWN: It will take a 10:47:21  
25 minute. It's a little bit larger. 10:47:23





1                   And then you have "claim 3(a)"                   10:49:09  
2           in parentheses.                   10:49:11  
3                   Do you see that?                   10:49:12  
4           A.       Yes, I do.                   10:49:13  
5           Q.       Yeah.                   10:49:16  
6                   So my first question is what is                   10:49:17  
7           your understanding or what -- what plain and                   10:49:19  
8           ordinary meaning understanding of                   10:49:21  
9           programmably processing sequences did you                   10:49:23  
10          apply to offer that opinion?                   10:49:26  
11          A.       The one that I believe a POSITA                   10:49:27  
12          at the time of invention would apply given                   10:49:31  
13          the full context of the intrinsic record.                   10:49:33  
14          Well, at least the patent itself.                   10:49:38  
15          Q.       And what is that understanding?                   10:49:40  
16          A.       I don't know that I have one off                   10:49:46  
17          the top of my head. It's the understanding                   10:49:47  
18          of a person of ordinary skill in the art.                   10:49:51  
19                   My recollection is the bulk of                   10:49:54  
20          this section is actually directed at                   10:49:56  
21          responding to the arguments that were made,                   10:50:00  
22          and I don't think it actually required me to                   10:50:04  
23          come up with a construction of programmably                   10:50:06  
24          processing sequences.                   10:50:09  
25                   But the passage goes on for                   10:50:11

1 several pages so I'm sort of flipping 10:50:14

2 through them to try to recall. 10:50:16

3	Q.	Sure.	10:50:17
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4	And I don't want to stop your	10:50:20
5	analysis. So if you want to -- if you feel	10:50:21
6	you need to read more, you know, feel free	10:50:23
7	to do so. But I can ask some specific	10:50:26
8	questions to maybe see if we can hone in on	10:50:29
9	it?	10:50:32

10	A. Yes.	10:50:32
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11	Q. When it talks about programmably	10:50:33
12	processing sequences, what are the	10:50:37
13	sequences?	10:50:38

14 A. So give me a moment of course. 10:50:42

15	[Pause.]	10:51:04
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16	A. So the programmably processing	10:51:05
17	sequences are what the processing elements	10:51:08
18	are adapted to.	10:51:13

19	O. Right.	10:51:18
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20	Let me ask it a little	10:51:19
21	differently and if you want -- well, let me	10:51:20
22	just ask it differently.	10:51:22

23	Do the sequences refer to	10:51:23
24	sequences of instruction?	10:51:25

25	MR. LI: Objection, form.	10:51:26
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1           A.     They could. I don't recall it           10:51:32  
2     actually being directed towards sequences of    10:51:33  
3     instructions. But the term "sequences"           10:51:36  
4     certainly could.                                 10:51:42

5           Q.     Okay.                             10:51:42

6                     Did you review the '301           10:51:52  
7     specification in sort of coming to an           10:51:54  
8     understanding of what programmably            10:51:56  
9     processing sequences meant?                    10:51:59

10          A.     I don't recall. I can look at       10:52:02  
11     the rest of my -- you've offered me the       10:52:05  
12     opportunity to review the -- the directed      10:52:07  
13     passage. I don't know. It's three or four      10:52:11  
14     pages. I don't recall commenting on what      10:52:13  
15     programmably processing sequences means.       10:52:16

16                     I wasn't asked to consider the   10:52:22  
17     metes and bounds or application of the        10:52:25  
18     claim. My task was to review the analysis      10:52:28  
19     offered up regarding its invalidity in the      10:52:32  
20     context of specific prior art and respond --   10:52:34  
21     respond to those arguments.                    10:52:39

22                     So, yes, I've got an           10:52:42  
23     understanding of a person of ordinary skill    10:52:44  
24     in the art of what programmably processing    10:52:46  
25     sequences means. It could mean multiple       10:52:49

1 things. I haven't had to come up with a 10:52:53  
2 more precise understanding or construction 10:52:56  
3 for the tasks I was asked to complete. 10:53:02  
4 Q. Got it. Okay. 10:53:05  
5 So why don't we talk about 10:53:06  
6 those, you know -- what it could mean to a 10:53:09  
7 person of ordinary skill? And I think 10:53:13  
8 you're saying one of the things it could 10:53:16  
9 mean is that it refers to programmably 10:53:18  
10 processing sequences of instructions. 10:53:22  
11 Right? 10:53:24  
12 MR. LI: Objection, form, 10:53:25  
13 foundation. 10:53:26  
14 A. Depending on the rest of the 10:53:31  
15 written description, it certainly is 10:53:32  
16 possible that that's what it means. 10:53:34  
17 Q. All right. 10:53:36  
18 But you've read the rest of the 10:53:37  
19 description; right? 10:53:39  
20 A. I have. But as I said, I wasn't 10:53:40  
21 looking for understanding the metes and 10:53:41  
22 bounds of claim 3, let alone this specific 10:53:46  
23 element of it. 10:53:49  
24 Q. Okay. 10:53:50  
25 And you've -- you've before used 10:53:51

1 the idea of sequences to refer to sequences 10:53:54  
2 of program of instructions; right? That's a 10:53:57  
3 common use of sequences in your experience? 10:54:00  
4 A. I would say it's not uncommon, 10:54:05  
5 sure. 10:54:07  
6 Q. And if it referred to -- if 10:54:16  
7 sequences referred to instructions, what is 10:54:18  
8 programmably processing instructions, then, 10:54:21  
9 if you're programmably processing sequences 10:54:24  
10 of instructions? 10:54:26  
11 MR. LI: Objection, form. 10:54:29  
12 A. Well, a programmable processor 10:54:31  
13 typically has a instruction set, a set of 10:54:34  
14 possible instructions. And typically 10:54:37  
15 instructions are in a specific order with a 10:54:38  
16 possibility of changing order through jump 10:54:44  
17 instructions. There are exceptions to this, 10:54:47  
18 but they tend to be fairly uncommon. 10:54:49  
19 And it's not at all uncommon for 10:54:56  
20 a processor to have something called an 10:54:58  
21 instruction sequencer that will read -- that 10:55:00  
22 will pick up one instruction and manage or 10:55:04  
23 start the process of executing it and 10:55:07  
24 perhaps before that's done determine a next 10:55:09  
25 instruction to pick up. 10:55:12

1                   But programmably processing                   10:55:15  
2       sequences could also mean -- for example, we           10:55:17  
3       talked about one task that gets broken up           10:55:21  
4       into two tasks with some sort of dependence       10:55:24  
5       relationship between them.                   10:55:29  
6           Q.       Right. Right. Okay.                   10:55:29  
7                   So if -- and let me -- we'll go           10:55:33  
8       back to your second point. Let me start           10:55:38  
9       with your first point.                   10:55:40  
10                   If this phrase means                   10:55:41  
11       programmably processing sequence of           10:55:43  
12       instructions, you would agree that that           10:55:45  
13       concept, programmably processing           10:55:49  
14       instruction, is disclosed in Nicol in what       10:55:51  
15       we were just looking at in Exhibit 1; right?   10:55:55  
16           MR. LI: Objection, form.                   10:55:58  
17           A.       Well, probably at least to the           10:56:04  
18       extent that they refer to a realtime           10:56:06  
19       operating system on -- on 100 PE, and I           10:56:09  
20       think there is a notion that there are tasks   10:56:14  
21       that are assigned, so presumably the tasks       10:56:18  
22       are programmable entities, it would not be       10:56:21  
23       uncommon for them to be programmed in some       10:56:25  
24       sort of instruction set.                   10:56:30  
25                   Off the top of my head, I don't       10:56:33

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1 recall Nicol specifically saying, "Oh, yeah, 10:56:35  
2 these are typical pieces of software that 10:56:38  
3 have an instruction set that can run in 10:56:40  
4 sequence." But that concept was certainly 10:56:43  
5 well known at the time. 10:56:46

6 Q. So then -- and let me just -- 10:56:53  
7 just to unpack a little bit, Nicol -- I 10:56:54  
8 think you mentioned this. Nicol does 10:56:57  
9 disclose that it's the tasks that it assigns 10:57:00  
10 are sort of a -- each contain a number of 10:57:01  
11 instructions; right? 10:57:03

12 A. That wouldn't surprise me. I 10:57:07  
13 don't recall them saying that, but it 10:57:09  
14 wouldn't surprise me. 10:57:12

15 I wasn't looking for that 10:57:13  
16 because I don't think that that's -- I 10:57:14  
17 wouldn't think that was a novel innovation 10:57:17  
18 in Nicol. 10:57:21

19 Q. Okay. I get it. 10:57:22

20 I can direct you to it if it's 10:57:25  
21 helpful. It's in column 3. But basically I 10:57:28  
22 think you're agreeing. Nicol does -- a 10:57:32  
23 person of ordinary skill reading Nicol would 10:57:33  
24 understand that it could use Nicol to 10:57:35  
25 programmably process sequences of 10:57:39

1 instructions; right? 10:57:40

2 MR. LI: Objection, form. 10:57:42

3 A. The PEs in Nicol could be, I 10:57:43

4 believe, a standard sort of microprocessor 10:57:48

5 or a core processor that executes 10:57:52

6 instructions in sequence to complete tasks. 10:57:59

7 There's other things that it could be, but I 10:58:01

8 think a person of ordinary skill in the art 10:58:03

9 looking at Nicol would understand that it 10:58:05

10 certainly could be that. 10:58:06

11 Q. Okay. 10:58:09

12 So then let's talk about the 10:58:12

13 other thing that you were -- you went to. 10:58:13

14 You mentioned that -- I think you were 10:58:18

15 saying that the other way you could 10:58:20

16 interpret programmably processing sequences 10:58:21

17 is -- and then you referenced splitting up a 10:58:24

18 task where tasks are dependent on one 10:58:27

19 another. Can you explain what you meant by 10:58:30

20 that? 10:58:33

21 A. Sure. 10:58:33

22 MR. LI: Objection, form, 10:58:36

23 foundation. 10:58:37

24 A. So -- and, again, I'm not 10:58:38

25 offering this up with regards to what the 10:58:45



1 claim literally means but just what it could 10:58:46  
2 mean because I haven't interpreted the 10:58:48  
3 claims scope or offered an opinion with 10:58:51  
4 that. 10:58:54  
5 But a person of ordinary skill 10:58:55  
6 in the art, given the context that we've 10:58:56  
7 discussed so far today, could certainly 10:58:58  
8 understand that if I had a task that took 10:59:01  
9 100 units of computation and -- and I could 10:59:05  
10 divide it up into 50 and 50, and the first 10:59:11  
11 50 computed some value that was read by the 10:59:15  
12 second -- well, even without that. Let's 10:59:19  
13 say I had 100 units and I broke it up into 10:59:22  
14 two tasks, 50 and 50 and I still put them on 10:59:25  
15 the same PE. That would be programmably 10:59:28  
16 processing a sequence of tasks. Even if 10:59:35  
17 they were on the same one, one would 10:59:37  
18 complete and then the next. Even if -- 10:59:39  
19 presumably, even if there was no comp- -- no 10:59:43  
20 communication between them, no dependence. 10:59:49  
21 Q. Got it. Okay. Okay. 10:59:52  
22 So then let's go to the next 11:00:02  
23 example where it would be 50 and 50 but on 11:00:05  
24 two different PEs and there is -- and there 11:00:09  
25 is a dependence where, you know, maybe the 11:00:14

1 PE 2 is waiting on PE 1 to finish its 50. 11:00:16  
2 Right? 11:00:19  
3 A. Yes. 11:00:22  
4 Q. Is that also a way to think 11:00:24  
5 about programmably processing sequences and 11:00:26  
6 how -- 11:00:30  
7 MR. LI: Objection, form and 11:00:30  
8 foundation. 11:00:32  
9 A. I think that if there is a 11:00:35  
10 dependence between them, then that does 11:00:37  
11 indicate that they are sequenced to some 11:00:41  
12 degree as opposed to two totally independent 11:00:44  
13 tasks being put on two totally independent 11:00:49  
14 PEs. 11:00:52  
15 Q. Got it. Okay. 11:00:55  
16 And so what sort of 11:00:59  
17 circumstances are there in, say, like, the 11:01:00  
18 DSP space where you would need to -- or, 11:01:05  
19 well, not "need to" but you would be 11:01:10  
20 benefited by sequencing in that way among 11:01:12  
21 multiple processing elements? 11:01:16  
22 MR. LI: Objection, form. 11:01:19  
23 A. That's -- 11:01:22  
24 MR. LI: And relevance. 11:01:23  
25 A. That's too broad a question. 11:01:25

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1 DSP is -- it's just too broad a 11:01:32  
2 subject area. There are many core concepts 11:01:36  
3 that constitute DSP software that execute -- 11:01:42  
4 would execute almost always in -- in one 11:01:47  
5 task. There are many others that are 11:01:50  
6 fundamental that fundamentally have to be 11:01:54  
7 decomposed into multiple tasks and then a 11:01:58  
8 whole range of options between them. Some 11:02:01  
9 that lend themselves to multiple different 11:02:05  
10 structures, software. 11:02:08  
11 Q. Okay. 11:02:11  
12 So in the sort of DSP tasks 11:02:13  
13 where they fundamentally must be decomposed 11:02:17  
14 into multiple tasks, are there also -- in 11:02:20  
15 that set of tasks are there also DSP tasks 11:02:25  
16 that benefit from sequencing those 11:02:28  
17 decomposed tasks across multiple processing 11:02:34  
18 units perhaps to achieve some sort of 11:02:37  
19 parallelism? 11:02:40  
20 MR. LI: Objection, form, 11:02:41  
21 foundation irrelevance. 11:02:43  
22 A. In theory, yes. Like I said, 11:02:45  
23 there is a wide range of different sorts of 11:02:49  
24 algorithms and architecture and software 11:02:53  
25 that needs to execute. 11:02:55

1           It may be beneficial to take two   11:02:58  
2   sequential tasks and -- with a dependence   11:03:02  
3   between them, and run them on a single   11:03:04  
4   processor. It may be beneficial to run them   11:03:09  
5   on separate processors. Yeah, I think   11:03:11  
6   that's fair.   11:03:17  
7           Typically -- well, I guess I'll   11:03:18  
8   leave it at that. If the PEs are   11:03:20  
9   homogenous, it seems to me typically you   11:03:28  
10   would benefit from running them on a single   11:03:30  
11   processor, but I certainly couldn't say that   11:03:32  
12   as a hard and fast rule.   11:03:35  
13         Q.    Okay.   11:03:36  
14           Can you think of any specific   11:03:40  
15   DSP algorithm that you think might benefit   11:03:42  
16   from the -- this idea of taking two   11:03:45  
17   sequential tasks and distributing them   11:03:49  
18   across multiple processing elements?   11:03:50  
19           MR. LI: Objection, form,   11:03:53  
20         foundation, relevance.   11:03:57  
21         A.    Yes, I think so. But it depends   11:04:01  
22   on too many other aspects of the -- of the   11:04:03  
23   hardware architecture to be able to comment   11:04:08  
24   on.   11:04:10  
25           There is -- we -- right.   11:04:12

1     There's a different choices in terms of how     11:04:14  
2     communication is done among the PEs. And I     11:04:18  
3     apologize. I should have been tracking     11:04:22  
4     this, but maybe you were clear before,     11:04:24  
5     whether we're talking fundamentally about     11:04:27  
6     the PEs running at the same voltage and the     11:04:29  
7     same clock speed but moving them around     11:04:31  
8     together. I think we were.     11:04:34  
9             But so there's that.     11:04:37  
10            And, again, there are likely to     11:04:39  
11     be efficiency issues with the power supply.     11:04:42  
12            So I could envision that a     11:04:48  
13     designer could decide it makes sense to     11:04:51  
14     schedule them on separate PEs.     11:04:53  
15            I think in general you wouldn't     11:04:58  
16     do that, but you have to look at the     11:05:04  
17     unresolved details of the specific example.     11:05:06  
18            Q.     So somebody sitting -- somebody     11:05:08  
19     making a decision about DSP work, a person     11:05:10  
20     of ordinary skill making a decision about     11:05:14  
21     how exactly to implement scheduling of a DSP     11:05:20  
22     task that might benefit from sequencing,     11:05:24  
23     would know, at the time of Nicol's invention     11:05:28  
24     at least, that he could distribute a task     11:05:30  
25     such that it sequences across multiple of     11:05:33

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1 the processing elements. But it would -- 11:05:37  
2 whether or not he made that decision would 11:05:40  
3 depend on other circumstances about the 11:05:41  
4 algorithm and the hardware. Is that fair? 11:05:43  
5 MR. LI: Objection, form, 11:05:46  
6 foundation. 11:05:47  
7 A. Yeah. I think at the time 11:05:50  
8 certainly whether it's DSPs or a broader 11:05:52  
9 range of algorithms, the notion of 11:05:56  
10 multiprocessors was well known. And the 11:06:00  
11 problem of scheduling tasks that had 11:06:02  
12 dependence between them was well known. 11:06:07  
13 There was no optimal solution, but people 11:06:11  
14 would come up with different solutions. 11:06:12  
15 And so in general a person could 11:06:14  
16 have decided, "I should put one task on the 11:06:18  
17 first PE and one on the second one." 11:06:20  
18 Q. And just to -- to finish that, 11:06:28  
19 you're saying in general a person could have 11:06:30  
20 decided to put one task on one PE and a 11:06:32  
21 second on a second PE where those two tasks 11:06:35  
22 had -- well, one of those tasks had a 11:06:39  
23 dependence on the output of the other task; 11:06:41  
24 right? 11:06:43  
25 MR. LI: Objection, form, 11:06:45

1 foundation. 11:06:45

2 A. Yes, that's certainly possible. 11:06:52

3 The dependence could be almost trivial. In 11:06:53

4 many cases the -- well, in many cases it's 11:06:58

5 just important to know did the other task 11:07:01

6 finish? 11:07:03

7 In many cases the first task 11:07:05

8 will compute a large amount of data that 11:07:07

9 needs to be conveyed to the -- to the second 11:07:10

10 task. 11:07:13

11 But it certainly is possible, 11:07:15

12 and was possible, to put two tasks with a 11:07:17

13 dependency between them on two separate 11:07:23

14 processing elements in a multiple PE system 11:07:26

15 in general. 11:07:29

16 Q. And how does this relate to the 11:07:31

17 idea of -- of pipeline processing? Is this 11:07:33

18 a similar idea to pipeline processing or is 11:07:37

19 it different? 11:07:39

20 MR. LI: Objection, form. 11:07:46

21 A. So I would say if we're talking 11:07:50

22 about how to structure software, there is a 11:07:53

23 relationship. It's more related to data 11:07:57

24 flow because we're talking just about one 11:08:03

25 task producing something that a second task 11:08:07

1 depends on. But in reality it could be the 11:08:11  
2 first task produces something that fires off 11:08:13  
3 three or four, and the branch can get more 11:08:16  
4 complicated. Whereas in pipeline processing 11:08:20  
5 you really just go one and then the next and 11:08:22  
6 then the next. 11:08:24  
7 And I would also say anybody 11:08:24  
8 reading the transcript or hearing this might 11:08:27  
9 think about pipelining in a processor inside 11:08:31  
10 a PE. 11:08:35  
11 In some sense the "Aha!" moment 11:08:41  
12 that made that work originally may have come 11:08:43  
13 about similarly to the "Aha!" for software 11:08:45  
14 structuring. But -- but they're both two 11:08:47  
15 really totally different approaches. 11:08:50  
16 Totally -- not approaches. They're not 11:08:52  
17 solving the same problem. They're just two 11:08:54  
18 totally different things. 11:08:57  
19 Q. Okay. 11:08:58  
20 Am I'm -- if I'm understanding 11:09:17  
21 this, you're -- I'm sure there -- well, one 11:09:19  
22 thing you're pointing out is that pipeline 11:09:25  
23 processing is when -- when there is -- the 11:09:28  
24 data is passed directly from, say, one PE to 11:09:36  
25 another versus other ways that you might 11:09:39



1 keep with the data, which would be the PE 11:09:46  
2 passing data to another PE but via something 11:09:48  
3 else, like via a controller. 11:09:51  
4 Is that a distinction you're 11:09:55  
5 making, or am I just getting that wrong? 11:09:55  
6 A. No, if there's an intermediate 11:09:56  
7 controller, it still would be pipelining. 11:09:57  
8 It's more a question of how many consumers 11:10:00  
9 are there? There's a first stage, a second 11:10:03  
10 stage, a third stage, and they just go in 11:10:06  
11 sequence? Well, okay. I would be inclined 11:10:09  
12 to say that's pipelining. 11:10:11  
13 Many DSP algorithms have a -- 11:10:14  
14 just a richer structure. You could think of 11:10:17  
15 them as having pipelines embedded within it 11:10:19  
16 because there is a sequence, but it's not 11:10:22  
17 just one sequence. There could be branches. 11:10:24  
18 So I wouldn't -- I wouldn't look 11:10:28  
19 at a network of computation and say, "Oh, 11:10:30  
20 that's -- that's pipelining." It is 11:10:33  
21 sequenced. It's just a little more 11:10:35  
22 complicated. 11:10:37  
23 Q. Okay. I get it. I get it. 11:10:38  
24 So pipelining is -- pipelining 11:10:47  
25 is in your mind sort of a -- a simple flavor 11:11:02

1 of sequencing. Does that sound right? 11:11:07

2 MR. LI: Objection, form. 11:11:10

3 A. I guess, you know, as I sit here 11:11:13

4 in general I would say, yeah, that -- that 11:11:15

5 makes sense. At least the -- the origins of 11:11:17

6 how it was thought is also comparable to, 11:11:21

7 like, an assembly line, right, you do for a 11:11:25

8 car. You do something. Next person does 11:11:27

9 something. Next person does something. All 11:11:29

10 in sequence. You never sort of take the car 11:11:32

11 and simultaneously move it to two different 11:11:35

12 physical stations. You couldn't do that. 11:11:37

13 Q. Got it. Got it. Okay. 11:11:40

14 And then you could make 11:11:41

15 sequencing more complicated by having maybe 11:11:44

16 a pipeline but then some branches off of it 11:11:47

17 as well with conditionals that you have to 11:11:51

18 deal with? 11:11:52

19 A. Sure. 11:11:53

20 MR. LI: Objection, form. 11:11:54

21 A. Yeah. Yeah. 11:11:55

22 Q. Got it. Okay. 11:11:57

23 And so just -- you know, I 11:11:58

24 think -- I think you're agreeing with this. 11:12:02

25 At the time of, you know, Nicol's invention 11:12:06

1 in the '301, this idea of, you know, at 11:12:09  
2 least pipeline processing in the DSP 11:12:14  
3 context, that was -- that was known; right? 11:12:17  
4 MR. LI: Objection, form. 11:12:21  
5 A. Yeah, the general concept of 11:12:23  
6 pipelining multiple tasks in the DSP world I 11:12:25  
7 would say was well known. 11:12:30  
8 Q. And it was -- it was well known 11:12:34  
9 that you could use multiple -- that if you 11:12:36  
10 had, like -- if you had multiple processing 11:12:39  
11 elements like you do in Nicol, you could -- 11:12:41  
12 you could use them to pipeline -- to sort of 11:12:45  
13 create a pipeline approach for an algorithm 11:12:48  
14 that you might have; right? 11:12:51  
15 MR. LI: Objection, form. 11:12:58  
16 A. Yes. At the time, if you've got 11:13:04  
17 multiple PEs and multiple tasks, it was 11:13:05  
18 known that even if the tasks had a 11:13:07  
19 dependence between them, in general, you 11:13:08  
20 know, all other relevant aspects ignored for 11:13:11  
21 the moment, you could conceivably put one 11:13:15  
22 task on one PE and one task on another. And 11:13:18  
23 those tasks may be DSP tasks. 11:13:21  
24 Q. Okay. 11:13:23  
25 And I think we covered this, but 11:13:30

1 just to make sure it's straightforward. 11:13:40

2 A person of ordinary skill 11:13:43

3 looking at, say, figure 2 in Nicol with its 11:13:48

4 multiple PEs, would know that, that could 11:13:52

5 allow for this sort of sequence data that 11:13:55

6 we're talking about; right? 11:13:58

7 MR. LI: Objection, form and 11:14:00

8 foundation. 11:14:02

9 BY MR. BROWN: 11:14:02

10 Q. That was -- that was a bad 11:14:02

11 question because I don't -- yeah, let me 11:14:04

12 rephrase it. That end of the question 11:14:06

13 didn't really make much sense. 11:14:08

14 A person of ordinary skill in 11:14:09

15 the art looking at figure 2 in Nicol with 11:14:10

16 its multiple PEs would know that they could 11:14:12

17 implement this, this pipeline approach, 11:14:15

18 where data was -- there were data 11:14:23

19 dependencies between what the tasks were on 11:14:27

20 various PEs. Right? 11:14:30

21 MR. LI: Objection, form and 11:14:31

22 foundation. 11:14:32

23 A. My understanding of Nicol and 11:14:32

24 their goals convinces me that they teach -- 11:14:36

25 they taught against that approach. But the 11:14:42

1 hardware is a multiple PE system, and if the 11:14:46  
2 two PEs can communicate, you could split 11:14:51  
3 things up that way. 11:14:56  
4 Q. Okay. 11:14:57  
5 So at least -- well, let me 11:14:59  
6 break that up. 11:15:01  
7 So at least the hardware 11:15:02  
8 disclosed in Nicol would allow for the 11:15:05  
9 pipeline processing approach with data 11:15:10  
10 dependencies; right? 11:15:13  
11 MR. LI: Objection, form. 11:15:15  
12 A. I would agree with that assuming 11:15:18  
13 that there is a communication path among the 11:15:21  
14 PEs that that could be effectively utilized. 11:15:25  
15 Yes. The hardware would support multiple 11:15:29  
16 tasks with an interdependence running on 11:15:32  
17 separate PEs as long as it was a 11:15:36  
18 communication path from, you know, at least 11:15:38  
19 one to the dependent PE. 11:15:41  
20 Q. Okay. 11:15:48  
21 And then let's go back to the 11:15:48  
22 Nicol reference. It's Exhibit 1 if you 11:15:52  
23 still have it open, the '762 patent. And 11:15:54  
24 I'm going to take you to column 6 when you 11:15:58  
25 get there. 11:16:01



1 was clearly present in figure 2 as well. 11:17:25

2 And also, while this is -- while 11:17:31

3 this is necessary to support communication 11:17:34

4 among the PEs, I don't believe that it's 11:17:37

5 sufficient. 11:17:40

6 Q. Got it. Okay. Well, let's let 11:17:42

7 me unpack that. 11:17:45

8 So I think -- is it -- I think 11:17:46

9 you had said that earlier that you read 11:17:50

10 the -- you read Nicol as probably also 11:17:53

11 requiring an asynchronous communication 11:17:57

12 network in figure 2 in order to allow for 11:18:01

13 this communication between individual PEs; 11:18:04

14 right? 11:18:07

15 A. I think what I said is just a 11:18:11

16 little bit different, which is that I 11:18:14

17 believe figure 2 requires a synchronizer, 11:18:16

18 the synchronizer to take data flows from 11:18:20

19 different clock grounds. Whether that's 11:18:23

20 simply, you know, a sequence of input and 11:18:29

21 output synchronized across, or something 11:18:31

22 more complex that satisfies whatever the 11:18:34

23 definition of a network is, I don't know. I 11:18:37

24 just wouldn't be inclined to it has to have 11:18:39

25 a network. It could be something fairly 11:18:42





1 | that what you're saying? 11:20:06

2	A. Yes.	11:20:10
---	---------	----------

3	Q.	Okay.	11:20:10
---	----	-------	----------

4 But it -- is it -- would it not 11:20:12

5 | be necessary for 101, 102, 103 and 104 to 11:20:14

6 talk to each other? 11:20:18

7 A. If the -- there isn't really 11:20:21

8 | a -- well, the bus that they -- whatever 11:20:26

```
9 |         that line is that goes into the level                                11:20:28
```

10 shifter, that thing at the bottom, if 11:20:30

```
11 | they're all operating at the same clock 11:20:33
```

```
12 frequency and other structures were put in 11:20:36
```

13	place such that they could communicate over	11:20:41
----	---	----------

14 that, it certainly wouldn't require the 11:20:42

```
15 | additional complication of a clock | 11:20:49
```

```
16 | synchronizer.                                     11:20:51
```

```
17 |         There's many different protocols      11:20:54
```

```
18 | you could implement to get different degrees 11:20:55
```

19 of efficiency. But a clock sequencer of the 11:20:57

20 sort we're talking about, when we know 11:21:04

21 | they're fundamentally operating in different | 11:21:05

```
22 clock domains, or they may be, would not be 11:21:07
```

23	necessary.	11:21:11
----	------------	----------

24	O. Got it.	11:21:11
----	------------	----------

25	And those different protocols	11:21:12
----	-------------------------------	----------

1     that you're talking about in order to allow     11:21:13  
2     101, 102, 103 and 104 to communicate with     11:21:17  
3     each other, many protocols like that were     11:21:22  
4     known at the time of the '301 patent     11:21:24  
5     invention; right?     11:21:27  
6             MR. LI: Objection, form,     11:21:28  
7             foundation, irrelevance.     11:21:28  
8             A.     Yeah. I don't remember     11:21:32  
9     commenting on this, but it -- but it's true.     11:21:33  
10    You could have, like, a round-robin fixed     11:21:36  
11    scheduler. You could have a dynamic request     11:21:39  
12    bus. There are many options that were known     11:21:43  
13    at the time. Yeah.     11:21:46  
14             Q.     So then if we go back to what we     11:21:51  
15    were reading in there in column -- I'm     11:21:55  
16    sorry, I heard a little feedback there?     11:21:55  
17             If we go back to column 6 at     11:21:57  
18    line -- back to that paragraph, it -- if --     11:22:00  
19    I think we're agreeing now that the     11:22:05  
20    synchronization schema being described here     11:22:09  
21    has to be implemented in figure 4 when there     11:22:13  
22    is a need to communicate data between PEs     11:22:17  
23    because they're operating at different     11:22:20  
24    frequencies in figure 4; right?     11:22:22  
25             A.     Well, I think the -- my     11:22:32

1 understanding is that the synchronization 11:22:33  
2 schema has to be supplemented, as I 11:22:35  
3 suggested, already because there is 11:22:38  
4 communications disclosed from the PE to -- 11:22:39  
5 back to the -- the RTOS, the controller PE. 11:22:42  
6 But, yeah, I would agree that if 11:22:46  
7 additionally the PEs needed to communicate 11:22:48  
8 directly as opposed to going through an 11:22:51  
9 intermediary such as that and were operating 11:22:55  
10 at different clock frequencies, there would 11:22:59  
11 likely need to be a synchronization function 11:23:02  
12 between them, among them. 11:23:07  
13 Q. Got it. 11:23:11  
14 So when we look at how this is 11:23:12  
15 described in figure 4, which is on page 3 if 11:23:14  
16 you -- if you need it, Nicol provides for 11:23:17  
17 this asynch communication network and the 11:23:23  
18 level converter, which enables the PEs, the 11:23:27  
19 processing PEs, to talk to each other and 11:23:36  
20 also enables them to talk with their 11:23:38  
21 controller PE; right? 11:23:41  
22 MR. LI: Objection, form. 11:23:47  
23 A. It would be used for the 11:23:48  
24 processing PEs to talk to each other. As I 11:23:50  
25 said, its -- its function and its features 11:23:53

1	are necessary but not sufficient.	11:23:56
2	Q. Right.	11:23:59
3	MR. BROWN: How are we doing on	11:24:35
4	time? I'm getting to a stop, like a	11:24:37
5	logical break point. I can keep	11:24:41
6	going, but I think we've been going an	11:24:42
7	hour, haven't we?	11:24:44
8	THE VIDEOGRAPHER: You've been	11:24:46
9	on for 55 minutes since we last	11:24:47
10	resumed.	11:24:50
11	MR. BROWN: Yeah.	11:24:50
12	THE WITNESS: You want to take	11:24:50
13	a --	11:24:50
14	MR. BROWN: How are you doing?	11:24:51
15	THE WITNESS: I'm doing fine.	11:24:53
16	But if this is a subject break, it's	11:24:54
17	probably close enough a good time to	11:24:56
18	take a ten-minute break.	11:24:58
19	MR. BROWN: Yeah, that sounds	11:24:59
20	great.	11:25:01
21	So ten minutes, not lunch yet.	11:25:01
22	Is that --	11:25:04
23	THE WITNESS: Yep.	11:25:05
24	MR. BROWN: That's your	11:25:06
25	preference?	11:25:06

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1	Okay. You got it.	11:25:07
2	THE VIDEOGRAPHER: Okay. Off	11:25:08
3	the record. The time is 11:25.	11:25:09
4	[Recess at 11:25 a.m. Pacific	11:25:13
5	Time.]	11:25:19
6	[Resuming at 11:41 a.m. Pacific	11:25:21
7	Time.]	11:25:41
8	THE VIDEOGRAPHER: Thank you.	11:41:46
9	We're back on the record at 11:41.	11:41:46
10	Go ahead.	11:41:49
11	MR. BROWN: Thank you.	11:41:51
12	EXAMINATION CONTINUING	11:41:51
13	BY MR. BROWN:	11:41:51
14	Q. So, Doctor, we were -- just	11:41:53
15	before the break we were talking about how	11:41:55
16	in -- I think your opinion was in figure 4	11:42:00
17	the asynchronous communication network is --	11:42:04
18	is -- is used to allow the processing PEs to	11:42:07
19	talk to one another, but you think that it	11:42:14
20	wasn't sufficient to completely do that;	11:42:17
21	right?	11:42:18
22	A. Yeah. It's not clear to me that	11:42:20
23	figure 4 discloses direct communication	11:42:23
24	among the PEs. It may be intended to do	11:42:28
25	that. It does disclose -- direct	11:42:31

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1 communication among PEs of that sort was 11:42:35  
2 generally known. One of the interesting 11:42:38  
3 things here is the differences in clock 11:42:41  
4 speed, and the synchronizer would address 11:42:46  
5 that. 11:42:50  
6 I just -- I don't know what 11:42:51  
7 other specific details they anticipate or 11:42:52  
8 uses they anticipated. 11:42:56  
9 Q. I get you. Okay. 11:42:58  
10 So a person of ordinary skill 11:43:00  
11 looking at figure 4 would understand -- 11:43:01  
12 well, figure 4 and the spec, would 11:43:03  
13 understand that, you know, Nicol is 11:43:06  
14 intending for the PEs to talk to one another 11:43:11  
15 but that there might be additional sort of 11:43:13  
16 changes required in order to completely 11:43:18  
17 allow that; right? 11:43:20  
18 A. I wouldn't -- 11:43:20  
19 Q. Did I get that right? 11:43:23  
20 A. Yeah, I wouldn't quite phrase it 11:43:24  
21 that way. I think a person of ordinary 11:43:26  
22 skill in the art would see that Nicol 11:43:27  
23 anticipates that figure 4 could be used to 11:43:30  
24 build a system where the PEs communicate and 11:43:35  
25 envisions that as a possibility. I don't 11:43:41

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1 know that it actually discloses that on its 11:43:43  
2 own. 11:43:47  
3 And the PEs presumably could 11:43:48  
4 communicate via the controller indirectly 11:43:52  
5 anyways. 11:43:55  
6 Q. Okay. Okay. 11:44:10  
7 Let me -- let me take you to 11:44:12  
8 Nicol. This is Exhibit 1. And I think at 11:44:25  
9 the bottom of column 2, the last paragraph 11:44:30  
10 there that rolls into column 3. 11:44:33  
11 A. Okay. I'm there. 11:45:06  
12 Q. Okay. 11:45:06  
13 So at the bottom of column 2 it 11:45:14  
14 says: 11:45:16  
15 "For a maximally utilized 11:45:18  
16 system, all of the available processors 11:45:20  
17 ought to be operating at full speed when 11:45:21  
18 satisfying the maximum load encountered by 11:45:24  
19 the system." 11:45:26  
20 What does that mean to you? 11:45:28  
21 A. I don't know. It's a very -- 11:45:32  
22 it's a strange thing to say. 11:45:34  
23 To me, you know, I would say a 11:45:39  
24 fully utilized system would be something 11:45:42  
25 that's utilized at -- for any particular 11:45:45

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1 period of time. It doesn't have to be 11:45:49  
2 forever. But it's utilized 100 percent. 11:45:51  
3 And in the context of -- of 11:45:57  
4 Nicol, I think what that would mean is that 11:46:01  
5 they're operating at the highest possible 11:46:04  
6 clock frequency, you know. But then they 11:46:07  
7 roll in this aspect of: 11:46:12  
8 "...when satisfying the maximum 11:46:13  
9 load encountered by the system." 11:46:15  
10 Well, what does "satisfying" 11:46:19  
11 mean? How do you know you've got the 11:46:21  
12 maximum load? Because you can always get 11:46:24  
13 new task requests that come in. 11:46:26  
14 But hopefully I responded enough 11:46:29  
15 for your followup question. 11:46:31  
16 Q. Yeah. I think I'm getting it. 11:46:35  
17 I think the issue that you're 11:46:36  
18 having is one that we've kind of discussed 11:46:38  
19 throughout of, like, you know, whether some 11:46:40  
20 of these adjectives or adverbs are 11:46:43  
21 superlative versus comparative and how 11:46:46  
22 you're going to actually be able to tell 11:46:49  
23 what is the absolute max of the system? 11:46:51  
24 When are you measuring it? That's kind of 11:46:54  
25 what your point is there? 11:46:55

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1     where, you know, all of the PEs are running     11:48:02  
2     at their maximum frequency, that will cause     11:48:06  
3     the temperature of the chip or of those     11:48:10  
4     individual PEs and of the chip in general to     11:48:14  
5     increase; right?     11:48:15  
6             MR. LI: Objection, form.     11:48:17  
7             A.     That will generally cause a     11:48:19  
8     temperature increase in multiple parts of     11:48:22  
9     the system, the PE, the power converter, the     11:48:26  
10    power supply.     11:48:29  
11            Q.     And what happens if -- well,     11:48:33  
12    withdrawn.     11:48:38  
13                    That concept, that, you know,     11:48:40  
14    increasing the voltage and increasing the     11:48:42  
15    frequency to very high levels can -- can --     11:48:44  
16    certainly impacts the temperature of the     11:48:49  
17    chip. That was well known at the time that     11:48:51  
18    Nicol was writing this in the '301 patent;     11:48:54  
19    right?     11:48:58  
20            A.     Yes. While Nicol, to the best     11:49:01  
21    of my recollection, doesn't address how to     11:49:05  
22    do scheduling to respond to those or adapt     11:49:06  
23    the system, certainly the notion that     11:49:09  
24    increased voltage and increased clock     11:49:14  
25    frequency will tend to increase temperature     11:49:17

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1 was well known. 11:49:20

2 Q. And at column 1, just over to 11:49:24

3 the left of what we're looking at, column 1, 11:49:26

4 Exhibit 1, at line 41, that's -- Nicol 11:49:28

5 actually sort of notes that. It says: 11:49:33

6 "Voltage scaling as a function 11:49:34

7 of temperature has been incorporated 11:49:35

8 into...." 11:49:38

9 And then references an Intel 11:49:38

10 product. 11:49:40

11 Do you see that? 11:49:40

12 A. Yes, I do. Yeah. 11:49:41

13 Q. And so what Nicol is saying is, 11:49:42

14 you know, that it's known that you have to 11:49:45

15 scale your voltage and monitor temperature 11:49:47

16 in order to make sure you don't overheat 11:49:51

17 your chip? 11:49:54

18 A. I don't know that I would say 11:49:57

19 that. It's disclosing that for the Intel 11:49:58

20 Pentium chips they decided it was necessary 11:50:03

21 to take that approach. Different systems 11:50:07

22 have different requirements. But the notion 11:50:09

23 that in some context you may want to do 11:50:14

24 that, it was known. 11:50:17

25 Q. And by -- yeah. Okay. 11:50:19

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1                   And then, you know, what -- what                   11:50:22  
2                   happens in the circumstance if, you know,                   11:50:30  
3                   one of Nicol's PEs or one of the other                   11:50:33  
4                   elements, you know, that would over -- that                   11:50:37  
5                   would overheat when they're running at their                   11:50:39  
6                   maximum frequency, what happens -- well,                   11:50:41  
7                   withdrawn. Sorry, that's a long question.                   11:50:43  
8                   What happens if one of Nicol's                   11:50:44  
9                   processing elements overheats?                   11:50:46  
10                   MR. LI: Objection, form,                   11:50:48  
11                   foundation.                   11:50:50  
12                   A. It depends. The phrase                   11:50:52  
13                   "overheat" I think on its own indicates that                   11:50:57  
14                   it's heated beyond where it's expected to                   11:51:01  
15                   operate. So presumably something bad                   11:51:04  
16                   happens. But the -- there's a wide range of                   11:51:06  
17                   bad things from temporary problems to                   11:51:09  
18                   permanent failures that could occur.                   11:51:12  
19                   Q. And at least in most of the                   11:51:19  
20                   circumstances, a PE that exceeds its                   11:51:21  
21                   temperature threshold is not going to be                   11:51:27  
22                   able to continue operating at full speed or                   11:51:30  
23                   that maximum speed?                   11:51:33  
24                   A. Presumably it -- whatever its                   11:51:38  
25                   maximum threshold is, it can't operate above                   11:51:42

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1     that.  Although, you know, there may be some     11:51:46  
2     issue like you can operate above that for a     11:51:49  
3     short period of time depending on how -- but     11:51:50  
4     in general, if you tell me this is the     11:51:53  
5     maximum operating temperature, I would     11:51:56  
6     expect if I'm operating above that,     11:51:59  
7     something bad will happen.     11:52:02

8             Q.     And so it's not -- it's not     11:52:06  
9     unreasonable for a person of ordinary skill     11:52:09  
10    looking at a system like Nicol to think,     11:52:11  
11    "You know, if we're going to actually do     11:52:16  
12    this and take the Nicol system, we probably     11:52:18  
13    need to have or should have some sort of,     11:52:21  
14    you know, temperature management built in."     11:52:25  
15    Right?     11:52:28

16             MR. LI:  Objection, form,     11:52:30  
17             foundation.     11:52:31

18             A.     While the technology was known,     11:52:32  
19    my understanding of what Nicol is focusing     11:52:35  
20    on is very different from Intel's.  And even     11:52:38  
21    today there are many relatively high     11:52:43  
22    performance processors that are on the     11:52:47  
23    market that don't have any thermal     11:52:49  
24    management of this sort.  They're -- they     11:52:52  
25    guarantee operability constraints are met     11:52:57

1 through other mechanisms without dynamically 11:53:00  
2 adjusting anything. 11:53:03  
3 So the technology used in the 11:53:05  
4 Pentium was known. It's in the prior art. 11:53:09  
5 In a number of ways I think 11:53:14  
6 it's -- what Nicol -- what Nicol does 11:53:19  
7 teach with regards to scheduling teaches 11:53:21  
8 against incorporating that sort of 11:53:25  
9 technology. But the technology was known to 11:53:28  
10 a person of ordinary skill in the art. 11:53:30  
11 Q. And how is it that you're 11:53:34  
12 saying -- what is it about Nicol that 11:53:36  
13 teaches against using temperature scaling or 11:53:37  
14 temperature monitors? 11:53:43  
15 A. Sure. So Nicol is focused on -- 11:53:46  
16 well, while they talk about a number of 11:53:49  
17 different kinds of tasks, I believe it's 11:53:52  
18 clear to me that one of the most important 11:53:56  
19 tasks they're focusing on is realtime tasks. 11:53:59  
20 If a task isn't realtime, then 11:54:04  
21 this whole notion of requires a lot of time 11:54:06  
22 or a little bit of time isn't -- for the 11:54:11  
23 most part isn't really known. 11:54:13  
24 Now, if you've got a realtime 11:54:15  
25 task and the realtime task is your antilock 11:54:17

1 brake system, I don't care if the processor 11:54:23  
2 gets hot. You know? If it burns up, I'll 11:54:26  
3 signal the system to do something else. But 11:54:30  
4 if it's getting hot, I would rather it keep 11:54:31  
5 trying to run the antilock brake system as 11:54:34  
6 opposed to stopping it. 11:54:37  
7 Realtime tasks, not all of them 11:54:39  
8 are mission critical and will result in 11:54:43  
9 somebody dying, but many of them are. So in 11:54:45  
10 general I -- that's one aspect of it. 11:54:49  
11 The second aspect is even if 11:54:52  
12 it's not -- I mean, there is some notion of 11:54:53  
13 criticality in any sort of realtime system. 11:54:56  
14 You will -- if you don't meet the 11:54:59  
15 processing, the system has failed to meet 11:55:02  
16 its requirements in some sense. And, again, 11:55:04  
17 I'll sort of vaguely say something bad 11:55:06  
18 happens. I don't know exactly what it is. 11:55:09  
19 A wide range of things. 11:55:10  
20 Now, Nicol's figure 2 teaches we 11:55:12  
21 spread the tasks out somehow and one of them 11:55:19  
22 has the greatest requirement. 11:55:23  
23 If the requirement tells me -- 11:55:28  
24 well, this is sort of along the point of 11:55:30  
25 what I was talking about. You set the clock 11:55:32

1 speed based on the maximum requirement. 11:55:34  
2 What do you do if suddenly 11:55:37  
3 dynamically halfway through running that 11:55:39  
4 task you decide you can't meet the maximum? 11:55:41  
5 Well, he says you set it to meet the 11:55:43  
6 maximum. Which is not to say that somebody 11:55:47  
7 couldn't come up with a -- you know, design 11:55:51  
8 a system that would try to incorporate these 11:55:56  
9 different notions. I just think its counter 11:55:58  
10 to what Nicol is teaching. 11:56:00  
11 Q. Got it. Okay. 11:56:05  
12 So one of the reasons that 11:56:06  
13 you're saying Nicol wouldn't -- wouldn't 11:56:10  
14 really have a sort of temperature threshold 11:56:15  
15 monitor is because it's -- it's talking 11:56:20  
16 about potentially critical tasks that you 11:56:25  
17 really can't stop just because you have a 11:56:27  
18 temperature issue? 11:56:31  
19 A. Well, so I would say -- I mean, 11:56:34  
20 Nicol doesn't disclose using those. But a 11:56:36  
21 person looking at Nicol and thinking about, 11:56:39  
22 "Well, do I want to incorporate those?" -- I 11:56:42  
23 think if they were really looking at using 11:56:46  
24 the technology in Nicol, they would be 11:56:50  
25 inclined not to use this sort of a 11:56:52



1 temperature adaptation. 11:56:55

2 Q. Right. 11:56:56

3 But Nicol doesn't say that it's 11:56:58

4 limited to tasks that are critical, like a 11:57:01

5 car's brakes; right? That's not the only 11:57:04

6 implementation that a person of ordinary 11:57:08

7 skill would look at Nicol and say, "I can 11:57:09

8 use this for"? 11:57:11

9 MR. LI: Objection, form. 11:57:13

10 A. I would agree with that. My 11:57:15

11 recollection is that Nicol says there are 11:57:17

12 realtime tasks or tasks with fixed deadlines 11:57:22

13 that need to be met, and then there are 11:57:25

14 other tasks. And the system, you know, 11:57:28

15 could run them both with -- I don't recall 11:57:32

16 any discussion of how you schedule amongst 11:57:35

17 in this mixed mode. And there are lots of 11:57:38

18 different systems that we've talked about. 11:57:40

19 But, yeah, it doesn't disclose 11:57:42

20 we only run with realtime mission critical 11:57:45

21 tasks. 11:57:47

22 Q. Right. 11:57:48

23 In fact, I think one embodiment 11:57:49

24 or application of Nicol that's described in 11:57:52

25 Nicol is to be a television set-top box; 11:57:55

1 right? 11:57:58

2 MR. LI: Object to form. 11:58:00

3 A. I believe so, yeah. That's my 11:58:02

4 recollection. 11:58:03

5 Q. Yeah. 11:58:04

6 A. But it's either in there or it's 11:58:04

7 not. 11:58:07

8 Q. Yeah. If you want to -- I do my 11:58:07

9 best not to misrepresent things. It is on 11:58:09

10 the bottom of column 2 right above where we 11:58:11

11 were reading previously, if that's helpful. 11:58:14

12 A. Yeah. A television set-top box 11:58:16

13 would traditionally have realtime and 11:58:18

14 nonrealtime applications. So I would expect 11:58:20

15 that they would have tried to sell into that 11:58:24

16 market. 11:58:27

17 Q. Right. 11:58:27

18 And, you know, a television 11:58:29

19 set-top box has realtime requirements in 11:58:32

20 terms of, say, processing the signal that 11:58:39

21 it's getting, the cable signal it's getting; 11:58:42

22 right? 11:58:45

23 A. Yes. 11:58:47

24 MR. LI: Object to form. 11:58:47

25 A. Yeah. And -- well, I was going 11:58:49

1 to say traditionally. It may still be the 11:58:52  
2 case. These -- traditionally you would have 11:58:54  
3 hardware accelerators for a lot of those, 11:58:59  
4 like video decoding and decryption. 11:59:02  
5 Although I guess at the moment we're doing 11:59:06  
6 videoconferencing in just a software 11:59:08  
7 environment. So -- 11:59:10  
8 Q. But -- and so unlike the 11:59:16  
9 antilock brakes example, though, a 11:59:19  
10 television set-top box isn't going to have 11:59:22  
11 the type of critical realtime tasks where a 11:59:26  
12 designer would -- would prioritize just 11:59:29  
13 damaging the device in order to complete the 11:59:34  
14 task; right? 11:59:36  
15 A. I guess. I would agree that in 11:59:40  
16 some sense the criticality is different. If 11:59:43  
17 I think somebody is going to die versus one 11:59:45  
18 individual is going to have a bad television 11:59:51  
19 experience, of course they're different. 11:59:54  
20 But I would also say that if my 11:59:56  
21 livelihood was selling televisions and 11:59:59  
22 getting good reviews, right, from the point 12:00:02  
23 of -- it's sort of like, well, am I -- you 12:00:04  
24 know, did I fail or did I fail horribly? 12:00:09  
25 Well, at the end of the day it doesn't 12:00:11

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1 matter. I failed. 12:00:13

2 So to them there are lots of 12:00:14

3 environments where, you know, failing to do 12:00:17

4 good video decoding when all your 12:00:20

5 competitors do is fatal in the marketplace. 12:00:23

6 But it's certainly not the same as somebody 12:00:25

7 losing their life. 12:00:27

8 Q. Right. 12:00:28

9 But, I mean -- I hear what 12:00:31

10 you're saying. But you agree that, you 12:00:33

11 know, failing to maybe perfectly decode a 12:00:36

12 video stream at one particular second is -- 12:00:41

13 is one type of failure. But having a 12:00:45

14 set-top box that actually just stops working 12:00:48

15 because you've overheated it is probably a 12:00:50

16 bit of a bigger deal. Right? 12:00:55

17 A. I'm sorry. 12:00:58

18 Q. I can -- 12:00:59

19 A. Repeat the question. 12:01:00

20 Q. Yeah, I can ask it differently. 12:01:00

21 Like a -- somebody -- some -- a 12:01:02

22 designer -- a person of ordinary skill at 12:01:05

23 this time designing set-top boxes is not 12:01:07

24 going to create a system where his set-top 12:01:10

25 box fails because its processors overheat; 12:01:15

1 right? That's not going to be something 12:01:18  
2 that he's going to want to do? 12:01:20  
3 A. Nobody wants to do that. 12:01:21  
4 MR. LI: Object to form. 12:01:23  
5 A. I would agree. There are 12:01:24  
6 different solutions to address the problem 12:01:25  
7 than what was disclosed in the Intel 12:01:31  
8 Pentium. You know, for example, as I was 12:01:34  
9 mentioning, maybe you -- you know, you can 12:01:36  
10 tolerate a certain degree of overtemperature 12:01:39  
11 operation, and that gives you enough time to 12:01:42  
12 turn on a fan, which you would rather have 12:01:44  
13 off because it -- it increases the overall 12:01:46  
14 system power consumption and it makes noise. 12:01:48  
15 But, you know, maybe you decide that's a 12:01:52  
16 better solution. 12:01:54  
17 Q. Right. 12:01:55  
18 So let's -- so before we get to 12:02:00  
19 the solution though. We agree that a person 12:02:02  
20 of ordinary skill in the art at the time of 12:02:03  
21 Nicol, who is designing, for instance, a 12:02:05  
22 set-top box, is probably going to want to do 12:02:08  
23 something. And we can talk about what that 12:02:10  
24 something is, but will want to do something 12:02:13  
25 to prevent his processors from overheating. 12:02:15

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1 Fair? 12:02:17

2 MR. LI: Objection, form. 12:02:20

3 A. I would change it a little bit. 12:02:22

4 They probably want to be comfortable and 12:02:25

5 assured to some degree as an engineer that 12:02:28

6 their systems will not go over temperature. 12:02:31

7 It may be the case that they look at all the 12:02:36

8 other design aspects and just are able to 12:02:38

9 conclude, "We don't need to worry about this 12:02:41

10 at runtime because it cannot happen." 12:02:44

11 And in many ways that was the 12:02:46

12 solution that was taken in the past before 12:02:49

13 people came up with these sort of active 12:02:52

14 mitigation techniques. 12:02:54

15 But -- and probably before that, 12:02:56

16 you know, some semiconductor designers sort 12:03:00

17 of took the approach, "We're just going to 12:03:02

18 tell you, 'Don't operate it in a room above 12:03:05

19 this temperature. And if you do, it's your 12:03:07

20 own fault.'" 12:03:09

21 But I agree with the premise 12:03:09

22 that, you know, I want to know -- I want my, 12:03:11

23 whatever I design, to work consistently at a 12:03:15

24 broad range of temperatures, and if a bad 12:03:18

25 environmental situation crops up, I would 12:03:21

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1	like to know either I can't feel this way or	12:03:25
2	I have some mitigation. It's just always a	12:03:29
3	question of tradeoffs.	12:03:31
4	Q. Right.	12:03:32
5	And so a person of ordinary	12:03:33
6	skill who is facing this decision, he's	12:03:34
7	got -- as you're saying, he's got a number	12:03:39
8	of options in his toolbox to make sure his	12:03:39
9	PEs aren't going to overheat and die right?	12:03:43
10	MR. LI: Objection, form.	12:03:48
11	A. Sure. He can -- he can be	12:03:50
12	convinced he's designed the system that	12:03:53
13	it -- such that it couldn't happen or he	12:03:56
14	could turn to some aggressive dynamic	12:03:57
15	adaptation.	12:04:04
16	Q. Right.	12:04:04
17	So like you're saying, one thing	12:04:05
18	a person of ordinary skill could do, reading	12:04:08
19	Nicol, who was worried about this would be	12:04:10
20	he could set some maximum frequency that he	12:04:16
21	knows the PEs will never overheat as long as	12:04:20
22	they only go up to that frequency; right?	12:04:24
23	That's one way that he could try to design	12:04:26
24	his system so it wouldn't overheat?	12:04:28
25	MR. LI: Object to form.	12:04:31

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1           A.     In general, yeah. With the           12:04:32  
2     caveat that of course you tell the consumer,     12:04:34  
3     "Don't operate this in a room that's 120         12:04:37  
4     degrees." But, yeah, within expected           12:04:40  
5     operating conditions, if you can control the     12:04:43  
6     frequency, presumably you can control the       12:04:45  
7     maximum temperature.                             12:04:48

8           Q.     Yeah.                               12:04:50

9                     And so another way that would be     12:04:51  
10    in the sort of person of ordinary skills           12:04:53  
11    toolbox at the time who didn't want a system     12:04:55  
12    implementing Nicole to overheat or to have       12:04:57  
13    its processors die would be to implement           12:05:01  
14    temperature sensors that would do something       12:05:04  
15    to reduce the PE frequency when it's getting     12:05:08  
16    too hot; right? That was something that a       12:05:13  
17    person of ordinary skill in the art would        12:05:15  
18    have known was an option?                         12:05:16

19                     MR. LI: Objection, form.           12:05:20

20           A.     So certainly at a minimum the       12:05:26  
21    approach disclosed, or utilized rather, by       12:05:28  
22    Intel in the Pentium was known and was known     12:05:30  
23    to a person of ordinary skill in the art. I       12:05:35  
24    don't recall specifically, for example,           12:05:38  
25    where -- you have to have a temperature           12:05:43



1       sensor. Well, okay. 12:05:46

2               Back in the day you would put a 12:05:49

3       temperature sensor on a printed circuit 12:05:51

4       board. So maybe it's external to the chip 12:05:53

5       and there was a wire running in. And then 12:05:55

6       the next step would be you would mount it 12:05:57

7       external to the chip but on the -- on the 12:05:59

8       unit. 12:06:02

9               Maybe Intel disclosed that. I 12:06:05

10       don't know. I don't recall if that was an 12:06:07

11       option at that point in our technological 12:06:09

12       development. 12:06:13

13               And eventually we've gotten to 12:06:14

14       the point where we can mount temperature 12:06:15

15       sensors on the silicon itself, inside the 12:06:18

16       packaging. 12:06:22

17               So there's a lot of -- a lot 12:06:23

18       of -- even within that notion, there's a lot 12:06:25

19       of options. And I don't recall which 12:06:27

20       specifically was used by Pentium, let alone, 12:06:30

21       you know, when the other ones were 12:06:34

22       introduced. 12:06:36

23       Q. I gotcha. 12:06:36

24               So putting aside specifically 12:06:38

25       where you would mount the temperature 12:06:40

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1 sensor, a person of ordinary skill in the 12:06:42  
2 art who was implementing Nicol but was 12:06:44  
3 concerned about overheating would at least 12:06:46  
4 know of ways that he could do temperature 12:06:50  
5 management using a temperature sensor 12:06:52  
6 somewhere near his chip; right? 12:06:56  
7 MR. LI: Objection, form. 12:06:59  
8 A. Yeah. At least to the extent 12:07:02  
9 that the Pentium disclosed it, for example. 12:07:04  
10 Q. Okay. 12:07:12  
11 And I think we've established 12:07:32  
12 this, but you're not saying that it would be 12:07:34  
13 unreasonable for a person of ordinary skill 12:07:38  
14 implementing Nicol to be concerned in some 12:07:41  
15 way with thermal management; right? 12:07:44  
16 MR. LI: Objection, form, 12:07:49  
17 foundation. 12:07:50  
18 A. No, I wouldn't say it would be 12:07:54  
19 unreasonable. It simply depends on the rest 12:07:56  
20 of the design goals and constraints of 12:08:00  
21 whatever system it is that they were 12:08:03  
22 building. 12:08:05  
23 There are likely lots of 12:08:07  
24 scenarios where immediately I would say, 12:08:09  
25 "Oh, yeah, you fundamentally have to care 12:08:11

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1     about, you know, adaptive temperature or     12:08:13  
2     responsiveness."     12:08:18  
3             And similarly there are almost     12:08:20  
4     certainly examples where I would say, "Oh,     12:08:21  
5     you don't need to worry about that."     12:08:23  
6             Q.     Right.     12:08:24  
7             And Nicol is, in describing sort     12:08:27  
8     of its -- its embodiments, it never says,     12:08:31  
9     "Don't do a temp- -- don't do thermal     12:08:35  
10    management because that's stupid or that's a     12:08:38  
11    bad idea."    Right?    It never says that?     12:08:40  
12             MR. LI:    Objection, form and     12:08:44  
13             foundation.     12:08:45  
14             A.     I don't recall.    I haven't     12:08:45  
15    memorized Nicol.    If it's in there, I     12:08:47  
16    certainly don't recall reading that.     12:08:50  
17             But as I said, there's a lot of     12:08:53  
18    discussion focused on utilizing of the     12:08:55  
19    system to where you schedule, where one     12:09:00  
20    processor is maximum loading, you lower the     12:09:04  
21    head room.    And in such a situation I think     12:09:07  
22    that's contrary to this dynamic voltage     12:09:09  
23    scaling.     12:09:13  
24             But I don't recall a place where     12:09:13  
25    they said, "Don't do it."     12:09:15

1 Q. Okay. 12:09:16

2 In fact, if you go to -- if you 12:09:46

3 go to column 4, line 11 to 16 of Nicol. 12:09:57

4 A. All right. 12:10:13

5 Q. You see it says: 12:10:13

6 "As indicated above, the 12:10:14

7 operating system can reduce the supply 12:10:15

8 voltage even further by tracking temperature 12:10:17

9 and process variations." 12:10:19

10 Do you see that? 12:10:21

11 A. I do. 12:10:22

12 Q. So Nicol is saying there that 12:10:23

13 you can -- at least as a possibility in 12:10:25

14 implementing its invention, that tracking 12:10:28

15 temperature can be -- can be -- is a 12:10:31

16 possibility; right? 12:10:35

17 A. It is saying: 12:10:36

18 "The operating system can reduce 12:10:39

19 the supply voltage even further by tracking 12:10:41

20 temperature and process variation." 12:10:44

21 I assume that that's a reference 12:10:47

22 to the -- to at least the Pentium discussion 12:10:48

23 that appeared above. 12:10:52

24 Q. So in that context Nicol isn't 12:10:57

25 necessarily criticizing thermal management 12:11:00

1 but it's suggesting that it's -- it's 12:11:03  
2 another possibility of something that could 12:11:06  
3 be considered when implementing its 12:11:07  
4 invention; right? 12:11:10

5 A. Well, I wouldn't phrase it that 12:11:17  
6 way necessarily because, to be honest with 12:11:17  
7 you, I wasn't focusing on what Nicol's 12:11:21  
8 invention is. Simply what it disclosed and 12:11:24  
9 the arguments made. 12:11:26

10 I think, in my understanding, 12:11:30  
11 Nicol is fundamentally disclosing two 12:11:33  
12 different hardware structures, figure 1 and 12:11:35  
13 figure 2. And they're largely silent on 12:11:39  
14 scheduling and applications in general 12:11:46  
15 beyond that. Other than sort of saying, 12:11:47  
16 "Oh, yeah, you could use it for realtime. 12:11:49  
17 And you might be concerned about this 12:11:51  
18 stuff." And here they're sort of saying, 12:11:53  
19 "Well, you could also do some sort of 12:11:55  
20 dynamic power management." But there's no 12:11:57  
21 discussion of how any of that would work. 12:12:03

22 Q. I gotcha. I gotcha. 12:12:06

23 So it's saying -- Nicol is 12:12:08  
24 saying, "You know, you could do thermal 12:12:10  
25 management," but your opinion is it's just 12:12:12

1 not -- it's not telling you exactly what 12:12:15  
2 thermal management to implement? 12:12:17  
3 A. Yes. 12:12:19  
4 MR. LI: Objection, form. 12:12:19  
5 A. At a minimum, it's not telling 12:12:21  
6 me how to do it. And I do think -- I'm 12:12:25  
7 sorry, I suggested to you that I was done 12:12:29  
8 speaking and then -- and then stepped over 12:12:31  
9 you. 12:12:33  
10 I do think that there are a 12:12:33  
11 number of aspects that Nicol does talk about 12:12:37  
12 that are really complicated by doing -- as 12:12:41  
13 I've discussed, doing this sort of active 12:12:43  
14 control for temperature management. 12:12:47  
15 Q. Gotcha. 12:12:51  
16 But I think -- so I understand 12:12:52  
17 what you're saying, and I apologize for 12:12:54  
18 interrupting. 12:12:56  
19 So I think that at least we can 12:13:00  
20 agree, you know, at least in this section, 12:13:04  
21 Nicol isn't criticizing or discrediting 12:13:07  
22 thermal management as an -- as something 12:13:14  
23 that could be done here; is that right? 12:13:17  
24 MR. LI: Objection, form. 12:13:22  
25 A. I think in this, the specific 12:13:24

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1 context of the discussion in chapter -- I'm 12:13:27  
2 sorry, in column 4, which I think is -- 12:13:31  
3 yeah, it exists in the context of figure 2. 12:13:35  
4 They are saying that thermal management may 12:13:39  
5 be a concern that you need to address and 12:13:42  
6 that perhaps you can address it somehow with 12:13:45  
7 what we are disclosing. I'm sorry, not -- 12:13:48  
8 perhaps you could use it in the context of 12:13:52  
9 what we are disclosing. 12:13:53  
10 Q. Got it. Got it. Okay. 12:13:57  
11 Let me switch gears and put 12:14:09  
12 the -- well, let me ask this first actually 12:14:17  
13 before I put another exhibit in. 12:14:20  
14 This is a question that you 12:14:22  
15 probably will laugh at me for asking, but 12:14:32  
16 you would agree with me that at the time of 12:14:34  
17 the '301 patent the use of batteries was 12:14:35  
18 well known as a form of power supply for 12:14:39  
19 computer devices; right? 12:14:42  
20 A. Yes. I had used many 12:14:47  
21 battery-powered computers at the time of 12:14:50  
22 invention, yes. 12:14:51  
23 Q. And also the -- monitoring the 12:14:52  
24 amount of battery reserve or power reserve 12:14:57  
25 left in that battery, that was also 12:15:01

1 something that was known at the time of the 12:15:04  
2 invention; right? 12:15:06

3 MR. LI: Objection, form. 12:15:08

4 A. Some systems for various battery 12:15:11  
5 technologies used a number of approaches to 12:15:15  
6 try to track battery capacity. That was a 12:15:17  
7 known -- that was a known goal with a number 12:15:21  
8 of different approaches. 12:15:27

9 Q. And there were -- at the time of 12:15:32  
10 the invention, there were known ways to 12:15:34  
11 determine sort of what the power reserve was 12:15:38  
12 in a battery; right? 12:15:40

13 MR. LI: Objection, form. 12:15:47

14 A. There were different -- 12:15:48  
15 different approaches based on, for example, 12:15:50  
16 battery chemistry and the cost of additional 12:15:52  
17 hardware. 12:15:56

18 But, yes, certainly I used 12:15:57  
19 MacIntosh and PC laptops that would show 12:16:03  
20 me -- you never knew how accurate -- some 12:16:07  
21 indication of how much capacity they 12:16:10  
22 believed was left. 12:16:11

23 Q. Okay. 12:16:12

24 So let me take you to the Bhatia 12:16:22  
25 reference, which we'll mark as a new 12:16:26



1 exhibit, and we'll -- I'll tell you when 12:16:30  
2 it's up there so you can -- 12:16:32  
3 A. All right. 12:16:35  
4 [Pause.] 12:16:37  
5 Q. Okay. 12:17:01  
6 It's up there now. I'll just 12:17:01  
7 note it for the record. 12:17:03  
8 What's been marked as Exhibit 4 12:17:04  
9 is US Patent 6,535,798 Bhatia, B-H-A-T-I-A. 12:17:07  
10 [Deposition Exhibit 4 marked for 12:17:07  
11 identification.] 12:17:23  
12 A. All right. I'm with it. 12:17:23  
13 Q. Awesome. 12:17:25  
14 So I'll take you to column 13 of 12:17:26  
15 Bhatia, line 29. 12:17:30  
16 A. All right. 12:17:46  
17 Q. And so it says -- you see: 12:17:48  
18 "When the system detects a power 12:17:53  
19 mode change..."? 12:17:55  
20 Is that where you are? 12:17:56  
21 A. Yes. 12:17:56  
22 Q. So it says: 12:17:57  
23 "When the system detects a power 12:17:58  
24 mode change (such as in response to the 12:18:00  
25 power management module writing to the 12:18:02

1     predetermined control register to indicate     12:18:05  
2     the new performance state), an interrupt may     12:18:06  
3     be generated (at E1), which may be an     12:18:09  
4     interrupt defined by the ACPI     12:18:13  
5     specification."     12:18:16  
6             So I'm going to ask you a couple     12:18:18  
7     questions about that.     12:18:19  
8             First of all, what is an     12:18:20  
9     interrupt?     12:18:22  
10            MR. LI: Objection, form.     12:18:22  
11            A.     The concept of an interrupt in     12:18:27  
12     general for programmable processors is a     12:18:29  
13     mechanism for responding to events that you     12:18:33  
14     anticipate could happen but you don't know     12:18:38  
15     when they will.     12:18:40  
16            So typically if I hit a key on     12:18:42  
17     the keyboard, it's a mechanism for tapping     12:18:45  
18     the processor on the shoulder and saying,     12:18:48  
19     "Hey, read this and do whatever is     12:18:51  
20     appropriate."     12:18:54  
21            Q.     And how long have interrupts     12:18:54  
22     been used in operating systems?     12:18:56  
23            MR. LI: Objection, form.     12:19:01  
24            A.     The notion of interrupts, I     12:19:07  
25     certainly made -- I was aware of interrupts     12:19:10

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1 and what we generally refer to as interrupt 12:19:13  
2 service routines back when I was an 12:19:16  
3 undergraduate in the late '80s. If that 12:19:19  
4 answers your question. 12:19:22  
5 Q. It did. It did. 12:19:23  
6 And so that -- interrupts are 12:19:26  
7 a -- 12:19:31  
8 [Loud audio disruption.] 12:19:45  
9 THE VIDEOGRAPHER: We've lost 12:19:58  
10 Brandon's audio. I know he's trying 12:19:59  
11 to reconnect. 12:20:01  
12 Perhaps we should go off the 12:20:02  
13 record, Sean? 12:20:03  
14 THE VIDEOGRAPHER: You're muted. 12:20:11  
15 Paul, can you hear me? 12:20:17  
16 THE COURT REPORTER: I can hear 12:20:20  
17 you. 12:20:21  
18 MR. BROWN: Okay. I don't know 12:20:21  
19 if that was me or -- did everybody 12:20:22  
20 hear a really loud noise? 12:20:24  
21 THE WITNESS: Oh, yeah. 12:20:26  
22 MR. BROWN: Okay. Did it stop 12:20:27  
23 when I hung up? 12:20:29  
24 THE VIDEOGRAPHER: Hang on a 12:20:30  
25 second. I think we just lost Sean. 12:20:31

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1	Yeah. He's disappeared from our	12:20:35
2	screen.	12:20:37
3	We need to go off, Brandon.	12:20:37
4	MR. BROWN: Oh, yes, sure. I'm	12:20:40
5	sorry. I thought we already had.	12:20:42
6	THE VIDEOGRAPHER: Off the	12:20:43
7	record. The time is 12:20.	12:20:44
8	[Recess at 12:20 p.m. Pacific	12:20:49
9	Time.]	12:20:52
10	[Resuming at 12:23 p.m. Pacific	12:20:54
11	Time.]	12:23:28
12	THE VIDEOGRAPHER: Stand by,	12:23:28
13	please.	12:23:29
14	We're back on the record at	12:23:33
15	12:23.	12:23:35
16	Go ahead.	12:23:36
17	MR. BROWN: Great. Okay.	12:23:36
18	EXAMINATION CONTINUING	12:23:36
19	BY MR. BROWN:	12:23:36
20	Q. Technical difficulties like that	12:23:40
21	are expected during our new age of remote	12:23:41
22	depositions. But could have been worse.	12:23:44
23	So let's see. We were talking	12:23:47
24	about -- you were describing that -- you	12:23:48
25	were describing ISRs.	12:23:53

1                   So, you know, the idea of                   12:23:56  
2   interrupt handling and interrupts were all           12:24:00  
3   very well known to people of ordinary skill       12:24:03  
4   in the art at the time of the '301's               12:24:05  
5   invention; right?                                   12:24:09

6                   MR. LI: Objection, form.               12:24:11

7           A.       I would -- I would say that the       12:24:12  
8   concepts were well known to a person of           12:24:14  
9   ordinary skill in the art.                           12:24:16

10                   It is possibly worth commenting       12:24:23  
11   that in the context of realtime tasks many       12:24:26  
12   systems will -- the realtime component will       12:24:29  
13   not use interrupts because it is suddenly a       12:24:34  
14   new task in essence that appears. But the       12:24:39  
15   notion of interrupts and interrupt service       12:24:43  
16   routines was certainly somewhere in a           12:24:46  
17   skilled practitioner's toolbox.                   12:24:49

18           Q.       And realtime operating systems       12:24:52  
19   didn't prevent the use of interrupts. There       12:24:56  
20   were -- there are interrupts in realtime       12:24:59  
21   operating systems that properly address the       12:25:01  
22   fact that it's running in realtime; right?       12:25:04

23           A.       Yes. The -- I mean, for           12:25:11  
24   example, a realtime operating system will       12:25:12  
25   typically have a clock interrupt that runs       12:25:15

1 to manage its tasks in, you know, in time 12:25:19  
2 units. 12:25:27

3 Q. Okay. So then back to Bhatia, 12:25:29  
4 Exhibit 4. The last clause of that sentence 12:25:32  
5 we read says: 12:25:35

6 "...which may be an interrupt 12:25:36  
7 defined by the ACPI specification." 12:25:37

8 Do you see that? 12:25:40

9 A. Yes, I do. 12:25:42

10 Q. What is the ACPI specification? 12:25:42

11 A. So that specification was -- 12:25:47  
12 it's -- I believe it's still used today, 12:25:52  
13 although things have advanced quite a bit -- 12:25:55  
14 is a mechanism for -- it was an early 12:25:58  
15 attempt to try to allow a system to manage 12:26:00  
16 changes in power operating conditions. 12:26:03

17 So, for example, so that you 12:26:09  
18 could determine when you had unplugged your 12:26:11  
19 battery-powered device, the OS is informed 12:26:15  
20 of that generally. When you plug it in, 12:26:21  
21 it's informed of that. 12:26:23

22 When perhaps one part of the 12:26:24  
23 system decides to switch to a 12:26:26  
24 high-performance state versus a 12:26:31  
25 low-performance state. These are the sorts 12:26:33

1 of events that ACPI discloses. 12:26:34

2 Q. And to be clear on the timing, 12:26:41

3 those are the kind of things that ACPI 12:26:43

4 disclosed at the time of the '301's 12:26:46

5 invention as well; right? 12:26:49

6 MR. LI: Objection, form. 12:26:50

7 A. I think -- I believe so. Yeah, 12:26:52

8 so there's also an issue of what are called 12:26:57

9 "P states." I don't recall. And those are 12:27:02

10 generally the high performance, low 12:27:05

11 performance sort of refinement. I don't 12:27:07

12 recall. And I know that they weren't there 12:27:11

13 in the original ACPI. I'm not sure exactly 12:27:13

14 when they were introduced. They may have 12:27:17

15 been known at the time of Bhatia. They may 12:27:19

16 have been introduced subsequently. I don't 12:27:22

17 recall the timing of that. 12:27:24

18 Q. Okay. 12:27:26

19 But at the time of Bhatia, at 12:27:32

20 least you would agree, the ACPI 12:27:34

21 specification was already pretty well known 12:27:35

22 by people of ordinary skill and in use; 12:27:37

23 right? 12:27:41

24 A. Yes. 12:27:41

25 Q. And what a person of ordinary 12:27:48

1 skill would know about the ACPI 12:27:50  
2 specification is that it discloses things, 12:27:53  
3 like you're saying, about power management 12:27:54  
4 and responding to sort of power-state 12:27:56  
5 changes in a device; right? 12:27:59  
6 MR. LI: Objection, form. 12:28:02  
7 A. Yes. So ACPI allow -- gives -- 12:28:06  
8 it's a hook that allows a system builder to 12:28:09  
9 be told when certain state changes occur, 12:28:13  
10 and then it's up to the system builder -- 12:28:16  
11 and when I say that I mean both the person 12:28:18  
12 who assembles the hardware board and the 12:28:21  
13 operating system -- to determine if there's 12:28:24  
14 anything useful they can do in response to 12:28:27  
15 that. 12:28:29  
16 You know, for example, if you 12:28:29  
17 don't have a battery and you get an 12:28:32  
18 indication that you're unplugged, there's 12:28:35  
19 not much you can do. But you may be told 12:28:37  
20 you're unplugged. 12:28:40  
21 So there's still a lot of 12:28:41  
22 complexity of utilizing that technology. 12:28:42  
23 But ACPI and the ability to use 12:28:45  
24 interrupts to indicate certain power-related 12:28:48  
25 system events that happen was certainly well 12:28:51



1 known. 12:28:55

2 Q. And one of the events that -- I 12:28:56

3 think you might have mentioned this one but 12:28:59

4 I'll just make sure. 12:29:01

5 One of the types of power events 12:29:02

6 that the ACPI specification defines is that 12:29:07

7 the -- the battery reserve is getting too 12:29:12

8 low; right? 12:29:15

9 MR. LI: Objection, form. 12:29:17

10 A. I don't recall saying that. I 12:29:19

11 don't know that it actually indicates that. 12:29:21

12 If it does, it does. My recollection is 12:29:25

13 that what it indicates is if you're running 12:29:28

14 on wall current or not and if you're -- and 12:29:33

15 likely if you're running on battery or not. 12:29:36

16 It certainly indicates if you're 12:29:38

17 plugged into a wall and a change when it's 12:29:41

18 unplugged. It may be the case that they 12:29:44

19 don't actually indicate, ah, you've switched 12:29:46

20 to battery, and the operating system just 12:29:49

21 knows if I'm still running and I'm not 12:29:51

22 plugged in the wall. I must be on a 12:29:53

23 battery. It's been some time since I looked 12:29:55

24 at the details of how the different events 12:29:57

25 are specified. 12:29:59

1 Q. Sure. Sure. 12:30:00  
2 Well, let me -- why don't I give 12:30:03  
3 you -- let me make that an exhibit so that 12:30:04  
4 you can refresh on it. And it will take 12:30:07  
5 just a second for us to get it on the 12:30:11  
6 system. 12:30:13  
7 [Pause.] 12:30:14  
8 A. You're referring to the ACPI 12:30:16  
9 specification? 12:30:18  
10 Q. I am, yeah. Yeah. 12:30:19  
11 [Pause.] 12:30:22  
12 MR. LI: Is this a good time to 12:30:31  
13 take lunch break, while you upload the 12:30:33  
14 exhibit? 12:30:37  
15 MR. BROWN: Yeah. Can you give 12:30:39  
16 me, like, maybe five minutes? Because 12:30:40  
17 I think it's going to be quick. 12:30:43  
18 MR. LI: Okay. 12:30:46  
19 MR. BROWN: And then I'll get 12:30:46  
20 off this. Yeah. 12:30:47  
21 THE WITNESS: I anticipate it 12:30:48  
22 will be quick as well because the 12:30:50  
23 specification says some stuff, and if 12:30:51  
24 you point me to it I'll agree that it 12:30:53  
25 says that. But I haven't reviewed it 12:30:55



1 Q. And so you see the bullet point 12:32:17  
2 under: 12:32:19  
3 "Battery Management"? 12:32:20  
4 A. Yes. 12:32:20  
5 Q. And so it says: 12:32:23  
6 "Battery management policy moves 12:32:25  
7 from the APM BIOS to the ACPI OS." 12:32:27  
8 And then it says: 12:32:31  
9 "The OS determines the Low 12:32:32  
10 Battery and battery warning points, and the 12:32:33  
11 OS also calculates the battery remaining 12:32:38  
12 capacity and battery remaining life." 12:32:41  
13 Do you see that? 12:32:43  
14 A. Yes, I see that. 12:32:45  
15 Q. Okay. 12:32:45  
16 So the ACPI -- people of 12:32:47  
17 ordinary skill reading ACPI know that ACPI 12:32:52  
18 teaches about watching for low battery and 12:32:55  
19 battery warning states; right? 12:32:57  
20 MR. LI: Objection, form. 12:33:00  
21 A. They know that the operating 12:33:02  
22 system calculates it and ACPI doesn't. Or 12:33:03  
23 the operating system can calculate it and 12:33:08  
24 ACPI doesn't. 12:33:10  
25 Q. Is that what it says? I think 12:33:11

1 it says "the ACPI" OS. Isn't that referring 12:33:22  
2 to -- to aspects of ACPI that are 12:33:27  
3 implemented in the OS? 12:33:32

4 A. I thought that meant the OS 12:33:33  
5 that's ACPI compatible. But you're right. 12:33:36  
6 Maybe it's referring to the -- a standard 12:33:39  
7 software foundation for ACPI. 12:33:43

8 Q. Okay. 12:33:44

9 Well, I mean, so either 12:33:49  
10 interpretation of it, people of ordinary 12:33:51  
11 skill in the art know it, are aware that you 12:33:53  
12 can monitor the power reserve and take 12:33:57  
13 action in response to changes in the power 12:34:02  
14 reserve of that battery; right? 12:34:04

15 MR. LI: Objection, form. 12:34:05

16 A. So this passage certainly says 12:34:17  
17 "battery management" which -- "policy," 12:34:21  
18 which I guess implies taking action. And it 12:34:24  
19 indicates that the ACPI OS, whether that's 12:34:28  
20 the -- the low-level operating system or the 12:34:31  
21 user-level operating system, can monitor the 12:34:35  
22 battery capacity. And so, yeah, both of 12:34:40  
23 those were known. 12:34:45

24 It's -- as we just said, it's a 12:34:47  
25 question of which functionality was built 12:34:50



1 state change, is the type of events that 12:36:06  
2 we're reading about in the ACPI 12:36:08  
3 specification, namely, this -- this would 12:36:11  
4 refer to, among other things, the battery 12:36:13  
5 reserve warning coming up; right? 12:36:16  
6 MR. LI: Objection, form, 12:36:19  
7 foundation. 12:36:20  
8 A. Well, it doesn't disclose, 12:36:21  
9 doesn't mention battery reserve. And as we 12:36:24  
10 just talked about, it's not -- it's not 12:36:26  
11 clear to me if the ACPI spec elsewhere is 12:36:29  
12 disclosing that it's responsible for keeping 12:36:33  
13 some track of battery or not. 12:36:36  
14 So I guess I feel uncomfortable 12:36:40  
15 saying this discloses the use of a battery 12:36:43  
16 reserve as -- as an event. But it's -- it's 12:36:48  
17 possible. It's just I don't think it's 12:36:53  
18 saying that. 12:36:55  
19 Q. Well, so a person of ordinary 12:36:57  
20 skill in the art knew that the battery 12:36:58  
21 reserve was -- battery reserve alarms were a 12:37:01  
22 type of event that was known at the time; 12:37:07  
23 right? At least because of the ACPI spec? 12:37:09  
24 MR. LI: Objection, form. 12:37:13  
25 A. I think at the time of the 12:37:15

1 invention, most persons of ordinary skill in 12:37:17  
2 the art would have used a laptop that would 12:37:23  
3 occasionally put up a notice that said, "Low 12:37:26  
4 battery warning, 10 percent." So there 12:37:29  
5 has -- whether that was done by ACPI or some 12:37:32  
6 cruder method or whatever, there was an 12:37:36  
7 interrupt generated somewhere based on at 12:37:42  
8 least some estimate of battery capacity. 12:37:46  
9 Q. And then -- so then a person of 12:37:51  
10 ordinary skill reading Bhatia and reading 12:37:53  
11 about performance state changes required in 12:37:55  
12 response to a received event could interpret 12:37:58  
13 that to encompass this idea of a battery 12:38:02  
14 reserve event that he already -- he already 12:38:05  
15 knows about, both from -- from wherever it 12:38:07  
16 is, from his own personal use on a laptop or 12:38:09  
17 from ACPI or wherever; right? 12:38:12  
18 MR. LI: Objection, form. 12:38:14  
19 A. That seems to me that it's 12:38:16  
20 certainly possible that this combined with 12:38:19  
21 their personal experience and/or the ACPI 12:38:22  
22 specification might have led somebody 12:38:25  
23 reading Bhatia to think of battery capacity. 12:38:27  
24 It's not disclosed there explicitly, but I 12:38:30  
25 don't think it's unreasonable to think a 12:38:34



1	person could think of that.	12:38:37
2	Q. Okay.	12:38:41
3	MR. BROWN: Well, great. I	12:38:42
4	think that was about the ten minutes	12:38:43
5	that I asked for. So we can take a	12:38:44
6	break for lunch.	12:38:47
7	I will tell you I don't think I	12:38:48
8	have -- I need to look at my notes,	12:38:51
9	but I don't think we're going to go	12:38:53
10	too much longer after lunch. So we	12:38:55
11	could kind of keep it quick and then	12:38:56
12	come back for what I think will be a	12:38:59
13	short and last session.	12:39:01
14	MR. LI: Okay.	12:39:02
15	THE VIDEOGRAPHER: Shall we go	12:39:03
16	off?	12:39:04
17	MR. BROWN: Yeah. Sorry. I	12:39:05
18	forgot.	12:39:06
19	THE VIDEOGRAPHER: Off the	12:39:07
20	record. The time is 12:39.	12:39:08
21	[Luncheon recess at 12:39 p.m.	13:16:23
22	Pacific Time.]	13:16:27

23  
24  
25

1	AFTERNOON SESSION	13:16:28
2	[Resuming at 1:16 p.m. Pacific	13:16:29
3	Time.]	13:16:32
4	THE VIDEOGRAPHER: Stand by,	13:16:32
5	please.	13:16:33
6	And we're back on the record at	13:16:43
7	1:16.	13:16:44
8	Go ahead.	13:16:44
9	MR. BROWN: Great. Thank you.	13:16:45
10	EXAMINATION CONTINUING	13:16:45
11	BY MR. BROWN:	13:16:45
12	Q. Welcome back, doctor.	13:16:47
13	A. Thank you.	13:16:50
14	Q. Did you speak with PACT's	13:16:51
15	counsel at all during that break?	13:16:54
16	A. No, I did not.	13:16:56
17	Q. Great. Okay.	13:16:59
18	So I don't have too much more,	13:17:01
19	so it will be pretty -- hopefully pretty	13:17:02
20	painless for the remainder.	13:17:06
21	I want to take you to figure 4	13:17:07
22	of Nicol, which is Exhibit 1.	13:17:09
23	A. Okay.	13:17:26
24	Q. Okay.	13:17:26
25	So in figure 4 the -- the	13:17:28

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1 controller has the ability to modulate the 13:17:33  
2 frequency and voltage of each one of those 13:17:36  
3 PEs, right, individually? 13:17:39  
4 A. Yeah. The discussion around the 13:17:44  
5 controller is really muddled in my opinion. 13:17:48  
6 But certainly some controller determines 13:17:50  
7 what the voltage setting should be and what 13:17:54  
8 the frequency setting should be, and I 13:17:58  
9 believe that that's almost -- that's most 13:18:01  
10 likely running on the controller disclosed 13:18:03  
11 here. 13:18:06  
12 Q. And decisions about that clock 13:18:10  
13 frequency and what that voltage are going to 13:18:12  
14 be is, at least in part, established by the 13:18:14  
15 load on each of those PEs and any possible 13:18:20  
16 completion times that are required by those, 13:18:24  
17 by that load; right? 13:18:26  
18 MR. LI: Objection, form. 13:18:28  
19 A. That's my understanding. Tasks 13:18:32  
20 are assigned using some method, and then I 13:18:34  
21 believe a person of ordinary skill in the 13:18:43  
22 art would assume that the voltage is then 13:18:44  
23 dropped as low as possible to meet whatever 13:18:47  
24 the performance goals were on each 13:18:50  
25 individual PE. 13:18:52

1 Q. And then -- so you don't 13:18:53  
2 dispute, then, that the -- that Nicol is 13:18:57  
3 able to determine that clock frequency based 13:19:04  
4 on the state of how much load is sitting on 13:19:06  
5 that PE; right? 13:19:11  
6 A. So -- 13:19:11  
7 MR. LI: Objection, form. 13:19:24  
8 A. I would have to think about it a 13:19:26  
9 little bit more. 13:19:27  
10 For example, if they're 13:19:28  
11 currently running at the highest clock and 13:19:31  
12 you put more -- you assign more tasks to it 13:19:33  
13 than maybe the not mission critical, then 13:19:36  
14 the frequency isn't determined by the number 13:19:39  
15 of tasks or that sort of load exhibited 13:19:42  
16 there. 13:19:47  
17 Q. I gotcha. 13:19:49  
18 So there may be some edge cases 13:19:50  
19 here. 13:19:53  
20 But would you agree that 13:19:53  
21 generally the determination of clock 13:19:56  
22 frequency for those PEs is based on the 13:19:58  
23 state of, you know, what the load is on that 13:20:00  
24 PE? 13:20:03  
25 MR. LI: Objection, form. 13:20:05

1           A.       Yeah, I -- out of an abundance           13:20:06  
2       of caution I don't want to answer that           13:20:08  
3       because I know that it's a claim term, and I       13:20:11  
4       have not endeavored to consider the -- like       13:20:13  
5       I said, the entire scope of the claims but       13:20:17  
6       rather focused on the arguments made and       13:20:20  
7       whether I thought they were accurate or not.       13:20:24  
8                 So I did talk about state in the       13:20:28  
9       context of the arguments put forward by the       13:20:32  
10      petition.   13:20:38  
11           Q.       Right. Okay. Yeah, let me try       13:20:38  
12      to rephrase it.                                   13:20:41  
13                 Are you saying that you haven't       13:20:42  
14      come to a conclusion on what the state of a       13:20:45  
15      processing device means in the '301 patent?       13:20:48  
16      Is that kind of what you're saying?           13:20:52  
17           A.       I guess I wouldn't disagree with   13:20:55  
18      that. I mean, the term "state" is fairly       13:20:56  
19      broad. Given a particular context, it           13:21:02  
20      narrows. In the context of the '762 or the       13:21:06  
21      '301, it's narrowed further to the           13:21:12  
22      understanding of a person of ordinary skill     13:21:15  
23      in the art. But I haven't endeavored -- I       13:21:17  
24      wasn't tasked with trying to determine the     13:21:20  
25      metes and bounds of that.                     13:21:22

1           Q.     Have you -- sitting here right           13:21:25  
2     now, do you have any reason to believe that       13:21:32  
3     the state of the processing device in the           13:21:34  
4     claims of the '301 patent couldn't include       13:21:37  
5     looking at the load that's on a processor       13:21:40  
6     device?   13:21:44

7                     MR. LI:  Objection, form.           13:21:46

8           A.     I'm not ready to reach such a       13:21:47  
9     conclusion.  I would have to see the           13:21:49  
10    entire -- entire analysis.                       13:21:52

11          Q.     So then let me -- let's try it       13:21:55  
12    this way.  If the state of a processing           13:21:58  
13    device can be met by consideration of the       13:22:08  
14    load on a processing device, you would agree   13:22:10  
15    that under that understanding Nicol           13:22:13  
16    discloses that the clock frequency of a PE       13:22:20  
17    is determinable by a state of a processing       13:22:23  
18    device; right?                                   13:22:27

19                     MR. LI:  Objection, form.           13:22:29

20          A.     Not necessarily.  I'm not           13:22:33  
21    prepared to develop an opinion as I sit           13:22:34  
22    here.  I will certainly agree with you that   13:22:38  
23    the load is a state of a PE, but that's --       13:22:40  
24    I'm not comfortable saying it's the state as   13:22:47  
25    claimed in claim 3 or whichever other claim   13:22:50

1 is of relevance. I really focused on the 13:22:54  
2 arguments put forward by the petition, the 13:22:57  
3 petitioner and the petitioner's expert. 13:23:00  
4 Q. I gotcha. 13:23:03  
5 And then so that we can -- we 13:23:05  
6 can sort of live in that, in that 13:23:07  
7 environment. 13:23:08  
8 So you agree with me that the 13:23:09  
9 load is a state of a PE and -- right? You 13:23:11  
10 said that? 13:23:17  
11 A. Yeah. One -- 13:23:20  
12 MR. LI: Object to the form. 13:23:21  
13 A. A person of ordinary skill in 13:23:24  
14 the art could look at the load and say, 13:23:26  
15 "That represents a state for some useful 13:23:28  
16 reason." 13:23:32  
17 Q. And Nicol discloses using the 13:23:34  
18 load as a basis for how it sets the clock 13:23:38  
19 frequency; right? 13:23:45  
20 MR. LI: Objection, form. 13:23:47  
21 A. Nicol discloses a number of 13:23:51  
22 different modes, but in general the clock 13:23:55  
23 frequency is at least in part based on the 13:23:57  
24 load. 13:24:02  
25 Q. So then going back to figure 4. 13:24:06

1                   So we were discussing how in                   13:24:09  
2     figure 4 some controller, I think was -- was           13:24:17  
3     what you said, makes a decision about how to       13:24:22  
4     set the frequency and voltage of each PE.           13:24:24  
5     And in doing so, that controller can --           13:24:28  
6     could decide to set some of the PEs to the           13:24:35  
7     exact same frequency and voltage. Right?           13:24:38  
8                   MR. LI: Objection, form.               13:24:43  
9                   A.     Presumably that controller could   13:24:48  
10    do that either intentionally or                   13:24:51  
11    unintentionally, just accidentally. It           13:24:55  
12    could end up being configured to the -- to       13:24:57  
13    the same level.                                   13:25:00  
14                   Yeah, I guess I would say that.       13:25:01  
15                   Q.     So let's -- let's focus on the    13:25:07  
16    intentionally con- -- time.                   13:25:08  
17                   One example of how the               13:25:12  
18    controller might decide to do that is if it       13:25:13  
19    wants to evenly distribute, say, a very           13:25:15  
20    large task among, say, three of the PEs, it       13:25:18  
21    could -- it could decide that it's going to       13:25:24  
22    completely evenly decide that task, let's       13:25:26  
23    assume that was possible, and then assign       13:25:29  
24    the same frequency and voltage to each of       13:25:32  
25    three PEs to complete that, that task;           13:25:34

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1 right? 13:25:36

2 A. I'm sorry, could you repeat the 13:25:38

3 question? 13:25:39

4 Q. I was really afraid you were 13:25:43

5 going to make me repeat that one. 13:25:44

6 Okay. You know what? I'll 13:25:45

7 break it up though, because it was very 13:25:47

8 long. 13:25:49

9 So the controller may 13:25:50

10 intentionally decide to set multiple PEs to 13:25:55

11 the same frequency and voltage if for 13:25:59

12 instance it's dividing up one big task 13:26:04

13 evenly among those PEs. Fair? 13:26:07

14 MR. LI: Objection, form. 13:26:11

15 A. Presumably it could. There's 13:26:12

16 also a question of when we talk about it 13:26:17

17 being the -- the -- the state -- you know, 13:26:19

18 the -- the load, the number of tasks 13:26:24

19 assigned being a state of the PE, it may 13:26:27

20 very well be time dependent. For example, a 13:26:33

21 scheduler decides I'm going to put this task 13:26:36

22 on PE 1. PE 1 -- has its state changed yet? 13:26:38

23 Well, you know, the task needs to be moved 13:26:44

24 somehow to PE 1. 13:26:48

25 And at some point in time 13:26:49

1 subsequent to that, likely the clock 13:26:51  
2 frequency needs to be increased and the 13:26:53  
3 voltage needs to be increased. 13:26:54  
4 So there's also this time aspect 13:26:56  
5 of what "state" may mean. 13:27:00  
6 Q. So I'm -- I understand. I'm 13:27:12  
7 actually not trying to -- I've kind of left 13:27:14  
8 "state" behind us because I think that was 13:27:17  
9 something I didn't want to make you 13:27:19  
10 uncomfortable with a term that you hadn't 13:27:22  
11 construed. So I'm really just talking more 13:27:23  
12 generally about figure 4. 13:27:25  
13 Essentially that -- the 13:27:27  
14 controller could decide, by setting multiple 13:27:29  
15 of the PEs to the same frequency and same 13:27:32  
16 voltage, that it wanted them to -- to work 13:27:36  
17 together on one big task that was going to 13:27:38  
18 be evenly distributed. That's something 13:27:41  
19 that would be -- that would fall within 13:27:44  
20 something a person of ordinary skill could 13:27:45  
21 do with figure 4; right? 13:27:48  
22 MR. LI: Objection, form. 13:27:50  
23 A. So Nicol does discuss taking a 13:27:53  
24 big task and dividing it in two and suggests 13:27:56  
25 that it could be evenly divided in two, 13:28:01

1     although they talk about it may very well     13:28:05  
2     not be.     13:28:08  
3             If it is evenly divided in two     13:28:08  
4     and it was assigned to two different PEs,     13:28:11  
5     and those were the only tasks assigned to     13:28:13  
6     those two different PEs in the context of an     13:28:15  
7     architecture, the embodiment in figure 4,     13:28:19  
8     presumably Nicol would then adjust the     13:28:23  
9     desirable clock frequency and voltage of the     13:28:27  
10    two so that they were the same.     13:28:29  
11            Q.     And so in doing so, the     13:28:34  
12    controller would essentially be deciding     13:28:38  
13    to -- to sort of group together those two     13:28:45  
14    PEs that are on the same -- that are now on     13:28:48  
15    the same clock frequency and voltage to sort     13:28:51  
16    of complete that one big task that they     13:28:53  
17    divided up.   Fair?     13:28:55  
18            MR. LI:   Objection, form.     13:28:58  
19            A.     I wouldn't say that,     13:28:59  
20    particularly -- well, because group --     13:29:01  
21    "grouping" can mean a number of things.     13:29:04  
22    They are running at the -- under this     13:29:08  
23    hypothetical they would be running at the     13:29:09  
24    same frequency and voltage rate.   If that     13:29:11  
25    constitutes grouping in a particular     13:29:16

1 context, that's grouping. 13:29:17

2 But in my -- and obviously I'm 13:29:23

3 being careful because it's a claim term. 13:29:24

4 So, yeah, it is grouping of some 13:29:28

5 sort. I don't believe that the arguments 13:29:33

6 put forward that it constitutes the grouping 13:29:36

7 of the claim term hold up. But I've 13:29:39

8 discussed that in my disclosure, in my -- 13:29:42

9 Q. All right. 13:29:47

10 A. -- my report. 13:29:47

11 Q. Declaration. Declaration, yeah. 13:29:48

12 A. Thank you. 13:29:50

13 After lunch is always a bad time 13:29:52

14 for me. 13:29:54

15 Q. I understand. For all of us. 13:29:56

16 You're doing great. 13:29:58

17 So let's -- if -- let me see if 13:30:00

18 I can replay that. 13:30:08

19 If grouping -- if grouping means 13:30:12

20 that these -- withdraw that. 13:30:20

21 If grouping is met by these two 13:30:21

22 PEs running at the same frequency and 13:30:24

23 voltage, then what we've been describing of 13:30:26

24 dividing one big task up evenly among the 13:30:35

25 two PEs and running them at the same 13:30:38

1 frequency and voltage, that is a form of 13:30:39  
2 grouping. Fair? 13:30:42  
3 MR. LI: Objection, form. 13:30:43  
4 A. I would say that in general, 13:30:48  
5 sure. Taking one task and dividing it up 13:30:50  
6 among multiple PEs, whether they are running 13:30:53  
7 at the same voltage and clock frequency or 13:30:56  
8 not, is arguably a form of grouping. I'm 13:30:58  
9 just not comfortable saying it's a form of 13:31:01  
10 grouping as disclosed in the claims. 13:31:04  
11 Q. And what is it that -- what is 13:31:24  
12 it that you think is distinguishing that 13:31:27  
13 kind of grouping from what's in the claims? 13:31:29  
14 A. I don't have an opinion because 13:31:37  
15 I haven't tried to construe the domain 13:31:38  
16 covered by the claims. 13:31:42  
17 Q. Okay. You know, there was one 13:31:48  
18 thing that I promised I would come back to 13:31:49  
19 that you said several hours ago, and it was 13:31:52  
20 about this idea -- I think what you were 13:31:59  
21 describing what I know as something called 13:32:02  
22 "big little arrangement." Does that phrase 13:32:04  
23 mean anything to you? 13:32:06  
24 A. Yes. I didn't use that, I don't 13:32:08  
25 think. I heard you use it, and I think 13:32:10

1 we're talking about the same thing, which is 13:32:12  
2 a -- 13:32:14  
3 Q. Let me -- 13:32:15  
4 A. -- a grouping of powerful 13:32:15  
5 processors and a grouping of less powerful 13:32:17  
6 processors where they run the same 13:32:21  
7 instruction sets so logically they can 13:32:23  
8 compute the same tasks. But one will do it 13:32:25  
9 much faster than the other. 13:32:29  
10 Q. Perfect. Yeah. Okay. Yeah, 13:32:34  
11 we're -- I think we are talking about the 13:32:35  
12 same thing. So -- and thank you for 13:32:37  
13 describing it because otherwise nobody would 13:32:39  
14 know what we were talking about. 13:32:41  
15 So Nicol envisions the 13:32:43  
16 possibility of having sort of different 13:32:48  
17 types of processors like a big little 13:32:50  
18 arrangement in its -- in its disclosure; 13:32:53  
19 right? 13:32:58  
20 A. To be honest with you, I don't 13:33:00  
21 recall. I have generally been operating 13:33:01  
22 under the belief that the PEs are 13:33:06  
23 homogeneous, largely because the discussion 13:33:10  
24 of scheduling seems to act as if you can 13:33:15  
25 move tasks from one to the other. But if 13:33:17

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1       there's some particular passage that you       13:33:24  
2       would like to direct me to, I would be happy       13:33:26  
3       to review that.       13:33:28

4               Q.       Yeah. Yeah, I can. Let me see       13:33:30  
5       if I can short circuit it though, because       13:33:33  
6       that's -- that's not necessarily where I was       13:33:35  
7       trying to go.       13:33:37

8                       If in figure 4 we were to have       13:33:39  
9       that kind of arrangement, like let's say we       13:33:44  
10      had four PEs in figure 4 rather than three,       13:33:47  
11      just to make this example work, and we had       13:33:51  
12      two big and two little. Presumably a person       13:33:54  
13      of ordinary skill implementing Nicol would       13:34:01  
14      want their scheduler to conceptually group       13:34:05  
15      together those two big ones and treat them       13:34:09  
16      as what they are, two big PEs with more       13:34:11  
17      capacity, and then simultaneously also       13:34:14  
18      consider those two smaller PEs as together,       13:34:16  
19      as a group. And I'm not trying to tie you       13:34:22  
20      to the group language of the claims, just       13:34:24  
21      generally grouping them together.       13:34:26

22               A.       I don't think so.       13:34:28

23                       MR. LI: Objection, form.       13:34:30

24               A.       Given that they're able to       13:34:34  
25      operate separately with separate voltages       13:34:36

1 and frequencies, it's not -- it's not clear 13:34:38  
2 to me that any particular system would 13:34:42  
3 benefit from treating the -- you know, 13:34:46  
4 the -- the like PEs together in some sort of 13:34:49  
5 meaningful aspect of scheduling. 13:34:53

6 It may very well be the case for 13:34:55  
7 other reasons that, you know, are -- aren't 13:34:57  
8 disclosed by the -- by the sort of general 13:35:02  
9 model as we've talked about it. But on the 13:35:07  
10 face of it, if efficiencies of the different 13:35:09  
11 power supplies and DC-to-DC converters are 13:35:13  
12 largely the same, it's not clear to me why 13:35:16  
13 you would be inclined to try to logically 13:35:18  
14 group the like processors for scheduling 13:35:21  
15 together. 13:35:24

16 Q. Got it. 13:35:25

17 So maybe then -- so I have an 13:35:27  
18 idea on that, but maybe the easier way to 13:35:29  
19 think about it is what if we go to the 13:35:31  
20 middle-ground embodiment where now we can 13:35:33  
21 decide which processors are going to be on 13:35:35  
22 the same clock together. In that 13:35:38  
23 circumstance you could divide that up so 13:35:39  
24 that if you had -- let's say you have two 13:35:41  
25 groups and four PEs. Two of them you put 13:35:43



1 the two big ones together, you put the two 13:35:46  
2 small ones together, and then you decide how 13:35:49  
3 to schedule that accordingly. That's 13:35:50  
4 something that a person of ordinary skill 13:35:52  
5 could do with the middle-ground embodiment; 13:35:55  
6 right? 13:36:00  
7 MR. LI: Objection to form. 13:36:00  
8 A. In theory but that complicates 13:36:01  
9 the scheduler to a significant extent. So I 13:36:03  
10 feel uncomfortable, particularly at the time 13:36:06  
11 of invention, saying doing that would have 13:36:09  
12 been obvious. But it's certainly possible. 13:36:12  
13 Q. Was the big -- the concept of 13:36:18  
14 big little known at the time of the 13:36:19  
15 invention? 13:36:22  
16 A. So that specific term I know 13:36:24  
17 from an architectural flavor that was 13:36:31  
18 produced by the company ARM, A-R-M. 13:36:33  
19 Q. Yeah. 13:36:37  
20 A. I don't know whether -- and so I 13:36:39  
21 can't answer that question. I mean, ARM 13:36:43  
22 introduced that specific term at some point 13:36:45  
23 in time. I don't know when that was. And 13:36:47  
24 it's certainly possible that the concept was 13:36:50  
25 percolating in people's heads before that 13:36:53



1	MR. BROWN: Okay. No, I think	13:38:45
2	we're good on my side.	13:38:52
3	Thank you so much, doctor. It	13:38:54
4	was a pleasure chatting with you.	13:38:55
5	THE WITNESS: Thank you. You as	13:38:57
6	well.	13:38:59
7	THE VIDEOGRAPHER: Shall I	13:39:01
8	conclude?	13:39:02
9	MR. LI: Brandon, can we take	13:39:04
10	about five- to ten-minute break?	13:39:07
11	THE VIDEOGRAPHER: And then --	13:39:07
12	okay.	13:39:07
13	MR. BROWN: Sure.	13:39:13
14	THE VIDEOGRAPHER: So we go off	13:39:13
15	the record, then. All right.	13:39:13
16	Off the record. The time is	13:39:14
17	1:39.	13:39:15
18	[Recess at 1:39 p.m. Pacific	13:39:17
19	Time.]	13:40:21
20	[Resuming at 1:46 p.m. Time.]	13:40:22
21	THE VIDEOGRAPHER: Let me get	13:46:29
22	you guys on the record. Stand by,	13:46:30
23	please.	13:46:31
24	Thank you. We're back on the	13:46:31
25	record at 1:46.	13:46:33

1	Go ahead.	13:46:34
2	MR. LI: The patent owner	13:46:36
3	doesn't have further questions and	13:46:37
4	reserves the right to submit errata.	13:46:38
5	MR. BROWN: Okay. Sounds like	13:46:45
6	we're done.	13:46:46
7	Thank you so much, doctor. Have	13:46:47
8	a great rest of your day.	13:46:48
9	THE WITNESS: All right. Thank	13:46:51
10	you, everybody. Enjoy the weekend.	13:46:52
11	MR. LI: Thank you very much.	13:46:52
12	MR. BROWN: Thank you. Okay.	13:46:56
13	Take care.	13:46:56
14	THE VIDEOGRAPHER: This will	13:47:18
15	conclude today's testimony by william	13:47:20
16	Mangione-Smith PhD. The total number	13:47:22
17	of media units used was four, and	13:47:22
18	these are retained by Veritext Legal	13:47:25
19	Solutions.	13:47:25
20	Going off the record. The time	13:47:27
21	is 1:47.	13:47:28
22	[Deposition concluded at	
23	1:47 p.m. Pacific Time.]	
24	[Deposition Exhibits 1 through 5	
25	marked for identification.]	

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[Signature reserved.]

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C E R T I F I C A T E  
\*\*\*\*\*

I, PAUL J. FREDERICKSON,  
California Certified Shorthand  
Reporter No. 13164, do hereby certify:

That prior to being examined,  
the witness named in the foregoing  
deposition was by me remotely sworn or  
affirmed to testify to the truth, the  
whole truth and nothing but the truth;

That said deposition was taken  
down by me remotely in shorthand at,  
and thereafter reduced to print by  
means of computer-aided transcription;  
and the same is a true, correct and  
complete transcript of said  
proceedings.

I further certify that I am not  
interested in the outcome of the  
action.

Witness my hand this 20th day of  
January 2021.

PAUL J. FREDERICKSON, CSR  
CA CSR 13164  
Expiration date January 31, 2022

\*\*\*\*\*

WITNESS SIGNATURE

\*\*\*\*\*

I, WILLIAM MANGIONE-SMITH, PhD,  
do hereby declare under penalty of perjury  
that I have read the foregoing transcript  
of my deposition; that I have made such  
corrections as noted herein, in ink,  
initialed by me, or attached hereto; that  
my testimony as contained herein, as  
corrected, is true and correct.

EXECUTED this\_\_\_\_day  
of\_\_\_\_\_, 2021,  
at\_\_\_\_\_(City),  
\_\_\_\_\_(State).

\_\_\_\_\_  
WILLIAM MANGIONE-SMITH, PhD

[&amp; - 66]

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Federal Rules of Civil Procedure

Rule 30

(e) Review By the Witness; Changes.

(1) Review; Statement of Changes. On request by the deponent or a party before the deposition is completed, the deponent must be allowed 30 days after being notified by the officer that the transcript or recording is available in which:

(A) to review the transcript or recording; and

(B) if there are changes in form or substance, to sign a statement listing the changes and the reasons for making them.

(2) Changes Indicated in the Officer's Certificate. The officer must note in the certificate prescribed by Rule 30(f)(1) whether a review was requested and, if so, must attach any changes the deponent makes during the 30-day period.

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THE ABOVE RULES ARE CURRENT AS OF APRIL 1, 2019. PLEASE REFER TO THE APPLICABLE FEDERAL RULES OF CIVIL PROCEDURE FOR UP-TO-DATE INFORMATION.

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COMPANY CERTIFICATE AND DISCLOSURE STATEMENT

Veritext Legal Solutions represents that the foregoing transcript is a true, correct and complete transcript of the colloquies, questions and answers as submitted by the court reporter. Veritext Legal Solutions further represents that the attached exhibits, if any, are true, correct and complete documents as submitted by the court reporter and/or attorneys in relation to this deposition and that the documents were processed in accordance with our litigation support and production standards.

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