

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

INTEL CORPORATION,)
)
PETITIONER,) CASE NO. IPR2020-00539
) PATENT NO. 9,552,047
VS.)
)
PACT XPP SCHWEIZ AG,) CASE NO. IPR2020-00541
) PATENT NO. 9,075,605
PATENT OWNER.)

VIDEOTAPED REMOTE ZOOM DEPOSITION

WILLIAM MANGIONE-SMITH, PH.D.

THURSDAY, FEBRUARY 18, 2021

JOB NO. 4438905

REPORTED BY: DAYNA HESTER, C.S.R. 9970

Page 1

1 VIDEOTAPED REMOTE ZOOM DEPOSITION OF WILLIAM
2 MANGIONE-SMITH, PH.D., TAKEN ON BEHALF OF
3 PETITIONER, AT 9:04 A.M., THURSDAY,
4 FEBRUARY 18, 2021, WITH THE WITNESS, COURT REPORTER,
5 AND VIDEOGRAPHER APPEARING REMOTELY VIA ZOOM
6 VIDEOCONFERENCE, BEFORE DAYNA HESTER, C.S.R. NO.
7 9970.

8
9 APPEARANCES OF COUNSEL:

10 FOR PETITIONER:

11 KIRKLAND & ELLIS LLP

BY: BRANDON H. BROWN, ESQ.

12 (PRESENT VIA ZOOM VIDEOCONFERENCE)

BY: KYLE CALHOUN, ESQ.

13 (PRESENT VIA ZOOM VIDEOCONFERENCE)

555 CALIFORNIA STREET, SUITE 2700

14 SAN FRANCISCO, CALIFORNIA 94104

(415) 439-1670

15 BHBROWN@KIRKLAND.COM

KYLE.CALHOUN@KIRKLAND.COM

16
17 KIRKLAND & ELLIS LLP

BY: SARAH MIKOSZ, ESQ.

18 (PRESENT VIA ZOOM VIDEOCONFERENCE)

555 SOUTH FLOWER STREET, SUITE 3700

19 LOS ANGELES, CALIFORNIA 90071

(213) 680-8400

20 SARAH.MIKOSZ@KIRKLAND.COM

21
22
23
24
25 -- APPEARANCES CONTINUED ON NEXT PAGE --

1 APPEARANCES OF COUNSEL (CONTINUED):

2 FOR PATENT OWNER:

3 QUINN EMANUEL URQUHART & SULLIVAN, LLP

BY: MARK YEH-KAI TUNG, ESQ.

4 (PRESENT VIA ZOOM VIDEOCONFERENCE)

555 TWIN DOLPHIN DRIVE, 5TH FLOOR

5 REDWOOD CITY, CALIFORNIA 94065

(650) 801-5000

6 MARKTUNG@QUINNEMANUEL.COM

7
8 ALSO PRESENT:

9 KEIGO PAINTER, VIDEOGRAPHER

(PRESENT VIA ZOOM VIDEOCONFERENCE)

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I N D E X

DEPONENT	EXAMINATION	PAGE
WILLIAM MANGIONE-SMITH, PH.D.		
	BY MR. BROWN	7
	BY MR. BROWN (CONT'D)	95
	BY MR. TUNG	204

E X H I B I T S

EXHIBIT NO.	PAGE	DESCRIPTION
EXHIBIT 1	9	FILE ENTITLED "EXHIBIT - 0001 - [TAB C] NICOL EX. 1008.PDF"
EXHIBIT 2	122	FILE TITLED "EXHIBIT - 0002 - %5BTAB G%5D 08_WILEY DICTIONARY.PDF"
EXHIBIT 3	148	FILE TITLED "EXHIBIT-0003 %5BTAB H%5D KLING EX. 1010.PDF"
EXHIBIT 4	159	FILE TITLED "EXHIBIT - 0004 - %5BTAB D%5D BHATIA EX. 1009.PDF"
EXHIBIT 5	184	FILE TITLED "EXHIBIT-0005 - %5BTAB A%5D EX. 2027 - 047 EXPERT DEC.PDF"
EXHIBIT 6	184	FILETITLED "EXHIBIT - 0006 - (002) 2020-02-07 INTEL'S PETITION (047 PATENT).PDF"
EXHIBIT 7	189	FILE TITLED "EXHIBIT - 0007 - EX. 1001 - 047 SECHEN DECL..PDF"

ZOOM VIDEOCONFERENCE

THURSDAY, FEBRUARY 18, 2021; 9:04 A.M.

THE VIDEOGRAPHER: Good morning.

We're going on the record at 9:04 a.m. on 09:04
February 18th, 2021. 09:04

This is Media Unit 1 of the video-recorded 09:04
deposition of William Mangione-Smith taken by 09:04
counsel for defendants in the matter of Intel 09:04
Corporation versus PACT XPP Schweiz AG filed in the 09:04
United States Patent and Trademark Office. Case 09:04
number is IPR2020-00539 and related cases. 09:04

This is a virtual Zoom deposition. 09:04

My name is Keigo Painter from the firm 09:04
Veritext. I'm the videographer. The court reporter 09:04
is Dayna Hester from the firm Veritext. 09:04

I am not related to any party in this 09:04
action, nor am I financially interested in the 09:04
outcome. 09:04

Counsel and all present in the room and 09:04
everyone attending remotely will now state their 09:04
appearances and affiliations for the record. 09:04

If there are any objections to the 09:04
proceeding, please state them at the time of your 09:04
appearance beginning with the noticing attorney. 09:05

1 MR. BROWN: Good morning. 09:05
2 I'm Brandon Brown with Kirkland & Ellis 09:05
3 representing Petitioners Intel. 09:05
4 And with me also from Kirkland & Ellis is 09:05
5 Kyle Calhoun and Sarah Mikosz. 09:05
6 MR. TUNG: Mark Tung from Quinn Emanuel 09:05
7 for PACT XPP. 09:05
8 THE VIDEOGRAPHER: Okay. Will the court 09:05
9 reporter please swear in the witness. 09:05
10 THE REPORTER: Okay. Would you please
11 raise your right hand.
12 THE WITNESS: (Witness did as requested.)
13 THE REPORTER: Do you affirm the testimony
14 you are about to give in the cause now pending will
15 be the truth, the whole truth, and nothing but the
16 truth?
17 THE WITNESS: Yes, I do.
18 THE REPORTER: Thank you.
19
20 WILLIAM MANGIONE-SMITH, PH.D.
21 having been first duly sworn, was
22 examined and testified as follows,
23 09:05
24 THE VIDEOGRAPHER: Thank you. 09:05
25 You may proceed. 09:05

1 MR. BROWN: Thank you. 09:05
2 09:05
3 EXAMINATION 09:05
4 BY MR. BROWN: 09:05
5 Q. Good morning, Doctor. It's good to see 09:05
6 you again. 09:05
7 A. Yes. How are you doing? 09:05
8 Q. I'm well. Thanks. 09:05
9 You have been deposed -- this is the 09:05
10 fourth time on matters between Intel and PACT in the 09:05
11 last couple of weeks; is that right? 09:06
12 A. Yeah. It's been a little busy. 09:06
13 Q. So I'll -- I'll skip -- unless you would 09:06
14 like me to do it, I'll skip the usual explanation of 09:06
15 how a deposition works because I think you are 09:06
16 pretty familiar with it at this point. Is that 09:06
17 fair? 09:06
18 A. That is fair. Thank you. 09:06
19 Q. Yeah. Let me ask some of the -- the basic 09:06
20 introductory questions, though. 09:06
21 Is there -- are you in electronic 09:06
22 communication or any kind type of communication with 09:06
23 counsel for PACT? 09:06
24 A. No. Not -- other than he's on the screen. 09:06
25 Q. Okay. And on your computer in front of 09:06

Page 7

1 you, is anything open other than the Exhibit Share 09:06
2 and your Zoom window? 09:06
3 A. The computer off to the side, I have the 09:06
4 Exhibit Share opened up in the browser, and I've got 09:06
5 some other browser windows open that I intend to get 09:06
6 back to later. 09:06
7 Q. Okay. 09:06
8 A. But I'm not looking at them. 09:06
9 Q. I missed what you said -- but you are not 09:06
10 looking at -- you're not looking -- never mind. It 09:06
11 just showed up. 09:06
12 Okay. And is -- are there any notes 09:07
13 around you or anything you will be referring to as 09:07
14 we proceed through the deposition? 09:07
15 A. No. 09:07
16 Q. And is there any reason today why you 09:07
17 can't give true and complete testimony? 09:07
18 A. Not that I am aware of. 09:07
19 Q. You are not any on medication or under the 09:07
20 influence of anything that would impact your ability 09:07
21 to give truthful testimony today? 09:07
22 A. I don't believe so, no. 09:07
23 Q. Great. Okay. Well, so let's just jump 09:07
24 into it then. I've got marked as Exhibit 1 on the 09:07
25 Exhibit Share the Nicole reference. 09:07

1 MR. BROWN: For the record that is 09:07
2 U.S. Patent Number 6,141,762. 09:07
3 (Deposition Exhibit 1 was marked for 09:07
4 identification and is attached hereto.) 09:08
5 THE WITNESS: All right. I have that. 09:08
6 BY MR. BROWN: 09:08
7 Q. And you are familiar with the -- with 09:08
8 Exhibit 1 -- correct? -- Doctor? 09:08
9 A. Yes, I am. 09:08
10 Q. Okay. I want to take you, to begin with, 09:08
11 to Figure 3 of the Nicol reference, which is on 09:08
12 third page of the reference. 09:08
13 A. All right. I'm there. 09:08
14 Q. And can you tell me what Figure 3 is? 09:08
15 MR. TUNG: Objection. Vague. 09:08
16 THE WITNESS: Yeah. It's a figure that 09:08
17 they found useful for explaining what is going on in 09:08
18 Figure 2 system, but it's a little bit under 09:08
19 discussed, under explained. 09:08
20 BY MR. BROWN: 09:08
21 Q. So let's do some basics to make sure we're 09:08
22 on the same page. 09:09
23 The headings for the -- the headings on 09:09
24 the X axis, let's say, a "New Task Started," "Task 09:09
25 Ended," and "New Task Created." 09:09

1 You agree that those are incorrect; right? 09:09

2 MR. TUNG: Objection to form. 09:09

3 THE WITNESS: No. I -- I wouldn't say 09:09

4 that. I don't have a strong opinion one way or the 09:09

5 another. I am assuming they are correct because 09:09

6 that's the way they are written. 09:09

7 BY MR. BROWN: 09:09

8 Q. Okay. So let's look at Task Ended there 09:09

9 in the middle of Figure 3. 09:09

10 Do you believe that that point is when the 09:09

11 task ends in Nicol? 09:09

12 A. I believe that's when they indicate the 09:09

13 task ends. 09:09

14 Q. I see. 09:09

15 And so you think that a person of ordinary 09:09

16 skill in the art reading Nicol would believe that 09:09

17 that middle part of Figure 3 when the frequency and 09:09

18 voltage is at the very highest is when a task has 09:09

19 ended? 09:10

20 MR. TUNG: Objection. 09:10

21 THE WITNESS: I believe that a person of 09:10

22 ordinary skill in the art looking at this figure 09:10

23 would assume that it's labeled correctly. If that's 09:10

24 where the task ended, perhaps the consequence of its 09:10

25 ending and the adaptation of less in the system, 09:10

1 which will always have some delay as the significant 09:10
2 delay on the X axis. 09:10
3 BY MR. BROWN: 09:10
4 Q. Okay. So -- let me unpack that a little 09:10
5 bit. 09:10
6 Your understanding, then, is Figure 3, if 09:10
7 correctly labeled, indicates that when a task ends 09:10
8 there is a delay or a lag before the frequency is 09:10
9 reduced; is that correct? 09:10
10 A. Well, as an engineer I'll tell you that I 09:10
11 believe that there is a delay regardless of what the 09:10
12 figure shows. An event -- conditions change and 09:10
13 then the system responds. 09:10
14 I'm simply saying that perhaps that's the 09:11
15 delay they are trying to show, but it does seem 09:11
16 fairly large. The delay between when it's marked 09:11
17 "Task Ended" and when the system voltage and clock 09:11
18 speed gets reduced. 09:11
19 Q. Okay. Let's go to -- if you can go to 09:11
20 Column 4 at Line 54. Let's just review what Nicol 09:11
21 says about the figure. 09:11
22 A. All right. I am there. 09:11
23 Q. Okay. So figure -- at Line 54, Nicol 09:11
24 explains that [as read]: 09:11
25 "Figure 3 demonstrates the timing 09:11

1 associated with increasing" -- several 09:11
2 values there -- "when a new task is 09:12
3 created and the load on the 09:12
4 multiprocessor is thus increased...." 09:12
5 Do you see that? 09:12
6 A. I do. 09:12
7 Q. Okay. And so when it says "is thus 09:12
8 increased," does that mean that there is -- there is 09:12
9 a possibility that there is already a load on that 09:12
10 micro -- that multiprocessor and that the addition 09:12
11 of a new task is a sub- -- an additional task that 09:12
12 the multiprocessor is being given? 09:12
13 MR. TUNG: Objection. Assumes facts. 09:12
14 THE WITNESS: I do think that they 09:12
15 envision that there -- there could be a load, and 09:12
16 then the load increases. So there could be tasks 09:12
17 already leveled prior to that. 09:12
18 But if this helps, this discussion helps 09:12
19 point out some of the -- I suggested ambiguity. 09:12
20 It's not clear to me -- I mean, I know how tasks 09:12
21 work in general and in detail in a number of 09:12
22 operating systems. But when they say "Tasks 09:12
23 Created" and then "Tasks Started," it's not clear to 09:12
24 me exactly what they mean by those two terms. 09:13
25 BY MR. BROWN: 09:13

1 Q. Okay. Well, so -- so let's keep going on 09:13
2 that paragraph, and we'll come back to that in a 09:13
3 second. Maybe we can add some clarity. 09:13

4 It describes that -- Column 4 in Nicol 09:13
5 describes that a new task is created and the load on 09:13
6 the multiprocessor is thus increased. And then 09:13
7 explains in the next sentence at Line 58 [as read]: 09:13

8 "Specifically, it shows the 09:13
9 operating -- the system operating at 09:13
10 70 megahertz from a 1.8 voltage supply 09:13
11 when the load is increased in three 09:13
12 steps to 140 megahertz." 09:13

13 Do you see that? 09:13

14 A. Yes, I do. 09:13

15 Q. Okay. And so it -- that -- that's 09:13
16 describing a -- a step process by which the voltage 09:13
17 increases from 70 megahertz to 140 megahertz; right? 09:13

18 A. It is, but they say that's the load 09:13
19 increasing, which, again, is not very clear. 09:13
20 They -- they previously said the load increases when 09:14
21 they create task. 09:14

22 So when does the load increase. And I 09:14
23 would assume that the load associated with the task 09:14
24 is a fixed amount. It's not going up in a stage 09:14
25 mode. 09:14

1 Q. Okay. But it's -- what it is describing 09:14
2 here, if you would agree, is a process of increasing 09:14
3 the frequency from 70 megahertz to 140 megahertz 09:14
4 through a series of steps. Is that fair? 09:14

5 A. Yes. That is consistent with my 09:14
6 understanding of what they are doing here. 09:14

7 Q. And -- and those steps are -- are used to 09:14
8 reduce the noise associated with frequency of 09:14
9 voltage changes; right? 09:14

10 MR. TUNG: Objection. 09:14

11 THE WITNESS: That's consistent with my 09:14
12 recollection of their explanation. They probably 09:14
13 say it right there. 09:14

14 And, in fact, in Figure 3, if you go back, 09:14
15 you can see that there is a little bit of noise on 09:15
16 the -- on the voltage line at -- at those voltage 09:15
17 points. 09:15

18 BY MR. BROWN: 09:15

19 Q. And so what you are pointing out is that 09:15
20 on Figure 3 every time there is a voltage change, 09:15
21 there is -- some noise that -- that Nicol's device 09:15
22 experiences; right? 09:15

23 A. That's right. 09:15

24 Q. And that's because every time we change 09:15
25 the supply voltage, there is a risk of introducing 09:15

1 noise; right? 09:15

2 A. That's correct. The figure is fairly 09:15

3 idealized. You are going to get ripples and -- and 09:15

4 a little bit of noise during regular operation as 09:15

5 well. But I believe that's what they are intending 09:15

6 to indicate there. 09:15

7 Q. And then the paragraph goes on to describe 09:15

8 that the final stage of Figure 3 is that some time 09:15

9 thereafter -- well, hold on. Let me pause there. 09:16

10 The sentence after the one we just read 09:16

11 says [as read]: 09:16

12 "When the 2.7 volt supply is stable, 09:16

13 as show by the supply voltage plot, the 09:16

14 new task is enabled for execution." 09:16

15 Do you see that? 09:16

16 A. Yes, I do. 09:16

17 Q. And what that means is that the task -- 09:16

18 once -- once the supply slots appear stable, the 09:16

19 task can then begin execution; right? 09:16

20 A. Yes. 09:16

21 Q. And then the final stage of Figure 3 it 09:16

22 explains is that, once that task completes, the 09:16

23 reduced load allows lowering the clock frequency to 09:16

24 a 100 megahertz; right? 09:16

25 A. [Witness reviews document]. 09:16

1 Yes, I see that. 09:16

2 Q. And so let me ask -- let me ask this 09:16

3 initial question: 09:17

4 We started the -- we started Figure 3 at 09:17

5 70 megahertz. We increased to 140. And then when 09:17

6 we decreased, we only went to a 100. 09:17

7 What does that indicate about the number 09:17

8 of tasks that have been added to this multi- -- this 09:17

9 processor's queue? 09:17

10 MR. TUNG: Objection. Assumes facts. 09:17

11 THE WITNESS: I -- I wouldn't know. I'm 09:17

12 not sure what it indicates. 09:17

13 BY MR. BROWN: 09:17

14 Q. So you don't know why we -- we started at 09:17

15 70, went to 140, but then dropped down to 100 09:17

16 instead of 70 at the end; right? 09:17

17 A. That's right. I would have expected it to 09:17

18 go back down. Perhaps if they continued Figure 3, 09:17

19 it would go back down. Perhaps other tasks were 09:17

20 introduced in the meantime, and the overall load is 09:17

21 higher. But I simply don't know. 09:18

22 Q. Okay. So it's -- it's possible one 09:18

23 example of what might happen there is that 09:18

24 additional tasks were added to the queue at some 09:18

25 point in the -- in the Figure 3 time plot; right? 09:18

1 MR. TUNG: Objection. Assumes facts. 09:18

2 THE WITNESS: It's possible. But it 09:18

3 seems -- actually now I think about it, it seems 09:18

4 very unlikely based on my understanding of Figure 3 09:18

5 and how the system in Figure 2 works. 09:18

6 BY MR. BROWN: 09:18

7 Q. And why -- why is it unlikely? 09:18

8 A. Well, Nicol is focused on real-time, 09:18

9 mission-critical applications with tasks that have 09:18

10 known time limits within which they need to 09:18

11 complete. And Nicol focuses on picking the critical 09:18

12 unit and setting the clock volt- -- the frequency, 09:18

13 the clock frequency, to a rate such that it's just 09:19

14 above what is needed to complete. 09:19

15 So here, if a task is added, the frequency 09:19

16 goes up to a certain point and then never goes up 09:19

17 again. That leads me to believe that no other task 09:19

18 was added; otherwise, the conclusion would have 09:19

19 been, "Well, the amount of time needed for the new 09:19

20 task needs to also be taken into consideration." 09:19

21 Q. I see. Let me unpack that a little bit. 09:19

22 So -- so is it the case in Nicol that, for 09:19

23 every new task, no matter how large or small, you 09:19

24 believe there will be a corresponding frequency 09:19

25 change? 09:19

1 A. I don't believe that's consistent with 09:19
2 what I have said. No. 09:19

3 Q. Okay. Well, so that -- then -- I -- I'm 09:19
4 not trying to characterize what you said. I'm just 09:19
5 trying to ask the question. So... 09:19

6 Is it correct that in Nicol, every new 09:20
7 task will always be accompanied by a frequency 09:20
8 change when it is added to a PE's queue? 09:20

9 A. Nicol does a very thin job explaining how 09:20
10 it actually does task allocation. There -- there is 09:20
11 a small number of parameters that are given. 09:20

12 So I would say that if -- if you have a PE 09:20
13 in the system -- in the system of Figure 2, if you 09:20
14 have a PE running a particular task and you add 09:20
15 another task to that PE, I would expect the clock 09:20
16 rate to go up. 09:20

17 That is typically what happens. You are 09:20
18 trying to set the system task to complete its task 09:20
19 at exactly the right time. Yeah. That's -- and 09:20
20 that's what I would expect. 09:20

21 But, like I said, there is not a whole lot 09:21
22 of explanation in Nicol for how the system works. 09:21

23 Q. And so -- so we know in Nicol that there 09:21
24 is -- there is a consideration of some -- some tasks 09:21
25 have completion required -- how do I say this. 09:21

1 Some tasks in Nicol have required 09:21
2 completion times. And we know that is not always 09:21
3 the case, though; right? Some tasks might not have 09:21
4 a required completion time. 09:21

5 A. Certainly, in general, there are systems 09:21
6 that have -- that are mission-critical, time 09:21
7 sensitive with known completion times and others 09:21
8 that don't have known completion times and are not 09:21
9 considered mission critical -- and/or are not 09:21
10 mission critical. 09:21

11 And my recollection is that Nicol was 09:21
12 focusing on the first -- I don't recall if they 09:21
13 specifically talked about addressing the second. 09:22
14 But maybe they did. 09:22

15 Certainly in the -- in the context of 09:22
16 Figure 2, I know they are focusing on, "Well, we 09:22
17 have got to set our tasks. We know how much time 09:22
18 they take. This is how we are going to allocate 09:22
19 them." 09:22

20 Q. Yeah. So let me -- just to clarify that 09:22
21 one, let me take you to Column 3, Line 49 to 50. 09:22

22 And there it says, in fact -- well, 09:22
23 actually, let's go -- we'll make the full point up 09:22
24 to 47. Nicol says [as read]: 09:22

25 "That is, the presumption is that 09:22

1 there is a certain time when the tasks 09:22
2 assigned to the chip must be finished." 09:22
3 And that's talking about the required 09:22
4 completion time that we were just discussing; right? 09:22
5 A. Right. 09:22
6 Q. And then the next sentence says [as read]: 09:22
7 "In fact, there might not be any 09:22
8 particular requirement for when the 09:22
9 tasks are to be finished." 09:22
10 Right? 09:22
11 A. Right. 09:22
12 Q. And so that's saying that there -- there 09:23
13 could also be circumstances, as you are saying, in 09:23
14 Nicol where there is no required completion time for 09:23
15 certain tasks. Is that fair? 09:23
16 A. They are certainly discussing that. I 09:23
17 don't know how that would work with the -- with the 09:23
18 schedule that they talked about. 09:23
19 But they do realized that there are -- in 09:23
20 computing systems there are tasks that don't have a 09:23
21 known completion time, and they envision being able 09:23
22 to address it. I just don't know how they do it -- 09:23
23 do address that. 09:23
24 Q. Right. And so -- so if we go back to 09:23
25 Figure 3 and we think about my original question, 09:23

1 which is, is the frequency always going to increase 09:23
2 when we add new tasks to a PE, there are 09:23
3 circumstances where a task that is added to a PE's 09:23
4 queue might not require an increase in frequency; 09:23
5 right? It might be so small that no increase is 09:24
6 required. Is that fair? 09:24
7 MR. TUNG: Objection. Assumes facts. 09:24
8 THE WITNESS: I think in the context of 09:24
9 Nicol we need to discuss it a little more. 09:24
10 For example, if there's one task that 09:24
11 is -- that is identified as requiring a significant 09:24
12 amount of time, they'll set -- in the Figure 2 09:24
13 system, they'll set the clock rate for all the PEs 09:24
14 even if that's the only task running on any of them. 09:24
15 Naturally, if you get another task, which 09:24
16 is smaller than that, then you assign it to one 09:24
17 of -- to one of the other PEs, the clock -- I would 09:24
18 not expect the clock to be increased. 09:24
19 On the other hand, it was my understanding 09:24
20 of how Nicol works in Figure 2, if you were to 09:24
21 assign that to sort of the tent pole PE, the one 09:24
22 that has the most -- the one that is most heavily 09:24
23 loaded, I would expect the clock frequency to 09:24
24 increase or for the system to not meet its 09:24
25 performance requirements. 09:25

1 BY MR. BROWN: 09:25

2 Q. And what about the circumstance where -- 09:25

3 and we'll -- we'll talk about the -- the heaviest 09:25

4 load PE as the tent pole PE to -- so that we are on 09:25

5 the same page. 09:25

6 What about the circumstances where a task 09:25

7 with no required completion time -- and -- and let's 09:25

8 also say is a relatively small in frequency -- 09:25

9 computing requirements is added to the most heavily 09:25

10 loaded PE, Would you -- 09:25

11 MR. TUNG: Objection. 09:25

12 BY MR. BROWN: 09:25

13 Q. -- always expect -- 09:25

14 MR. BROWN: Sorry, Mark. 09:25

15 BY MR. BROWN: 09:25

16 Q. Would you always -- 09:25

17 MR. TUNG: Objection. 09:25

18 BY MR. BROWN: 09:25

19 Q. -- expect the heaviest loaded PE's 09:25

20 frequency to increase in that circumstance? 09:25

21 MR. TUNG: Objection. Incomplete 09:25

22 hypothetical. 09:25

23 THE WITNESS: I appreciate your comment a 09:25

24 moment ago, and I'll strive to stick with the -- 09:25

25 with the tent pole analogy as opposed to introducing 09:25

Page 22

1 two or three more, like I did last time. 09:25

2 The answer is, I -- I don't know. Nicol 09:26

3 doesn't -- my recollection, does not discuss, 09:26

4 particularly in the context of Figure 2, what to do 09:26

5 with any -- how to schedule any of these tasks where 09:26

6 there is no known required completion time. 09:26

7 Furthermore, if -- in -- in most cases, 09:26

8 when you -- when you don't have a known completion 09:26

9 time because you don't know what the compute -- what 09:26

10 the actual compute computation requirements are. So 09:26

11 they may be high, they may be low, it may be data 09:26

12 dependent, the same tasks may require a lot of time 09:26

13 with, you know, one instance and not so much if 09:26

14 it's -- when it is running higher later. 09:26

15 So I honestly don't know how to mix that, 09:26

16 particularly with the scheduling in Figure 2. 09:26

17 That's why I, you know, I -- I acknowledge 09:26

18 their ambition of saying "Yes. Our system can 09:27

19 handle both kind of tasks." 09:27

20 From my experience, you just don't do 09:27

21 that. If you have got a real-time, mission-critical 09:27

22 system, you schedule the tasks. And you have tight 09:27

23 control over them, and you don't introduce some 09:27

24 piece of code that sort of, in the wild, it can 09:27

25 just, you know, go on for some unbounded period of 09:27

1 time. 09:27

2 BY MR. BROWN: 09:27

3 Q. Got it. 09:27

4 So one of the things that you mentioned 09:27

5 earlier was that the -- the lack of a required 09:27

6 completion time -- I think you just said -- could 09:27

7 indicate that you don't know how long somebody is 09:27

8 going to take; right? 09:27

9 A. Yes. 09:27

10 Q. And -- and I think you also mentioned 09:27

11 earlier a lack of required completion time could 09:27

12 also indicate that this isn't one of those 09:27

13 mission-critical tasks; right? 09:27

14 A. I don't know if I said that. I might 09:28

15 have. I think that that's true, that -- you know, 09:28

16 for most of the -- for most real-time systems in 09:28

17 general, a mission-critical task is going to be -- 09:28

18 have bounded computation time -- some performance in 09:28

19 it. 09:28

20 That limits what you can actually compute 09:28

21 in one of those tasks because there are many things 09:28

22 we want to -- functions that we want to compute, but 09:28

23 we don't know how long they are going to take. 09:28

24 Well, that's a little tough. We want to 09:28

25 be sure that we can get done with some key things; 09:28

1 so we are going to give up that flexibility is the 09:28
2 approach that is typically taken. 09:28

3 Q. Right. Right. I think -- I think that 09:28
4 makes sense. 09:28

5 I think I am following that. But -- so 09:28
6 let me just make sure that I understand the answer 09:29
7 to my question. 09:29

8 The -- the lack of a required completion 09:29
9 time could also indicate that a task isn't a 09:29
10 mission-critical task; right? 09:29

11 A. I think, in general, the lack of a 09:29
12 non-completion time in a real-time system could 09:29
13 indicate that a task is not a mission-critical task, 09:29
14 at least within the bounds of being able to run on a 09:29
15 mission-critical, real-time environment. 09:29

16 I mean, there absolutely could be -- 09:29
17 typically what happens is you'll -- you'll have two 09:29
18 systems. One is the real-time, tightly controlled, 09:29
19 we'll do our best, put everything that is mission 09:29
20 critical on there. 09:29

21 And the second is a more general purpose 09:29
22 computer that can run more abstract control code 09:29
23 that is less tightly bounded. 09:29

24 There are absolutely all situations where 09:30
25 you might have to put some mission-critical code on 09:30

1 the second processor. So it's a good -- it's a good 09:30
2 indication that, if it's not bounded, it's at least 09:30
3 not generally intended to run on the tightly bounded 09:30
4 real time in that environment. 09:30
5 But it certainly still could be mission 09:30
6 critical. If they are landing -- whatever it is -- 09:30
7 Percival [phonetic] today on Mars. And that system 09:30
8 is designed in essentially that same way. 09:30
9 But I would expect, from the point of view 09:30
10 of the engineers, really almost all of the software 09:30
11 running on the whole thing is mission critical. 09:30
12 They just try to build backup systems and 09:30
13 redundancy. Even the stuff that they -- know they 09:30
14 can't run it in a tightly constrained, real-time 09:30
15 environment. 09:30
16 Q. Got it. 09:30
17 So then when we are -- when we are looking 09:30
18 at something like Figure 3 and assuming that Nicol 09:30
19 is -- as it explains, at least envisioning, the 09:31
20 ability to have real time -- have these 09:31
21 mission-critical and less mission-critical tasks 09:31
22 running on its PEs, would you -- would you expect -- 09:31
23 well, let me ask it differently. 09:31
24 Would a person of ordinary skill looking 09:31
25 at Nicol think that he should always increase the 09:31

1 frequency even -- for every new task that is added, 09:31
2 even if it's a, you know, light computational load, 09:31
3 non-mission critical task? 09:31
4 MR. TUNG: Objection. 09:31
5 THE WITNESS: I think that depends on 09:31
6 several factors that we -- in hypothetical that -- I 09:31
7 don't feel I can answer at the moment. 09:31
8 BY MR. BROWN: 09:32
9 Q. What are the factors that you think I -- 09:32
10 we need to fill in? 09:32
11 A. So, for example, what is the granularity 09:32
12 of when you could increase the clock frequency? It 09:32
13 may be the case that you put a task down and the 09:32
14 most heavily loaded PE just barely steps into that 09:32
15 band and it has, you know, a step band between -- 09:32
16 maybe you could go from a 140 to 180 and it needs 09:32
17 140 -- let me -- let me give it -- back that up. 09:32
18 Let's say a band is between 120 and 140, 09:32
19 and you put a task on it that puts it at 121. Well, 09:32
20 then you are going to program it at 140. And you 09:32
21 may decide, "I have some headroom." 09:32
22 So I get another task that comes in that I 09:32
23 know requires a very small amount of computation, I 09:32
24 may know that I can slip it in in that headroom and 09:32
25 not maybe increase over 140. 09:33

1 You just don't know what sort of 09:33
2 granularity they provide. Now, in general, in my 09:33
3 experience, that obviously they -- they try to 09:33
4 provide as much granularity as possible. It gives 09:33
5 you more choices. 09:33

6 So with that understanding, I would expect 09:33
7 that -- well, I -- I know that they are attempting 09:33
8 to bring the clock frequency down as much as 09:33
9 possible so that it's -- it's essentially the task 09:33
10 that is running -- we call it "just in time." It's 09:33
11 going to complete before it needs to but as close to 09:33
12 when it needs to as possible. 09:33

13 So, you know, with that understanding, I 09:33
14 have no reason to think in a particular 09:33
15 configuration there would be significant headroom 09:33
16 in -- in whatever the step capability is. For the 09:33
17 clock frequencies you can slide another task in. 09:33

18 I would concede that hypothetically it's 09:33
19 possible. I just don't know. 09:33

20 Q. Okay. So let me -- let me -- there's a 09:34
21 new concept we haven't talked about. This -- this 09:34
22 idea of a band of frequency. 09:34

23 So -- so what you are saying is that 09:34
24 there -- a POSITA reading Nicol could think that -- 09:34
25 or could have a system that has a band -- bands of 09:34

1 frequencies that only allow -- maybe I should -- I 09:34
2 shouldn't ask the question. I'm trying to summarize 09:34
3 your point, but I'm not sure I have it yet. 09:34
4 What -- what would a person of ordinary 09:34
5 skill reading Nicol know about this idea of the band 09:34
6 that you are explaining? 09:34
7 A. So a best possible situation would be: I 09:34
8 have got a task; I'm using Nicol Figure 2, and I 09:34
9 estimate that it needs a 140 megahertz. Let's go 09:34
10 back to my previous example, 120 megahertz. 09:35
11 Now, at that point, I could just dial up 09:35
12 the controls between voltage of frequency and say 09:35
13 "Okay. Go to 120 megahertz." I probably wouldn't 09:35
14 do that. 09:35
15 I would probably build in some safety 09:35
16 margins and -- and also need to account for the fact 09:35
17 that there is a little bit of time for the frequency 09:35
18 to ramp up. So I might say, hypothetically, "Oh, 09:35
19 it's not -- it's 120 megahertz, but let's put it at 09:35
20 123." And so we dial that up and let things run. 09:35
21 Now, the people who actually did the 09:35
22 engineering on designing the power system on the 09:35
23 clock system for Nicol might have told me "You know, 09:35
24 we can't give you that much tight control. We can 09:35
25 give you increments of 5 megahertz or 10 or 20 or 09:35

1 40, whatever. I could see reasons for doing it one 09:35
2 way or the other. I just don't know. Nicol doesn't 09:35
3 get into any of those details other than saying "we 09:35
4 want to get the frequency as low as possible that 09:35
5 still allows the task to complete." 09:36

6 Q. Got it. 09:36

7 So -- so prac- -- so that's the -- that's 09:36
8 the idealized situation in Nicol. The ideal 09:36
9 situation is that we have as tight of granularity as 09:36
10 we can over the control of the frequency? 09:36

11 A. In essence, I would say that. But, you 09:36
12 know, I assume that hopefully we're understanding -- 09:36
13 there always is some granularity. I am running at 09:36
14 120 megahertz. I would never expect the system to 09:36
15 say, okay, you can program me at 120 -- you know, 09:36
16 163 point -- there's some degree of control, even if 09:36
17 I get as finite a degree as I want. 09:36

18 But -- but -- yeah. Ideally, I would be 09:36
19 able to get almost arbitrarily close to whatever 09:36
20 frequency I thought was the perfect one. 09:36

21 Q. Right. 09:36

22 And so -- so the inverse to the idealized 09:36
23 situation is that, practically speaking, a system 09:37
24 that a POSITA would be looking at -- or would have 09:37
25 in mind when reading Nicol is that he would be 09:37

1 targeting certain bands of frequency that amount to 09:37
2 the -- really to the amount of control that he can 09:37
3 over the frequency on a device; is that right? 09:37

4 A. I think, practically, a POSITA would look 09:37
5 at this and understand that that might be the case 09:37
6 or it might not. I don't think he would look -- 09:37
7 they would look at it and say necessarily "We have 09:37
8 to have such a system." 09:37

9 Q. I gotcha. 09:37

10 It's a -- it's a circumstance that a 09:37
11 POSITA would know is possible but might not feel 09:37
12 restricted to. 09:37

13 Is that what you are saying? 09:37

14 A. Yeah. There are -- there are many factors 09:37
15 in Nicol that are under-specified. I think there 09:37
16 are -- like most patents, it is doing broad strokes 09:37
17 of the major issues they are concerned with. And 09:37
18 they are not really concerned with -- I don't 09:37
19 believe -- fundamentally how do you design the 09:37
20 electronics to get very precise control over clock 09:38
21 frequency in relationship to voltage. 09:38

22 They are just sort of acknowledging this 09:38
23 is a trend. "We know we have some control. How can 09:38
24 we take advantage of that in a -- in a unique and 09:38
25 interesting way." 09:38

1 Q. Got it. 09:38

2 And so -- so let's -- let's fill out the 09:38

3 hypothetical like the one you are explaining. 09:38

4 We have got -- the PE is running at 09:38

5 120 megahertz. And let's -- let's give it a band 09:38

6 of -- hold on. Let me actually reset this. 09:38

7 Let's create a PE that has a band of 09:38

8 10 megahertz. So it -- it can only control by the 09:38

9 10 megahertz on the frequency. Okay? 09:38

10 A. Yes. 09:38

11 Q. And let's say that it has a task that it 09:38

12 has calculated to run at 123 megahertz? 09:38

13 A. Okay. 09:38

14 Q. In that circumstance with the granularity 09:38

15 of only 10 megahertz of band, a POSITA would know 09:39

16 that that -- in order to achieve the objective of 09:39

17 Nicol, it would need to set the frequency of the PE 09:39

18 at 130 to make sure it's in the right band; is that 09:39

19 right? 09:39

20 A. I think under that hypothetical situation 09:39

21 that's what a POSIT would expect, yes. 09:39

22 Q. And then, let's say that a new task comes 09:39

23 along and is added to the existing workload. And 09:39

24 this new task has been calculated to only require -- 09:39

25 or to require 125 megahertz. 09:39

1 comes along and in some sense requires, like, 09:40
2 2 megahertz for a short period of time. 09:40

3 Q. Yeah. You -- I mean, I think you just 09:40
4 identified the mistake and that -- yeah. That was 09:41
5 what I was trying to insinuate. 09:41

6 So I can ask it again and see if it solves 09:41
7 the problem. But I will correct it for what you are 09:41
8 pointing out. 09:41

9 You have the one task that required 123, 09:41
10 and so you have set -- you set your PE at 09:41
11 130 megahertz to make sure you are covering the 123. 09:41

12 The new task only needs an additional 09:41
13 2 megahertz on that top of that for them to be run 09:41
14 together and still meet the required completion 09:41
15 time. 09:41

16 In that instance, a person of ordinary 09:41
17 skill would not -- would know that he wouldn't have 09:41
18 to increase the frequency in response to the new 09:41
19 task because he is already within the right band for 09:41
20 what he is supposed to be targeting; is that right? 09:41

21 MR. TUNG: Same objection. 09:41

22 THE WITNESS: I would expect that under 09:41
23 such a hypothetical it certainly is possible that a 09:41
24 person would look at such a condition on such a 09:41
25 system and say, "Yes. I can add another task in 09:41

1 this sort of context and not necessarily see the 09:42
2 voltage increase." 09:42
3 BY MR. BROWN: 09:42
4 Q. And so -- so a person of ordinary skill in 09:42
5 the art looking at Nicol and knowing about a -- 09:42
6 knowing of a potential limitation with the frequency 09:42
7 bands that we have been discussing, would know that 09:42
8 there are some circumstances where the addition of a 09:42
9 new task wouldn't necessarily require increasing the 09:42
10 frequency on the PE; right? 09:42
11 MR. TUNG: Objection. Asked and answered. 09:42
12 THE WITNESS: I think it depends on a lot 09:42
13 of other factors that could vary from situation to 09:42
14 situation. 09:42
15 Is it possible? Yes. Many things are 09:42
16 possible, but I'm mostly trying to consider, you 09:43
17 know, what would have been obvious or generally 09:43
18 understood. 09:43
19 Nicol doesn't -- doesn't discuss these 09:43
20 bands. I brought it up because they don't say you 09:43
21 have got infinite control; they don't say there are 09:43
22 bands. They are silent on the matter. And that is 09:43
23 a concern that I would have in responding to the 09:43
24 question. 09:43
25 But, you know, I would have to look at the 09:43

1 details -- specific system in order to be able to 09:43
2 answer that question. 09:43
3 BY MR. BROWN: 09:43
4 Q. But, I mean, the -- in the circumstance 09:43
5 that we just have been discussing and the 09:43
6 hypothetical of a 10-degree granularity and a large 09:43
7 task followed by a very small additional task, that 09:43
8 is, at least, a circumstance where I think we agree 09:43
9 there might not be a need to change the frequency in 09:43
10 response to adding that new task. Is that fair? 09:44
11 MR. TUNG: Same objection. 09:44
12 THE WITNESS: In the hypothetical 09:44
13 situation where there is a band of frequency 09:44
14 available of some width and you are running, 09:44
15 perhaps, at the low end of the band and you know 09:44
16 where the high end of the band is and you know that 09:44
17 a task has come in that has low enough computation 09:44
18 requirements that it can fit in that space without 09:44
19 requiring a bump out of the band, then if -- if all 09:44
20 that information is available to you inside the 09:44
21 system, yeah, I would expect you probably would not 09:44
22 increase the frequency. 09:44
23 With the one caveat, as I said, you 09:44
24 usually want to add some sort of safety margin. 09:44
25 Assuming you are within the safety margin, I would 09:44

1 expect you probably wouldn't increase the frequency. 09:44
2 BY MR. BROWN: 09:44
3 Q. And let's -- let's just unpack a little 09:44
4 bit this idea of -- of why you might not have, you 09:45
5 know -- or let me ask it: 09:45
6 There are -- there are a couple of reasons 09:45
7 why you would only have a certain amount of granular 09:45
8 control over the frequency. One of them could just 09:45
9 be limitations of the hardware that you have; right? 09:45
10 A. Yes. 09:45
11 Q. Another could be that you could recognize 09:45
12 that making a number of small changes to the voltage 09:45
13 could introduce unnecessary noise in the process; 09:45
14 right? 09:45
15 A. I guess I would say that, in general, 09:45
16 introducing -- introducing a change in the voltage 09:45
17 is going to introduce some noise. The smaller the 09:45
18 change is, the smaller the noise will result. 09:46
19 So, in general, if you have very fine 09:46
20 control, you can very slowly increase it, you will 09:46
21 get a better noise response. 09:46
22 Q. Okay. Are there other disruptions in the 09:46
23 system caused by increasing -- caused by voltage 09:46
24 changes in addition to the noise? 09:46
25 A. There -- there -- it could be. There 09:46

1 could be. It depends on lots of other issues that 09:46
2 we just don't know about. 09:46

3 There could be fundamental limitations on 09:46
4 the power supply. There could be a factor that is 09:46
5 called ground bounce, which used to be much more 09:46
6 important. But, you know, we are talking about some 09:46
7 art that is a little bit older these days. 09:46

8 So I guess the answer is potentially but 09:46
9 none that I recall being addressed by Nicol. 09:46

10 Q. Right. Now, we know that Nicol implements 09:47
11 this -- this step function to get from one voltage 09:47
12 to the desired voltage and frequency; right? 09:47

13 A. Yes. 09:47

14 Q. And it doesn't actually start the new task 09:47
15 until it reaches and sort of is steady on that 09:47
16 target frequency and voltage; right? 09:47

17 A. That's right. Although with a caveat, as 09:47
18 I said, they talk about "Task Created" and "Task 09:47
19 Started." I mean, I could speculate on what the 09:47
20 differences are. Clearly they are different, but I 09:47
21 don't know what they are. 09:47

22 But yes. To some extent they don't -- 09:47
23 they don't put the load on the new tasks on the 09:47
24 processor until the processor, the PE, can meet the 09:47
25 frequency requirements that they have determined for 09:47

1 that task. 09:47

2 Q. And so -- so there's actually a little bit 09:47
3 of a delay in execution on Nicol, then, every time 09:48
4 there is a voltage change; right? 09:48

5 A. There is presumably -- what -- what they 09:48
6 show is a little bit of delay in putting the load on 09:48
7 the PE when you increased it. In -- when they -- 09:48
8 when you said when they said -- I think you said 09:48
9 when there a change in the voltage when they -- when 09:48
10 we decrease, things go, you know -- operate 09:48
11 differently. 09:48

12 Yes. But they certainly disclose -- for 09:48
13 example, if you have got a task running on the PE 09:48
14 currently and you are going to add a new one and you 09:48
15 have determined that you need to increase the clock 09:48
16 frequency, then hypothetically the existing task 09:48
17 would continue to execute and, in fact, would simply 09:48
18 be running faster as the frequency speeds up. 09:49

19 But there -- they do show a delay in 09:49
20 putting the new load on the processor until the 09:49
21 frequency is stabilized at the target range. 09:49

22 Q. Okay. So -- so you are saying that -- let 09:49
23 me -- let me present the hypothetical that I have in 09:49
24 mind and see what you think. 09:49

25 I'm trying -- I'm envisioning a 09:49

1 circumstance where, you know, we have -- let's say, 09:49
2 we have -- we have a pretty important task that we 09:49
3 are working on -- that one PE is working on. And 09:49
4 then there is sort of a rapid assignment of a bunch 09:49
5 of not-critical tasks that are added to the queue 09:49
6 for that PE to deal with later. 09:49

7 And these don't necessitate any sort of 09:49
8 meaningful increase in voltage; they are roughly the 09:50
9 same. But maybe -- maybe small increases that are 09:50
10 calculated are necessary, like, half volt here, half 09:50
11 volt there. 09:50

12 Is a person of ordinary skill in the art 09:50
13 going to assume that Nicol will just repeatedly 09:50
14 attempt to increase the voltage in response to each 09:50
15 one of those small, fairly minor tasks? 09:50

16 Or will it do something -- would a person 09:50
17 of ordinary skill be inclined to -- to do something 09:50
18 to minimize that sort of rapid change? 09:50

19 MR. TUNG: Objection. 09:50

20 THE WITNESS: Nicol doesn't address any of 09:50
21 the scheduling issues in -- in anywhere near enough 09:50
22 detail to -- to answer that question. 09:50

23 For example, it was -- why -- I'm not sure 09:50
24 why you would assign a task to the heaviest 09:50
25 [verbatim] -- the most heavily loaded PE that is 09:50

1 running a mission critical one even if you are just 09:51
2 delaying it; right? 09:51

3 You would -- you would be inclined to 09:51
4 assign it to another PE. And if they are too busy, 09:51
5 just sort of hold off and wait until one of them is 09:51
6 free and then assign it to that. 09:51

7 I guess. 09:51

8 But, you know, there is -- as we talked 09:51
9 about the last time, there is a huge range of 09:51
10 scheduling algorithms for real-time systems that 09:51
11 operate differently. And then when you throw in 09:51
12 non-mission critical or non-time bounded tasks, the 09:51
13 complexity increases dramatically. 09:51

14 So I'm sorry. I don't know how to answer 09:51
15 that in the context of Nicol and what they disclose 09:51
16 and what I would do there. 09:51

17 BY MR. BROWN: 09:51

18 Q. Gotcha. Gotcha. I'll try to ask it 09:51
19 better, then. 09:51

20 So the -- I think as we talked about last 09:51
21 time, there are -- a person of ordinary skill in the 09:51
22 art reading Nicol at the time had in his mind a 09:51
23 whole range of different implementations of 09:52
24 schedulers for distributing tasks; right? 09:52

25 A. It depends on their background. I think 09:52

1 that the way we have defined a person of ordinary 09:52
2 skill in the art, they -- they may not be that 09:52
3 expertise in real-time system -- mission-critical 09:52
4 system. But certainly, such a person could come to 09:52
5 Nicol with knowledge of the whole -- of a range of 09:52
6 options and problems that need to be addressed. 09:52
7 Q. And -- and one of the options that a 09:52
8 person of ordinary skill in the art might have in 09:52
9 mind or -- well, let me ask: 09:52
10 One of the options that a person of 09:52
11 ordinary skill had available to them at the time, 09:52
12 was -- was a recognition of schedulers that would -- 09:52
13 well, with- -- withdrawn. 09:53
14 Let me ask it differently. 09:53
15 The -- what I am trying to get at is -- is 09:53
16 that -- is this concept of -- let's just -- I 09:53
17 understand what you are saying about Nicol not 09:53
18 necessarily needing to rapidly add a bunch of sort 09:53
19 of lower important tasks to -- to a loaded PE. 09:53
20 Let's just assume that there is a circumstances 09:53
21 that -- that can happen in. 09:53
22 What I am getting at is, wouldn't a person 09:53
23 of ordinary skill in the art, at least having 09:53
24 some -- you know, with some knowledge of existing 09:54
25 schedulers, not want to repeatedly change the 09:54

1 frequency of a PE in small, minor increments in 09:54
2 order to avoid any of the negative impacts that we 09:54
3 have been talking about? 09:54
4 MR. TUNG: Objection. 09:54
5 THE WITNESS: Under that hypothetical, I 09:54
6 guess I would say not necessarily. The cost of 09:54
7 noise injection for very small increases may be so 09:54
8 minimal that -- that it wouldn't be a concern. 09:54
9 But -- but I would say that I don't know. 09:54
10 I can't think of any particular scheduler that would 09:54
11 have been known to a person of ordinary skill in the 09:54
12 art at the time that would handle both fundamentally 09:54
13 time-bound tasks and mixed in unbounded or 09:54
14 uncritical tasks. 09:54
15 I'm not saying they didn't exist. It's 09:54
16 just such a complex problem. I don't know of any 09:54
17 system that -- myself even with hindsight. And so I 09:55
18 certainly don't know of any system that would have 09:55
19 been obvious to a person of ordinary skill in the 09:55
20 art at the time. 09:55
21 BY MR. BROWN: 09:55
22 Q. Okay. Let's switch gears a little bit and 09:56
23 talk about the -- a distribution of tasks in the 09:56
24 Figure 4 embodiment, which is the one where they 09:56
25 each have their own clocks. 09:56

1 A. Yes. 09:56

2 Q. So the -- the distribution of tasks -- so 09:56

3 in Figure 4, each of the PEs is independently -- its 09:56

4 voltage and frequency is independently controlled; 09:56

5 right? 09:56

6 A. Yes. That's consistent with my 09:56

7 understanding. 09:56

8 Q. And so the -- the frequency of those PEs 09:56

9 increased when the voltage is increased; right? 09:57

10 A. So what -- I mean, what typically happens 09:57

11 is you increase the voltage because you intend to 09:57

12 subsequently increase the frequency. 09:57

13 Q. And the -- the frequency can't be 09:57

14 increased if the voltage hasn't been increased; 09:57

15 right? 09:57

16 A. In general, you -- they go -- they are 09:57

17 married together depending on undisclosed details 09:57

18 of, hypothetically, how Nicol could be built. 09:57

19 In my experience, a lot of times there is 09:57

20 just a sort of programmable dial that says "put the 09:57

21 frequency at this range." In which case, you could 09:57

22 set it at something that wouldn't be supported by 09:57

23 the voltage. But I certainly don't think that it is 09:57

24 anticipated that that is what anyone would want to 09:58

25 do. 09:58

1 Q. Okay. Right. 09:58

2 So, generally speaking, the -- the 09:58

3 frequency and the voltage are married together. 09:58

4 That is what you are saying in that, when you 09:58

5 increase the voltage, you then increase -- the 09:58

6 frequency can then be increased; right? 09:58

7 A. I think it's envisioned that -- that 09:58

8 typically in -- in -- not just in Nicol but, you 09:58

9 know, details need to be flushed. But in most of 09:58

10 these systems, yes, when you -- you typically 09:58

11 increase the voltage because you wish to increase 09:58

12 the frequency, and when you decrease the frequency, 09:58

13 subsequently, you typically decrease the voltage. 09:58

14 With the caveat that there are other 09:58

15 exceptions. It may be a high power component in the 09:58

16 system that doesn't require, you know, a clock 09:58

17 frequency higher. May just require some higher 09:58

18 voltage, but we're not talking about that. 09:59

19 Q. And -- and so when we look at how work is 09:59

20 distributed among the PEs in Figure 4, if -- sorry. 09:59

21 I am distracted because my -- my cat is 09:59

22 attempting to jump up and ruin this entire 09:59

23 deposition. And so I am holding him -- there -- 09:59

24 sorry. 09:59

25 I apologize for that interruption. 09:59

1 When a -- when a PE is assigned a small 09:59
2 number of -- of operations, that PE's frequency will 09:59
3 be set accordingly. And, as compared to a PE that 09:59
4 has been assigned a large number of operations, the 09:59
5 frequency will be set relatively high -- let me 10:00
6 withdraw and ask it different. 10:00

7 The PEs in Figure 4, their frequency is 10:00
8 set in accordance with the amount of work that they 10:00
9 have to complete; is that right? 10:00

10 A. Yes. That's my understanding. In 10:00
11 Figure 4, each of the PEs can operate at a different 10:00
12 frequency and a different voltage. And without 10:00
13 Nicol going into too much detail, that is done, I 10:00
14 would say, roughly in accordance to the load put on 10:00
15 the individual PE. 10:00

16 Q. And so if a PE has a small load, it would 10:00
17 be set -- its frequency will be set -- will be set 10:00
18 low. Is that fair? 10:00

19 A. I think that that's not an unfair 10:00
20 characterization. Previously, I talked about it as 10:00
21 a tent pole -- maybe hopefully not stretching the 10:00
22 analogy too far. 10:01

23 You know, the tent pole in the middle of 10:01
24 the tent might be the highest, but around the edges 10:01
25 you would have lower tent pole. So the most heavily 10:01

1 loaded PE would be operating at the highest voltage, 10:01
2 and some other ones with the lower load would, I 10:01
3 expect be, configured to operate at a lower voltage. 10:01

4 Q. And those -- those PEs at the lowest at -- 10:01
5 with the smaller load will be set -- and, actually, 10:01
6 this is true for everything. And so let me ask it 10:01
7 differently. 10:01

8 The PEs with a small load will be set to 10:01
9 the lowest frequency possible to complete those 10:01
10 tasks at times; right? 10:01

11 A. In general, that comports with my 10:01
12 understanding with the usual caveat that there 10:01
13 usually is some safety margin or there maybe be some 10:01
14 band. But that is certainly my understanding of the 10:02
15 intent of Figure 4. 10:02

16 Q. And there could be circumstances where, if 10:02
17 we look at Figure 4 and the drawing has three PEs, 10:02
18 let's say, that there were only two tasks that could 10:02
19 be -- that we had to work on at that moment, and 10:02
20 they would be assigned to, say, the first two PEs. 10:02
21 The third PE would have no work to do in that 10:02
22 circumstance; right? 10:02

23 A. Yes. 10:02

24 Q. And so in that circumstance, the PE would 10:02
25 have its frequency set to as -- as low as possible 10:02

1 to keep it running, but essentially clock it in; 10:02
2 right? 10:02
3 MR. TUNG: Objection. Assumes facts. 10:02
4 THE WITNESS: Not necessarily. There are 10:02
5 a number of techniques that are -- that are 10:03
6 possible. And Nicol really doesn't get into the -- 10:03
7 anything close to enough details to speculate on 10:03
8 that. 10:03
9 BY MR. BROWN: 10:03
10 Q. One of the things that would be possible 10:03
11 if a PE had -- had no work to do at the time, would 10:03
12 be to bring that supply voltage down -- to 10:03
13 essentially shutdown that PE so that we -- we met -- 10:03
14 we realize Nicol's goal is about power saving; 10:03
15 right? 10:03
16 MR. TUNG: Same objection. 10:03
17 THE WITNESS: Like I said, there are a 10:03
18 number of techniques that could be taken. Some of 10:03
19 which don't fundamentally require changing the 10:03
20 frequency to get the desired benefit as much as 10:03
21 others. 10:03
22 I can't speculate on, you know, what a 10:03
23 POSITA looking at Nicol at the time of invention 10:04
24 would have done. You know, if we could talk about 10:04
25 what they could have done, but that is -- there is a 10:04

1 huge basket of tools that one could look at. 10:04

2 BY MR. BROWN: 10:04

3 Q. So if I could take you in Nicol to 10:04

4 Column 5, Line 40 -- 42. 10:04

5 A. I'm there. 10:04

6 Q. And Nicol there says, [as read]: 10:04

7 "Of course, Vdd local can only be 10:04

8 reduced so far before the circuits 10:04

9 start to fail, at which point the 10:04

10 operating system employs gated clocking 10:04

11 techniques to 'shut down' PEs that are 10:04

12 not needed." 10:04

13 Do you see that? 10:05

14 A. I do. 10:05

15 Q. Yeah. And so what -- at least part of 10:05

16 what Nicol is saying there is that it can shutdown 10:05

17 PEs that are not needed; is that right? 10:05

18 A. Well, I mean, it says what it says, but it 10:05

19 doesn't say much in any great detail for me to 10:05

20 really figure out what it is they mean. 10:05

21 Clock gating is used quite widely, 10:05

22 particularly today. But it is a technique that is 10:05

23 supplied to circuits, not an operating system. 10:05

24 So the notion of an operating system doing 10:05

25 clock gating is largely foreign to me. I don't know 10:05

1 exactly what they mean in this context. 10:05

2 And with that caveat, if I could follow 10:05

3 up. If we could -- no rush, but sort of schedule a 10:05

4 break in the next five to ten minutes, that would be 10:05

5 appreciated. 10:05

6 Q. Sure. Sure. 10:05

7 Let -- yeah. Let's just -- let's -- maybe 10:05

8 a couple of more questions about this, and then for 10:06

9 sure we'll take a break. 10:06

10 So the -- regardless of how the clock 10:06

11 gating is implemented, you agree that a person of 10:06

12 ordinary skill in the art would understand that PEs 10:06

13 that are not needed should be put in some sort of 10:06

14 low-voltage state so as to reduce power usage. Is 10:06

15 that fair? 10:06

16 MR. TUNG: Objection. 10:06

17 THE WITNESS: I don't know that I would 10:06

18 even say this. The best that they suggest is that, 10:06

19 as you said, you should do clock gating without any 10:06

20 discussion of how that gets -- gets done. 10:06

21 Let me finish reading this again for a 10:06

22 moment. 10:06

23 [Witness reviews document]. 10:06

24 All right. I apologize. 10:07

25 Could you repeat the question. 10:07

1 BY MR. BROWN: 10:07

2 Q. Yeah. Sure. 10:07

3 So regardless of how the person of 10:07

4 ordinary skill interprets how to implement the gated 10:07

5 clocking techniques that are described here, a 10:07

6 person of ordinary skill reading Nicol would 10:07

7 understand that, when a PE has no load on it, it can 10:07

8 be put into some type of low-voltage state so as to 10:08

9 not cause power drain. Is that fair? 10:08

10 MR. TUNG: Objection. Form. 10:08

11 THE WITNESS: I would -- I would say that 10:08

12 I think that I almost agree with that. My 10:08

13 understanding from Nicol is, for example, if you 10:08

14 have no task running on a processor, a PE in 10:08

15 Figure 4, you would -- you would naturally be 10:08

16 inclined to reduce the voltage as much as you deemed 10:08

17 reasonable. 10:08

18 And -- and there are reasons why you 10:08

19 may -- in certain situations, you may not want to go 10:08

20 as low as you could. You may anticipate some work 10:08

21 coming in and want to be able to start quickly. 10:08

22 My one caveat with what you said is, 10:08

23 whatever voltage -- wherever you put it at, there 10:08

24 still will be some -- I forget the term you use -- 10:08

25 some power consumption. If the voltage is on -- 10:08

1 1 even if the clocks are gated, there is still some 10:08
2 2 consumption. But, presumably, you have done your 10:09
3 3 best to lower it, reduce it as much as possible. 10:09
4 4 BY MR. BROWN: 10:09
5 5 Q. Got it. Yeah. Let me correct that. So I 10:09
6 6 think that seems fair. 10:09
7 7 A person of ordinary skill in the art 10:09
8 8 reading Nicol would understand that, when a PE 10:09
9 9 doesn't have a load on it, it should be put into 10:09
10 10 some sort of low-voltage state that will minimize 10:09
11 11 power consumption. Is that fair? 10:09
12 12 A. I think it's fair to say that in such a 10:09
13 13 situation where there is no task running on a PE, a 10:09
14 14 person would be inclined to put it in such a voltage 10:09
15 15 state as to reduce the power consumption -- that 10:09
16 16 would result in reducing the power consumption as 10:09
17 17 much as they knew how to. Yeah. 10:09
18 18 Q. Okay. Got it. 10:09
19 19 MR. BROWN: So let's take that break. And 10:09
20 20 why don't we come back at -- is 10:20 okay? 10:09
21 21 THE WITNESS: That works for me. 10:09
22 22 THE VIDEOGRAPHER: We're going off the 10:09
23 10:09 23 record. The time is .
10:09
24
24 24 (Brief recess.) 10:23
25
25 25 THE VIDEOGRAPHER: We're back on the 10:23

1 10:23 1 record. The time is .
2 10:23
3 2 BY MR. BROWN: 10:23
4 3 Q. Welcome back, Doctor. 10:23
5 4 During the break, did you communicate with 10:23
6 5 counsel for PACT at all? 10:23
7 6 A. No, I did not. And if he tried to call 10:23
8 7 me, my -- I apologize. My phone was muted and -- 10:23
9 8 no, I did not communicate with them or anyone else, 10:24
10 9 any other attorneys. 10:24
11 10 Q. Okay. Thank you. 10:24
12 11 So we talked about -- before the break we 10:24
13 12 were talking about how -- when a PE has a -- has no 10:24
14 13 load, it is run -- its voltage is set to as low as 10:24
15 14 possible in order to minimize a power consumption; 10:24
16 15 right? 10:24
17 16 A. It's my understanding that under that 10:24
18 17 hypothetical scenario, the PEs in a Figure 4 Nicol 10:24
19 18 system, such as an unloaded PE would be set to some 10:24
20 19 very low number in an attempt -- very low voltage in 10:24
21 20 an attempt to reduce the power consumption. 10:24
22 21 Q. And as a result of that, its frequency 10:25
23 22 will also be set correspondingly low; right? 10:25
24 23 A. Yes. As we talked about before, for any 10:25
25 24 of these systems that use adaptive clock and clock 10:25
25 25 frequency and voltage, you tend to change one in 10:25

1 order to change the other. 10:25

2 Q. And on the -- now, let's switch to the 10:25

3 flip side. 10:25

4 There are circumstances in Figure 4 where 10:25

5 all of the PEs were running at their absolute 10:25

6 maximum frequency; is that right? 10:25

7 MR. TUNG: Objection. 10:25

8 THE WITNESS: I think each of the PEs in 10:25

9 Figure 4 has -- as they show its own -- their own 10:26

10 independent power supply and dynamic voltage. 10:26

11 It is hypothetically possible certainly 10:26

12 that a particular load situation may cause them all 10:26

13 to be running at their highest possible clock 10:26

14 frequency and voltage. 10:26

15 BY MR. BROWN: 10:26

16 Q. And one thing that -- let's break this 10:26

17 down a little bit. 10:26

18 One thing that could cause -- in Figure 4 10:26

19 let's -- let's number the PEs for our ease of 10:26

20 reference just in order. We'll make the first one 10:26

21 on the left PE 1; the middle one, PE 2; and the one 10:26

22 on the right, PE 3. 10:26

23 A. Understood. 10:26

24 Q. So if -- one of the circumstances that 10:26

25 could cause PE 1 to have to run at its maximum clock 10:26

1 frequency is if PE 2 and PE 3 are already running at 10:27
2 their maximum clock frequency and a new task needs 10:27
3 to be added to one of the PEs, and PE 1 is the only 10:27
4 one with some feeling to do so; is that right? 10:27
5 MR. TUNG: Objection. Incomplete 10:27
6 hypothetical. 10:27
7 THE WITNESS: It's hard for me to say 10:27
8 because Nicol really doesn't disclose much of 10:27
9 anything about how the task scheduler works in 10:27
10 Figure 4 even less than in Figure 2, which was 10:27
11 pretty sufficient detail. 10:27
12 BY MR. BROWN: 10:27
13 Q. Okay. Well, let's -- let's create the 10:27
14 hypothetical, and then see if it fits into what 10:27
15 people in the skill might know at the time. 10:27
16 Let's say, PE 2 and PE 3 in Figure 4 are 10:27
17 already running at their maximum frequency. They 10:27
18 are capped out, and PE 1 is not currently at its 10:27
19 maximum and has a little bit of headroom. 10:28
20 Are you with me so far? 10:28
21 A. Yes, I am. 10:28
22 Q. Okay. And that hypothetical could 10:28
23 certainly happen in Nicol; right? 10:28
24 MR. TUNG: Same objection. 10:28
25 THE WITNESS: I imagine it could. I 10:28

1 haven't really considered it, though. 10:28

2 BY MR. BROWN: 10:28

3 Q. In that circumstance, if a new task were 10:28

4 to -- the controller would have had a new task that 10:28

5 they had to assign, a person of ordinary skill in 10:28

6 the art with the knowledge of those schedulers that 10:28

7 were available to him could consider assigning that 10:28

8 new task to PE 1 because it had some available 10:28

9 headroom on frequency and voltage; right? 10:28

10 MR. TUNG: Same objection. 10:28

11 THE WITNESS: Under such a hypothetical 10:28

12 situation for this hypothetical scheduler, a person 10:28

13 of ordinary skill in the art might decide to do 10:28

14 that. It's possible. Yeah. 10:29

15 BY MR. BROWN: 10:29

16 Q. And that would achieve the -- what Nicol 10:29

17 talks about, about sort of trying to keep load as 10:29

18 evenly distributed as possible among the PEs; right? 10:29

19 MR. TUNG: Objection. Assumes facts. 10:29

20 THE WITNESS: My recollection is that that 10:29

21 was only discussed in the context of Figure 2. Not 10:29

22 Figure 4. 10:29

23 But I may simply not recall it. If you 10:29

24 want to point me to something, I'll be happy to 10:29

25 review it. 10:29

1 BY MR. BROWN: 10:29

2 Q. You would agree with me that there are 10:29

3 benefits to evenly distributing the work in a 10:29

4 Figure 4 embodiment just as they are in Figure 2; 10:29

5 right? 10:29

6 MR. TUNG: Same objection. 10:29

7 THE WITNESS: I would say that there is 10:29

8 too many unspecified factors. 10:29

9 There are times when -- I could envision 10:29

10 situations where that would be beneficial. I can 10:29

11 envision situations where it would not be. 10:29

12 BY MR. BROWN: 10:29

13 Q. Okay. So a person of ordinary skill in 10:30

14 the art would know that there are some circumstances 10:30

15 where it would be beneficial to aim to evenly 10:30

16 distribute tasks among PEs in the Figure 4 10:30

17 embodiment; fair? 10:30

18 A. No. I guess it depends on factors for how 10:30

19 Figure 4 system is built that we just don't know 10:30

20 about. Some of which get into exactly how the clock 10:30

21 system and the power supply works, so this task 10:30

22 scheduler and all of which are unspecified. 10:30

23 Q. I'm sorry. Maybe I misunderstood with 10:30

24 your testimony, then. You just said -- you said 10:30

25 "There are times when -- I could envision situations 10:30

1 Q. And so what are the circumstances when 10:32
2 somebody might view a benefit to evenly distributing 10:32
3 tasks in the Figure 4 embodiment? 10:32

4 A. That's difficult to say without knowing 10:32
5 details of the system. But I can -- I can certainly 10:32
6 envision that under a hypothetical implementation of 10:32
7 the scheduler and -- and analog electronics in the 10:32
8 Nicol system. 10:32

9 One may conclude that one desires to try 10:32
10 to balance the load on the PEs of Figure 4. 10:32

11 Q. Okay. So there are -- there are at least 10:32
12 circumstances depending on, you know, implementation 10:32
13 details in which a person of ordinary skill would 10:32
14 benefit from distributing task evenly among PEs in 10:32
15 Figure 4. Is that fair? 10:32

16 A. I think it's fair to say that there could 10:32
17 be, yes. 10:33

18 Q. So -- so let's -- let's go back to that 10:33
19 hypothetical I was talking about -- about PE 1 10:33
20 having some available headroom, PE 2, and PE 3 not 10:33
21 having -- being already at their maximum frequency. 10:33

22 The controller in that circumstance, if it 10:33
23 was programmed to evenly distribute work among the 10:33
24 PEs, would evaluate the current load on PE 2 and 3 10:33
25 and decide that, because of the load on PE 2 and 3, 10:33

1 it should assign the task to PE 1; is that fair? 10:33

2 MR. TUNG: Objection. Incomplete 10:33

3 hypothetical. 10:33

4 THE WITNESS: That is an option. I think 10:33

5 it's fair to say that the hypothetical controller in 10:33

6 this particular implementation of Nicol Figure 4 10:33

7 could choose to do just about anything. I have no 10:33

8 idea what it is. 10:34

9 I certainly agree that there -- I'm sorry. 10:34

10 I suggested I was done answering. 10:34

11 I would agree that, you know, there are 10:34

12 times where it might be attractive and beneficial to 10:34

13 attempt to balance the load, but I don't know 10:34

14 anywhere near enough about how such a system would 10:34

15 be used and specified completely. 10:34

16 BY MR. BROWN: 10:34

17 Q. And so if the controller was trying to 10:34

18 balance the load, it would consider the load on 10:34

19 PE 2 and 3 and decide that because of the load on 10:34

20 PE 2 and 3, it would have to assign this task to 10:34

21 PE 1 -- right? -- in our hypothetical? 10:34

22 MR. TUNG: Same objection. 10:34

23 THE WITNESS: I can envision that a person 10:34

24 of ordinary skill in the art given that hypothetical 10:34

25 scenario may build a scheduler that would reach the 10:34

1 conclusion that it should put the new task on PE 1. 10:34
2 BY MR. BROWN: 10:35
3 Q. And -- and by putting the new task on 10:35
4 PE 1, let's assume that that task required -- was 10:35
5 one that was heavy enough that required bringing the 10:35
6 PE 1 to its maximum voltage. 10:35
7 There are circumstances where that would 10:35
8 occur; right? 10:35
9 MR. TUNG: Same objection. 10:35
10 THE WITNESS: I could envision that there 10:35
11 might be. I could envision situations where that 10:35
12 could never happen because the system might be 10:35
13 considered under defined for whatever the mission 10:35
14 was that it was intended to be used for. 10:35
15 BY MR. BROWN: 10:35
16 Q. Okay. And so in that circumstance, the 10:35
17 decision about -- assigning the task to PE 1 and 10:35
18 increasing PE 1's frequency would be influenced by 10:35
19 how loaded PE 2 and PE 3 are in our hypothetical; 10:36
20 right? 10:36
21 A. It's -- it's certainly possible with the 10:36
22 load on the other PEs might be taken into account in 10:36
23 allocating the tasks -- newly introduced tasks. 10:36
24 Q. Okay. Let me switch gears now and go to 10:36
25 the middle ground embodiments. 10:36

1 Do you know what I am talking about? 10:36

2 A. I think I know as much as Nicol provides. 10:36

3 Yes. I recall the reference in Nicol. 10:37

4 Q. Okay. The middle ground embodiment is 10:37

5 where PEs are grouped together such that they share 10:37

6 a common voltage supply and frequency; right? 10:37

7 A. Yes. 10:37

8 Q. Okay. 10:37

9 A. That's -- that's about -- about as much as 10:37

10 he -- they talk about with the middle ground. 10:37

11 Q. Okay. And so for the ease of talking 10:37

12 about this, let's -- let's assume that we have one 10:37

13 group with two PEs in it, and we'll call those PEs 10:37

14 PE 1 and PE 2. 10:37

15 Can we agree on with that terminology? 10:37

16 A. Yes. 10:37

17 Q. Okay. So in that circumstance, if -- 10:37

18 let's say both PEs have a relatively light load. 10:37

19 The -- let's just say they actually have the -- 10:38

20 just -- as low a load as possible. One task each 10:38

21 and the frequency can be set to the lowest possible 10:38

22 frequency. 10:38

23 In that circumstance, the frequency on 10:38

24 either of those PEs is going to be set based on that 10:38

25 light load; right? 10:38

1 MR. TUNG: Objection. Assumes facts. 10:38

2 THE WITNESS: Well, my understanding of 10:38

3 the middle ground is essentially saying we have 10:38

4 got -- some of them operate as in Figure 4 and some 10:38

5 of them operate as in Figure 2. 10:38

6 And if I understand correctly, you are 10:38

7 suggesting that PE 1 and PE 2 operate as if they 10:38

8 were in Configuration 2, in which case they would 10:38

9 share a clock voltage -- a clock frequency and 10:39

10 voltage setting that was determined in response to 10:39

11 whatever the most heavily loaded of the PEs was. 10:39

12 And so presumably, if they were exactly 10:39

13 evenly loaded, whatever that value is, that would 10:39

14 determine their clock frequency. 10:39

15 BY MR. BROWN: 10:39

16 Q. And -- and, likewise, if neither PE had -- 10:39

17 had any load at all, they would be -- they would 10:39

18 both be running at some very low voltage and clock 10:39

19 frequency; right? 10:39

20 A. Presumably. Under this hypothetical 10:39

21 operating situation, I would not be surprised if 10:39

22 there were situations where there were no tasks 10:39

23 running on either PE, and whatever corresponded to 10:39

24 the lowest possible configuration is what they would 10:40

25 be dialed into. 10:40

1 Q. Right. And so now, let's say, that we 10:40
2 have the two PEs. They do have a load but a 10:40
3 relatively light load. They each have a relatively 10:40
4 light load, and then a large task comes along and is 10:40
5 assigned to PE -- let's say, PE 2. Okay? 10:40

6 A. All right. 10:40

7 Q. In a circumstance where PE 1 has a 10:40
8 relatively light load and PE 2 now has a very heavy 10:40
9 load, the frequency of both PE 1 and PE 2 is going 10:40
10 to be set in accordance with PE 2's load; right? 10:40

11 MR. TUNG: Objection. Assumes facts. 10:40

12 THE WITNESS: My understanding -- although 10:40
13 I have no idea how any such assignment task schedule 10:40
14 would be introduced, my understanding is that, if 10:41
15 PE 1 and PE 2 are operating as if they were under 10:41
16 the rules of Figure 2, then whichever was the most 10:41
17 heavily loaded one, the clock frequency and voltage 10:41
18 for that set would be assigned in accordance with 10:41
19 the most heavily -- the needs of the most heavily 10:41
20 loaded one. 10:41

21 BY MR. BROWN: 10:41

22 Q. And so -- so in that circumstance, one of 10:41
23 the PE's frequencies could be increased because some 10:41
24 other PEs load. Fair? 10:41

25 MR. TUNG: Same objection. 10:41

1 THE WITNESS: Well, certainly if the PE is 10:41
2 not taking into account the other PE's load, but 10:41
3 there is a controller at some part in the system 10:42
4 that is simply considering where are the needs of 10:42
5 the most heavily loaded PE. 10:42

6 And based upon that sets of voltage and 10:42
7 the clock frequency for -- in this case both, but 10:42
8 there could be presumably could be multiple -- more 10:42
9 than two PEs operating with a ganged up Figure 2 10:42
10 type scenario. 10:42

11 BY MR. BROWN: 10:42

12 Q. So in the middle ground embodiment there 10:42
13 are circumstances where one PE's frequency will be 10:42
14 set by the controller to be -- will be set by the 10:42
15 controller based on the load of another PE; fair? 10:42

16 MR. TUNG: Same objection. 10:42

17 THE WITNESS: I do think that in this 10:42
18 hypothetical situation we were just talking about, 10:42
19 whether it's a Figure 2 system in isolation or sort 10:42
20 of this middle ground that combines elements of 10:43
21 Figure 2 with Figure 4, the Figure 2 components, 10:43
22 PE 1 and 2, will operate -- will be configured to 10:43
23 operate at a clock speed that satisfies the 10:43
24 requirements of whichever one is most heavily 10:43
25 loaded. 10:43

1 BY MR. BROWN: 10:43

2 Q. Right. So there are circumstances where 10:43

3 PE 1 -- PE 1's frequency will be determined by its 10:43

4 own load if its own load is the larger of the two; 10:43

5 right? 10:43

6 A. Yes. In this -- in the situations we have 10:43

7 talked about, whichever one is the highest loaded 10:43

8 will determine the clock frequency, and that might 10:43

9 be PE 1 or PE 2. They certainly don't know what the 10:43

10 loads are of the other processors, but there is, 10:43

11 presumably, a controller that makes that 10:44

12 determination. 10:44

13 Although, really, as I -- as I suggested, 10:44

14 the problem gets much more complicated when you -- 10:44

15 when you configure such a heterogeneous system 10:44

16 combining Figure 2 and Figure 4. 10:44

17 And Nicol doesn't discuss anything about 10:44

18 how they imagine scheduling could be done in that 10:44

19 situation, let alone how they envisioned, actually, 10:44

20 it. 10:44

21 Q. Right. So I -- I -- let me try to work 10:44

22 that into the question. 10:44

23 In the middle ground embodiment, there are 10:44

24 circumstances where the controller would set PE 1's 10:44

25 frequency based on -- based on the load that's on 10:44

1 PE 1 when PE 1 has the larger load of the two PEs; 10:44
2 correct? 10:44
3 MR. TUNG: Same objection. 10:45
4 THE WITNESS: I would say that it's my 10:45
5 understanding that whatever the load is on -- on the 10:45
6 PEs that are operating in a Figure 2 type mode, the 10:45
7 most heavily loaded one is what will set the clock 10:45
8 frequency for the -- for the gang and the voltage. 10:45
9 My -- my caveat is that there are many 10:45
10 ways you can calculate that. And it may be the case 10:45
11 that the software never really considers, well, you 10:45
12 know, let's load up the PE 1. Let's load up the 10:45
13 PE 2. Which one is greater. Put it that way. 10:45
14 So whichever -- whatever the most highly 10:45
15 loaded PE is the one that will determine the voltage 10:45
16 and the clock frequency for whatever other PEs are 10:45
17 in the same gang. 10:45
18 BY MR. BROWN: 10:45
19 Q. And you are using the word "gang" to 10:45
20 indicate PEs that are grouped together in sharing a 10:46
21 clock frequency; right? 10:46
22 A. I'm using the term "gang" -- and I 10:46
23 apologize for introducing a new term -- but to refer 10:46
24 to whichever PEs are operating in a mode like 10:46
25 disclosed in Figure 2. And it was my attempt to 10:46

Page 67

1 avoid using the word "group" because that is a claim 10:46
2 term, and that is a term that is under contention. 10:46

3 But, yes, it's plurality of PEs that are 10:46
4 operating in a mode like the constraints of 10:46
5 Figure 2. 10:46

6 Q. Got it. 10:46

7 Okay. So I think -- I think we're on the 10:46
8 same page, but let me try to -- let me try to ask 10:46
9 this. 10:46

10 In the middle ground embodiment, there are 10:46
11 circumstances where a PE's -- a PE's frequency will 10:46
12 be set in accordance with the number of operation -- 10:47
13 withdrawn. 10:47

14 In the middle ground embodiment, there are 10:47
15 circumstances where a PE's frequency will be set in 10:47
16 accordance with the load on that -- that it has on 10:47
17 itself, and there are also circumstances where that 10:47
18 frequency will be set based on the load of a 10:47
19 different PE; correct? 10:47

20 MR. TUNG: Objection. Asked and answered. 10:47

21 THE WITNESS: Yeah. I think I am inclined 10:47
22 to stick with the answer I gave before about -- in 10:47
23 an attempt to maybe summarize it and be consistent 10:47
24 with that. 10:47

25 Whatever the most highly loaded PE is, is 10:47

1 the one that will determine the frequency and 10:47
2 voltage for what I am calling the "gang." 10:47
3 And that may involve specifically 10:47
4 considering each PE in order or it may not. There 10:47
5 are other approaches that can be used. 10:47
6 BY MR. BROWN: 10:48
7 Q. So if a PE is not the most heavily loaded 10:48
8 PE in the gang, then its frequency will be set based 10:48
9 on some other PE's load; right? 10:48
10 MR. TUNG: Objection. Mischaracterizes. 10:48
11 THE WITNESS: I think that that is largely 10:48
12 consistent with what I said. 10:48
13 In a sense that, you know, if there's a PE 10:48
14 that is not the most heavily loaded one, its 10:48
15 operating state will be set based on whatever the 10:48
16 load is of the most heavily loaded PE. 10:48
17 BY MR. BROWN: 10:49
18 Q. And just so the record is clear, the 10:49
19 situation you were just speaking about occurs in the 10:49
20 middle ground embodiment as well as in Figure 2; is 10:50
21 that right? 10:50
22 A. Yes. It's my understanding using the 10:50
23 scant information that is provided, that what I am 10:50
24 calling a gang in the middle ground would operate 10:50
25 the same as the -- the system in Figure 2. 10:50

1 Q. Okay. Great. I am smiling when you say 10:50
2 "gang" because I keep hearing West Side Story in my 10:50
3 head. 10:50

4 (Laughter elicited.) 10:50

5 THE WITNESS: Yeah. After the last 10:50
6 deposition we did, I tried to be sensitive enough 10:50
7 and not introduce too much jargon. Hopefully this 10:50
8 one works and I address the meaningful issue. 10:50

9 BY MR. BROWN: 10:50

10 Q. Okay. Let's go back to something you 10:51
11 talked about earlier but we didn't spend a lot of 10:51
12 time on. 10:51

13 You mentioned -- you mentioned something 10:51
14 about -- well, we had a discussion about 10:51
15 mission-critical tasks, and I guess how those are 10:51
16 sort of endemic to a real-time operating system. 10:51

17 So let me start with this: 10:51

18 What is a mission-critical task, in your 10:51
19 mind? 10:51

20 A. In my mind, a mission-critical task is 10:51
21 whatever task must be guaranteed to reliably and 10:51
22 accurately complete within whatever performance 10:51
23 constraints are required of it. 10:51

24 Now, that being said, I think it -- if I 10:51
25 was building a wi-fi modem, certainly from my point 10:52

1 of view as a designer, there would be elements that 10:52

2 I considered critical to the mission of the wi-fi. 10:52

3 But I think we would all agree that is 10:52

4 much less critical in the grand scheme of things 10:52

5 from designing a controller for anti-lock brake 10:52

6 system; so mission critical varies dramatically 10:52

7 based on different situations. 10:52

8 Q. Got it. 10:52

9 And it can -- the idea of something being 10:52

10 mission critical can also vary in a single device; 10:52

11 right? And by that I mean, there are -- there are 10:52

12 some tasks that are more mission critical than 10:52

13 others depending on the circumstances. Is that 10:52

14 fair? 10:52

15 A. I -- people don't really talk about them 10:52

16 that way. I mean mission critical kind of means 10:53

17 it's critical. If you miss it, somehow the -- the 10:53

18 system has failed. 10:53

19 That being said, for example, there -- I 10:53

20 mean, there are tasks that get run much more 10:53

21 frequently. And tasks much less frequently. 10:53

22 So you might think that the criticality of 10:53

23 a -- if the rate of failure in either was the same. 10:53

24 You might think that "Well, my mission would longer 10:53

25 survive if the -- if the more frequently run ones 10:53

1 were less likely to fail than the less frequently 10:53
2 run ones." 10:53
3 But at the end of the day, those -- people 10:53
4 think about these things as "No. No. Everything 10:53
5 will stop and we have failed if we fail on a 10:53
6 mission-critical task." 10:53
7 Q. I gotcha. 10:53
8 So there are -- there are -- all 10:54
9 mission-critical tasks are important. But are 10:54
10 there -- there are circumstances where some 10:54
11 mission-critical tasks may be -- are constrained by 10:54
12 other things, like some -- like they need to be 10:54
13 completed faster or more immediately than other 10:54
14 mission-critical tasks that need to be completed 10:54
15 slower. Is that fair? 10:54
16 A. Yes. I would say so. For example, in 10:54
17 real-time systems, as I was talking about, the -- 10:54
18 the machine that is landing on Mars today, there are 10:54
19 mission-critical tasks that don't have fixed time 10:54
20 constraints. And you just -- as an engineer, you 10:54
21 try to take that into account when you work to make 10:54
22 a survivable system. 10:54
23 Q. So let's -- to put some examples on this. 10:54
24 If we think about, you know, like a -- a 10:55
25 communication system as our application, its ability 10:55

1 to correctly and accurately receive voice data and, 10:55
2 say, text data, those are potentially both 10:55
3 mission-critical tasks in that they need to be done 10:55
4 correctly; right? 10:55
5 A. Yes. I would say so. 10:55
6 Q. But the voice tasks, likely need to be 10:55
7 performed with -- you know, on a tighter time 10:55
8 restriction than the text tasks -- task; is that 10:55
9 right? 10:55
10 A. I think it's fair to say that they'll have 10:55
11 much more stringent operating requirements. So it 10:55
12 may -- yes. Time task might be a way to think of 10:55
13 it, or it may be the case that they don't -- that 10:55
14 some implementation may not say "Oh, this has to be 10:56
15 done in a certain period of time, but if you get it 10:56
16 done faster, you will have higher quality," which, 10:56
17 you know, is -- is attractive. 10:56
18 Q. Well, not just higher quality. Like, if 10:56
19 we consider voice tasks, voice tasks that take more 10:56
20 than -- you probably know better than I do -- but 10:56
21 it's some period of milliseconds that take longer 10:56
22 than a certain period of milliseconds to process, 10:56
23 are really considered failing voice tasks because 10:56
24 you can't have a conversation with a too significant 10:56
25 delay; right? 10:56

1 A. Yes. I would agree with that. 10:56

2 Q. And it's -- let's say the timing of, say, 10:56

3 text messages is important, but the time 10:56

4 restrictions are substantially different. You can't 10:56

5 really -- nobody is going to really notice if 10:56

6 there's a second or two delay in text communication. 10:56

7 A. I would not disagree with that 10:57

8 characterization. Yes. 10:57

9 Q. And so in that circumstance, it would be 10:57

10 important to prioritize the voice tasks over other 10:57

11 mission-critical tasks in order to ensure that those 10:57

12 required completion times are met. Fair? 10:57

13 A. In that hypothetical situation, if they 10:57

14 were both operating on the same processing elements, 10:57

15 one may prioritize one task over the other. Yes. 10:57

16 Q. And it can do that by setting required 10:57

17 completion times that are around the bandwidth that 10:57

18 we are talking about here; right? For instance, we 10:57

19 could say the voice tasks have to complete within 10:57

20 50 milliseconds but the text tasks can take two to 10:57

21 three full seconds. Fair? 10:57

22 A. I guess one could design such a system. 10:57

23 Q. Oh. I mean, not just "could." That would 10:57

24 be -- that would be a logical implementation of this 10:58

25 kind of communication system, wouldn't it? 10:58

1 MR. TUNG: Objection. Assumes facts. 10:58

2 THE WITNESS: It depends. I mean, there's 10:58

3 a lot of complexity in voice coding. 10:58

4 For example, a lot of times what happens 10:58

5 is much of that work is offloaded to a specialized 10:58

6 processor and dealt with -- and broken up into known 10:58

7 fixed-time tasks. 10:58

8 So, you know, it wouldn't be a notion 10:58

9 "Well, this needs to be done in 50 milliseconds." 10:58

10 It would be "No. I am going to run this task, and I 10:58

11 know that it will be done within 20 milliseconds." 10:58

12 But there certainly -- I can -- I can 10:58

13 agree that both tasks could be considered mission 10:58

14 critical to a modern smartphone, and they have very 10:58

15 different parameters for what would satisfy success. 10:58

16 BY MR. BROWN: 10:58

17 Q. Okay. And so assigning, you know, 10:58

18 required completion times, the way that I described 10:59

19 earlier, could be a way to ensure that those 10:59

20 voice -- both of those mission-critical tasks are 10:59

21 completed as they -- in accordance with the 10:59

22 requirements of those tasks; right? 10:59

23 A. Who would be assigning these required 10:59

24 completion times? 10:59

25 Q. Yeah. That's a fair point. 10:59

1 Let me -- well, I mean, there is a couple 10:59
2 of ways to look at that. Let me -- there are 10:59
3 certainly some inherent required completion times 10:59
4 with certain tasks; right? 10:59

5 Like voice tasks. Voice tasks have some 10:59
6 period of time that they can exceed before there's 10:59
7 failure; right? 10:59

8 A. Yes. I would agree with that. You know, 11:00
9 your example previously, if there's a two-second 11:00
10 delay, people would consider that -- in a voice 11:00
11 call, people would consider that to be failure. 11:00

12 Q. And so a designer would reasonably have a 11:00
13 sense -- or, withdrawn. 11:00

14 A POSITA that's implementing, say, Nicol, 11:00
15 would have a reasonable sense of these kind of 11:00
16 inherent requirements for different types of tasks 11:00
17 if, for instance, he was implementing a 11:00
18 communication system; right? 11:00

19 MR. TUNG: Objection. Assumes facts. 11:00

20 THE WITNESS: I -- frankly, as well as I 11:00
21 understand Nicol, I think that a POSITA wanting to 11:00
22 use it would be -- would only turn to it if they 11:00
23 were thinking about real-time tasks with known 11:00
24 completion times. 11:00

25 And I -- as we talked about, I'll 11:01

1 acknowledge that they say "Well, we could imagine 11:01
2 running, you know, unbounded tasks with unknown 11:01
3 completion times." I just don't know how to mix 11:01
4 those two in any sort of meaningful way. 11:01
5 BY MR. BROWN: 11:01
6 Q. Hold on. The known -- your concept of 11:01
7 known completion times is -- is sort of saying "I 11:01
8 know that this voice processing task is going to 11:01
9 take me this number of milliseconds"; right? That's 11:01
10 what you are saying? 11:01
11 A. Yes. Or alternatively, as we sort of 11:01
12 discussed before, it needs to run at 130 megahertz. 11:01
13 It's got some bounded unit of computation that's -- 11:01
14 that needs to be met or will be deemed to have 11:01
15 failed. 11:02
16 Q. Right. But isn't that known completion 11:02
17 time going to scale with the frequency? 11:02
18 A. It depends. I guess I would say that the 11:02
19 actual completion time will generally scale with the 11:02
20 frequency, which is one complication that Nicol 11:02
21 really is silent on. 11:02
22 It's just sort of this notion that there 11:02
23 is -- there is a known amount of work and you need 11:02
24 to -- you need to do load balancing and mode to -- 11:02
25 to try to, you know, optimize the system. 11:02

1 But I agree with you. Sometimes it's a 11:02
2 situation where -- or, rather, I agree with what I 11:02
3 think you are getting at. 11:02
4 Sometimes it's a situation where I know I 11:02
5 need 120 megahertz for this task, but maybe I need 11:02
6 it for 2 seconds. Maybe I need it for 10 minutes. 11:03
7 And if I need it for 10 minutes and instead I give 11:03
8 it 140 instead of 120, maybe it will only take 11:03
9 7 minutes and maybe that is a good thing. 11:03
10 I don't know. 11:03
11 Now, part of the issue is it makes a 11:03
12 little more sense in Nicol because -- in my 11:03
13 understanding of Nicol, when you look fundamentally 11:03
14 at real-time systems, in a real-time system, the 11:03
15 important thing is that you meet the deadline. You 11:03
16 get it done faster. Nobody cares. That's not 11:03
17 better; it's not bad. But nobody cares. You got 11:03
18 to -- you meet the deadline, and that is the only 11:03
19 thing that matters. 11:03
20 In which case, his notion of how to deal 11:03
21 with workload makes a little more sense. But I -- I 11:03
22 agree, there are certainly times where, if I 11:03
23 increase the frequency, it will get done sooner. 11:03
24 And that -- and in many situations, that might be a 11:04
25 good thing. 11:04

1 Q. Got it. Got it. Okay. 11:04

2 So maybe then, if I am understanding this 11:04

3 right, the known completion time is -- is really the 11:04

4 floor -- it's not an apt analogy. 11:04

5 The known -- withdrawn. 11:04

6 The known completion time is the maximum 11:04

7 amount of time that something can -- sorry. I don't 11:04

8 know why I am having trouble with this question. 11:04

9 Withdrawn. We're on the same page. I'll 11:04

10 get the question worded right. 11:04

11 The -- well, you're -- when you talk about 11:04

12 the known completion time, that is the maximum 11:04

13 amount of time that a task can take to complete. Is 11:04

14 that fair? 11:04

15 A. That's right. And in my experience, 11:04

16 that's the most common way to specify real-time 11:05

17 tasks. Whether it is a voice communication, in your 11:05

18 example, or any sort of a -- you know, real-time 11:05

19 controlance [verbatim]. And if that happens, I need 11:05

20 to analyze it in a certain time. I need to respond 11:05

21 to it in a certain time. 11:05

22 Q. Got it. 11:05

23 And so that known completion time is -- is 11:05

24 really the concept of the required completion time 11:05

25 in Nicol, in Nicol's real-time operating system; 11:05

1 right? 11:05

2 A. I -- I would agree with that. 11:05

3 Now, turning that around to a notion that 11:05

4 Nicol talks about, which is sort of the load and 11:05

5 what the required frequency is, requires a step 11:05

6 that -- that he doesn't get into at all. 11:05

7 But if my known completion time is half a 11:05

8 second but I am making significant use of the 11:05

9 computation of the compute facilities that are 11:05

10 available, I will need a relatively high voltage and 11:06

11 high clock rate. 11:06

12 If it is half a second and it's dead, it's 11:06

13 a very simple task. I just need to get it done in 11:06

14 half a second. Then the effective load on the 11:06

15 processor will be much lower. 11:06

16 And Nicol -- I think it's not 11:06

17 unreasonable. They just sort of say, "Well, you 11:06

18 have a load, and we try to put what" -- however you 11:06

19 figure out what it is, you know -- "one of the 11:06

20 processors will be running at the highest clock rate 11:06

21 because of its load. And then we set the other ones 11:06

22 according to that." 11:06

23 And -- but it's missing this step of how 11:06

24 you get from the way people actually specify tasks 11:06

25 to what is the load. 11:06

1 Q. And -- but this step of how to specify 11:06
2 tasks in a real-time operating system and how to 11:06
3 determine what the load is on a -- on a processor, 11:06
4 these were components of real time -- these were 11:06
5 known components of real-time operating system 11:07
6 schedulers at this time, weren't they? 11:07

7 A. I would say in general, yes. What people 11:07
8 did then and still largely do is they say "You know, 11:07
9 a set of tasks with a set of requirements is my 11:07
10 entire world. And I know that different tasks take 11:07
11 different amount of time, and they are interrelated 11:07
12 based on one task happens and then sometime later I 11:07
13 know another task happens." 11:07

14 And the people who build those systems sit 11:07
15 down and very precisely schedule out the time blocks 11:07
16 so they know exactly that they are going to meet 11:07
17 their performance requirements. 11:07

18 Q. Got it. 11:07

19 And so when we -- when we talk about this 11:07
20 known completion time that -- that is part of the 11:07
21 Nicol system -- this is what will help ensure that 11:08
22 mission-critical tasks that are more time 11:08
23 restrictive complete in time? 11:08

24 That's my question. 11:08

25 A. Yes. I -- I think that the time 11:08

1 completion requirement is inherent in the notion 11:08
2 of "This is the load a task is that we are going to 11:08
3 tune in the system to operate such that I am going 11:08
4 to meet that load." 11:08
5 Q. And there can be the different -- 11:08
6 different tasks in these real-time operating systems 11:08
7 like we talked about can have varying priorities in 11:08
8 their completion times such that voice tasks might 11:08
9 need to be completed faster than, say, the text 11:09
10 tasks that we were talking about earlier. 11:09
11 MR. TUNG: Objection. Vague. 11:09
12 THE WITNESS: It depends. In -- for 11:09
13 example, in a -- in a -- in the phone scenario that 11:09
14 we talked about with voice and text, I could easily 11:09
15 agree and say, yes, both of those are considered 11:09
16 mission critical. 11:09
17 And maybe the voice is more mission 11:09
18 critical, but I sort of put it out there that for 11:09
19 the most part, if you can't send a text, nobody is 11:09
20 going to buy your phone. So at some level they are 11:09
21 both mission critical. 11:09
22 But they are not real-time tasks. They 11:09
23 are not tasks -- for the most part. They are not 11:09
24 tasks where I can guarantee to hit a certain 11:09
25 performance goal. That is almost certainly the case 11:09

1 with almost all the elements of texts for many of 11:09
2 the reasons you discussed. 11:10

3 It's less likely to be the case with all 11:10
4 the elements of voice but for those elements that 11:10
5 really do have real-time components. From my 11:10
6 experience, people take those tasks and they put 11:10
7 them in sort of an isolated environment that runs as 11:10
8 a real-time environment. 11:10

9 And usually that means a separate 11:10
10 processor or on your cellphone if you buy a Qualcomm 11:10
11 modem, it will be the DSP that runs some of those 11:10
12 tasks. And it doesn't run any other tasks. It 11:10
13 knows all the tasks that it might have run; so it 11:10
14 runs those in a real-time environment. 11:10

15 BY MR. BROWN: 11:10

16 Q. Okay. Let me -- let me -- I think I am 11:10
17 following you. So let -- let's focus on just 11:10
18 real-time tasks, then. Voice -- some components of 11:10
19 a voice task are real time. 11:10

20 Can you give me another example of 11:10
21 something that is maybe a -- also real-time task but 11:10
22 it may be a lower priority, in terms of how long you 11:10
23 have to complete the task? 11:11

24 A. Not -- not off the top of my head. But I 11:11
25 certainly can imagine that -- maybe this will help. 11:11

1 But I'm not sure if it addresses your question. 11:11

2 Some modern real-time systems do things 11:11

3 like object tracking. So you've got a video screen; 11:11

4 you've got a video feed. You know, you are 11:11

5 interested in tracking a football player running 11:11

6 across the screen. The performance requirement to 11:11

7 accurately track that might be much, much tighter 11:11

8 than the time requirements to conduct a 11:11

9 3D cellphone. They are both real time. 11:11

10 They both have or may be considered 11:11

11 mission critical for those applications. But -- but 11:11

12 the time deadline between two different real-time 11:11

13 systems or applications can vary widely and will -- 11:11

14 will, in fact, as we talked about before. The time 11:12

15 deadlines within a single system like a cell phone 11:12

16 can vary widely in terms of what's the required 11:12

17 completion time. 11:12

18 I'm not sure if that answered your 11:12

19 question, but, hopefully, it said something useful. 11:12

20 Q. It was -- yes, it did. It said a lot 11:12

21 useful. I -- I think I am following you. 11:12

22 The -- so in a single system -- maybe we 11:12

23 can do this abstractly then instead of using 11:12

24 specific examples. 11:12

25 In a single real-time operating system, 11:12

1 there are some tasks that have higher priorities 11:12
2 that are indicated by, you know, tighter completion 11:12
3 times as compared to other real-time tasks that are 11:12
4 still mission critical but are lower priority and 11:12
5 have longer periods of time to be completed; is that 11:12
6 fair? 11:12

7 MR. TUNG: Objection to the extent it 11:12
8 calls for a legal conclusion. 11:13

9 THE WITNESS: So -- and I know this may 11:13
10 sound odd, but -- but, really, I disagree with that 11:13
11 for this reason. 11:13

12 When people are dealing with 11:13
13 real-time tasks, the engineers who do that 11:13
14 absolutely get fanatical; so if I've got two 11:13
15 real-time tasks and one takes 30 milliseconds and 11:13
16 another one takes 5 minutes, they have the same 11:13
17 priority. Because if they are real time and deemed 11:13
18 mission critical, you know, it doesn't -- if I blow 11:13
19 either one, I have failed. 11:13

20 And so just the concept of priority just 11:13
21 doesn't really get talked about in -- in real-time 11:13
22 context. 11:13

23 People have built hybrid system but Nicol 11:13
24 sort of, you know, vaguely suggests we got real-time 11:13
25 task, and we've got all this other stuff, we don't 11:13

1 know what it is doing, but we are going to throw it 11:14
2 into the system. We don't know what the time bounds 11:14
3 are. 11:14
4 But at the end of the day, those -- those 11:14
5 aren't traditional real-time systems because you 11:14
6 cannot guarantee -- you can't reason about how the 11:14
7 computation will flow to guarantee that you won't 11:14
8 fail, which is what real time is all about. 11:14
9 BY MR. BROWN: 11:14
10 Q. Got it. 11:14
11 So let me unpack that. Nicol describes 11:14
12 this -- the possibility of a hybrid system where you 11:14
13 have some prioritized real-time tasks along with 11:14
14 some tasks that don't have time requirements; right? 11:14
15 A. Yes. 11:14
16 Q. And -- but in a -- in a -- withdrawn. 11:14
17 In a real-time system, where everything is 11:14
18 real time, are you saying that there's -- there is 11:15
19 no need to schedule tasks according to their -- 11:15
20 their required completion time? 11:15
21 A. Not really. I am saying that that job is 11:15
22 done in advance. It's done when the system is 11:15
23 designed. 11:15
24 So, for example, you'll say, "Well, look, 11:15
25 I know that I need to read data from the video 11:15

1 camera. And I know that the processor reading that 11:15
2 data takes a certain amount of time, and I know that 11:15
3 it happens every 50 milliseconds. It doesn't happen 11:15
4 in a random rate. It happens every 50 milliseconds. 11:15
5 So I'll schedule that out, and I know that 11:15
6 that is happening. And then, you know, I know 11:15
7 whatever other time scheduled events happen, and 11:15
8 then I just make sure that none of -- none of the 11:15
9 PEs are oversubscribed such that I miss one of those 11:16
10 schedules. 11:16
11 I mean, to some extent Nicol is -- and as 11:16
12 the -- as the main inventor on a number of patents, 11:16
13 I understand why they are doing this. But I think 11:16
14 they are sort of saying, "We got this system," and 11:16
15 then they are opening things up to try to cover as 11:16
16 much ground as possible. 11:16
17 In real hardcore real-time systems, you 11:16
18 don't have tasks just sort of randomly coming up and 11:16
19 saying, "Okay, well, you know, how do I schedule 11:16
20 this. Let's make a decision. What else is going on 11:16
21 in the processor." You know what to do. You are 11:16
22 expecting the task. 11:16
23 And this is kind of getting a little bit 11:16
24 to that notion in Figure 3 where it said, "Task 11:16
25 Created," "Task Started," I think, and then, "Task 11:16

1 Ended." 11:17

2 Well, what does "Task Created" mean if you 11:17
3 are making it but you're not starting it. And the 11:17
4 answer -- a potential answer is that, in a lot of 11:17
5 real-time systems, you know, I am only ever going to 11:17
6 have ten tasks. So you create them in advance -- 11:17
7 you set the data structures all set up, and they are 11:17
8 all set to go -- you do that once at the very 11:17
9 beginning, and then as their time comes up, you 11:17
10 start one running. 11:17

11 Q. So I understand what you are saying, but I 11:17
12 am having trouble synching it with -- I think some 11:17
13 of the other things we've talked about maybe in the 11:17
14 last deposition. 11:17

15 There are -- there are -- let me use one 11:17
16 example. Real-time operating systems have to deal 11:17
17 with interrupts, don't they? 11:17

18 A. Yes. For example, when I was saying that 11:17
19 the video camera might need to run -- might need to 11:17
20 be sampled every 50 milliseconds, what you typically 11:18
21 do or -- or often do is set a timer to say, 11:18
22 interrupt me in 50 milliseconds. 11:18

23 Q. Uh-huh. 11:18

24 A. Interrupt -- interrupts may be scheduled. 11:18
25 Oftentimes they are, particularly in real-time 11:18

1 systems. 11:18

2 In many systems they are not scheduled. 11:18

3 They come in at unpredictable times. 11:18

4 Q. Right. So it's the unpredictable ones, 11:18

5 the one unscheduled ones that I am sort of driving 11:18

6 at here. 11:18

7 The -- if you got -- let's say you got 11:18

8 your real-time system -- we'll use your video 11:18

9 camera. 11:18

10 You know that your PEs every 50 seconds 11:18

11 [verbatim] have to go sample that feed, but you also 11:18

12 know you get a real-time interrupt that you weren't 11:18

13 expecting. 11:18

14 There are going to be circumstances where 11:18

15 you are going to say, "I am going to ignore that 11:18

16 interrupt until I can finish this sampling because I 11:18

17 have a tighter time restriction on the sampling than 11:18

18 I do to handle that interrupt" or vice versa; right? 11:18

19 Really, what I am asking is -- and I'll 11:19

20 ask it in an actual question rather than in this 11:19

21 long narrative now. 11:19

22 There are circumstances where the 11:19

23 real-time operating system has to decide how to 11:19

24 schedule conflicting tasks; right? 11:19

25 A. Potentially it -- it depends an awful lot 11:19

1 on how the real-time schedule is done. In my 11:19
2 experience -- you know, but really is it considered 11:19
3 a real-time system. 11:19

4 Like I said, the tasks are known in 11:19
5 advance, and they're in a relationship that is known 11:19
6 in advance. 11:19

7 Now, I will certainly agree, for example, 11:19
8 that it may be the case that a timer interrupt is 11:19
9 set to flare close in time after a previous timer 11:19
10 interrupt. And -- and hardware for many reasons is 11:19
11 almost always designed to ignore one interrupt until 11:19
12 enough progress has been made on an earlier arriving 11:20
13 one. 11:20

14 And I say that -- maybe under the control 11:20
15 of software, but it's blocked in hardware. 11:20

16 Conceivably a designer might say, "Yeah. 11:20
17 I know that this interrupt is going to come in while 11:20
18 I am still processing the other one." That is okay. 11:20

19 Or they may say, "You know what, I'll 11:20
20 just -- since I can't process that interrupt, I'll 11:20
21 schedule it to happen later in time." 11:20

22 Either approach could work. 11:20

23 Q. Right. And part of the decision that is 11:20
24 going to impact which of those approaches is used is 11:20
25 some consideration of your required completion time 11:20

1 of those two tasks. 11:20

2 For instance, if we are processing data 11:20

3 and we know we have to finish this in one second but 11:20

4 we know that interrupt that just came in we have 11:20

5 four seconds to deal with it, we're going to 11:20

6 prioritize the task that requires us to finish it 11:20

7 quickly before moving on to the longer period of 11:20

8 time that we have; is that fair? 11:21

9 A. I would say that we're going to do that 11:21

10 task that is expiring sooner before -- before the 11:21

11 other one. 11:21

12 But I am just uncomfortable with the word 11:21

13 "prioritize" because, as I said, it's -- in this 11:21

14 environment it's a binary. Did you succeed, or did 11:21

15 you fail? And everyone has equal priority. 11:21

16 With that being said, there are, for 11:21

17 example, operating systems out there that claim to 11:21

18 be real-time or have real-time characteristics. 11:21

19 And they will attempt to merge these two 11:21

20 concepts to a greater or lesser degree. So it may 11:21

21 be the case that we are going to do our best to make 11:21

22 sure that the real-time stuff runs and gets all that 11:21

23 it needs, but make use of the star [phonetic] 11:21

24 computations cycles for other stuff going in the 11:21

25 background. 11:21

1 It's just very dangerous because you may 11:21
2 allocate a PE to some piece of software that then is 11:22
3 hard to stop and cause you to miss a deadline 11:22
4 somewhere else. 11:22

5 So they're -- they're hybrid real-time 11:22
6 operating systems that, you know, are not firm real 11:22
7 time necessarily. 11:22

8 Q. Okay. So I can pull the word "priority" 11:22
9 out; so we don't focus on that. 11:22

10 Let me -- I think what we are agreeing on 11:22
11 is that real-time operating systems will, in -- in 11:22
12 some cases, attempt to complete tasks that are 11:22
13 expiring sooner before completing tasks that have 11:22
14 longer expiration dates -- times; right? 11:22

15 A. All things being equal in these 11:23
16 hypothetical systems, yes. We will try to meet the 11:23
17 more looming deadline and push off tasks that are 11:23
18 farther in the future. 11:23

19 Q. So in our voice and -- and text message 11:23
20 example, putting aside whether or not text is a 11:23
21 real-time or not. If we -- in that example, the 11:23
22 voice tasks would expire sooner than the text tasks, 11:23
23 and so we would make sure we are finishing those 11:23
24 voice tasks before turning to the text tasks; is 11:23
25 that fair? 11:23

1 MR. TUNG: Objection. Vague. 11:23

2 THE WITNESS: Yes. Getting rid of the 11:23

3 term "priority," as said, they arguably have equal 11:23

4 priority if they are considered mission critical. 11:23

5 You would schedule the voice tasks to 11:23

6 happen sooner with a -- with a tighter time deadline 11:24

7 than the text tasks. 11:24

8 And some -- and this might help. I'm not 11:24

9 sure. 11:24

10 Some -- some tasks can be easily 11:24

11 considered mission critical, but have close to no 11:24

12 real-time component. Because if we agree that text 11:24

13 is required, you know, the process may just mean 11:24

14 "Oh, whenever my processor has free time, contact 11:24

15 the server, see if I have got a text. If I got it, 11:24

16 download." 11:24

17 You know, that has got to happen in some 11:24

18 timely enough manner to not annoy the customer. But 11:24

19 I can't look at any component of it and say "Ah-ha, 11:24

20 that needs to happen within a specific bound to 11:24

21 multiply." 11:25

22 BY MR. BROWN: 11:25

23 Q. Got it. Okay. So let's see. I am about 11:25

24 to move to a new topic. We have been going about an 11:25

25 hour, do you want to go until noon or -- then try to 11:25

1 take lunch then? You want to take a break and eat 11:25
2 lunch now? Where -- what is sort of your 11:25
3 preference? 11:25

4 A. Frankly, either one is fine with me. So 11:25
5 I'll let the other participants voice their opinion, 11:25
6 but thank you for asking. 11:25

7 Q. Of course. 11:25

8 MR. BROWN: Madam Court Reporter, do you 11:25
9 have a preference? 11:25

10 THE REPORTER: I don't. 11:25

11 MR. BROWN: Okay. Well, then why don't 11:25
12 we -- why don't we take a lunch now. We'll keep it 11:25
13 relatively short. What do you guys think? Is half 11:25
14 an hour enough for lunch, or do you guys need more 11:25
15 time? 11:25

16 THE WITNESS: Why don't just we just try 11:25
17 to get in at noon. Call it 35 even. 11:25

18 MR. BROWN: Perfect. Sounds good. 11:25

19 THE WITNESS: All right. 11:25

20 THE VIDEOGRAPHER: And we're going off the 11:25
21 record. The time is 11:26. 11:25

22 (At the hour of 11:26 a.m. a luncheon
23 recess was taken. The deposition was
24 resumed at 12:03 p.m., the same persons
25 being present.)

1 1 ZOOM REMOTE PROCEEDING
2 2 Thursday, February 18, 2021; 12:03 p.m.
3 3 12:03
4 4 THE VIDEOGRAPHER: We're back on the 12:03
5 12:03 5 record. The time is .
6 12:03
7 6 12:03
8 7 EXAMINATION (CONTINUED) 12:03
9 8 BY MR. BROWN: 12:03
10 9 Q. All right. Welcome back, Doctor. 12:03
11 10 I'll ask the same question. Did you speak 12:03
12 11 with PACT's counsel during that break at all? 12:03
13 12 A. No. 12:03
14 13 Q. Okay. So good. 12:03
15 14 So let me -- let's now talk about Nicol 12:03
16 15 still, but on Column 4. I want to take you to 12:04
17 16 line -- starting on Line 11. This is Exhibit 1 12:04
18 17 still. 12:04
19 18 A. All right. 12:04
20 19 Q. So Nicol at Line 11 of Column 4, says 12:04
21 20 [as read]: 12:04
22 21 "As indicated above, the operating 12:04
23 22 system can reduce the supply voltage 12:04
24 23 even further by tracking temperature 12:04
25 24 and process variations." 12:04
25 25 Do you see that? 12:04

1 A. I do. 12:04

2 Q. So one thing that Nicol mentions is that 12:04
3 the voltage -- the supply voltage that it provides 12:04
4 to the PEs can vary based on a temperature 12:04
5 variation; is that right? 12:04

6 A. It says "...the operating system can 12:04
7 reduce the supply voltage even further by tracking 12:04
8 temperature and process variations." It also says 12:04
9 "as indicated above." 12:04

10 My recollection is there isn't much 12:05
11 discussion of it at all, but it does say that. 12:05
12 Yeah. 12:05

13 Q. And at the time of Nicol, a person of 12:05
14 ordinary skill in the art would know that you could 12:05
15 use, for example, temperature sensors to track the 12:05
16 temperature on the chip; right? 12:05

17 MR. TUNG: Objection. Vague. 12:05

18 THE WITNESS: The use of temperature 12:05
19 sensors on chip, I believe, was known at the time of 12:05
20 Nicol. 12:05

21 BY MR. BROWN: 12:05

22 Q. And so was the use of multiple temperature 12:05
23 sensors; right? 12:05

24 A. Possibly. I'm not sure about that. 12:05

25 Q. We can come back to that in a -- in a few 12:05

1 minutes. 12:05

2 But when Nicol -- so Nicol contemplates 12:05

3 making changes to the voltage based on the 12:05

4 temperature on the chip. Would -- would a person of 12:06

5 ordinary skill in the art think that he should make 12:06

6 changes to the voltage based on every minute 12:06

7 temperature change? Like every .01 degrees? Or is 12:06

8 there a different level of granularity that people 12:06

9 of ordinary skill in the art would use to adjust 12:06

10 voltage with the temperature? 12:06

11 MR. TUNG: Objection. Incomplete 12:06

12 hypothetical. 12:06

13 THE WITNESS: Yeah. I'm not really 12:06

14 following the question. 12:06

15 As best as I can understand this, it's -- 12:06

16 it's saying that processes do is vary -- the 12:06

17 manufacturing process does result in chips with 12:06

18 varying performance and that one could -- I guess 12:06

19 I -- to be honest with you, I'm not sure what it's 12:06

20 really trying to disclose. In the context of other 12:06

21 parts of the system, it doesn't make a lot of sense 12:07

22 to me. 12:07

23 BY MR. BROWN: 12:07

24 Q. Uh-huh. Well, it's suggesting, at least, 12:07

25 that by tracking temperature changes on the chip, 12:07

Page 97

1 you could make adjustments to your supply voltage; 12:07
2 right? 12:07
3 MR. TUNG: Objection. Assumes facts. 12:07
4 THE WITNESS: It does say you "...can 12:07
5 reduce the supply voltage even further by tracking 12:07
6 temperature and process variations." 12:07
7 So I imagine that it's using a combination 12:07
8 of context that it can infer based on measurements 12:07
9 of its own performance in -- in contrast to other 12:07
10 instances of other -- of a chip. That would be the 12:07
11 process variation. And then based upon that and 12:07
12 temperature information, makes them a reasonable 12:07
13 conclusion. 12:07
14 BY MR. BROWN: 12:07
15 Q. And so -- right. 12:07
16 So -- so in some way, the temperature 12:08
17 measured on the chip could be used to -- as an 12:08
18 input to decisions about what the supply voltage 12:08
19 would be. Is that fair? 12:08
20 MR. TUNG: Objection. Assumes facts. 12:08
21 THE WITNESS: It -- I mean, it says what 12:08
22 it says. The operating system can reduce the supply 12:08
23 voltage even further by tracking the temperature and 12:08
24 process variation. 12:08
25 For example, when the chip is nominal in 12:08

1 its characteristics, then it can be operated along 12:08
2 Line 20 of Figure 1, which calls for only 12:08
3 1.5 voltage supply when operating at 70 megahertz. 12:08
4 How -- how to take that any further and understand 12:08
5 what they are suggesting, I don't know. It's -- 12:08
6 yeah. 12:08
7 They don't disclose nearly enough that a 12:08
8 person of ordinary skill, in my opinion, would look 12:08
9 at that and say, "Aha. It would be too obvious to 12:09
10 then do something." 12:09
11 Could you control voltage as a consequence 12:09
12 of temperature? Yes. 12:09
13 Would they? I -- I don't know. I don't 12:09
14 think so for a number of reasons. 12:09
15 BY MR. BROWN: 12:09
16 Q. Okay. Well, let's -- let's start with 12:09
17 we -- we agree that a person of ordinary skill in 12:09
18 the art would know that you could control the supply 12:09
19 voltage as a consequence of temperature; right? 12:09
20 MR. TUNG: Same objection. 12:09
21 THE WITNESS: I agree that the notion of 12:09
22 controlling supply voltage as a function of 12:09
23 temperature was known in certain situations. 12:09
24 Generally not real-time environments. I don't 12:09
25 remember if -- off the top of my head what the 12:09

1 various POSITA definitions were on either side. 12:09

2 So if a person came from strictly a 12:10

3 real-time environment, they may not be that aware of 12:10

4 those techniques. But it was not unknown by any 12:10

5 means. 12:10

6 BY MR. BROWN: 12:10

7 Q. Okay. And regardless of whether you agree 12:10

8 with its application to real-time operating systems, 12:10

9 we can agree that Nicol is at least suggesting that 12:10

10 we control the supply voltage in part due to the 12:10

11 temperature changes; right? 12:10

12 MR. TUNG: Same -- same objection. 12:10

13 THE WITNESS: I think here Nicol is 12:10

14 suggesting that an operating system can be used to 12:10

15 reduce the supply voltage even further by tracking 12:10

16 temperature and process variation. 12:10

17 BY MR. BROWN: 12:10

18 Q. Is there something in my question that you 12:10

19 disagree with? 12:10

20 A. I just want to be careful to be precise 12:10

21 with what they are saying. 12:10

22 I think that, for example, they are not -- 12:10

23 well, there's two problems I have here. Two 12:10

24 concerns in how I am answering my question. 12:10

25 One is there's really scant disclosure of 12:11

1 so many elements that go into this. How, in detail, 12:11
2 any system does scheduling. How they do scheduling 12:11
3 in the context of real-time and -- and mixed 12:11
4 nonreal-time tasks. 12:11

5 This doesn't say real-time operating 12:11
6 system. Are they thinking in the context of 12:11
7 real-time operating system or just an operating 12:11
8 system in general? 12:11

9 That's why I -- I just feel more 12:11
10 comfortable going with, "Well, they say what they 12:11
11 say." I can't fill in the gaps to understand what 12:11
12 they were trying to mean by those words. 12:11

13 But -- but all of -- you know, many of the 12:11
14 elements, if not all of the elements that we talked 12:11
15 about, such as using a temperature sensor on a chip 12:11
16 or multiple sensors in a system and using that to 12:11
17 control clock frequency in certain situations was 12:11
18 certainly known. 12:11

19 Q. So -- okay. So let's talk about what was 12:12
20 known about that. 12:12

21 So when -- when a person of ordinary skill 12:12
22 in the art at the time would -- withdrawn. 12:12

23 When a person of ordinary skill in the art 12:12
24 at the time would use a temperature sensor to adjust 12:12
25 the clock frequency, how -- how does that work? 12:12

1 Does -- well, let me just ask. 12:12

2 Like, how would that work to -- in -- 12:12

3 that's the question. 12:12

4 MR. TUNG: Objection. Vague. 12:12

5 THE WITNESS: It depends on the context of 12:12

6 the computer system and -- and the objectives. 12:12

7 For example, you could have a system that 12:12

8 was trying to avoid what we call thermal runaway. A 12:12

9 fatal error in the silicon, in which case the 12:13

10 response might be remove power or drop the clock 12:13

11 rate to absolute lowest, "don't worry about anything 12:13

12 else." 12:13

13 Or it could be -- and that might be like 12:13

14 in a -- in a server computer, for example. Or it 12:13

15 could be in a battery-powered computer where one 12:13

16 says, "My -- I'm running on a battery. I am not 12:13

17 plugged in. The temperature is getting a little 12:13

18 hot. I guess I would like to slow things down." 12:13

19 There is too many un- -- undetermined 12:13

20 variables in any possible situation to say 12:13

21 conclusively what -- what does happen. 12:13

22 BY MR. BROWN: 12:13

23 Q. So at the time of -- at the time of the 12:13

24 '605 and '047 patent there were -- there were ways 12:13

25 in which -- people of ordinary skill knew of ways in 12:13

1 which you could remove power or drop the clock when 12:14
2 we are worried about an overheating or 12:14
3 over-temperature condition; right? 12:14

4 A. There was knowledge of how to remove for 12:14
5 the clock in over-temperature situations in a number 12:14
6 of systems. 12:14

7 Q. Is there a relationship between the -- the 12:18
8 supply voltage that you need to achieve a certain 12:18
9 frequency and the temperature of the environment? 12:18

10 A. These days we certainly recognize that in 12:18
11 many situations there is. I -- to be -- I'm not 12:18
12 sure when that -- when that knowledge really entered 12:18
13 the community. It may pre-date the invention; it 12:18
14 may not. I simply don't know. 12:18

15 Q. And so in those circumstances there would 12:18
16 need to be a change -- there could be situations 12:18
17 where based on the temperature, you could use less 12:18
18 voltage to achieve a certain frequency than what you 12:18
19 would need to in a different temperature setting; is 12:18
20 that right? 12:18

21 MR. TUNG: Objection. Vague. 12:18

22 THE WITNESS: I guess perhaps. I -- I 12:18
23 can't think of a particular situation, as I sit 12:18
24 here. It would likely result in some sort of a 12:18
25 temperature dependence -- well, there is a 12:18

1 temperature dependence in the performance of the 12:18
2 silicon itself. And then there is a temperature 12:18
3 dependence -- well, that doesn't affect the clock. 12:18
4 It just affects whether it works with a given clock. 12:18
5 I guess largely it would be a temperature 12:18
6 dependence with the PLL or the crystal circuitry. 12:18
7 It's possible. Yeah. 12:18
8 BY MR. BROWN: 12:18
9 Q. And so there are -- there are 12:18
10 circumstances where we would want to be making to 12:18
11 the supply voltage -- well, withdrawn. 12:18
12 There are ways in which we could optimize 12:18
13 our supply voltage based on the temperature that is 12:18
14 being measured. 12:18
15 Am I understanding this right? 12:18
16 A. I can imagine that there are such 12:18
17 situations particularly identified today. There are 12:18
18 a number of issues related to thermal response of 12:18
19 semiconductors which simply weren't known at the 12:18
20 time, for example, that would enter into that 12:18
21 discussion. 12:18
22 Q. And so which way does that go? If the 12:18
23 temperature increases, we can reduce the supply 12:18
24 voltage; or is it the other way around? 12:18
25 A. My recollection is that it trends both 12:18

1 ways. It depends. It depends on where you are in 12:18
2 the curve. It goes up at certain spots, wiggles 12:18
3 down, and then goes down again. 12:18
4 Q. Got it. That makes sense. 12:18
5 A. Actually, it's -- 12:18
6 Q. Okay. 12:18
7 A. It didn't make any sense to me at all. It 12:18
8 was a startling -- I'm sorry. I interrupted you. 12:18
9 But it was a startling new discovery to me 12:18
10 when I read about this six months ago. 12:18
11 Q. So in circumstances where you are 12:18
12 adjusting your voltage in light of the temperature 12:18
13 changes, what is the level of granularity that you 12:18
14 are going to want to be responsive to in those 12:18
15 temperature changes? 12:18
16 And by that I mean are we going to be 12:18
17 changing at every hundredth of a Fahrenheit, degree 12:18
18 of Fahrenheit, or is there some sort of banding that 12:18
19 we are going to be using to make decisions about how 12:18
20 to change the voltage? 12:18
21 A. I would say in general, I have no idea and 12:18
22 no way to state that. I mean, ultimately these are 12:18
23 digital systems. So the controller is reading in 12:18
24 some temperature measurements in some digital 12:18
25 representation, which will have a granularity. 12:18

1 They certainly -- I can't imagine -- 12:18
2 consider anything finer than that. But that might 12:19
3 very well be way more fine than they actually will 12:19
4 want to respond to. 12:19

5 Q. Yeah. 12:19

6 So why -- why do you say that, that it may 12:19
7 be -- what does that mean that it may be "way more 12:19
8 fine" than what they want to respond to? 12:19

9 A. You may be able to detect a temperature 12:19
10 variation that you do not believe is going to have 12:19
11 an interesting impact on the relationship between 12:19
12 the voltage and the clock. 12:19

13 Q. Uh-huh. So -- so you could have sort of a 12:19
14 band around how much of a temperature change you 12:19
15 need to make -- I'm sorry. Withdrawn. 12:19

16 You might have a band around how much of a 12:19
17 temperature change you need to see before you are 12:19
18 going to start making changes to your supply 12:19
19 voltage? 12:19

20 MR. TUNG: Objection. 12:19

21 THE WITNESS: I think that that is 12:19
22 certainly possible. One -- one could build a system 12:19
23 that way. 12:19

24 BY MR. BROWN: 12:20

25 Q. And part of that is because you -- you 12:20

1 don't want to be necessarily over-responsive to 12:20
2 changes in temperature and keep -- well, let me stop 12:20
3 there. I'll just ask the question again. 12:20
4 You don't want to be over-responsive to 12:20
5 changes in temperature; right? 12:20
6 A. That certainly could be a concern in a 12:20
7 system you are designing. You may not even 12:20
8 fundamentally be concerned about the variations. 12:20
9 Just certain, "have I crossed a particular 12:20
10 threshold?" 12:20
11 Q. And one of the reasons -- there's a couple 12:20
12 of reasons why you wouldn't want to be 12:20
13 over-responsive to changes in temperature. 12:20
14 One would be, as you are saying, it's just 12:20
15 too small of a change to require any action from 12:20
16 you; right? 12:20
17 MR. TUNG: Objection. 12:21
18 THE WITNESS: Yes. Presumably there could 12:21
19 be, you know, some level of temperature variation 12:21
20 below which, based on some additional outside 12:21
21 knowledge, the control system may conclude that is a 12:21
22 variation that won't result in any meaningful change 12:21
23 on the relationship between voltage and clock speed. 12:21
24 Presumably. 12:21
25 ///

1 BY MR. BROWN: 12:21

2 Q. Yeah. 12:21

3 And not -- not being over-responsive to 12:21

4 the temperature change will also prevent you from -- 12:21

5 from sort of toggling back and forth between 12:21

6 different voltages if the temperature is changing in 12:21

7 small ways back and forth? 12:21

8 A. I guess I -- 12:21

9 MR. TUNG: Just object. Objection to 12:21

10 form. 12:21

11 Go ahead. Sorry. 12:21

12 THE WITNESS: Yeah, I guess I would say if 12:21

13 you through -- for whatever reason decide that you 12:21

14 are going not respond that quickly, then you'll 12:21

15 avoid making these toggles. 12:22

16 And I -- as I was suggesting, you know, 12:22

17 ultimately there has to be some granularity, some 12:22

18 finite difference in the temperature that can be 12:22

19 measured. And it could be very, very small. But it 12:22

20 also could be quite relatively large. And by that I 12:22

21 mean that granularity is limited by at least two 12:22

22 things. 12:22

23 One is the reliability in information that 12:22

24 the thermal sensor puts out, which may not be very 12:22

25 fine. It may be very coarse. And so it's certainly 12:22

1 possible that, you know, that the variation -- that 12:22
2 whatever the smallest increment is could be enough 12:22
3 that you would want to respond to it. I imagine. 12:22
4 BY MR. BROWN: 12:22
5 Q. Uh-huh. It's -- it's sort of like a 12:22
6 thermostat is what we are talking about. It's the 12:22
7 same logic of why a standard household thermostat 12:23
8 doesn't -- doesn't respond, you know, to immediate 12:23
9 temperature variations, but kind of waits for there 12:23
10 to be enough of a change in one direction before it 12:23
11 kicks the furnace on or kicks the air-conditioning 12:23
12 on; right? 12:23
13 MR. TUNG: Objection. Assumes facts. 12:23
14 THE WITNESS: I think these days -- yeah, 12:23
15 you -- one could design such a system specifically 12:23
16 to avoid making frequent variations -- frequent -- 12:23
17 frequently changing the setting of the system. 12:23
18 But, again, it depends on way too many 12:23
19 factors, like when I change the voltage or power 12:23
20 supply by a small amount, how quickly does it 12:23
21 respond; how quickly does it -- does the temperature 12:23
22 sensor get updated; what is it's granularity. 12:24
23 I mean, we are talking about way too many 12:24
24 variables to say what would or wouldn't happen. 12:24
25 ///

1 BY MR. BROWN: 12:24

2 Q. Right. 12:24

3 So -- so really what we are saying is 12:24

4 there -- the trick is to be responsive enough to the 12:24

5 temperature changes without unnecessarily toggling 12:24

6 your voltage supply or unnecessarily -- or on the 12:24

7 other hand unnecessarily ignoring temperature 12:24

8 changes that could be meaningful. 12:24

9 Does that seem fair? 12:24

10 A. I would agree with that in -- in general. 12:24

11 But at the risk of being pedantic with the -- with 12:24

12 the observations that, you know -- I mean 12:24

13 unreasonably means it wasn't reasonable; you didn't 12:24

14 need to do it. 12:24

15 So nobody is going to design a system that 12:24

16 they think is unreasonable. You know, we disagree 12:24

17 on what is unreasonable, perhaps. But just with 12:25

18 that observation, yeah, you could design such a 12:25

19 system in so many different ways to respond. 12:25

20 In some sense what we are talking about is 12:25

21 control theory. And we're talking about an 12:25

22 incredibly trivial sort of notion of a control 12:25

23 system which gets incredibly complex -- which can -- 12:25

24 and steps into an area where I am not an expert. 12:25

25 There's many things you could do. 12:25

1 Q. Right. 12:25

2 So maybe -- maybe a way to conceptualize 12:25

3 this is the -- at a -- at a very high level, if you 12:25

4 are going to use temperature as an input to 12:26

5 decisions about the supply voltage, there's -- 12:26

6 there's some level of granularity of temperature 12:26

7 change that is going to matter to you, and there is 12:26

8 some level of granularity that is not going to 12:26

9 matter to you. 12:26

10 And whether or not that granularity is 12:26

11 defined by hardware limitations or defined by what 12:26

12 you were doing in software, in terms of deciding 12:26

13 what -- what that threshold is, there is 12:26

14 ultimately kind of -- there is a band of a minimum 12:26

15 and maximum drop or increase around your existing 12:26

16 temperature that you are going to wait for before 12:26

17 you are going to make changes to your voltage in 12:26

18 response to that temperature. 12:26

19 Does that make sense? 12:26

20 A. I -- I think so. Although I would say 12:26

21 it's an accumulation of change, Right. There is a 12:26

22 small instantaneous change that, for the most part, 12:26

23 doesn't interest me. 12:27

24 But if you are getting at every sample 12:27

25 over a ten-minute period you may blow past the 12:27

1 temperature goal. But I suspect you were talking 12:27
2 about the accumulation of temperature change. 12:27
3 Q. I was. That's a good clarification. 12:27
4 I mean, so -- so basically we're going to 12:27
5 make decisions about how to impact supply voltage 12:27
6 based on an accumulation or a trend of temperature 12:27
7 change in one direction or the other. And we're 12:27
8 going to wait for that trend to pass sort of a 12:27
9 minimum or maximum before making that supply voltage 12:27
10 change; right? 12:27
11 MR. TUNG: Objection to form. 12:27
12 THE WITNESS: For the most part, that 12:27
13 would not be an unreasonable way to start with 12:27
14 designing a control system -- for one of these 12:27
15 hypothetical systems. 12:27
16 BY MR. BROWN: 12:28
17 Q. Okay. Let me take you to a similar 12:28
18 concept in Nicol on Column 5. 12:28
19 A. All right. I am there. 12:28
20 Q. And I want to talk about the calibration 12:28
21 circuit that is discussed in that first full 12:28
22 paragraph on Column 5. 12:28
23 A. Yes. 12:28
24 Q. 5, 3 to 20- -- 22. 12:28
25 So let me -- if you want to read it to 12:28

1 refresh on it, please do. 12:28

2 A. Okay. 12:28

3 Q. But I'll try to -- I'll try to ask a 12:28

4 question. 12:28

5 So this calibration block and calibration 12:28

6 circuitry in Nicol essentially operates with -- with 12:28

7 two copies of part of a PE circuit with one of those 12:29

8 copies running slightly slower than the other; 12:29

9 right? 12:29

10 A. [Witness reviews document]. 12:29

11 I guess that's probably fair and 12:29

12 certainly -- actually, I don't know. 12:29

13 It -- it's not clear that they are running 12:29

14 at the same clock rate. It's not clear that they 12:29

15 are not. Let's put it that way. At least that's my 12:29

16 recollection. 12:29

17 Q. So I was -- oh, I see. Maybe this is what 12:29

18 you are pointing out. 12:29

19 One of them is slightly slower than the 12:29

20 other. You don't know if that is by hardware 12:29

21 designed or by the frequency it has been given; is 12:29

22 that right? 12:29

23 A. I'm not sure. Is there a particular part 12:29

24 in here that you were looking at with regards to the 12:29

25 speed -- 12:29

1 Q. For sure. 12:29

2 A. -- so I can -- 12:30

3 Q. Line 10. 12:30

4 A. [Witness reviews document]. 12:30

5 Oh, okay. Yes. I -- I missed that -- 12:30

6 sure. 12:30

7 So they -- they replicate part of the PE 12:30

8 that they think is going to be the slowest portion, 12:30

9 and then have two versions, assuming that they'll -- 12:30

10 they'll use the one that is worst-case. 12:30

11 Okay. Yeah. 12:30

12 Q. Well, not -- so -- so I agree with you 12:30

13 that they make two copies of this critical path and 12:30

14 one of them is designed to be slower. 12:30

15 And then what -- and then what they do is 12:30

16 they -- they give it the same supply voltage. And 12:30

17 they try to adjust that supply voltage down so that 12:31

18 the slower one fails to operate properly, but the 12:31

19 normal one operates properly; right? 12:31

20 A. Uh-huh. 12:31

21 Q. And they are doing that to sort of 12:31

22 identify that -- that sweet spot of supply voltage 12:31

23 that will keep the PE just barely active without it 12:31

24 failing; is that right? 12:31

25 A. That's my understanding. I -- I question 12:31

1 whether it would achieve that goal, but it's a 12:31
2 clever idea. 12:31

3 Q. Okay. And that's the same -- I don't know 12:31
4 if you have looked at it. That's the same technique 12:31
5 that is in that Koruda article that is cited on -- 12:31
6 at Line 5? 12:31

7 A. Now that you point it out and I have 12:31
8 reviewed it, I assume that is probably the same 12:31
9 technique. I didn't go off and review Koruda, but 12:31
10 it seems that that's what they are saying. 12:31

11 Q. Okay. And -- and so what -- so what this 12:32
12 paragraph ends with noting is that because these two 12:32
13 copies experience the same variation in 12:32
14 temperatures -- temperature as the regular PEs do, 12:32
15 it's able to adjust the supply voltage in response 12:32
16 to temperature variation; right? 12:32

17 A. I imagine. I don't understand why they 12:32
18 necessarily experience the same temperature 12:32
19 variation. Whether they are on the same die or not 12:32
20 the temperature is going to vary. 12:32

21 Yeah, and they are also trying to get 12:32
22 process variation issues, I think, with the notion 12:32
23 of having two different -- one which is specifically 12:32
24 delayed. 12:32

25 So the process variation might actually 12:32

1 cause one of the PEs to, you know, use even more 12:33
2 time than the delayed one that they have got in 12:33
3 place. But -- but I think I understand what they 12:33
4 are trying to do. I'm just -- I'm not sure how well 12:33
5 it would work in practice. 12:33
6 Q. Yeah, so there -- I mean, what they are 12:33
7 saying is, essentially, the conditions are the same. 12:33
8 And so between these -- these critical paths -- 12:33
9 these sort of calibration circuit and the other PEs. 12:33
10 And so changes in temperature will be 12:33
11 experienced roughly the same between them; right? 12:33
12 That's -- that's basically what Nicol is trying to 12:33
13 say? 12:33
14 A. Just give me just a moment. 12:33
15 [Witness reviews document]. 12:33
16 Yeah, so -- they say it. I don't know 12:33
17 that it's true. But they say that [as read]: 12:33
18 "Since the two critical paths within 12:33
19 the element 120 experience the same 12:33
20 variations in temperature as do the 12:34
21 PEs...." 12:34
22 Yada, yada, yada. And that is -- that's 12:34
23 certainly one element where I don't see why that is 12:34
24 true. But they do state that. 12:34
25 Q. Right. 12:34

1 So I mean we don't need to bicker about 12:34
2 they are going to experience the exact same 12:34
3 temperature changes, but -- but what they are noting 12:34
4 here, at least we can agree is temperature is going 12:34
5 to have some affect on where this supply voltage 12:34
6 sweet spot is; right? 12:34
7 A. That's my -- let me see. 12:34
8 [Witness reviews document]. 12:34
9 Yeah, it says the [as read]: 12:34
10 "...the Vdd local supply voltage 12:34
11 appropriately tracks the temperature 12:34
12 variations as well as the different 12:34
13 operating frequency specifications." 12:34
14 Q. Yeah, so then my -- one of my questions -- 12:35
15 and this goes back to what we were just talking 12:35
16 about, at least some of the theories we were just 12:35
17 talking about is if temperature is going -- if 12:35
18 temperature changes are going to have an effect on 12:35
19 what that sweet spot is, that could mean that if -- 12:35
20 depending on how granular we are on where that sweet 12:35
21 spot is, on where that right voltage is, we could be 12:35
22 looking at a circumstance where that -- that 12:35
23 voltage, live voltage, has to change fairly 12:35
24 regularly based on how much the temperature is 12:35
25 changing; right? 12:35

1 MR. TUNG: Objection. Vague. 12:35

2 THE WITNESS: I guess -- I mean, it's not 12:35

3 really -- there's not enough disclosure here for me 12:35

4 to understand how -- you know, do they -- do they -- 12:35

5 the controller that they have got, are they 12:36

6 considering temperature at one point after a change 12:36

7 in the system state is requested? Or are they 12:36

8 tracking it at a regular time sample? 12:36

9 I -- I don't know. 12:36

10 BY MR. BROWN: 12:36

11 Q. Yeah, I mean, it -- what I am really 12:36

12 getting at is, because -- because there is a risk 12:36

13 that -- 12:36

14 I mean, this sweet spot is, like, right on 12:36

15 the edge of a cliff. Right? That's -- that's 12:36

16 really what we are talking about. 12:36

17 We are talking about this, like if we go 12:36

18 just below this sweet spot, we are going to fail; 12:36

19 right? That's what is being described there. 12:36

20 A. Uh-huh. That's -- that's the notion that 12:36

21 they are aiming for, yes. 12:36

22 Q. And so you would need to have -- because 12:36

23 temperature is having an effect on this, you would 12:36

24 need to have some sort of buffer to keep yourself 12:36

25 from being right on that cliff; right? Because 12:36

1 otherwise both PEs would fail, and thus all your PEs 12:36
2 would fail if you are using that wrong supply 12:36
3 voltage. 12:36
4 A. Yeah. I think you are getting at 12:36
5 something that I was talking about in a couple of 12:36
6 different situations before. 12:37
7 You -- as an engineering design principle, 12:37
8 you almost always take advantage of an opportunity 12:37
9 to build yourself a little bit of headroom -- a 12:37
10 little -- a safety margin. And that -- that could 12:37
11 be, you know, an estimate of how long a task would 12:37
12 be, maybe overestimate it a little bit. 12:37
13 In this case, it could be, you know, 12:37
14 making sure that, "well, you think you have 12:37
15 calculated the exact lowest supply voltage, add a 12:37
16 little bit above that to give yourself some safety." 12:37
17 You know, they -- they seem to be talking 12:37
18 about something that is going to do their best to 12:37
19 zero-in on that exact line without any added safety 12:37
20 margins. 12:37
21 But maybe it's built into their notion of 12:37
22 making sure that one of the critical paths runs 12:37
23 slower than the other; "We'll make sure it runs slow 12:37
24 enough that that will give us our safety margin." 12:38
25 I -- I just don't know from the 12:38

1 disclosure. 12:38

2 Q. Got it. 12:38

3 And so -- so I think an engineering design 12:38

4 principle here in implementing this could be to put 12:38

5 a bit of a safety margin in here so that you are 12:38

6 not -- you are not seeing the PEs toggling back and 12:38

7 forth between a failing state and a passing state 12:38

8 based on minor fluctuations of temperature; right? 12:38

9 MR. TUNG: Objection. Assumes facts. 12:38

10 THE WITNESS: I guess I would go a little 12:38

11 bit farther than that and say, Well, an engineering 12:38

12 design principle, in general -- and in particular in 12:38

13 this system, would be to make sure that the system 12:38

14 never failed. 12:38

15 Yeah, and failure would be the -- the 12:38

16 voltage dropping below whatever the critical limit 12:38

17 was that was required to meet the real-time 12:38

18 requirement. 12:38

19 BY MR. BROWN: 12:38

20 Q. Yeah, so they -- they build some sort of 12:39

21 buffer in or some sort of deadband in to have that 12:39

22 safety margin to make sure we're not falling below 12:39

23 that voltage and failing? 12:39

24 A. I think that in general, that's a common 12:39

25 design principle. 12:39

Page 120

1 Much of what Nicol is doing sort of -- in 12:39
2 disclosing, is teaching against that, which is 12:39
3 figuring out, you know, exactly the right spot to 12:39
4 be. But that's not to say in the back of, you know, 12:39
5 their mind they were thinking "Yeah, we want to know 12:39
6 the exact right spot." 12:39

7 Maybe they thought, "We know we have to 12:39
8 build in some margins. But we are better off 12:39
9 knowing exactly where that line is, and we'll take 12:39
10 care of that later on." 12:39

11 I just don't -- -- 12:39

12 Q. And -- 12:39

13 A. -- know that either. 12:39

14 Q. I'm sorry. 12:39

15 So at least a person of ordinary skill in 12:39
16 the art at the time reading this, you know, could 12:39
17 look at it and go, "Okay, I get that you found the 12:39
18 right spot, but it's good design principle, is for 12:40
19 me to add a safety buffer to make sure I don't 12:40
20 fail." 12:40

21 Is that fair? 12:40

22 MR. TUNG: Object. Object to the form. 12:40

23 THE WITNESS: Yeah. Although as I said 12:40
24 before, I think I would go broader and say that a 12:40
25 person of ordinary skill in the art would say, "I am 12:40

1 going to do whatever I have to do to make sure I 12:40
2 don't fail. And if one aspect of that response is, 12:40
3 you know, to look at various points of the system, 12:40
4 whether it's -- whether it's the voltage or response 12:40
5 to temperature or -- or time, I'm going to try to 12:40
6 give myself a little bit of slack." 12:40
7 BY MR. BROWN: 12:40
8 Q. Okay. Got it. 12:40
9 Let me switch gears and ask you -- I'm 12:40
10 going to put an exhibit in. I'll let you know when 12:41
11 it's ready. 12:41
12 (Deposition Exhibit 2 was marked for 12:41
13 identification and is attached hereto.) 12:42
14 BY MR. BROWN: 12:42
15 Q. Okay. It should be up now. 12:42
16 A. This is Exhibit 2, I assume; right? 12:42
17 Q. Exhibit 2. Yes. 12:42
18 A. All right. 12:42
19 Q. So Exhibit 2, for the record, is an 12:42
20 excerpt of the Wiley Electrical -- Electronics 12:42
21 Engineering Dictionary, and it's Page 355. And I'm 12:42
22 going to take you down to the word -- the 12:43
23 definition of "hysteresis." 12:43
24 Do you see that? 12:43
25 A. Yes. 12:43

1 Q. So you see the third definition of 12:43
2 "Hysteresis," it says hysteresis is [as read]: 12:43
3 "Any phenomenon in which there is 12:43
4 lag between the cause and the induced 12:43
5 or observed effect. For instance, the 12:43
6 output of an instrument depending on 12:43
7 whether the input resulted from an 12:43
8 increase or decrease from the previous 12:43
9 value. 12:43
10 "Another example is the manner in 12:43
11 which a thermostat utilizes the right 12:43
12 amount of hysteresis to maintain the 12:43
13 desired temperature. Too little 12:43
14 hysteresis would result in constant 12:43
15 switching between cycles, and too much 12:43
16 would allow too large a temperature 12:43
17 interval between cycles." 12:43
18 Do you see that? 12:43
19 A. I do. 12:43
20 Q. Okay. Does that def- -- do you agree with 12:43
21 that definition in Exhibit 2 of "Hysteresis"? 12:43
22 MR. TUNG: Object. 12:43
23 THE WITNESS: I don't. 12:43
24 MR. TUNG: I'm sorry. Object. Objection. 12:43
25 Go ahead. 12:44

1 THE WITNESS: Yeah, I don't find it all 12:44
2 that useful, in -- in particular. I think there are 12:44
3 aspects of it that are just wrong. 12:44

4 BY MR. BROWN: 12:44

5 Q. Which is aspect of the definition that I 12:44
6 read do you think is wrong? 12:44

7 A. Well, so -- so the definition is just the 12:44
8 first sentence, and the others are examples. So 12:44
9 it's [as read]: 12:44

10 "Any phenomenon in which there was a 12:44
11 lag between the cause and the induced 12:44
12 or observed effect." 12:44

13 That's the definition of delay -- or lag. 12:44
14 That -- that is absolutely not hysteresis. 12:44

15 Q. So just so I understand it, your -- your 12:44
16 testimony is you don't believe hysteresis is the lag 12:44
17 or delay in a -- in a response to some changing 12:44
18 condition? 12:44

19 A. I do not believe that hysteresis is any 12:44
20 phenomenon in which there is a lag between the cause 12:45
21 and the induced or observed fact -- effect. 12:45

22 I guess I haven't thought about it. It's 12:45
23 possible that that is an element of -- a suitable 12:45
24 definition of hysteresis, but it fails far short of 12:45
25 being a useful definition in and of itself. 12:45

1 Q. Okay. What about the example it provides 12:45
2 of a thermostat utilizing the right amount of 12:45
3 hysteresis to maintain a desired temperature? 12:45

4 Do you agree that a thermostat that -- 12:45
5 that introduces that delay in a decision to take 12:45
6 action on a temperature measurement is using 12:45
7 hysteresis? 12:45

8 MR. TUNG: Objection. Vague. 12:45

9 THE WITNESS: I think that one could 12:45
10 design a thermostat such that it utilized 12:45
11 hysteresis. One could also build a thermostat, even 12:46
12 a smart one that didn't use hysteresis, at least as 12:46
13 defined here. 12:46

14 BY MR. BROWN: 12:46

15 Q. Uh-huh. Well, let me -- let me unpack 12:46
16 that a little bit. 12:46

17 So if a thermostat waits to make an 12:46
18 adjustment to -- let me ask it different way. 12:46

19 The thermostat waits to turn off the 12:46
20 furnace or turn on the air conditioning; it waits 12:46
21 for enough of a trend in one direction of 12:46
22 temperature change before it makes that decision. 12:46
23 Is that hysteresis? 12:46

24 MR. TUNG: Objection. Vague. 12:46

25 THE WITNESS: It may be. I haven't -- I 12:46

1 guess I haven't thought of it. 12:46

2 But in this case, their example of 12:46

3 hysteresis for a thermostat literally does not meet 12:46

4 their own offered definition of "hysteresis" at all. 12:47

5 BY MR. BROWN: 12:47

6 Q. Okay. And we can -- I understand that you 12:47

7 don't like the definition, so I am actually asking a 12:47

8 separate question so -- just to understand where 12:47

9 your perspective is. 12:47

10 If -- if a thermostat waits for a certain 12:47

11 trend in one direction of temperature changes, 12:47

12 before it takes action on that temperature change, 12:47

13 is that using hysteresis? 12:47

14 A. Not necessarily. It depends on other 12:47

15 under-specified aspects of the -- of the control 12:47

16 algorithm. 12:47

17 Q. What would you need to know to determine 12:47

18 whether or not that is hysteresis? 12:47

19 A. I have to consider all of what was used 12:47

20 for controlling the output. 12:47

21 I do think, for example -- and this might 12:47

22 help moving the discussion along. If a thermostat 12:47

23 is set for 70 degrees, for example, it may have a 12:47

24 very simple control algorithm that says, "Don't turn 12:48

25 the furnace on unless the temperature is more than 12:48

1 though the thermostat is set to 70, is that using 12:49
2 hysteresis? 12:49
3 A. I would say that for the most part that is 12:49
4 a fairly good definition of hysteresis. Yes. 12:49
5 Q. And part of that is essentially having 12:49
6 this -- this deadband between -- from 70, the thing 12:49
7 that it is actually set to, and some threshold for 12:49
8 change before it takes action; right? 12:49
9 A. In this scenario -- excuse me. 12:50
10 In this hypothetical scenario we are 12:50
11 talking about, I would say that that 12:50
12 characterization is not faulty. There is a deadband 12:50
13 within which for a number of reasons the 12:50
14 hypothetical thermostat would not respond to changes 12:50
15 in the temperature. 12:50
16 Q. And implementation of -- of that kind of 12:50
17 deadband in -- is using hysteresis; right? 12:50
18 MR. TUNG: Objection. Vague. 12:50
19 THE WITNESS: Yeah, I mean, I was just -- 12:50
20 we were talking about this -- the example with the 12:50
21 deadband in the context of something that -- I think 12:50
22 I had already said, it's a pretty good example of 12:50
23 hysteresis. Yes. 12:51
24 BY MR. BROWN: 12:51
25 Q. Okay. And part of the -- part of what is 12:51

1 making that hysteresis is that we're -- we're using 12:51
2 sort of a safety margin to make sure that we're not 12:51
3 toggling a lot between the kind of on- and 12:51
4 off-state; right? 12:51
5 MR. TUNG: Objection. Mischaracterizes. 12:51
6 THE WITNESS: I think for the most part, 12:51
7 the reason why somebody would build that sort of 12:51
8 capability into a thermostat is indeed to avoid 12:51
9 rapidly turning on the furnace and 5 seconds later 12:51
10 turning it off. 12:51
11 How -- in control systems in general, how 12:51
12 important such a decision is depends on a lot of 12:51
13 other factors. 12:51
14 Like, I may be able to turn the furnace on 12:51
15 and off very quickly with little cost that I care 12:51
16 about. 12:52
17 It may be the case that it irritates 12:52
18 people when suddenly it goes on and then it goes 12:52
19 off. 12:52
20 So there is a lot of things to consider. 12:52
21 BY MR. BROWN: 12:52
22 Q. And that -- that temperature example -- 12:52
23 okay. Or that the -- 12:52
24 Well, isn't that introducing, as this 12:52
25 definition explains, a lag between the cause and the 12:52

1 induced or observed effect? And I can ask it 12:52
2 differently. 12:52
3 Isn't that introducing a lag between when 12:52
4 we take action versus when we were -- you know, our 12:52
5 specific point of action was? 12:52
6 A. No. I don't think so. Because, for 12:52
7 example, if you are in this hypothetical band 12:52
8 between 69 and 71, temperatures going up and down a 12:52
9 little bit, you are never -- and it never exceeds 12:53
10 either threshold, you are never going to cause a 12:53
11 change. So there is no lag there. 12:53
12 And in theory, if you are in that and you 12:53
13 go above the threshold, you are going to do your 12:53
14 best to cause a change to happen right now. There's 12:53
15 no notion of, "Well, the furnace is on; I crossed my 12:53
16 threshold; I know I want it to be off, but I'm going 12:53
17 to wait." You try to turn it off as soon as you 12:53
18 can. 12:53
19 And similarly, you could be bouncing 12:53
20 around all over the place in that -- as you 12:53
21 characterize that deadband; that is a reasonable 12:53
22 term -- and drop just below the critical line and 12:53
23 decide, "I need the furnace turned on now. It's too 12:53
24 cold." There's -- you wouldn't want to build a 12:53
25 delay in there. 12:53

1 Q. Well, I am -- I am confused about where 12:53
2 you are triggering this "delay." So what you are 12:53
3 viewing is the "delay." 12:54

4 So if our -- if I go and I set my 12:54
5 thermostat to 70, and it doesn't turn on until the 12:54
6 temperature continues to decrease all the way down 12:54
7 to 68, that's a delay between the temperature I set 12:54
8 it to be at, 70, and the lower threshold of the 12:54
9 deadband; right? 12:54

10 A. Assuming you can't change temperature 12:54
11 instantaneously; yeah, that would be a delay. 12:54

12 But the definition here is getting to an 12:54
13 element of hysteresis, which is the cause and the 12:54
14 induced or observed effect. 12:54

15 The cause of a change in the thermostat is 12:54
16 not the temperature I want to be at. It's the 12:54
17 temperature I am at. 12:54

18 I mean, in a -- in the scenarios we have 12:55
19 been talking about, the temperature I want to be at, 12:55
20 the 70 degrees, we haven't talked about that 12:55
21 changing at all. 12:55

22 Q. Right. 12:55

23 But like -- but okay. But so -- so as the 12:55
24 temperature crosses -- 12:55

25 Let's say the furnace is turned off and as 12:55

1 the temperature crosses from 71 to 70 to 69, it is 12:55
2 not kicking in after it goes below 70, despite that 12:55
3 being what I set it at; right? 12:55

4 A. I think that's right. But furthermore, 12:55
5 you have no guarantees that it will ever kick in. 12:55
6 The temperature, you know, may be the sun is coming 12:55
7 up and the temperature will go back to 70. 12:55

8 That's why I am saying it's not a delay in 12:55
9 response to the incremental change. It's a delay to 12:55
10 hitting those -- the low mark and the high mark. 12:55

11 Q. Well -- sorry. 12:55

12 A. It's responding to hitting those two, but 12:55
13 I don't see a delay built into hitting those two. 12:55

14 Q. Yeah, so I -- let me try to rephrase. 12:56

15 There are two issues you are having with 12:56
16 lag, if I am understanding it right. 12:56

17 The first is that lag could be permanent 12:56
18 because there is no indication that we are ever 12:56
19 going to get to that point that we might have been 12:56
20 trending to, or, you know, like you're saying, the 12:56
21 sun might come out, it might get warm. So the first 12:56
22 issue is sometimes it never happens. 12:56

23 And the second problem I think you are 12:56
24 having is -- well, actually, I don't think I 12:56
25 understand the second problem, which is why I am 12:56

1 asking my question. 12:56

2 So it's that you are not seeing -- you are 12:56

3 viewing the change between 69 and 67 as like an 12:56

4 instantaneous change, where you are saying there is 12:56

5 no lag; right? 12:56

6 A. I guess -- let me -- let me be cautious 12:56

7 here. I mean, there will be a lag. You know, there 12:56

8 is a thermostat. It's on one side of the room, the 12:56

9 furnace is, you know, in the basement. 12:56

10 But there is no designed lag. Lag is not 12:56

11 a characteristic that we want in the system. It's 12:57

12 just a fact that there's always cause and effect. 12:57

13 That -- that's not what hysteresis is -- is about. 12:57

14 And in -- I believe in the scenario 12:57

15 that -- that we sort of refined with a -- with a 12:57

16 thermostat, the desire is to have an instantaneous 12:57

17 change. There is no notion -- like I said, there is 12:57

18 no notion of, "Well, we want there to be to a 12:57

19 delay." 12:57

20 And there's not much concern about, "Well, 12:57

21 there is a delay." There is some delay. That's 12:57

22 just the way things are. 12:57

23 Q. But isn't -- I guess this is where I am 12:57

24 not -- I'm just not sure we are speaking the same 12:57

25 language here. 12:57

1 Because isn't the -- isn't the lag the 12:57
2 thresholds that we built around -- isn't the lag the 12:57
3 deadband? 12:57

4 If I am -- I am a human being who set my 12:57
5 thermostat at 70 but it's not going to kick on until 12:57
6 68, that is a lag that I am perceiving between what 12:58
7 I set it at and what it kicks in at. 12:58

8 And so isn't -- from the design system, 12:58
9 it's saying, "Okay, the input setting was 70; I am 12:58
10 going to add a delay and not act until the 12:58
11 temperature goes 2 degrees below that"? 12:58

12 A. No. I don't think so. For example, 12:58
13 let's -- let's think about applying this to 12:58
14 something like a hysteresis in a -- in a very 12:58
15 high-speed digital circuit as opposed to a furnace 12:58
16 and -- and along there. 12:58

17 It could be the case that that -- that 12:58
18 change between where you want to be and where you 12:58
19 get concerned and you decide to make a change could 12:58
20 happen, in essence, instantaneously to the system. 12:58
21 So there may be -- so what is that lag? There -- as 12:58
22 far as I know, there is no lag or it could be a 12:58
23 long, slow trend. 12:58

24 And -- and as I said, I don't -- I don't 12:58
25 think those -- those small changes can be considered 12:59

1 the input that causes a lag result because they 12:59
2 don't necessarily cause any result. They don't -- 12:59
3 they are not delayed. Right? 12:59

4 If I get all the way down to just over 12:59
5 68 degrees, but don't cross 68 degrees, there's no 12:59
6 delayed output. It -- there's -- I'm sorry. 12:59
7 There's no delayed change in that output. It never 12:59
8 happened. 12:59

9 Q. Right. I want to separate the two 12:59
10 concepts though because I think there were -- let's 12:59
11 put on pause the never-happening point. 12:59

12 A. Okay. 12:59

13 Q. But that's -- that's a different point. 12:59
14 But I hear you. I hear you. And we can go back to 12:59
15 it. 12:59

16 But it does seem like -- like the issue 12:59
17 that we are having is who -- is really about 12:59
18 perception of the lag. 12:59

19 Who it -- what you are saying is, "Look, 12:59
20 there could be times that the temperature just goes 12:59
21 from 71 to 68 like that," and in that case, there is 13:00
22 no lag at all; right? 13:00

23 A. Right. 13:00

24 Q. But there could also be times where the 13:00
25 temperature slowly decreases in a trend and passes 13:00

1 below 70, passes below 69, and then doesn't kick in 13:00
2 until we hit 68, and there is a delay between the 13:00
3 user setting and the low threshold being hit. Fair? 13:00
4 A. Yes. There is a delay between moving off 13:00
5 of the desired temperature and hitting the trigger 13:00
6 point. 13:00
7 Q. So there are at least some circumstances 13:00
8 in this sort of textbook definition of hysteresis in 13:00
9 our thermostat where -- where there is a lag element 13:00
10 between the set target and when the system acts on 13:00
11 that target as a result of this threshold, some 13:00
12 circumstances, not all, but there are some? 13:00
13 A. Yes. I mean, there are some circumstances 13:01
14 where there is some delay in the -- in the system. 13:01
15 I mean, as I suggested before, even once 13:01
16 you decide to make the change, there is -- there is 13:01
17 no instantaneous affect. Although, you try to keep 13:01
18 it as small as possible. 13:01
19 Q. Yeah. 13:01
20 And so the dispute that you are having 13:01
21 with the definition is not that -- is not that lag 13:01
22 can -- lag of the kind that we are discussing can be 13:01
23 an indicia that hysteresis is occurring, but you are 13:01
24 saying that it's not -- not always the case. There 13:01
25 are circumstances where there is no lag but there is 13:01

1 still hysteresis occurring; is that right? 13:01

2 A. Yes. For example -- yeah, the term "lag" 13:01

3 that -- and may be this is just me. 13:02

4 When I read that and I hear "lag," I think 13:02

5 time; there is a delay. 13:02

6 At the same time, we use hysteresis all 13:02

7 over the place, like in an electric circuit where 13:02

8 it's based on voltage or -- well, temperature 13:02

9 without an impact. But, you know, it's not a 13:02

10 question of how much time has passed. It's a 13:02

11 question of how much voltage change have you got. 13:02

12 Q. Yeah. Yeah. I think I am -- I think I am 13:02

13 understanding. 13:02

14 I mean, really, in your mind, this 13:02

15 definition is -- is maybe too narrow in that it 13:02

16 doesn't capture non-time impacted hysteresis, like 13:02

17 the voltage example that you are providing? 13:02

18 MR. TUNG: Objection. Mischaracterizes. 13:02

19 THE WITNESS: Yeah. Although, I -- 13:02

20 actually, I would flip it around the other way: 13:02

21 It's too broad. 13:02

22 It may be the case that that occurs in -- 13:02

23 in the thermostat example that we are talking about, 13:03

24 but it's not narrow enough to actually define what 13:03

25 is hysteresis in that -- in that context. 13:03

1 BY MR. BROWN: 13:03

2 Q. Got it. Okay. But, so -- right. 13:03

3 So whatever it is that we're -- whatever 13:03

4 it is that we are talking about, that -- well, 13:03

5 withdrawn. 13:03

6 Well, we -- I think what we can agree on 13:03

7 as part of what hysteresis is, is as we have talked 13:03

8 about in the thermostat example. 13:03

9 Using a two-level threshold band such as 13:03

10 in a thermostat, that is an example of hysteresis? 13:03

11 A. I think that that's a good example of 13:04

12 hysteresis writ large, yes. 13:04

13 Q. And so we -- we can fight about what lag 13:04

14 means another day and just agree on that. Okay. 13:04

15 Good. 13:04

16 How are we doing on time? When did we 13:04

17 take our last break? Yeah, noon. 13:04

18 You want a break or do you want to keep 13:04

19 going? It's up to you. 13:04

20 A. Any sense of -- I assume we are not close? 13:04

21 I would love to push through and be done 13:04

22 but, you know, maybe we should take a break if it's 13:04

23 going to be another hour or two. 13:04

24 Q. Yeah. It's probably going to be at least 13:04

25 one more module. I mean, we're not going to go all 13:04

1 day, though. So -- but, yeah. 13:04

2 A. Why don't we -- 13:04

3 Q. Why don't we take a break. Yeah. 13:04

4 THE VIDEOGRAPHER: We're going off the 13:04

5 record. The time is 1:04. 13:04

6 (Brief break.) 13:19

7 THE VIDEOGRAPHER: We're back on the 13:19

8 record. The time is 1:19. 13:19

9 BY MR. BROWN: 13:19

10 Q. All right. I'm going to ask you, as I 13:19

11 always do, did you -- 13:19

12 Welcome back, Doctor. 13:19

13 And did you speak with counsel for PACT 13:19

14 during that break? 13:19

15 A. No. 13:19

16 Q. Okay. So I'm going to go in Nicol to 13:19

17 Column 6, starting at Line 34. It's the paragraph 13:19

18 that says [as read]: 13:19

19 "The principles disclosed above for 13:19

20 a multiprocessor is extendible to other 13:19

21 system arrangements." 13:19

22 Do you see that? 13:19

23 A. Yes. 13:19

24 Q. Okay. So Nicol discloses -- or, 13:19

25 withdrawn. 13:19

Page 139

1 Nicol states that its principles are 13:19
2 extendable to other system arrangements; right? 13:19
3 A. They make that statement. Yes, sir. 13:19
4 Q. And if we go down a little bit to Line -- 13:19
5 well, 39 to 41, there's a reference to the use of 13:20
6 personal computers. 13:20
7 Do you see that? 13:20
8 A. Yes, I do. 13:20
9 Q. And you don't disagree that the 13:20
10 implement -- that the Nicol device could be 13:20
11 implemented in a personal computer situation; right? 13:20
12 A. I have no idea what specifically they are 13:20
13 referring to when they say the principles above. 13:20
14 One of the principles they have disclosed 13:20
15 is how to do task scheduling when tasks are known. 13:20
16 I don't see how that could be applied to a window 13:20
17 system. 13:20
18 One of the principles they've disclosed is 13:20
19 varying the POP frequency and the voltage. I think 13:20
20 that could be applied, sure. 13:20
21 But -- and I don't know. I just cannot 13:20
22 tell what they are referring to when they say "the 13:21
23 principles" above. 13:21
24 Q. Well, let's -- I mean, let me just unpack 13:21
25 that point. 13:21

1 It -- there are -- in a personal computer, 13:21
2 there could be -- there could be multiple processors 13:21
3 in a personal computer; right? 13:21

4 A. Today, typically, most personal computers 13:21
5 would have multiple processor cores. And I only say 13:21
6 that because Intel, for example, uses the term 13:21
7 "processor" oftentimes to mean one chip; whereas, I 13:21
8 think really they are talking here about the -- like 13:21
9 a PE. So there are multiple things that would be 13:21
10 comparable to a PE. 13:21

11 Q. Sure. 13:21

12 And back at the time of the invention for 13:22
13 the '047 and the '605, personal computers could have 13:22
14 multiple processors as well; right? 13:22

15 A. It wouldn't surprise me. I don't remember 13:22
16 exactly when the notion of multiple -- for example, 13:22
17 multiple Intel cores hit the market, but it wouldn't 13:22
18 surprise me if that date pre-dated the time of 13:22
19 invention. I just don't recall. 13:22

20 Q. Yeah. But there's also other ways that 13:22
21 you could have multiple processors in a personal 13:22
22 computer back then, for instance, a graphics card 13:22
23 that's inserted into the PCI slot of an older 13:22
24 personal computer would typically have its own 13:22
25 processor; right? 13:22

1 A. So a graphic card back in those days would 13:22
2 typically have something that we would call a 13:22
3 processor. I don't think that it fits the 13:22
4 definition of a processor here in -- in any useful 13:23
5 way. 13:23

6 But, yes, they were -- well, there were -- 13:23
7 there probably were programmable processors on 13:23
8 graphics cards as of that date. 13:23

9 Q. Okay. And there were also other 13:23
10 processors that you could sort act- -- well, 13:23
11 withdrawn. 13:23

12 There was also, at the time, other types 13:23
13 of processors, other than graphics processors, that 13:23
14 you could interface with a personal computer via a 13:23
15 PCI card or slot; right? 13:23

16 MR. TUNG: Objection. Vague. 13:23

17 THE WITNESS: I guess. For example, you 13:23
18 could plug in a network card in a PCI and run a 13:23
19 network cable over to some other computer, and 13:23
20 thus -- thus be interconnected in some meaningful 13:23
21 way. 13:23

22 BY MR. BROWN: 13:23

23 Q. Okay. And so -- so at least some of the 13:24
24 concepts of Nicol from -- could be -- in addition to 13:24
25 being applicable in the way you described earlier, 13:24

1 could also be applicable to a personal computer at 13:24
2 the time of invention as a -- in a coprocessor role 13:24
3 as the main processor; right? 13:24

4 MR. TUNG: Objection. Vague. 13:24

5 THE WITNESS: So when you say 13:24
6 "coprocessor," I assume, for example, you are 13:24
7 considering, like, the graphics processor that we 13:24
8 mentioned? 13:24

9 I don't -- I don't see how any of the 13:24
10 disclosures in Nicol could be applied, particularly 13:24
11 at that date, in any meaningful way to such a system 13:24
12 with a graphics processor, unless, as I suggested, 13:24
13 all they meant was, "Well, we can -- we can vary the 13:24
14 voltage and, thus, vary the clock speed." 13:24

15 Was that used at that time? I don't know. 13:25
16 But, you know, it wouldn't shock me if it was. But 13:25
17 that was not coordinated between the -- a CPU and a 13:25
18 graphic processor. That would just be done in 13:25
19 isolation on a graphics processor. 13:25

20 BY MR. BROWN: 13:25

21 Q. Ah, I see. I see the issue. You are -- 13:25
22 right. 13:25

23 So there are at least circumstances where 13:25
24 personal computers could have had sort of an 13:25
25 independent coprocessor -- or, let me say it 13:25

1 differently. 13:25

2 Could have implemented Nicol in a 13:25

3 coprocessor in a way that maybe was independent of 13:25

4 the other processors in the system; is that right? 13:25

5 A. So I would say that aspects of what they 13:25

6 have disclosed could be used in such a system. 13:25

7 Q. Yeah. 13:25

8 A. But much of what I am thinking of are 13:25

9 elements that they discussed and made use of but 13:25

10 didn't necessarily invent themselves. 13:25

11 For example, dynamically changing the 13:26

12 voltage and clock in some relationship. 13:26

13 Q. Right. 13:26

14 And at the time of the invention of the 13:26

15 '047 and the '605 patent, one type of personal 13:26

16 computer that was around at the time was a laptop 13:26

17 computer; right? 13:26

18 A. Yes. 13:26

19 Q. Okay. And a laptop computer is a type of 13:26

20 mobile computer; right? 13:26

21 A. I would consider a laptop to be a kind of 13:26

22 mobile computer, generally. Granted -- well, I 13:26

23 think that's a pretty good example. 13:26

24 There were -- there were very old laptop 13:26

25 computers like the size of a phone machine, but 13:26

1 we're not talking about those. 13:26

2 Q. Okay. And -- and you would agree that 13:26

3 the -- in Nicol, Nicol's suggestion that however it 13:26

4 might be implemented in a mobile computer, as a 13:27

5 coprocessor or something like that, the benefits of 13:27

6 minimizing power consumption are applicable to 13:27

7 mobile computers; right? 13:27

8 MR. TUNG: Objection. Form. 13:27

9 THE WITNESS: I -- I would go farther than 13:27

10 that and say that the benefits of minimizing power 13:27

11 consumption are valuable to a greater or lesser 13:27

12 degree in any sort of computing system. 13:27

13 BY MR. BROWN: 13:27

14 Q. Now, I -- I think you were saying earlier 13:27

15 that if you were to implement Nicol as a -- on a 13:27

16 coprocessor in a computer system, it -- that Nicol 13:28

17 would not then sort of extend to the primary 13:28

18 processor; right? It would be an independent 13:28

19 implementation on just that coprocessor. 13:28

20 Was I understanding that right? 13:28

21 A. No. I don't think that's exactly what I 13:28

22 was saying. 13:28

23 I was showing one example of a part of the 13:28

24 technology that Nicol discusses or discloses whether 13:28

25 it's -- whether they invented or it's in the prior 13:28

1 art, and that here's an example of something that I 13:28
2 think could be applied to the coprocessor. But I 13:28
3 don't think that it's Nicol, as I understand Nicol. 13:28

4 Q. I gotcha. Okay. 13:28

5 Would you agree that if -- let's assume 13:28
6 this coprocessor arrangement: Either a graphics 13:28
7 card or some other coprocessor, and then there is a 13:28
8 primary CPU in our -- in our computer as well. 13:28

9 Does that all make sense so far? 13:29

10 A. Yes. 13:29

11 Q. Yeah. So if -- would a person of ordinary 13:29
12 skill in the art -- well, actually, withdrawn. 13:29

13 Let me -- let me take this out of the 13:29
14 space of a personal computer. Let's just make this 13:29
15 a device; all right? Not -- not a personal 13:29
16 computer. Just a -- any device that is implementing 13:29
17 a coprocessor arrangement. 13:29

18 You agree that the -- there's a difference 13:29
19 in behavior in Nicol between its controller PE, 13:29
20 which is running the real-time operating system and 13:29
21 handling distribution of the tasks, and -- and the 13:29
22 other PEs that are doing those tasks; right? 13:29

23 A. Yes. I believe in general -- for example, 13:29
24 in 2, in Figure 2 embodiment, they sort of talk 13:29
25 about real-time operating system only runs on one, 13:30

1 and its job is largely as disclosed to distribute 13:30
2 tasks. And those tasks are the computations of 13:30
3 interest. And those go to the other PE. 13:30

4 Q. And -- and in your mind that is -- well, 13:30
5 withdrawn. 13:30

6 The task that those PEs are working on, 13:30
7 the working PEs, the type of tasks envisioned by 13:30
8 Nicol are digital signal processing tasks in a set 13:30
9 top box; right? 13:30

10 A. That seems to be the sort of task that 13:30
11 they are focusing on. Although as we talked about, 13:30
12 you know, they throw in caveats that could be 13:30
13 anything. But they certainly are largely focused on 13:30
14 DSP applications. 13:30

15 Q. Yeah. And so those working PEs, those 13:30
16 could actually be DSPs, couldn't they? 13:30

17 MR. TUNG: Objection. Form. 13:31

18 THE WITNESS: I would imagine that they 13:31
19 could be DSPs and, in fact, the sort of main 13:31
20 difference processor where the R -- RTOS is running 13:31
21 could also be a DSP. It depends on the details of 13:31
22 the DSP. 13:31

23 BY MR. BROWN: 13:31

24 Q. For sure. 13:31

25 But it's -- it's possible, or it's 13:31

1 reasonable that a person of ordinary skill in the 13:31
2 art could look at this arrangement and say, "Okay, 13:31
3 the working PEs should be DSPs, but I'm going to use 13:31
4 a CPU for the controller PE because it's 13:31
5 functionality is different." 13:31

6 That's a possible interpretation of a 13:31
7 decision that a person of ordinary skill at the time 13:31
8 in the art could make; right? 13:31

9 MR. TUNG: Object to the form. 13:31

10 THE WITNESS: I think that a person of 13:31
11 ordinary skill in the art could, at the time of 13:31
12 invention, could look at those and say, "The 13:31
13 disclosed roles are -- are fundamentally different 13:32
14 in meaningful ways, and it might make sense to have 13:32
15 a customized DSP run the computations task and more 13:32
16 general purpose device run the controller task 13:32
17 real-time operating system aspect." 13:32

18 MR. BROWN: Okay. Let me introduce a new 13:32
19 exhibit. 13:32

20 (Deposition Exhibit 3 was marked for 13:32
21 identification and is attached hereto.) 13:33

22 BY MR. BROWN: 13:33

23 Q. All right. It should be up. 13:33

24 A. Let me make the observation that I would 13:33
25 not characterize that delay of hysteresis but... 13:33

1 (Laughter elicited.) 13:33

2 THE WITNESS: Yeah, I have Kling up on my 13:33

3 screen now. 13:33

4 BY MR. BROWN: 13:33

5 Q. Excellent. 13:33

6 So, for the record, what is now marked as 13:33

7 Exhibit 3 is U.S. Patent 6367023, which we'll refer 13:33

8 to as the "Kling reference" throughout the rest of 13:33

9 the deposition. 13:33

10 Have you reviewed the Kling reference? 13:33

11 A. Yes, I have. 13:33

12 Q. So what I want to -- I want to sort of 13:33

13 understand a little bit of how Kling works first. 13:33

14 So I'm going to take you to Figure 2A. And we can 13:33

15 go to the text too if you need a refresher. Just 13:34

16 let me know. 13:34

17 But Figure 2A shows that Kling implements 13:34

18 an upper limit and power limit of power consumption 13:34

19 as part of its disclosure; right? 13:34

20 A. Yes. 13:34

21 Q. Yeah. And essentially what it says is 13:34

22 "when we get close to the upper limit threshold, we 13:34

23 should scale back frequency so that we don't use 13:34

24 more power than we are -- we are allowed to use"; is 13:34

25 that right? 13:34

1 A. I think that's -- yes, that is one aspect 13:34
2 of what they are showing here. 13:34

3 Q. And -- and that upper threshold that is 13:34
4 being set there is really sort of saying "this is 13:34
5 the maximum available power that I -- that's 13:35
6 available for you to use"; is that right? 13:35

7 A. Yes. That's how I interpret it. 13:35

8 Q. And then it makes decisions based on what 13:35
9 the clock frequency should be based on that 13:35
10 available power? 13:35

11 MR. TUNG: Objection to the form. 13:35

12 THE WITNESS: It makes decisions based in 13:35
13 part on -- yes, what that upper limit is. 13:35

14 BY MR. BROWN: 13:35

15 Q. The -- these upper and lower thresholds in 13:35
16 Kling can also be set by a user; is that right? 13:35

17 MR. TUNG: Objection. 13:36

18 THE WITNESS: It's my recollection that 13:36
19 they discussed at least the lower limit. I don't 13:36
20 recall if the upper limit was set. It could be 13:36
21 implemented in some hypothetical system in a buyer 13:36
22 setting that a user could have some control over. 13:36

23 BY MR. BROWN: 13:36

24 Q. So you are -- you agree, at least, that 13:36
25 the lower threshold can be set by a user in the 13:36

1 Kling reference; right? 13:36

2 A. That's my recollection. I'm not saying it 13:36

3 wasn't the upper limit as well. I just don't 13:36

4 recall. 13:36

5 Q. Yeah. Yeah, no. I'll take you there in a 13:36

6 second. 13:36

7 And what that means is that -- well, why 13:36

8 don't we do upper limit too. 13:36

9 So if you go to Column 5, the first full 13:36

10 paragraph. 13:36

11 A. All right. 13:36

12 Q. Lines -- right in the middle of that there 13:36

13 is a sentence that starts "the upper threshold," and 13:36

14 it says at Line 16 of Column 5 [as read]: 13:36

15 "This threshold may be permanently 13:37

16 set within the power controller or may 13:37

17 be modifiable by the system designer or 13:37

18 system user via software or hardware 13:37

19 control." 13:37

20 Do you see that? 13:37

21 A. Yes, I do. 13:37

22 Q. Okay. So in the Kling reference, the 13:37

23 upper and lower threshold may be set by a user 13:37

24 setting. Is that fair? 13:37

25 MR. TUNG: Object to form. 13:37

1 THE WITNESS: That's my recollection. 13:37

2 Although, you having pointed this out to 13:37

3 me, I see no reason why they would make the upper 13:37

4 programmable and not the lower. But I wonder if I 13:37

5 remembered them in reverse. 13:37

6 But yeah, I -- if you can do one, I'm sure 13:37

7 you could do the other. 13:37

8 BY MR. BROWN: 13:37

9 Q. Sure. 13:37

10 Well, let me -- I don't want you to feel 13:37

11 like I am misleading you. So let me take you to 13:37

12 Column 5, Line 56, or -7 where it says [as read]: 13:37

13 "Alternatively, the lower threshold 13:37

14 may be modifiable by a user...." 13:37

15 Do you see that? 13:37

16 A. I do. 13:37

17 Q. There you go. Okay. 13:37

18 So -- so the-- in the Kling reference, the 13:37

19 upper and lower threshold may -- may both be set by 13:37

20 a user setting; right? 13:38

21 A. That's my understanding from what they 13:38

22 disclosed. Yes. 13:38

23 Q. And that -- those upper and lower 13:38

24 thresholds then impact, in part, what the frequency 13:38

25 of the processor will be; right? 13:38

1 MR. TUNG: Object to the form. Assumes 13:38
2 facts. 13:38
3 THE WITNESS: As I understand Kling, as we 13:38
4 just discussed, if the power consumption goes over 13:38
5 the upper threshold, the system will throttle it -- 13:38
6 when it subsequently goes below the lower threshold, 13:38
7 and the throttle will be turned off. 13:38
8 And by "throttle," I mean changing the 13:38
9 clock frequency in some meaningful way. 13:38
10 BY MR. BROWN: 13:38
11 Q. And then if I -- right. So -- so just to 13:38
12 be clear. 13:38
13 When you turn off the throttle, that -- 13:38
14 that changes the clock frequency because it allows 13:39
15 the clock frequency to stop going down and either 13:39
16 stabilize or continue going back up; right? 13:39
17 A. I -- I am pretty sure that's explicitly 13:39
18 disclosed. My recollection is they also have other 13:39
19 ways to throttle, which doesn't necessarily affect 13:39
20 the clock frequency. Like, inserting no-ops. 13:39
21 Q. Got it. Okay. 13:39
22 And then let me take you to Column 10. 13:39
23 It's going to be claim 12. 13:39
24 A. All right. 13:39
25 Q. And claim 12 says [as read]: 13:39

Page 153

1 "The method of claim 11" 13:39

2 And we can go and look at that if you 13:39

3 would like. But it says [as read]: 13:39

4 "...further comprising determining 13:39

5 if the calculation reaches a threshold 13:39

6 that is predetermined to be a 13:39

7 user-defined value associated with the 13:39

8 power delivery specification of the 13:39

9 outlet into which the computer system 13:39

10 is plugged." 13:39

11 Do you see that? 13:39

12 A. I do. 13:40

13 Q. And so what is that -- well, which I'll 13:40

14 just ask. 13:40

15 The power delivery specification of the 13:40

16 outlet into which the computer system is plugged, 13:40

17 that refers to the available power that you can get 13:40

18 from that outlet; right? 13:40

19 MR. TUNG: Object to the form. 13:40

20 THE WITNESS: That's my understanding. 13:40

21 It's ambitious. I don't know how they would know 13:40

22 that a particular outlet in my home was plugged to a 13:40

23 30-amp circuit breaker. But that is what they are 13:40

24 disclosing in -- in principle. 13:40

25 ///

1 BY MR. BROWN: 13:40

2 Q. Right. 13:40

3 And, in fact, it's a good point that you 13:40

4 are raising because they're -- what they are saying 13:40

5 is not that they know that, necessarily, but that 13:40

6 there's a user-defined value associated with the 13:40

7 power delivery specification. 13:40

8 And so isn't that saying that "we'll use a 13:40

9 user-defined value that tells us what the total 13:40

10 available power is from that outlet"? 13:40

11 MR. TUNG: Same objection. 13:40

12 THE WITNESS: That may be what they are 13:41

13 saying. I -- to be honest with you, I am not sure. 13:41

14 I haven't spent the time studying the claim. But 13:41

15 there is certainly a user-specified setting for the 13:41

16 upper limit, which in some way is intended to be 13:41

17 related to the power that they can extract from the 13:41

18 wall socket. I -- in some other disclosed usages. 13:41

19 I mean, I don't think it always has to be 13:41

20 that. It could be that they're -- it's simply 13:41

21 related to the maximum power that could be consumed 13:41

22 by the power supply inside the device, but they 13:41

23 certainly do talk about relating it in some 13:41

24 circumstances to a wall socket. 13:41

25 ///

1 BY MR. BROWN: 13:41

2 Q. Uh-huh. And in particular to a user 13:41

3 defined value associated with that wall socket's 13:41

4 available power in claim 12? 13:41

5 MR. TUNG: Objection. 13:41

6 THE WITNESS: Well, they certainly do 13:41

7 disclose that at least in claim 12. I don't recall 13:42

8 if they do it elsewhere in the specification. 13:42

9 BY MR. BROWN: 13:42

10 Q. Yeah. Let me take you to Column 5, 13:42

11 Line 20 -- 21 to 25. You know, here it talks about 13:42

12 the [as read]: 13:42

13 "...constant value may be associated 13:42

14 with an approximately maximum power 13:42

15 that can be reliably consumed by the 13:42

16 computer system from a power outlet 13:42

17 into which the system is plugged before 13:42

18 the outlet's fuse or circuit breaker 13:42

19 trips." 13:42

20 Right? 13:42

21 A. Yes. Yeah. 13:42

22 Q. And so that is consistent with your 13:42

23 interpretation of the power delivery specification 13:42

24 of the outlet being kind of that available power 13:42

25 that the outlet can provide before the fuse breaks; 13:42

1 right? 13:42

2 A. I think the maximum power is the -- is in 13:42
3 this situation a reasonably good synonym for 13:42
4 available power. 13:43

5 Q. Now, the Kling reference in general is 13:43
6 directed to minimizing power consumption by use of 13:43
7 these thresholds; right? 13:43

8 A. I don't believe that that's quite 13:43
9 accurate. It's directed to not exceeding an unsafe 13:43
10 power consumption. And within that context, not 13:43
11 being overly punishing when you temporarily get into 13:43
12 a bad context. 13:43

13 Q. Got it. 13:43

14 So maybe it would be better to say Kling 13:43
15 relates to power management; that's a little more 13:43
16 acceptable? 13:43

17 A. I think it definitely does relate to power 13:43
18 management, yes. 13:43

19 Q. And monitoring the power consumption in 13:43
20 the way that Kling does, that's -- that has 13:43
21 application to -- and use in multiprocessor systems; 13:44
22 right? 13:44

23 MR. TUNG: Objection. Vague. 13:44

24 THE WITNESS: It -- I guess it may. 13:44

25 Frankly, I don't know of anybody who implements 13:44

1 Kling, but in theory, it may. Maybe people do. I 13:44
2 simply don't know. 13:44
3 BY MR. BROWN: 13:44
4 Q. Do you -- whether or not they are 13:44
5 implementing all of Kling, there's -- the idea of 13:44
6 having sort of power limit thresholds like Kling 13:44
7 describes, that wasn't a... 13:44
8 Are you okay? 13:44
9 A. Oh. Yeah. Sorry. Just getting a little 13:44
10 tired. 13:45
11 Go ahead, please. 13:45
12 Q. Okay. The -- the idea of having power 13:45
13 limit thresholds like Kling, that's something that 13:45
14 was already known to people of ordinary skill in the 13:45
15 art at the time of the '605 and '047 patents; right? 13:45
16 MR. TUNG: Object to the form. 13:45
17 THE WITNESS: I would agree with that. 13:45
18 For example, you know, when I -- I plug my PC power 13:45
19 in my laptop into the wall, there is a fuse in 13:45
20 there, and that is there to make sure I don't exceed 13:45
21 some power limit. 13:45
22 I wouldn't be surprised if there's also a 13:45
23 similar fuse inside the computer itself. 13:45
24 BY MR. BROWN: 13:45
25 Q. Okay. Let me give you -- let me put in 13:45

1 another exhibit. This will be Bhatia. 13:45

2 (Deposition Exhibit 4 was marked for 13:45

3 identification and is attached hereto.) 13:46

4 BY MR. BROWN: 13:46

5 Q. Should be up, and while you are grabbing 13:46

6 it, I'll note for the record, Bhatia is Exhibit 4. 13:46

7 It's US Patent 6,535,798, which we'll refer to as 13:46

8 the "Bhatia reference" which is B-H-A-T-I-A. 13:46

9 A. All right. I have it open. 13:46

10 Q. Great. 13:47

11 If we go to -- just a couple of things on 13:47

12 Bhatia. If we go to Column 4 at Line 21 to 24. 13:47

13 A. All right. 13:47

14 Q. Like Kling, Bhatia also discloses 13:47

15 throttling a processor in order to -- well, let me 13:47

16 not bring Kling into it. Well -- sorry. Let me ask 13:47

17 it this way. 13:47

18 Bhatia discloses at Column 4 the ability 13:47

19 to throttle a processor's frequency in order to put 13:47

20 it into a reduced power mode; is that right? 13:47

21 A. Yes. In this passage, Bhatia discloses 13:48

22 that they can throttle the processor by, in essence, 13:48

23 stopping it from doing anything. 13:48

24 Q. Uh-huh. And the idea of putting one or 13:48

25 more processors in a multiprocess system into low 13:48

1 power mode, that was -- that was not a novel concept 13:48
2 to a person of ordinary skill in the art; right? 13:48
3 MR. TUNG: Object to the form. 13:48
4 THE WITNESS: The notion at the time of 13:48
5 the invention of putting a processor -- certainly an 13:48
6 individual processor into some sort of low power 13:48
7 state was well-known. 13:48
8 I suspect that there are examples of 13:48
9 putting multiple processors in a low power state was 13:48
10 also in use. 13:48
11 BY MR. BROWN: 13:48
12 Q. Okay. And then if we go to the bottom of 13:48
13 Column 3 of Bhatia, the column to the left, there's 13:48
14 a reference there to [as read]: 13:48
15 "In addition, thermal management in 13:49
16 the system 10 may be performed 13:49
17 independently for multiple thermal 13:49
18 zones." 13:49
19 Do you see that? 13:49
20 A. Yes, I do. 13:49
21 Q. What are "multiple thermal zones"? 13:49
22 A. What I believe they are referring to is, 13:49
23 for example, you could have the -- you know, system 13:49
24 memory be one zone, maybe a processor is another 13:49
25 one. If there is the ability to measure temperature 13:49

Page 160

1 there, maybe the graphics processor would be another 13:49
2 zone. So these are -- these are separate physical 13:49
3 portions of the system. 13:49

4 Q. Uh-huh. So it's envisioning that you 13:49
5 could have multiple -- multiple temperature sensors 13:49
6 on the device that are measuring different zones? 13:49

7 MR. TUNG: Object to the form. 13:49

8 THE WITNESS: I would say that if the 13:49
9 device is an entire laptop, for example, they 13:49
10 certainly are disclosing that you could have 13:49
11 multiple temperature sensors in the laptop that 13:50
12 measure temperature at different physical parts of 13:50
13 the system at the same time. 13:50

14 BY MR. BROWN: 13:50

15 Q. Okay. Let me take you back to Exhibit 1, 13:50
16 which is Nicol. It's been a little while since we 13:50
17 talked about Nicol so... 13:50

18 A. All right. 13:50

19 Q. And I want to take you to the discussion 13:50
20 of Figure 2 on -- sorry -- on Column 5, Line 23 it 13:51
21 says [as read]: 13:51

22 "The Figure 2 system uses the 13:51
23 operating system to react to variations 13:51
24 in the system load. As more tasks are 13:51
25 entered into the 'to-do' list, the 13:51

1 operating system of PE 100 computes the 13:51
2 correct way to balance the additional 13:51
3 computational requirements and 13:51
4 allocates the tasks to the processors. 13:51
5 It then computes the required operating 13:51
6 frequency." 13:51
7 Do you see that? 13:51
8 A. Yes, I do. 13:51
9 Q. And so when it talks about computing the 13:51
10 required operating frequency, what -- when more 13:51
11 tasks enter the to-do list, what that is talking 13:52
12 about is how to handle the additional computational 13:52
13 requirements that have been added to that PE; right? 13:52
14 MR. TUNG: Objection. 13:52
15 THE WITNESS: Well, let me first say that, 13:52
16 as we talked about in the previous deposition, I 13:52
17 think if there is fundamental aspects, the phrasing 13:52
18 at least, that are incredibly difficult. 13:52
19 But certainly their desire is to come up 13:52
20 with the best possible schedule. 13:52
21 So yes, they are determining that perhaps 13:52
22 you had a PE that was loaded at -- had a 50 percent 13:52
23 load on it and now it's at a 100 percent, and they 13:52
24 might conclude, "Well, I should dial up the clock 13:52
25 frequency to a 100 percent of what it could do as 13:52

1 well." 13:52

2 BY MR. BROWN: 13:52

3 Q. Okay. And then how would you -- well, 13:53

4 let's try -- 13:53

5 How do you measure that load that we are 13:53

6 talking about? 13:53

7 MR. TUNG: Objection. Vague. 13:53

8 THE WITNESS: It is vague. In the context 13:53

9 of Nicol as we -- excuse me -- as we talked about, 13:53

10 in the sense that -- well, first of all, when he 13:53

11 expands it beyond tasks that have known bounded 13:53

12 computation. 13:53

13 But even setting those aside, it's a 13:53

14 little hard to know -- we talked about this issue 13:53

15 before. Is it -- is it that a task needs to 13:53

16 complete by a certain period of time? Probably. 13:53

17 It's at least part of that. 13:53

18 Is it also related to how much computation 13:53

19 is likely needed to be done to accomplish that? 13:53

20 Right. 13:53

21 So I have got a long delay -- I got a 13:53

22 short day with very, very little computation, I 13:54

23 might say, "Well, the load is very light." 13:54

24 If I have got a long delay, but I got a 13:54

25 huge amount of computation, I might say, "Oh, the 13:54

1 load is very heavy." 13:54

2 BY MR. BROWN: 13:54

3 Q. Uh-huh. 13:54

4 A. Nicol doesn't really, in my mind, deal 13:54

5 with what load really means, which at some level of 13:54

6 abstraction is not unreasonable. It -- the load is 13:54

7 what they can service, and if they understand what 13:54

8 that is, they try to optimize the system for it. 13:54

9 But in practice, it could mean a number of different 13:54

10 things. 13:54

11 BY MR. BROWN: 13:54

12 Q. Yeah. Okay. Well, let's -- let's just 13:54

13 use the term "load" then and -- and let me ask you 13:54

14 this: 13:54

15 If we -- if we add, say, 1 percent load to 13:54

16 one of the PEs, like 1 percent of... 13:54

17 Are you with me on that? Is that okay? 13:54

18 A. Yeah. 13:54

19 Q. Is the measurement okay? 13:54

20 A. Yep. Something very small. 13:54

21 Q. Okay. Right. 13:55

22 So we add something very small to the PE, 13:55

23 are we going to always see an increase in the 13:55

24 frequency of that PE? 13:55

25 MR. TUNG: Objection to the form. 13:55

1 THE WITNESS: Yes, so it depends. In the 13:55
2 system disclosed in Figure 2, as we talked about, 13:55
3 they -- they largely try to tune things to be right 13:55
4 on the razor's edge. 13:55

5 So if you add that 1 percent to the PE 13:55
6 that is the most utilized, I would expect that their 13:55
7 little controller will adapt and raise the clock 13:55
8 frequency and raise the voltage. 13:55

9 If you happen to assign that 1 percent to 13:55
10 one of the under-utilized PEs, you would not see 13:55
11 that. 13:55

12 In the case of a Figure 4, where you are 13:55
13 controlling the voltage and clock independently for 13:55
14 each one of the PEs, I would expect that if you add 13:56
15 some load, regardless of how small it is, they think 13:56
16 they are going to fine-tune the system to exactly 13:56
17 accommodate that in the load, so it's overbroad. 13:56

18 BY MR. BROWN: 13:56

19 Q. And so even -- so let's make it even 13:56
20 smaller then. Like we talked about a 1 percent 13:56
21 increase. 13:56

22 If this gets down to, like, 1/100th of an 13:56
23 increase, just some absolutely, very minimum 13:56
24 additional tasks that is being added on to the 13:56
25 heavily loaded PE, are we going to -- you are saying 13:56

1 that Nicol will attempt to make a corresponding 13:56
2 frequency change for even those most minute 13:56
3 increases? 13:56

4 MR. TUNG: Object to the form. 13:56

5 THE WITNESS: I am saying that what I 13:56
6 understand Nicol to disclose, yes, it would make 13:56
7 minute changes. But as we talked about, in any sort 13:56
8 of a measurement system, there is -- you can never 13:56
9 get a precise measurement. 13:56

10 So at some point, the load that you will 13:57
11 have added will be -- could be so small that it may 13:57
12 not be measurable by the controller. I just don't 13:57
13 know. 13:57

14 BY MR. BROWN: 13:57

15 Q. Yeah. Well, and maybe another example -- 13:57
16 and I think this is consistent with what we talked 13:57
17 about early. 13:57

18 Another example could be that a person of 13:57
19 ordinary skill in the art implementing Nicol could 13:57
20 decide as a basis of those standard design 13:57
21 principles that we discussed, you know, "I am only 13:57
22 going to increase frequency for a certain size of 13:57
23 task, and if it's below that threshold, I am just 13:57
24 going to leave the frequency the way it is." 13:57

25 That's a possible implementation; right? 13:57

1 MR. TUNG: Object. Incomplete 13:57
2 hypothetical. 13:57
3 THE WITNESS: I think that in principle 13:57
4 under such a hypothetical situation a person could 13:57
5 do almost anything. They certainly could do that. 13:57
6 You know, I think it teaches against 13:57
7 what -- I think Nicol teaches against that, but we 13:57
8 have talked about -- I think Nicol is in many ways 13:57
9 aspirational: "You should try to do this," but you 13:58
10 probably wouldn't carry it out exactly that way. 13:58
11 BY MR. BROWN: 13:58
12 Q. Right. Right. So a person of ordinary 13:58
13 skill in the art would -- reviewing Nicol could 13:58
14 think or probably likely would think that, "All 13:58
15 right. I'm not going to make these frequency 13:58
16 changes on every single new task. I'm going to wait 13:58
17 for only the important bigger changes before I start 13:58
18 changing frequency"; right? 13:58
19 MR. TUNG: Same objection. 13:58
20 THE WITNESS: I think the way Nicol 13:58
21 discloses that controller that we were just talking 13:58
22 in particular makes it harder to reach such a 13:58
23 conclusion, because that controller is taking into 13:58
24 account the load that it sees and doing fine-tuning 13:58
25 based on the critical paths. 13:58

1 So it seems to me that that's sort of off 13:58
2 and running and doing its own thing, but -- but I 13:58
3 think if that -- if a different control algorithm 13:59
4 was implemented like running in software, a decision 13:59
5 could certainly be made to not immediately respond 13:59
6 to every instantaneous situational change. 13:59
7 BY MR. BROWN: 13:59
8 Q. Got it. 13:59
9 So at least a person of ordinary skill in 13:59
10 the art looking at Nicol had in his tool box a 13:59
11 control algorithm that would not immediately respond 13:59
12 to every instantaneous change to the processor load; 13:59
13 is that right? 13:59
14 MR. TUNG: Object to the form of the 13:59
15 question. 13:59
16 THE WITNESS: I think if it's the tool box 13:59
17 writ large absolutely. The notion of hysteresis in 13:59
18 some sense is closely related to that. 13:59
19 You know, it's a matter of how to 13:59
20 incorporate it into what Nicol is actually disclosed 13:59
21 and whatever is the essence of Nicol if we draw a 13:59
22 box around that. 14:00
23 BY MR. BROWN: 14:00
24 Q. Okay. And let me just -- a little bit 14:00
25 more on that. 14:00

1 The -- when -- in Nicol we talk about 14:00
2 assigning tasks to PEs. Those tasks comprise a 14:00
3 series of instructions; right? 14:00

4 A. I think that in general it's understood 14:00
5 that those tasks would be compiled software for 14:00
6 programmable processor of some sort. In which case, 14:00
7 they are typically instructions that are executed in 14:00
8 the sequence. 14:01

9 So the reason why I am being a little bit 14:01
10 careful with that is the -- the issue of "Dehan" has 14:01
11 been brought in. And in my mind, Dehan, he may 14:01
12 refer to them as instructions some of what he does, 14:01
13 but I do think it is fundamentally different. 14:01

14 Q. I gotcha. And so -- excuse me. 14:01

15 So in Nicol's PEs -- I'm not -- I'm not 14:01
16 asking about Dehan, and I understand you are not 14:01
17 intending to comment on it. 14:01

18 In Nicol's PEs, the instructions -- it has 14:01
19 a series of instructions that are sitting in -- 14:01
20 likely in an instruction queue, and those 14:01
21 instructions are executed sequentially; right? 14:01

22 MR. TUNG: Objection. 14:01

23 (Simultaneously speaking.) 14:01

24 THE WITNESS: It may be. As we talked 14:01
25 about, I think it -- I think it's certainly 14:01

1 envisioned, a person reading it, that the PEs could 14:01
2 be DSPs. 14:01
3 And when I say "DSPs," sometimes they 14:01
4 are -- they're fixed hardware that does one thing, 14:02
5 but -- but I really was referring to something 14:02
6 programmable with an instruction set that will take 14:02
7 in a program written, you know, large set of 14:02
8 instructions that have some order and go through 14:02
9 them. 14:02
10 The notion of an instruction buffer inside 14:02
11 a programmable processor was known, but I don't 14:02
12 think that that was necessarily fundamental to, you 14:02
13 know, having a processor, for example. 14:02
14 But there are plenty of processors that 14:02
15 don't have instruction buffers of any sort. 14:02
16 MR. TUNG: So I just want to confirm, you 14:02
17 got my objection in the last question? Is it -- we 14:02
18 got mixed up a little bit. 14:02
19 MR. BROWN: It's in the record. 14:02
20 MR. TUNG: Okay. 14:02
21 BY MR. BROWN: 14:02
22 Q. Okay. The -- so let me -- it's not -- 14:02
23 withdrawn. 14:02
24 It's not unreasonable that a person of 14:02
25 ordinary skill in the art looking to implement Nicol 14:02

1 and its PEs would use an instruction buffer to store 14:03
2 that queue of instructions; right? 14:03
3 MR. TUNG: Objection. Form. 14:03
4 THE WITNESS: My -- let me rephrase that 14:03
5 and see if it gets to your point. 14:03
6 It's not unreasonable that a person of 14:03
7 ordinary skill in the art at the time of invention 14:03
8 looking at Nicol might consider using a processor 14:03
9 that has an instruction buffer. 14:03
10 For the most part, the details in the 14:03
11 instruction buffer are like just way outside of the 14:03
12 concerns that that sort of a designer would -- would 14:03
13 imagine. They buy a processor: It has one, it 14:03
14 doesn't. 14:03
15 BY MR. BROWN: 14:03
16 Q. Got it. Got it. 14:03
17 And -- and so when -- when a PE -- a PE's 14:03
18 load is in part reflected by the number of 14:03
19 instructions and -- and the content of the 14:03
20 instructions that are -- that are in that 14:03
21 instruction buffer; is that right? 14:04
22 MR. TUNG: Objection to the form. 14:04
23 THE WITNESS: No. I wouldn't say that for 14:04
24 a -- for a couple of reasons. 14:04
25 Oftentimes, one of the most heavily loaded 14:04

Page 171

1 processors is one that is simply jumping around all 14:04
2 the time, and it -- it's not logically following 14:04
3 much of any -- linear sequence. It is a sequence of 14:04
4 instructions, but not a linear sequence. 14:04

5 In which case, there will tend to be very 14:04
6 few, if any, instructions in the instruction buffer, 14:04
7 but it still might be heavily loaded. 14:04

8 Similarly at least in the context of 14:04
9 Nicol, there may be a task on there that really is 14:04
10 just one gigantic linear sequence of instructions 14:04
11 that Nicol from their point of view would say, "This 14:04
12 is a very low load task; it doesn't require much," 14:04
13 and yet the instruction buffer might be maxed out 14:04
14 throughout its entire execution. 14:04

15 BY MR. BROWN: 14:05

16 Q. So it's not -- it's the number of 14:05
17 instructions in the -- in that instruction queue are 14:05
18 not always going to be a measure of the load of that 14:05
19 PE. 14:05

20 Is that what you are saying? 14:05

21 A. I think I am going broader, and saying 14:05
22 it's not a measure of the load at all. 14:05

23 Q. Well, so -- maybe I misunderstood it. It 14:05
24 sounds like there are -- there are circumstances 14:05
25 where it could be; right? 14:05

1 Let's take -- let's take an edge case, and 14:05
2 then we can move up from it. But if we had -- let's 14:05
3 say we have a three PE system, and we had only one 14:05
4 task to assign, and so we assign that task to PE 1, 14:05
5 and that task included a number of instructions. 14:05

6 If you were to compare the instruction 14:05
7 queues of all three PEs, the most heavily loaded one 14:05
8 in that circumstance would be the one with the most 14:05
9 instructions in the instruction queue; right? 14:05

10 MR. TUNG: Object to the form. 14:06

11 THE WITNESS: I think it's true that you 14:06
12 can have the most heavily loaded one correspond to 14:06
13 the one that -- I'm sorry. The most heavily -- 14:06

14 It's true that -- that it can be the case 14:06
15 that the PE with the heaviest load also has the 14:06
16 largest occupancy in the instruction buffer. 14:06

17 But it's also true that the exact opposite 14:06
18 could be the case, and I -- I just don't think there 14:06
19 is any useful relationship between the two. It's 14:06
20 apples and oranges. 14:06

21 BY MR. BROWN: 14:06

22 Q. Okay. And so going through -- if we 14:06
23 are -- let's assume -- 14:06

24 Let's just start talking about one PE, 14:06
25 whose frequency is being set only by its load. It's 14:06

1 the -- it's the heaviest loaded so it's -- it's 14:07
2 guiding the frequency of the device. 14:07
3 When that PE is in the process of 14:07
4 executing its task, meaning maybe it's about 14:07
5 50 percent through one task, do we -- does Nicol 14:07
6 reduce the frequency of that device in response to 14:07
7 the fact that it's gotten through part of its load 14:07
8 so it isn't technically as heavily loaded? 14:07
9 MR. TUNG: Objection. Incomplete 14:07
10 hypothetical. 14:07
11 THE WITNESS: I don't think Nicol 14:07
12 discloses changing any settings based on a 14:07
13 particular task being some fraction of the way 14:07
14 completed. 14:07
15 Now, it's possible that if -- that if 14:07
16 there are two tasks on that most heavily loaded PE, 14:07
17 naturally one of them may be halfway down, the other 14:07
18 one may finish, and as a result, Nicol could 14:08
19 respond. 14:08
20 But -- but I think you were simply 14:08
21 referring to a simpler situation where there is one 14:08
22 task on one PE; it gets halfway done; does Nicol 14:08
23 make a change. And I don't think there is any 14:08
24 disclosure. I don't think it does. 14:08
25 ///

1 BY MR. BROWN: 14:08

2 Q. Right. 14:08

3 So when we are looking at something like 14:08

4 Figure 3, it -- as the task is being executed 14:08

5 through -- wherever it was that drove it up to 14:08

6 140 megahertz, so as the task is being executed, the 14:08

7 level of granularity at which Nicol teaches to 14:08

8 respond to load is really on a task-by-task basis, 14:08

9 not on something more granular. 14:08

10 Does that seem right? 14:08

11 MR. TUNG: Object to the form. 14:08

12 THE WITNESS: I think it's on the basis of 14:08

13 all of the tasks that are running at a particular 14:09

14 instance. So not just one of them, but whatever is 14:09

15 assigned to that PE. Could be multiple. 14:09

16 But yeah, it's not on the basis of how far 14:09

17 we are close to completing one of those tasks. 14:09

18 BY MR. BROWN: 14:09

19 Q. Right. 14:09

20 So as -- even though these -- the PE, 14:09

21 let's just talk -- just focusing on one PE and one 14:09

22 task. 14:09

23 Even though the PE is -- you know, gets 14:09

24 halfway through the task and is ostensibly 14:09

25 50 percent less loaded than it was before, Nicol 14:09

1 isn't going to make frequency changes to that PE 14:09
2 until that entire task is complete; right? 14:09
3 MR. TUNG: Object to the form. 14:09
4 THE WITNESS: That's consistent with my 14:09
5 understanding of Nicol, with the caveat that I am 14:09
6 assuming in this question and the past series, we're 14:09
7 really just talking about what they talk about in 14:09
8 Figure 2 which is, "you have got all these tasks, 14:10
9 they have got a fixed load, and we're going to 14:10
10 manage that." As opposed to "we have got these 14:10
11 random, wild task that come in." 14:10
12 So yeah. So under -- under that notion 14:10
13 that I have got some model of load assigned to each 14:10
14 of the tasks, but each of the tasks that I'm 14:10
15 currently running, I don't see anything in Nicol 14:10
16 that says, "Well, I am halfway done. Change the 14:10
17 system." It's just waiting until you are completely 14:10
18 done. 14:10
19 So the -- they only discuss their -- yeah. 14:10
20 They only discuss thinking about the load on the 14:10
21 system until you are completely done. 14:10
22 BY MR. BROWN: 14:10
23 Q. Right. Right. 14:10
24 So it's -- it's Nicol's adjustment of 14:10
25 frequency is not always linearly responsive to the 14:10

1 amount of load left on a PE. It waits until it 14:10
2 finishes the task before it makes that 14:10
3 determination. 14:11

4 A. Frankly, I wouldn't phrase it that way at 14:11
5 all. Their notion is that the load is associated 14:11
6 with task. And if they are halfway done with the 14:11
7 task, the load is the same. As it was at the 14:11
8 beginning. As it was at the end. 14:11

9 The load of the task is something that 14:11
10 allows them to calculate what the desired clock rate 14:11
11 is so the task just finishes. Well, if they are 14:11
12 halfway and they say, "Well, half the load is gone," 14:11
13 I would presume they would naturally be inclined to 14:11
14 reduce the clock frequency, at which point they 14:11
15 would miss their deadline. The load is the same. 14:11
16 It hasn't changed. 14:11

17 Q. Right. Right. 14:11

18 So the -- yeah, so it's really that the 14:11
19 level of granularity at which Nicol has -- is going 14:11
20 to measure load is on a task-by-task basis. Nothing 14:11
21 more granular than that. 14:11

22 A. Yes. That -- that's the only thing I see 14:11
23 disclosed. 14:11

24 Q. And then you had mentioned this -- that -- 14:12
25 you know, when we were talking about Figure 3 14:12

1 earlier, we talked about what happens if additional 14:12
2 small tasks are added, and your position is -- I 14:12
3 think your position was, every new task that is 14:12
4 added will require changing the frequency -- 14:12
5 could -- well, let me rephrase that. 14:12

6 In a circumstance where we are working -- 14:12
7 we're on the tent pole PE, we're on the highest 14:12
8 loaded PE, every new task that is added will result 14:12
9 in a corresponding frequency change no matter how 14:12
10 large or small; right? 14:12

11 A. That's my understanding of what Nicol 14:12
12 discloses. With, again, the caveat that you can 14:12
13 only increase it to the maximum. If you are at the 14:12
14 max and you throw something else on, I expect it 14:12
15 won't change. 14:12

16 Q. Yeah. And -- and I think the -- I think 14:12
17 you testified that the -- if we are working on -- 14:13

18 Let's say we are working at one task at 14:13
19 120 megahertz, and then additional tasks are added 14:13
20 that require that PE to increase its frequency to, 14:13
21 say, 125, 130. That increase you are saying will 14:13
22 occur while we are working on that original task; 14:13
23 right? 14:13

24 A. Yeah. That's -- that's my understanding. 14:13
25 If you are -- for example, in Figure 3 14:13

1 where it starts out at 70 megahertz, I don't recall 14:13
2 them saying there were no tasks running them. 14:13
3 Perhaps there were. 14:13

4 And so -- but a new task came in and was 14:13
5 added to it. And the first one keeps going, and the 14:13
6 new task causes the frequency and the voltage to 14:13
7 increase. 14:13

8 Q. But isn't this going to increase -- isn't 14:13
9 this going to introduce -- because of the way that 14:13
10 Nicol is doing this step function and frequency, 14:14
11 isn't this going to introduce a delay every time we 14:14
12 need to increase the frequency? 14:14

13 A. Well, it depends. For example, there -- 14:14
14 there are a number of systems that are designed such 14:14
15 that -- and this is more common back in years, which 14:14
16 recognized, "Well, look, if I am changing the clock 14:14
17 frequency in the intermediate zone, it's not 14:14
18 reliable." So I think that might be what you are 14:14
19 getting at. 14:14

20 It might be the case that if a second task 14:14
21 comes in, and I need to increase a clock frequency, 14:14
22 that may cause a stall on the first one. 14:14

23 But it's not -- it's more and more common, 14:14
24 and it is certainly not unheard of that while the 14:14
25 clock frequency is changing, it still is reliable. 14:14

1 So it's getting faster, but you can keep the first 14:14
2 task running. Nicol really is silent on issues like 14:14
3 that. 14:15

4 Q. Right. 14:15

5 So -- okay. So there are circumstances in 14:15
6 which changing the frequency while a task is 14:15
7 running -- or being executed, may be -- create 14:15
8 not-reliable or unreliable results; right? 14:15

9 A. I would assume given the goals and the 14:15
10 context of Nicol that they intend that not to be the 14:15
11 case. 14:15

12 And, for example, if I have a system 14:15
13 where, when I increase the frequency, I have to 14:15
14 stall anything that is running, I can try to take 14:15
15 that into account. 14:15

16 And it may be the case that I may put off 14:15
17 starting that second task because maybe I know the 14:15
18 first task is just about ready to finish, but that 14:15
19 stall will make it miss its deadline. 14:15

20 Or -- or maybe the first task just got 14:15
21 started and the stall will delay things, but the 14:16
22 higher clock rate means it will get done faster. 14:16

23 Q. Yeah. 14:16

24 A. I mean, it's a fairly simple scheduling 14:16
25 system; so you could play around with a number of 14:16

1 possible scenarios for what kind of work comes in. 14:16

2 Q. Yeah. So I guess -- I guess what I am 14:16

3 hearing is, you know, a person of ordinary skill in 14:16

4 the art looking to implement this -- implement 14:16

5 Nicol, you know, might have a system in front of him 14:16

6 where the change in the frequency has no impact 14:16

7 whatsoever on running tasks -- or only a positive 14:16

8 influence on running tasks, but there are 14:16

9 circumstances or limitations where it could -- it 14:16

10 could be detrimental to increase the frequency while 14:16

11 a task is running; right? 14:16

12 A. Yes. I believe that to be the case. And 14:16

13 Nicol just doesn't get into any of the sort of 14:16

14 details that would allow us to analyze that. 14:17

15 Q. Right. 14:17

16 And so if a person of ordinary skill in 14:17

17 the art implementing Nicol were -- were running into 14:17

18 the situation where it was detrimental to 14:17

19 continually increase the frequency while a task is 14:17

20 running, is one thing that he could do is to 14:17

21 implement a threshold for when he will make those 14:17

22 changes and when he won't? 14:17

23 MR. TUNG: Object to the form. 14:17

24 THE WITNESS: Well, Nicol schedulers 14:17

25 under-specified enough that they could do just about 14:17

1 anything. They -- you know, they -- it really 14:17

2 doesn't go into any of those details at all. 14:17

3 BY MR. BROWN: 14:17

4 Q. Uh-huh. But that -- using that kind of -- 14:17

5 For instance, if the person of ordinary 14:17

6 skill in the art were to say, "Okay, I know I need 14:17

7 to change the frequency if a lot of new tasks get 14:17

8 added, but I don't want to do it if it's just a 14:18

9 small task because I'll be okay, and I don't -- the 14:18

10 detriment is worse than the benefit," what he could 14:18

11 do is he could implement, as we talked about in 14:18

12 other circumstances, a deadband that would say, "I 14:18

13 am going to wait to change the frequency until I 14:18

14 know that I need to change it to a certain amount"; 14:18

15 right? 14:18

16 MR. TUNG: Object to the form. 14:18

17 THE WITNESS: In general, I think that is 14:18

18 a hypothetical that's painted the system into a 14:18

19 domain where Nicol just doesn't work because what I 14:18

20 think are its targets for real-time and 14:18

21 mission-critical applications. 14:18

22 That being said, you know, we have talked 14:18

23 about a hypothetical system where you change the 14:18

24 clock frequency by 10 megahertz, in chunks of 14:18

25 10 megahertz, and you -- you may know that you are 14:18

1 just over one threshold and somehow be able to know 14:18
2 that this new task won't push you to where you need 14:18
3 to be in that second change. 14:19

4 Well, a new task comes in. So it's -- and 14:19
5 you have decided it has to be allocated to a 14:19
6 particular processor. I mean, it's not really a 14:19
7 choice. There are -- there are two situations in 14:19
8 the way the hypothetical is set up. 14:19

9 Either I could put the new task on without 14:19
10 making a change and everything works fine. Or the 14:19
11 system fails because either I don't run the new 14:19
12 task, which is mission critical, or I make the first 14:19
13 task crash because I delayed it. 14:19

14 So it's not really a scheduling choice. 14:19
15 You -- I don't know what you do. But it's a damned 14:19
16 if you do, damned if you don't. 14:19

17 BY MR. BROWN: 14:19

18 Q. Okay. Okay. I gotcha. 14:19

19 So let's -- I think I am getting pretty 14:19
20 close. Can you -- can we take like a ten-minute 14:19
21 break for me to take a look at any notes and see 14:20
22 where we are, and then come back and see if we can 14:20
23 go off the record? 14:20

24 All right. Let's go off the record. 14:20

25 THE VIDEOGRAPHER: We're going off the 14:20

1 record. The time is 2:20. 14:20
2 (Brief break.) 14:30
3 THE VIDEOGRAPHER: We're back on the 14:30
4 record. The time is 2:31. 14:31
5 MR. BROWN: All right. I have introduced 14:31
6 two new exhibits. 14:31
7 I have just a little bit more, 14:31
8 Dr. Mangione. 14:31
9 (Deposition Exhibit 5 was marked for 14:31
10 identification and is attached hereto.) 14:31
11 BY MR. BROWN: 14:31
12 Q. Exhibit 5 is your declaration in the '047 14:31
13 petition. 14:31
14 (Deposition Exhibit 6 was marked for 14:31
15 identification and is attached hereto.) 14:31
16 BY MR. BROWN: 14:31
17 Q. And Exhibit 6 is Intel's '047 Petition. 14:31
18 THE REPORTER: Counsel, could you move --
19 Counsel, could you put the mic a little closer to
20 your mouth there?
21 Yeah, I think that will help.
22 MR. BROWN: Sure. Sorry about that.
23 THE REPORTER: That's okay.
24 THE WITNESS: All right. 14:32
25 ///

1 BY MR. BROWN: 14:32

2 Q. Okay. So I want -- in your -- in 14:32

3 Exhibit 5, your declaration, I want to take you to 14:32

4 Paragraph 114 on Page 65, if that helps. 14:32

5 A. All right. I'm there. 14:32

6 Q. Okay. And on the -- basically the second 14:32

7 sentence there, you have got [as read]: 14:32

8 "However, in my opinion, Petitioner 14:32

9 makes a leap of logic and uses this 14:32

10 non-disclosure as evidence that 'Nicol 14:32

11 is agnostic to the internal structures 14:32

12 of the PE.'" 14:32

13 Do you see that? 14:32

14 A. I do. 14:32

15 Q. Okay. And then there is no, you know, 14:32

16 "[dot, dot, dot]" or any indication that you are -- 14:32

17 you are quoting part of a sentence from the 14:32

18 petition; right? 14:32

19 A. I believe I am quoting it but, perhaps, I 14:32

20 wasn't. It either was a quote or was not. 14:33

21 Q. Right. 14:33

22 A. I don't -- I don't -- I'm sorry. Go on. 14:33

23 Q. No. No. Well, finish your sentence. 14:33

24 Sorry. 14:33

25 A. I was just going to say, I -- I don't 14:33

1 recall when I sit here. But seeing it as a quote, I 14:33
2 anticipate I looked somewhere, and it's actually a 14:33
3 quote. 14:33
4 Q. Right. 14:33
5 And so if you go to Exhibit 6, which is 14:33
6 the petition that you cite there. You cite the 14:33
7 petition at 57. So if you go to 6, Exhibit 6, at 14:33
8 Page 57. 14:33
9 A. All right. I'm there. 14:33
10 Q. Okay. You see that this -- and now we're 14:33
11 looking at Intel's petition that you are quoting. 14:33
12 It says [as read]: 14:33
13 "Moreover, a POSITA would have 14:33
14 understood that the power control 14:33
15 scheme discussed in Nicol is agnostic 14:33
16 to the internal structures of the PE." 14:33
17 Do you see that? 14:33
18 A. I do. 14:33
19 Q. So -- so Intel didn't say that all of 14:33
20 Nicol is agnostic to the internal structure of the 14:34
21 PE, but rather said the power control scheme 14:34
22 discussed in Nicol is agnostic to the internal 14:34
23 structures of the PE; right? 14:34
24 MR. TUNG: Object to the form. 14:34
25 THE WITNESS: You are right. In this 14:34

Page 186

1 passage it says -- which I -- which I pointed to, at 14:34
2 least this sentence, it says that the power control 14:34
3 scheme in Nicol is agnostic to the internal 14:34
4 structures of the PE. 14:34
5 BY MR. BROWN: 14:34
6 Q. Yeah. 14:34
7 So you didn't include that earlier phrase, 14:34
8 the "power control scheme discussed in Nicol," in 14:34
9 your quote; right? 14:34
10 A. Those words do not appear in my quote. 14:34
11 Yep. 14:34
12 Q. Okay. And that would have been a more 14:34
13 accurate quote from what the petition said; right? 14:34
14 MR. TUNG: Object to the form of the 14:34
15 question. 14:34
16 THE WITNESS: It would have been a more 14:34
17 fulsome, sure. Yeah. 14:35
18 I mean, assuming that I don't see any 14:35
19 other passage which says literally what I -- what I 14:35
20 typed, yeah, I would have preferred if I had used 14:35
21 the -- a broader quote. Yeah. 14:35
22 BY MR. BROWN: 14:35
23 Q. So you would have preferred if you had 14:35
24 quoted that the "power control scheme discussed in 14:35
25 Nicol is agnostic to the internal structures of PE"; 14:35

Page 187

1 right? 14:35

2 MR. TUNG: Same objection. 14:35

3 THE WITNESS: That -- 14:35

4 MR. TUNG: Sorry. 14:35

5 THE WITNESS: That would have been more 14:35

6 precise. I agree. Yes. 14:35

7 BY MR. BROWN: 14:35

8 Q. Okay. And then let me take you to 14:35

9 Paragraph 91 of your declaration, and I'm going to 14:35

10 introduce a new exhibit in a moment. 14:35

11 A. All right. I'm there. 14:36

12 Q. So at Paragraph 91, you write [as read]: 14:36

13 "I understand Professor Sechen 14:36

14 acknowledges that Nicol is devoid to 14:36

15 any reference to hysteresis." 14:36

16 Do you see that? 14:36

17 A. I see that. 14:36

18 Q. And you reviewed Professor Sechen's 14:36

19 declaration; didn't you? 14:36

20 A. Yes, I did. 14:36

21 Q. And you know that he didn't say that 14:36

22 "Nicol is devoid of any reference to hysteresis," 14:36

23 don't you? 14:36

24 A. I don't recall he did or he didn't 14:36

25 explicitly say that. 14:36

1 I think given that the issue of hysteresis 14:36
2 was being discussed, not bringing it up in the 14:36
3 context of Nicol is acknowledgement that it doesn't 14:36
4 exist there if you are going off looking for 14:36
5 something. But it certainly is possible, if we look 14:36
6 at the passage. 14:36

7 He didn't say, "I acknowledge that 14:36
8 hysteresis is not discussed in Nicol." 14:37

9 Q. Okay. So I have marked Exhibit 7, and 14:37
10 we'll go look at his declaration. 14:37

11 (Deposition Exhibit 7 was marked for 14:37
12 identification and is attached hereto.) 14:37

13 BY MR. BROWN: 14:37

14 Q. While you are pulling that up, Exhibit 7 14:37
15 is Dr. Sechen's declaration in support of Intel's 14:37
16 decision on the '047 patent, which is dated -- well, 14:37
17 I don't have the date. It's Exhibit 10 -- 1001 to 14:37
18 the -- to the Intel petition on the '047. 14:37

19 I want to take -- you cite there as to -- 14:37
20 as support for this statement that Dr. -- that 14:37
21 Professor Sechen acknowledges that Nicol is devoid 14:37
22 of any reference to hysteresis. You cite to 14:37
23 Paragraph 200. 14:37

24 Do you see that? 14:37

25 A. Yes. 14:37

1 Q. Okay. So I'll give you a second to read 14:37

2 Paragraph 200 in Exhibit 7. 14:38

3 A. I see that. 14:38

4 Q. And you see that, in fact, what you said 14:38

5 in -- about Professor Sechen's acknowledgement was 14:38

6 completely inaccurate; right? 14:38

7 MR. TUNG: Object to the form. 14:38

8 THE WITNESS: No. I think it's actually 14:38

9 completely accurate. 14:38

10 He specifically did not say that it's in 14:38

11 accordance with hysteresis or even hysteresis 14:38

12 characteristics. He said he is looking for 14:38

13 hysteresis. 14:38

14 And he says that this vague statement, it 14:38

15 is [as read]: "...in accordance with a hysteresis 14:38

16 characteristic." 14:38

17 Now, as we've discussed, hysteresis is 14:38

18 kind of a complicated thing to define. So a 14:39

19 hysteresis characteristic could be when I change an 14:39

20 input, an output changes. 14:39

21 BY MR. BROWN: 14:39

22 Q. Okay. Let me -- I'm sorry. You are still 14:39

23 going? 14:39

24 A. No. I suggested I was still going but I 14:39

25 am not. Sorry about that. 14:39

1 Q. Okay. 14:39

2 A. The delay with the video is a little 14:39

3 awkward. 14:39

4 Q. Okay. Let's read the last sentence of 14:39

5 Paragraph 200 of Professor Sechen's declaration. He 14:39

6 writes [as read]: 14:39

7 "It should be noted that the 14:39

8 '047 patent specification is devoid of 14:39

9 any description of a hysteresis 14:39

10 characteristics." 14:39

11 Do you see that? 14:39

12 A. Yes. I see that. 14:39

13 Q. He -- he is acknowledging that the 14:39

14 '047 patent is devoid of any description of 14:39

15 hysteresis; correct? 14:39

16 A. He is acknowledging that in his opinion 14:39

17 the '047 specification is devoid of any description 14:39

18 of a hysteresis characteristic. 14:39

19 Q. Okay. That sentence does not say that 14:39

20 Nicol is devoid of any description of a hysteresis 14:40

21 characteristic, does it? 14:40

22 A. I mean, it says what it says. But it 14:40

23 certainly doesn't literally -- that sentence does 14:40

24 not literally refer to Nicol. 14:40

25 Q. And he doesn't -- he never actually 14:40

1 acknowledges. Because you use the word 14:40
2 "acknowledges" here. You don't say "he impliedly 14:40
3 admits." You don't say "he doesn't contest." You 14:40
4 say he "acknowledges that Nicol is devoid of any 14:40
5 reference to hysteresis." That is not what this 14:40
6 sentence says. 14:40
7 Do you agree with me on that? 14:40
8 A. That -- 14:40
9 MR. TUNG: Object to the form of the 14:40
10 question. 14:40
11 THE WITNESS: Well, the final sentence 14:40
12 doesn't refer to Nicol at all. 14:40
13 But in my opinion, what I cited to is 14:40
14 Paragraph 200. And Paragraph 200, I think, arguably 14:40
15 inherently acknowledges that, given that he was 14:40
16 looking for it. 14:40
17 And I -- I will certainly agree that 14:40
18 "acknowledges" was maybe not the best word to 14:41
19 choose, but I think that a person of ordinary skill 14:41
20 in the art looking at this, saying, "He is looking 14:41
21 for hysteresis, he is looking at Nicol, he says it's 14:41
22 got characteristics of it" -- which, to me means 14:41
23 it's not hysteresis -- he is inherently saying it's 14:41
24 not there. 14:41
25 That's just my reading of it. It's for -- 14:41

1 well, that's just my reading of it. 14:41

2 BY MR. BROWN: 14:41

3 Q. Okay. Your read of a sentence where 14:41

4 Professor Sechen says [as read]: 14:41

5 "In my opinion, a POSITA would have 14:41

6 appreciated that Nicol discloses the 14:41

7 system of claim 6 adapted to 14:41

8 subsequently reduce the clock frequency 14:41

9 in accordance with a hysteresis 14:41

10 characteristic," 14:41

11 Your interpretation of that sentence is 14:41

12 that he is acknowledging that Nicol doesn't disclose 14:41

13 hysteresis? 14:41

14 A. Yes. 14:42

15 MR. TUNG: Object to the form. 14:42

16 THE WITNESS: Otherwise he would have said 14:42

17 "Here's where it is." 14:42

18 Not only did he not say that there is 14:42

19 hysteresis there, he says that there is a 14:42

20 hysteresis -- "a hysteresis characteristic." 14:42

21 Actually, he doesn't -- he doesn't even 14:42

22 show where a hysteresis characteristic is disclosed. 14:42

23 He just says a POSITA would have understood that 14:42

24 there is a hysteresis characteristic. 14:42

25 Not -- as I said, I agree with you in 14:42

1 retrospect. Maybe "acknowledges" was not the best 14:42
2 word to choose. But I think it's completely clear 14:42
3 that he knows that there is no disclosure, and he is 14:42
4 saying there is no disclosure. 14:42
5 BY MR. BROWN: 14:42
6 Q. Yeah, that's your read from reading his 14:42
7 declaration. You feel -- I just want to be super 14:42
8 clear about this. 14:42
9 You feel very comfortable with saying, 14:42
10 under oath, in this -- in this declaration that 14:42
11 Professor Sechen's declaration acknowledges that 14:42
12 there is no -- that "Nicol is devoid of any 14:43
13 reference to hysteresis"? 14:43
14 You believe that is a true statement under 14:43
15 oath; is that correct? 14:43
16 MR. TUNG: Counsel, you have asked this 14:43
17 question three or four times. It's been about 14:43
18 12 minutes. It's been asked and answered. 14:43
19 I'll let him answer the question. But can 14:43
20 we move on, please. 14:43
21 MR. BROWN: Mr. Tung, your speaking 14:43
22 objection is inappropriate particularly at this 14:43
23 moment. 14:43
24 MR. TUNG: Your -- your repeated 14:43
25 questioning on the same thing and badgering the 14:43

1 witness is also inappropriate. It's time that I 14:43
2 speak up because I have been letting this go with 14:43
3 very little objection along the way. 14:43
4 BY MR. BROWN: 14:43
5 Q. The question is pending, Doctor. 14:43
6 THE WITNESS: Could you read it back 14:43
7 please, Court Reporter. 14:43
8 THE REPORTER: Readback. One second.
9 (The following record was read:
10 "QUESTION: Yeah. That's your read
11 from reading his declaration. You
12 feel -- I just want to be super clear
13 about this.
14 "You feel very comfortable with
15 saying, under oath, in this -- in this
16 declaration that Professor Sechen's
17 declaration acknowledges that there is
18 no -- that 'Nicol is devoid of any
19 reference to hysteresis'?
20 "You believe that is a true
21 statement under oath; is that
22 correct?")
23 THE WITNESS: No. I believe that largely 14:44
24 matches what I wrote in my declaration, which was -- 14:44
25 I think technically under oath as well. Certainly 14:44

1 under charges of perjury. This is my understanding. 14:44

2 I think he is making it very clear that he 14:44

3 couldn't find any characteristic, any use of 14:44

4 hysteresis in Nicol because he wanted to, he was 14:44

5 charged -- presumably, he was charged with finding 14:44

6 evidence of that in the art, he talked about it; so 14:44

7 he just didn't ignore the issue. But he didn't 14:44

8 point to anything. He didn't -- 14:44

9 BY MR. BROWN: 14:44

10 Q. Okay. 14:44

11 A. He didn't even point to anything that -- 14:44

12 how did he phrase that? -- that shows hysteresis 14:45

13 characteristic. He just said a POSITA would find it 14:45

14 there. 14:45

15 Q. You know "hysteresis characteristic" is 14:45

16 claim language; right? 14:45

17 A. I don't recall. I haven't memorized all 14:45

18 the claims. I don't know if that's been construed. 14:45

19 I mean what -- seriously, what is the 14:45

20 hysteresis characteristic? I can describe what is 14:45

21 hysteresis. 14:45

22 Q. Uh-huh. 14:45

23 A. And does Nicol exhibit hysteresis? I 14:45

24 didn't find it. And I don't think he found it. 14:45

25 As I said, there are almost -- there has 14:45

1 to be multiple elements of what defines hysteresis. 14:45
2 Some of those characteristics are characteristics of 14:45
3 almost any system. 14:45
4 We saw that one you put in front of me 14:45
5 that said delay. A delay is characteristic of a 14:45
6 huge number of systems. Is it also present in 14:45
7 hysteresis? It may be, but that's not really very 14:46
8 meaningful. That doesn't -- if I see a delay, I 14:46
9 can't say "Ah-ah, I have got hysteresis." 14:46
10 So, yeah, the fact that he is -- the fact 14:46
11 that he is referring to a characteristic of 14:46
12 hysteresis, but not showing hysteresis and not 14:46
13 pointing to anything in particular, makes it pretty 14:46
14 clear to me that he didn't find it. 14:46
15 Q. Uh-huh. Do you not know what a hysteresis 14:46
16 characteristic is? 14:46
17 MR. TUNG: Object to the form of the 14:46
18 question. 14:46
19 THE WITNESS: What do you mean a 14:46
20 hysteresis characteristic? What do -- what do you 14:46
21 mean by "hysteresis characteristic"? 14:46
22 BY MR. BROWN: 14:46
23 Q. Do you not know what it means to reduce 14:46
24 the clock frequency in accordance with a hysteresis 14:46
25 characteristic? 14:46

1 MR. TUNG: I'm objecting to the form of 14:46
2 the question. 14:46

3 THE WITNESS: I haven't really considered 14:46
4 it all that much because that would be a matter that 14:46
5 largely came up in the context of infringement, and 14:46
6 we're not talking about infringement. 14:46

7 What I am doing is I'm reading the 14:47
8 arguments put forth by him. 14:47

9 He says hysteresis effect. Okay, well, 14:47
10 what is the definition of a hysteresis effect? Has 14:47
11 it been construed? If it has, I apologize. I don't 14:47
12 remember it being construed but -- I don't know 14:47
13 whether if it has been construed. 14:47

14 BY MR. BROWN: 14:47

15 Q. Yeah. Let me take you to Paragraph 204, 14:47
16 which is on the next page. 14:47

17 A. All right. 14:47

18 Q. Paragraph 204 of Mr. Sechen's -- 14:47
19 Dr. Sechen's declaration states [as read]: 14:47

20 "Nicol's Figure 3 also clearly 14:47
21 demonstrates hysteresis in setting the 14:47
22 power supply voltage and clock 14:47
23 frequency." 14:47

24 Do you see that? 14:47

25 A. I do. 14:47

1 Q. Did you consider that sentence when you 14:47
2 represented in your declaration that "Professor 14:47
3 Sechen acknowledges Nicol is devoid of any reference 14:47
4 to hysteresis"? 14:47

5 A. I did my best to consider the entire 14:47
6 report. 14:47

7 Q. Are you still -- given that sentence where 14:47
8 he says "Nicol's Figure 3 also clearly demonstrates 14:47
9 hysteresis," are you still confident in your 14:48
10 position that Professor Sechen acknowledges that 14:48
11 Nicol is actually devoid of any reference to 14:48
12 hysteresis? 14:48

13 A. Having this refreshed my memory, I would 14:48
14 agree. He seems to not know what hysteresis is, but 14:48
15 believes that he found it. 14:48

16 Q. Okay. So -- 14:48

17 A. He is -- he is pointing to something that 14:48
18 he thinks supports that conclusion. 14:48

19 Q. Okay. So now that we have gone through 14:48
20 this, you -- I think you are agreeing with me that 14:48
21 it is inaccurate to say that Professor Sechen 14:48
22 acknowledges that Nicol is devoid of any reference 14:48
23 to hysteresis; is that correct? 14:48

24 MR. TUNG: I'm objecting to the form of 14:48
25 that question. 14:48

1 THE WITNESS: Give me just a moment to... 14:48
2 [Witness reviews document]. 14:48
3 Yeah, I think that is accurate. I mean, I 14:48
4 could have said, "I understand that Professor Sechen 14:49
5 acknowledges that Nicol is devoid of any references 14:49
6 to hysteresis in that context of Paragraph 200" 14:49
7 because I believe that is true. 14:49
8 But you are right, putting that other 14:49
9 paragraph in front of me, I -- I think he is not 14:49
10 saying that. 14:49
11 BY MR. BROWN: 14:49
12 Q. Okay. So you agree that Professor Sechen 14:49
13 does state that Nicol includes references to 14:49
14 hysteresis; right? 14:49
15 MR. TUNG: Object to the form. 14:49
16 THE WITNESS: My recollection is that he 14:49
17 presented characteristics of hysteresis. He said, 14:49
18 "Look, I find this hysteresis in Figure 3. I did an 14:49
19 analysis of it and said without saying that 14:49
20 definition is accurate or sufficient, Figure 3 14:49
21 doesn't meet that definition." 14:49
22 But your question seems to be focused on 14:49
23 did he say he found it in Figure 3. And he 14:50
24 certainly did say it in that second paragraph that 14:50
25 you pointed me to. 14:50

Page 200

1 BY MR. BROWN: 14:50

2 Q. Okay. So would you agree that -- well, 14:50

3 let me -- let me ask this: 14:50

4 In order to ensure that you are making 14:50

5 accurate statements to the patent office, would you 14:50

6 remove that first sentence of Paragraph 91 of your 14:50

7 declaration in order to remain accurate, in light of 14:50

8 what you have learned just now or been refreshed of 14:50

9 just now? 14:50

10 MR. TUNG: I object to the form. 14:50

11 THE WITNESS: No, I would not. I don't 14:50

12 know how to do such a thing. My understanding is 14:50

13 that this is part of the existing record now. 14:50

14 If the -- I have done my best to clearly 14:50

15 state my opinions now that you have put the two in 14:50

16 front of me. 14:51

17 If somebody from the patent office asks me 14:51

18 about this or if the attorneys ask me to file a 14:51

19 corrected or supplemental report, I don't -- I don't 14:51

20 think I would have any trouble with that. 14:51

21 But I wouldn't take such an action on my 14:51

22 own. I'm not an attorney, and I don't know what the 14:51

23 process would be for that. 14:51

24 BY MR. BROWN: 14:51

25 Q. Sure. 14:51

1 Would you agree that this paragraph would 14:51
2 be more accurate if that first sentence wasn't 14:51
3 there? 14:51

4 A. I -- I have already answered that question 14:51
5 at least twice so I'm comfortable staying with that 14:51
6 answer. 14:51

7 Q. I don't think you have answered it. 14:51
8 Can you answer it for me? 14:51

9 A. I can, but I'm comfortable staying with my 14:51
10 previous answer, which I am -- it was what I stated 14:51
11 and is on the record previously. 14:51

12 We -- I mean, I could look over the 14:52
13 realtime and if I am remembering wrong, sure. But I 14:52
14 think we discussed whether it would have be more 14:52
15 accurate and more precise or whether he inherently 14:52
16 discloses this, and I think I answered it. 14:52

17 Q. Uh-huh. 14:52

18 A. But I don't have the realtime up so I 14:52
19 can't be sure. 14:52

20 Q. Yeah. I don't see you answering this 14:52
21 question previously. And I think it's a simple 14:52
22 matter of just answering it now because here -- 14:52

23 What I want to be able to -- I want to 14:52
24 know whether or not I have to tell the patent office 14:52
25 that this is a problematic sentence and that it's 14:52

1 inaccurate; or if you'll just agree "Yeah, this 14:53
2 sentence was a mistake," and I could just say 14:53
3 everybody agrees that this sentence was a mistake, 14:53
4 and there's no problem. So that's what I am asking. 14:53
5 Do you agree that this sentence, the first 14:53
6 sentence of Paragraph 91, is a mistake and we don't 14:53
7 even need it in here? 14:53
8 MR. TUNG: Object to the form. 14:53
9 THE WITNESS: Well, I -- you know, I have 14:53
10 no control over what you -- what you tell the patent 14:53
11 office. 14:53
12 I think I said it's not the most precise, 14:53
13 and in retrospect, I shouldn't have used that word 14:53
14 "acknowledges" or, you know, whether it should have 14:53
15 brought in with "this is constrained to 14:53
16 Paragraph 200." 14:53
17 And I said that I wouldn't have a problem 14:53
18 with filing some sort of a correction if the 14:53
19 attorneys asked me to and -- and we drafted one 14:53
20 together. 14:53
21 I don't see any reason why this particular 14:54
22 sentence is a key to any of the arguments here. 14:54
23 So I don't know -- I mean, it's in there. It says 14:54
24 what it says. I would rather it not have said 14:54
25 "acknowledges." I don't think it particularly 14:54

1 forwards -- advances the arguments because at the 14:54
2 end of the day, you know, the issue is whether a 14:54
3 fact-finder thinks it's disclosed there or not. But 14:54
4 that's the best characterization I can get. 14:54
5 But what I think I said before was that 14:54
6 it's not as precise and accurate as I wanted, or 14:54
7 something along those lines. 14:54
8 BY MR. BROWN: 14:54
9 Q. Okay. I think I have your position on 14:54
10 that now. 14:54
11 MR. BROWN: So I think -- I think that 14:55
12 should wrap it up for me, unless there's any 14:55
13 follow-up questions from PACT's counsel. 14:55
14 MR. TUNG: So I just wanted to follow-up 14:55
15 on one point. 14:55
16 14:55
17 EXAMINATION 14:55
18 BY MR. TUNG: 14:55
19 Q. If you could turn in your declaration, I 14:55
20 think this is Exhibit 5. 14:55
21 Do you remember you were asked about 14:55
22 Paragraph 114? 14:55
23 A. All right. I'm there. 14:55
24 Q. And to just remind you, you were asked 14:56
25 about a quote in this paragraph about [as read]: 14:56

1 "'Nicol is agnostic to the internal 14:56
2 structures of the PE'?" 14:56
3 A. Yes. 14:56
4 Q. And then counsel pointed you to the 14:56
5 original petition which had some additional text 14:56
6 before that -- that part of the quote. 14:56
7 Do you recall that? 14:56
8 A. Yes. 14:56
9 Q. And so you had read the petition and that 14:56
10 entire sentence before; right? 14:56
11 A. Yes. 14:56
12 Q. And so the fact you quoted part of the 14:56
13 sentence, does that affect the rest of your opinion 14:56
14 here? 14:56
15 A. No. I don't think it does. 14:56
16 Q. Okay. 14:56
17 MR. TUNG: Thank you. I have no further 14:56
18 questions. 14:56
19 MR. BROWN: Nothing -- oh, go ahead. 14:56
20 Sorry, Mark. 14:56
21 MR. TUNG: I just -- well, you have no 14:56
22 more questions, I was just going to reserve the 14:56
23 right to submit an errata. 14:56
24 MR. BROWN: Sure. Okay. No further 14:56
25 questions from us either. 14:56

1 Thank you, Doctor. 14:57
2 THE WITNESS: Thank you. Have a good 14:57
3 afternoon. 14:57
4 THE VIDEOGRAPHER: Ms. Hester, do you want 14:57
5 to take copy orders on the record? 14:57
6 THE REPORTER: No. 14:57
7 THE VIDEOGRAPHER: Okay. 14:57
8 We're off the record at 2:57 p.m. This 14:57
9 concludes today's testimony given by William 14:57
10 Mangione-Smith, total Number of Media used was five 14:57
11 and will be retained by Veritext. 14:57
12 (Whereupon, at 2:57 p.m., the deposition
13 of WILLIAM MANGIONE-SMITH, PH.D. was
14 adjourned.)
15 --- oOo ---
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I, WILLIAM MANGIONE-SMITH, PH.D., hereby
certify under penalty of perjury under the laws of
the State of California that the foregoing is true
and correct.

Executed this _____ day of
_____, 2021, at _____,
California.

WILLIAM MANGIONE-SMITH, PH.D.

1 STATE OF CALIFORNIA)
2 COUNTY OF LOS ANGELES) SS.
3

4 I, Dayna Hester, C.S.R. No. 9970, in
5 and for the State of California, do hereby certify:

6 That, prior to being examined, the witness
7 named in the foregoing deposition was by me duly
8 sworn to testify to the truth, the whole truth, and
9 nothing but the truth;

10 That said deposition was taken down by me
11 in shorthand at the time and place therein named and
12 thereafter reduced to typewriting under my
13 direction, and the same is a true, correct, and
14 complete transcript of said proceedings;

15 That if the foregoing pertains to the
16 original transcript of a deposition in a Federal
17 Case, before completion of the proceedings, review
18 of the transcript { } was { } was not required;

19 I further certify that I am not interested
20 in the event of the action.

21 Witness my hand this 23rd day of February, 2021.
22
23

24 

25 Dayna Hester, C.S.R. No. 9970

[& - 3]

&	160:16 182:24,25 189:17	159 4:17	20 29:25 52:20 53:20 75:11 95:20 99:2 112:24 156:11
& 2:11,17 3:3 6:2 6:4	100 15:24 16:6,15 33:13,21 162:1,23 162:25	16 52:16 53:16 95:16 151:14	200 189:23 190:2 191:5 192:14,14 200:6 203:16
0	1001 4:22 189:17	163 30:16	2020-02-07 4:20
0001 4:12	1008.pdf 4:12	17 52:17 53:17 95:17	2021 1:19 2:4 5:2 5:6 95:2 207:9 208:21
0002 4:13	1009.pdf 4:17	18 1:19 2:4 5:2 52:18 53:18 95:2 95:18	2027 4:19
0003 4:15	1010.pdf 4:16	180 27:16	204 4:6 198:15,18
0004 4:17	10:20 52:20	184 4:18,20	21 52:21 53:21 95:21 156:11 159:12
0005 4:18	11 52:11 53:11 95:11,16,19 154:1	18516 208:24	213 2:19
0006 4:20	114 185:4 204:22	189 4:22	22 52:22 53:22 95:22 112:24
0007 4:22	11:26 94:21,22	18th 5:6	23 52:23 53:23 95:23 161:20
002 4:20	12 52:12 53:12 95:12 153:23,25 156:4,7 194:18	19 52:19 53:19 95:19	23rd 208:21
01 97:7	120 27:18 29:10,13 29:19 30:14,15 32:5 78:5,8 116:19 178:19	1:04 139:5	24 52:24 53:24 95:24 159:12
047 4:19,20,22 102:24 141:13 144:15 158:15 184:12,17 189:16 189:18 191:8,14 191:17	121 27:19	1:19 139:8	245 33:21
08 4:14	122 4:13	2	25 52:25 53:25 95:25 156:11
1	123 29:20 32:12 33:14 34:9,11	2 4:13 9:18 17:5 18:13 19:16 21:12 21:20 23:4,16 29:8 34:2,13 52:2 53:2 54:21 55:1 55:10,16 56:21 57:4 59:20,24,25 60:19,20 61:19 62:14 63:5,7,8 64:5,8,9,15,16 65:9,19,21,21,22 66:9,16 67:6,13,25 68:5 69:20,25 78:6 95:2 122:12 122:16,17,19 123:21 127:1,5 134:11 146:24,24 161:20,22 165:2 176:8	2700 2:13
1 4:12 5:7 8:24 9:3 9:8 52:1 53:1 54:21,25 55:3,18 56:8 59:19 60:1 60:21 61:1,4,6,17 62:14 63:7 64:7,9 64:15 65:22 66:3 66:9 67:1,1,12 95:1,16 99:2 161:15 164:15,16 165:5,9,20 173:4	13 52:13 53:13 95:13	2's 64:10	2:20 184:1
1's 61:18 66:3,24	130 32:18 34:11 77:12 178:21	2.7 15:12	2:31 184:4
1.5 99:3	14 52:14 53:14 95:14		2:57 206:8,12
1.8 13:10	140 13:12,17 14:3 16:5,15 27:16,17 27:18,20,25 29:9 78:8 175:6		2a 149:14,17
1/100th 165:22	148 4:15		3
10 29:25 32:8,9,15 36:6 52:10 53:10 78:6,7 95:10 114:3 153:22	15 52:15 53:15 95:15		3 4:15 9:11,14 10:9,17 11:6,25 14:14,20 15:8,21 16:4,18,25 17:4 19:21 20:25 26:18 52:3 53:3 54:22 55:1,16 59:20,24 59:25 60:19,20

[3 - act]

61:19 87:24 95:3 112:24 148:20 149:7 160:13 175:4 177:25 178:25 198:20 199:8 200:18,20 200:23 30 85:15 154:23 34 139:17 35 94:17 355 122:21 3700 2:18 39 140:5 3d 84:9	156:10 161:20 184:9,12 185:3 204:20 50 19:21 74:20 75:9 87:3,4 88:20 88:22 89:10 162:22 174:5 175:25 54 11:20,23 555 2:13,18 3:4 56 152:12 57 186:7,8 58 13:7 5btab 4:14,15,17 4:18 5d 4:14,16,17,19 5th 3:4	70 13:10,17 14:3 16:5,15,16 99:3 126:23 128:1,6 131:5,8,20 132:1,2 132:7 134:5,9 136:1 179:1 71 130:8 132:1 135:21 72 127:25	124:14 165:23 168:17 abstract 25:22 abstraction 164:6 abstractly 84:23 acceptable 157:16 accommodate 165:17 accompanied 18:7 accomplish 163:19 account 29:16 61:22 65:2 72:21 167:24 180:15 accumulated 127:9,10 accumulation 111:21 112:2,6 accurate 157:9 187:13 190:9 200:3,20 201:5,7 202:2,15 204:6 accurately 70:22 73:1 84:7 achieve 32:16 56:16 103:8,18 115:1
4	6	8 52:8 53:8 95:8 801-5000 3:5	act 134:10 142:10
4 4:17 11:20 13:4 43:24 44:3 45:20 46:7,11 47:15,17 51:15 52:4 53:4 53:17 54:4,9,18 55:10,16 56:22 57:4,16,19 58:23 59:3,10,15 60:6 63:4 65:21 66:16 95:4,15,19 159:2,6 159:12,18 165:12 40 30:1 49:4 41 140:5 415 2:14 42 49:4 439-1670 2:14 4438905 1:24 47 19:24 49 19:21	6 4:20 52:6 53:6 95:6 139:17 184:14,17 186:5,7 186:7 193:7 6,141,762 9:2 6,535,798 159:7 605 102:24 141:13 144:15 158:15 6367023 149:7 65 185:4 650 3:5 67 133:3 68 127:24 131:7 134:6 135:5,5,21 136:2 680-8400 2:19 69 130:8 132:1 133:3 136:1	9 4:12 52:9 53:9 95:9 9,075,605 1:9 9,552,047 1:7 90071 2:19 91 188:9,12 201:6 203:6 94065 3:5 94104 2:14 95 4:5 9970 1:25 2:7 208:4,25	acknowledge 23:17 77:1 189:7 acknowledgement 189:3 190:5 acknowledges 188:14 189:21 192:1,2,4,15,18 194:1,11 195:17 199:3,10,22 200:5 203:14,25 acknowledging 31:22 191:13,16 193:12
5	7	a	act 134:10 142:10
5 4:18 29:25 49:4 52:5 53:5 85:16 95:5 112:18,22,24 115:6 129:9 151:9 151:14 152:12	7 4:4,22 52:7 53:7 78:9 95:7 152:12 189:9,11,14 190:2	a.m. 2:3 5:2,5 94:22 ability 8:20 26:20 72:25 159:18 160:25 able 20:21 25:14 30:19 36:1 51:21 106:9 115:15 129:14 183:1 202:23 absolute 54:5 102:11 absolutely 25:16 25:24 85:14	

[action - application]

action 5:18 107:15 125:6 126:12 128:8 130:4,5 201:21 208:20 active 114:23 acts 136:10 actual 23:10 33:5 77:19 89:20 adapt 165:7 adaptation 10:25 adapted 193:7 adaptive 53:24 add 13:3 18:14 21:2 34:25 36:24 39:14 42:18 119:15 121:19 134:10 164:15,22 165:5,14 added 16:8,24 17:15,18 18:8 21:3 22:9 27:1 32:23 40:5 55:3 119:19 162:13 165:24 166:11 178:2,4,8,19 179:5 182:8 adding 36:10 addition 12:10 35:8 37:24 142:24 160:15 additional 12:11 16:24 34:12 36:7 107:20 162:2,12 165:24 178:1,19 205:5 address 20:22,23 40:20 70:8 addressed 38:9 42:6 addresses 84:1	addressing 19:13 adjourned 206:14 adjust 97:9 101:24 114:17 115:15 adjusting 105:12 adjustment 125:18 176:24 adjustments 98:1 admits 192:3 advance 86:22 88:6 90:5,6 advances 204:1 advantage 31:24 119:8 affect 104:3 117:5 127:11 136:17 153:19 205:13 affiliations 5:22 affirm 6:13 afternoon 206:3 ag 1:8 5:10 agnostic 185:11 186:15,20,22 187:3,25 205:1 ago 22:24 105:10 127:7 agree 10:1 14:2 36:8 50:11 51:12 57:2 60:9,11 62:15 71:3 74:1 75:13 76:8 78:1,2 78:22 80:2 82:15 90:7 93:12 99:17 99:21 100:7,9 110:10 114:12 117:4 123:20 125:4 138:6,14 145:2 146:5,18 150:24 158:17 188:6 192:7,17 193:25 199:14	200:12 201:2 202:1 203:1,5 agreeing 92:10 199:20 agrees 203:3 ah 93:19 143:21 197:9,9 aha 99:9 ahead 108:11 123:25 158:11 205:19 aim 57:15 aiming 118:21 air 109:11 125:20 algorithm 126:16 126:24 168:3,11 algorithms 41:10 allocate 19:18 92:2 allocated 183:5 allocates 162:4 allocating 61:23 allocation 18:10 allow 29:1 123:16 181:14 allowed 149:24 allows 15:23 30:5 153:14 177:10 alternatively 77:11 152:13 ambiguity 12:19 ambition 23:18 ambitious 154:21 amount 13:24 17:19 21:12 27:23 31:1,2 37:7 46:8 77:23 79:7,13 81:11 87:2 109:20 123:12 125:2 163:25 177:1 182:14	amp 154:23 analog 59:7 analogy 22:25 46:22 79:4 analysis 200:19 analyze 79:20 181:14 angeles 2:19 208:2 annoy 93:18 answer 23:2 25:6 27:7 36:2 38:8 40:22 41:14 68:22 88:4,4 194:19 202:6,8,10 answered 35:11 68:20 84:18 194:18 202:4,7,16 answering 60:10 100:24 202:20,22 anti 71:5 anticipate 51:20 186:2 anticipated 44:24 anybody 157:25 anyways 127:20 apologize 45:25 50:24 53:7 67:23 198:11 appeal 1:3 appear 15:18 187:10 appearance 5:25 appearances 2:9 2:25 3:1 5:22 appearing 2:5 apples 173:20 applicable 142:25 143:1 145:6 application 72:25 100:8 157:21
--	---	---	--

[applications - based]

applications 17:9 84:11,13 147:14 182:21 applied 140:16,20 143:10 146:2 applying 134:13 appreciate 22:23 appreciated 50:5 193:6 approach 25:2 90:22 approaches 69:5 90:24 appropriately 117:11 approximately 156:14 apt 79:4 arbitrarily 30:19 area 110:24 arguably 93:3 192:14 arguments 198:8 203:22 204:1 arrangement 146:6,17 148:2 arrangements 139:21 140:2 arriving 90:12 art 10:16,22 35:5 38:7 40:12 41:22 42:2,8,23 43:12,20 50:12 52:7 56:6 56:13 57:14 60:24 96:14 97:5,9 99:18 101:22,23 121:16,25 146:1 146:12 148:2,8,11 158:15 160:2 166:19 167:13 168:10 170:25	171:7 181:4,17 182:6 192:20 196:6 article 115:5 aside 92:20 163:13 asked 35:11 68:20 194:16,18 203:19 204:21,24 asking 89:19 94:6 126:7 133:1 169:16 203:4 asks 201:17 aspect 122:2 124:5 148:17 150:1 aspects 124:3 126:15 144:5 162:17 aspirational 167:9 assign 21:16,21 40:24 41:4,6 56:5 60:1,20 165:9 173:4,4 assigned 20:2 46:1 46:4 47:20 64:5 64:18 175:15 176:13 assigning 56:7 61:17 75:17,23 169:2 assignment 40:4 64:13 associated 12:1 13:23 14:8 154:7 155:6 156:3,13 177:5 assume 10:23 13:23 30:12 40:13 42:20 61:4 62:12 115:8 122:16 138:20 143:6 146:5 173:23	180:9 assumes 12:13 16:10 17:1 21:7 48:3 56:19 63:1 64:11 75:1 76:19 98:3,20 109:13 120:9 153:1 assuming 10:5 26:18 36:25 114:9 131:10 176:6 187:18 attached 9:4 122:13 148:21 159:3 184:10,15 189:12 attempt 40:14 53:19,20 60:13 67:25 68:23 91:19 92:12 166:1 attempting 28:7 45:22 attending 5:21 attorney 5:25 201:22 attorneys 53:9 201:18 203:19 attractive 60:12 73:17 available 36:14,20 42:11 56:7,8 59:20 80:10 150:5 150:6,10 154:17 155:10 156:4,24 157:4 avoid 43:2 68:1 102:8 108:15 109:16 129:8 aware 8:18 100:3 awful 89:25 awkward 191:3	axis 9:24 11:2
			b b 4:10 159:8 back 8:6 13:2 14:14 16:18,19 20:24 27:17 29:10 52:20,25 53:3 59:18 70:10 95:4 95:9 96:25 108:5 108:7 117:15 120:6 121:4 127:6 132:7 135:14 139:7,12 141:12 141:22 142:1 149:23 153:16 161:15 179:15 183:22 184:3 195:6 background 41:25 91:25 backup 26:12 bad 78:17 157:12 badgering 194:25 balance 59:10 60:13,18 162:2 balancing 77:24 band 27:15,15,18 28:22,25 29:5 32:5,7,15,18 33:3 33:6 34:19 36:13 36:15,16,19 47:14 106:14,16 111:14 130:7 138:9 banding 105:18 bands 28:25 31:1 35:7,20,22 bandwidth 74:17 barely 27:14 114:23 based 17:4 62:24 65:6,15 66:25,25

[based - buffer]

68:18 69:8,15 71:7 81:12 96:4 97:3,6 98:8,11 103:17 104:13 107:20 112:6 117:24 120:8 137:8 150:8,9,12 167:25 174:12 basement 133:9 basic 7:19 basically 112:4 116:12 185:6 basics 9:21 basis 166:20 175:8 175:12,16 177:20 basket 49:1 battery 102:15,16 beginning 5:25 88:9 177:8 behalf 2:2 behavior 146:19 believe 8:22 10:10 10:12,16,21 11:11 15:5 17:17,24 18:1 31:19 96:19 106:10 124:16,19 133:14 146:23 157:8 160:22 181:12 185:19 194:14 195:20,23 200:7 believes 199:15 beneficial 57:10 57:15 58:1 60:12 benefit 48:20 59:2 59:14 182:10 benefits 57:3 145:5,10 best 25:19 29:7 50:18 52:3 91:21 97:15 119:18	130:14 162:20 192:18 194:1 199:5 201:14 204:4 better 37:21 41:19 73:20 78:17 121:8 157:14 beyond 163:11 bhatia 4:17 159:1 159:6,8,12,14,18 159:21 160:13 bhbrown 2:15 bicker 117:1 bigger 167:17 binary 91:14 bit 9:18 11:5 14:15 15:4 17:21 29:17 37:4 38:7 39:2,6 43:22 54:17 55:19 87:23 119:9,12,16 120:5,11 122:6 125:16 130:9 140:4 149:13 168:24 169:9 170:18 184:7 block 113:5 blocked 90:15 blocks 81:15 blow 85:18 111:25 board 1:3 bottom 160:12 bounce 38:5 bouncing 130:19 bound 43:13 93:20 bounded 24:18 25:23 26:2,3 41:12 77:13 163:11 bounds 25:14 86:2 box 147:9 168:10 168:16,22	brake 71:5 brandon 2:11 6:2 break 50:4,9 52:19 53:4,11 54:16 94:1 95:11 138:17 138:18,22 139:3,6 139:14 183:21 184:2 breaker 154:23 156:18 breaks 156:25 brief 52:24 139:6 184:2 bring 28:8 48:12 159:16 bringing 61:5 189:2 broad 31:16 137:21 broader 121:24 172:21 187:21 broken 75:6 brought 35:20 169:11 203:15 brown 2:11 4:4,5 6:1,2 7:1,4 9:1,6 9:20 10:7 11:3 12:25 14:18 16:13 17:6 22:1,12,14,15 22:18 24:2 27:8 33:22 35:3 36:3 37:2 41:17 43:21 48:9 49:2 51:1 52:4,19 53:2 54:15 55:12 56:2 56:15 57:1,12 60:16 61:2,15 63:15 64:21 65:11 66:1 67:18 69:6 69:17 70:9 75:16 77:5 83:15 86:9	93:22 94:8,11,18 95:8 96:21 97:23 98:14 99:15 100:6 100:17 102:22 104:8 106:24 108:1 109:4 110:1 112:16 118:10 120:19 122:7,14 124:4 125:14 126:5 128:24 129:21 138:1 139:9 142:22 143:20 145:13 147:23 148:18,22 149:4 150:14,23 152:8 153:10 155:1 156:1,9 158:3,24 159:4 160:11 161:14 163:2 164:2,11 165:18 166:14 167:11 168:7,23 170:19,21 171:15 172:15 173:21 175:1,18 176:22 182:3 183:17 184:5,11,16,22 185:1 187:5,22 188:7 189:13 190:21 193:2 194:5,21 195:4 196:9 197:22 198:14 200:11 201:1,24 204:8,11 205:19,24 browser 8:4,5 buffer 118:24 120:21 121:19 170:10 171:1,9,11 171:21 172:6,13 173:16
---	--	---	---

[buffers - changing]

buffers 170:15 build 26:12 29:15 60:25 81:14 106:22 119:9 120:20 121:8 125:11 129:7 130:24 building 70:25 built 44:18 57:19 85:23 119:21 132:13 134:2 bump 36:19 bunch 40:4 42:18 busy 7:12 41:4 buy 82:20 83:10 171:13 buyer 150:21	camera 87:1 88:19 89:9 capability 28:16 129:8 capped 55:18 capture 137:16 card 141:22 142:1 142:15,18 146:7 cards 142:8 care 121:10 129:15 careful 100:20 169:10 cares 78:16,17 carry 167:10 case 1:6,8 5:11 17:22 19:3 27:13 31:5 44:21 58:3,6 58:9 63:8 65:7 67:10 73:13 78:20 82:25 83:3 90:8 91:21 102:9 114:10 119:13 126:2 129:17 134:17 135:21 136:24 137:22 165:12 169:6 172:5 173:1,14,18 179:20 180:11,16 181:12 208:17 cases 5:12 23:7 92:12 cat 45:21 cause 6:14 51:9 54:12,18,25 58:4 92:3 116:1 123:4 124:11,20 129:25 130:10,14 131:13 131:15 133:12 135:2 179:22	caused 37:23,23 causes 135:1 179:6 cautious 133:6 caveat 36:23 38:17 45:14 47:12 50:2 51:22 67:9 176:5 178:12 caveats 147:12 cell 84:15 cellphone 83:10 84:9 certain 17:16 20:1 20:15 31:1 33:15 33:19 37:7 51:19 73:15,22 76:4 79:20,21 82:24 87:2 99:23 101:17 103:8,18 105:2 107:9 126:10 163:16 166:22 182:14 certainly 19:5,15 20:16 26:5 34:23 39:12 42:4 43:18 44:23 47:14 54:11 55:23 58:9 59:5 60:9 61:21 65:1 66:9 70:25 75:12 76:3 78:22 82:25 83:25 90:7 101:18 103:10 106:1,22 107:6 108:25 113:12 116:23 147:13 155:15,23 156:6 160:5 161:10 162:19 167:5 168:5 169:25 179:24 189:5 191:23 192:17 195:25 200:24	certify 207:5 208:5,19 change 11:12 14:20,24 17:25 18:8 33:4,5 36:9 37:16,18 39:4,9 40:18 42:25 53:25 54:1 97:7 103:16 105:20 106:14,17 107:15,22 108:4 109:10,19 111:7 111:21,22 112:2,7 112:10 117:23 118:6 125:22 126:12 127:9,11 128:8 130:11,14 131:10,15 132:9 133:3,4,17 134:18 134:19 135:7 136:16 137:11 166:2 168:6,12 174:23 176:16 178:9,15 181:6 182:7,13,14,23 183:3,10 190:19 changed 177:16 changes 14:9 37:12,24 97:3,6,25 100:11 105:13,15 106:18 107:2,5,13 110:5,8 111:17 116:10 117:3,18 126:11 127:8 128:14 134:25 153:14 166:7 167:16,17 176:1 181:22 190:20 changing 48:19 58:5 105:17 108:6 109:17 117:25 124:17 131:21
c			
c 4:12 c.s.r. 1:25 2:6 208:4,25 cable 142:19 calculate 67:10 177:10 calculated 32:12 32:24 40:10 119:15 calculation 154:5 calhoun 2:12 6:5 calibration 112:20 113:5,5 116:9 california 2:13,14 2:19 3:5 207:6,10 208:1,5 call 28:10 53:6 62:13 76:11 94:17 102:8 142:2 called 38:5 calling 69:2,24 calls 85:8 99:2			

[changing - compare]

144:11 153:8 167:18 174:12 178:4 179:16,25 180:6 characteristic 133:11 190:16,19 191:18,21 193:10 193:20,22,24 196:3,13,15,20 197:5,11,16,20,21 197:25 characteristics 91:18 99:1 190:12 191:10 192:22 197:2,2 200:17 characterization 46:20 74:8 128:12 204:4 characterize 18:4 130:21 148:25 charged 196:5,5 charges 196:1 chip 20:2 96:16,19 97:4,25 98:10,17 98:25 101:15 141:7 chips 97:17 choice 183:7,14 choices 28:5 choose 60:7 192:19 194:2 chunks 182:24 circuit 112:21 113:7 116:9 134:15 137:7 154:23 156:18 circuitry 104:6 113:6 circuits 49:8,23 circumstance 22:2 22:20 31:10 32:14	33:2 36:4,8 40:1 47:22,24 56:3 59:22 61:16 62:17 62:23 64:7,22 74:9 117:22 173:8 178:6 circumstances 20:13 21:3 22:6 35:8 42:20 47:16 54:4,24 57:14 58:21 59:1,12 61:7 65:13 66:2 66:24 68:11,15,17 71:13 72:10 89:14 89:22 103:15 104:10 105:11 136:7,12,13,25 143:23 155:24 172:24 180:5 181:9 182:12 cite 186:6,6 189:19 189:22 cited 115:5 192:13 city 3:5 claim 68:1 91:17 153:23,25 154:1 155:14 156:4,7 193:7 196:16 claims 196:18 clarification 112:3 clarify 19:20 clarity 13:3 clear 12:20,23 13:19 69:18 113:13,14 153:12 194:2,8 195:12 196:2 197:14 clearly 38:20 198:20 199:8 201:14	clever 115:2 cliff 118:15,25 clock 11:17 15:23 17:12,13 18:15 21:13,17,18,23 27:12 28:8,17 29:23 31:20 39:15 45:16 48:1 49:21 49:25 50:10,19 53:24,24 54:13,25 55:2 57:20 58:5 58:17 63:9,9,14,18 64:17 65:7,23 66:8 67:7,16,21 80:11,20 101:17 101:25 102:10 103:1,5 104:3,4 106:12 107:23 113:14 143:14 144:12 150:9 153:9,14,15,20 162:24 165:7,13 177:10,14 179:16 179:21,25 180:22 182:24 193:8 197:24 198:22 clocking 49:10 51:5 clocks 43:25 52:1 close 28:11 30:19 48:7 90:9 93:11 138:20 149:22 175:17 183:20 closely 168:18 closer 184:19 coarse 108:25 code 23:24 25:22 25:25 coding 75:3 cold 130:24	column 11:20 13:4 19:21 49:4 95:15 95:19 112:18,22 139:17 151:9,14 152:12 153:22 156:10 159:12,18 160:13,13 161:20 combination 98:7 combines 65:20 combining 66:16 come 13:2 36:17 42:4 52:20 89:3 90:17 96:25 132:21 162:19 176:11 183:22 comes 27:22 32:22 34:1 58:15 64:4 88:9 179:21 181:1 183:4 comfortable 101:10 194:9 195:14 202:5,9 coming 51:21 87:18 132:6 comment 22:23 33:11 169:17 common 62:6 79:16 120:24 179:15,23 communicate 53:4 53:8 communication 7:22,22 72:25 74:6,25 76:18 79:17 community 103:13 comparable 141:10 compare 173:6
--	--	---	--

[compared - contention]

compared 46:3 85:3 compiled 169:5 complaint 127:15 complete 8:17 17:11,14 18:18 28:11 30:5 33:16 46:9 47:9 70:22 74:19 79:13 81:23 83:23 92:12 163:16 176:2 208:14 completed 72:13 72:14 75:21 82:9 85:5 174:14 completely 60:15 176:17,21 190:6,9 194:2 completes 15:22 completing 92:13 175:17 completion 18:25 19:2,4,7,8 20:4,14 20:21 22:7 23:6,8 24:6,11 25:8,12 34:14 74:12,17 75:18,24 76:3,24 77:3,7,16,19 79:3 79:6,12,23,24 80:7 81:20 82:1,8 84:17 85:2 86:20 90:25 208:17 complex 43:16 110:23 complexity 41:13 75:3 complicated 66:14 190:18 complication 77:20	component 45:15 93:12,19 components 65:21 81:4,5 83:5,18 comports 47:11 comprise 169:2 comprising 154:4 computation 23:10 24:18 27:23 36:17 58:8 77:13 80:9 86:7 163:12 163:18,22,25 computational 27:2 162:3,12 computations 91:24 147:2 148:15 compute 23:9,10 24:20,22 80:9 computer 7:25 8:3 25:22 102:6,14,15 140:11 141:1,3,22 141:24 142:14,19 143:1 144:16,17 144:19,20,22 145:4,16 146:8,14 146:16 154:9,16 156:16 158:23 computers 140:6 141:4,13 143:24 144:25 145:7 computes 162:1,5 computing 20:20 22:9 145:12 162:9 concede 28:18 conceivably 90:16 concept 28:21 42:16 77:6 79:24 85:20 112:18 160:1	concepts 91:20 135:10 142:24 conceptualize 111:2 concern 35:23 43:8 107:6 133:20 concerned 31:17 31:18 107:8 134:19 concerns 100:24 171:12 conclude 59:9 107:21 162:24 concludes 206:9 conclusion 17:18 61:1 85:8 98:13 167:23 199:18 conclusively 102:21 condition 34:24 103:3 124:18 conditioning 109:11 125:20 conditions 11:12 116:7 conduct 84:8 confident 199:9 configuration 28:15 63:8,24 configure 66:15 configured 47:3 65:22 confirm 170:16 conflicting 89:24 confused 131:1 conjunction 127:2 consequence 10:24 99:11,19 consider 35:16 56:7 60:18 73:19 76:10,11 106:2	126:19 129:20 144:21 171:8 199:1,5 consideration 17:20 18:24 90:25 considered 19:9 56:1 61:13 71:2 73:23 75:13 82:15 84:10 90:2 93:4 93:11 134:25 198:3 considering 58:4 65:4 69:4 118:6 143:7 considers 67:11 consistent 14:5,11 18:1 44:6 68:23 69:12 156:22 166:16 176:4 constant 123:14 156:13 constrained 26:14 72:11 203:15 constraints 68:4 70:23 72:20 construed 196:18 198:11,12,13 consumed 155:21 156:15 consumption 51:25 52:2,11,15 52:16 53:14,20 58:7 145:6,11 149:18 153:4 157:6,10,19 cont'd 4:5 contact 93:14 contemplates 97:2 content 171:19 contention 68:2
---	---	--	---

[contest - deadline]

contest 192:3 context 19:15 21:8 23:4 35:1 41:15 50:1 56:21 85:22 97:20 98:8 101:3 101:6 102:5 128:21 137:25 157:10,12 163:8 172:8 180:10 189:3 198:5 200:6 continually 181:19 continue 39:17 153:16 continued 2:25 3:1 16:18 95:7 continues 131:6 contrast 98:9 control 23:23 25:22 29:24 30:10 30:16 31:2,20,23 32:8 35:21 37:8 37:20 90:14 99:11 99:18 100:10 101:17 107:21 110:21,22 112:14 126:15,24 129:11 150:22 151:19 168:3,11 186:14 186:21 187:2,8,24 203:10 controlance 79:19 controlled 25:18 44:4 controller 56:4 59:22 60:5,17 65:3,14,15 66:11 66:24 71:5 105:23 118:5 146:19 148:4,16 151:16 165:7 166:12	167:21,23 controlling 99:22 126:20 165:13 controls 29:12 conversation 73:24 127:7 coordinated 143:17 copies 113:7,8 114:13 115:13 coprocessor 143:2 143:6,25 144:3 145:5,16,19 146:2 146:6,7,17 copy 206:5 cores 141:5,17 corporation 1:5 5:10 correct 9:8 10:5 11:9 15:2 18:6 34:7 52:5 67:2 68:19 162:2 191:15 194:15 195:22 199:23 207:7 208:13 corrected 201:19 correction 203:18 correctly 10:23 11:7 63:6 73:1,4 correspond 173:12 corresponded 63:23 corresponding 17:24 166:1 178:9 correspondingly 53:22 cost 43:6 129:15 counsel 2:9 3:1 5:9 5:20 7:23 53:5 95:11 139:13	184:18,19 194:16 204:13 205:4 county 208:2 couple 7:11 37:6 50:8 76:1 107:11 119:5 159:11 171:24 course 49:7 94:7 court 2:4 5:15 6:8 94:8 195:7 cover 87:15 covering 34:11 cpu 143:17 146:8 148:4 crash 183:13 create 13:21 32:7 55:13 88:6 180:7 created 9:25 12:3 12:23 13:5 38:18 87:25 88:2 critical 17:9,11 19:6,9,10 23:21 24:13,17 25:10,13 25:15,20,25 26:6 26:11,21,21 27:3 40:5 41:1,12 42:3 58:11,15 70:15,18 70:20 71:2,4,6,10 71:12,16,17 72:6,9 72:11,14,19 73:3 74:11 75:14,20 81:22 82:16,18,21 84:11 85:4,18 93:4,11 114:13 116:8,18 119:22 120:16 130:22 167:25 182:21 183:12 criticality 71:22 cross 135:5	crossed 107:9 130:15 crosses 131:24 132:1 crystal 104:6 current 59:24 currently 39:14 55:18 176:15 curve 105:2 customer 93:18 customized 148:15 cycles 91:24 123:15,17 d d 4:1,17 damned 183:15,16 dangerous 92:1 data 23:11 73:1,2 86:25 87:2 88:7 91:2 date 103:13 141:18 142:8 143:11 189:17 dated 141:18 189:16 dates 92:14 day 72:3 86:4 138:14 139:1 163:22 204:2 207:8 208:21 dayna 1:25 2:6 5:16 208:4,25 days 38:7 103:10 109:14 142:1 dead 80:12 deadband 120:21 128:6,12,17,21 130:21 131:9 134:3 182:12 deadline 78:15,18 84:12 92:3,17
---	---	---	--

[deadline - determine]

93:6 177:15 180:19 deadlines 84:15 deal 40:6 78:20 88:16 91:5 164:4 dealing 85:12 dealt 75:6 dec.pdf 4:19 decide 27:21 56:13 59:25 60:19 89:23 108:13 127:11 130:23 134:19 136:16 166:20 decided 183:5 deciding 58:13 111:12 decision 61:17 87:20 90:23 125:5 125:22 129:12 148:7 168:4 189:16 decisions 98:18 105:19 111:5 112:5 150:8,12 decl 4:22 declaration 184:12 185:3 188:9,19 189:10 189:15 191:5 194:7,10,11 195:11,16,17,24 198:19 199:2 201:7 204:19 decrease 39:10 45:12,13 123:8 131:6 decreased 16:6 decreases 135:25 deemed 51:16 77:14 85:17	def 123:20 defendants 5:9 define 137:24 190:18 defined 42:1 61:13 111:11,11 125:13 154:7 155:6,9 156:3 defines 197:1 definitely 157:17 definition 122:23 123:1,21 124:5,7 124:13,24,25 126:4,7 127:15,20 128:4 129:25 131:12 136:8,21 137:15 142:4 198:10 200:20,21 definitions 100:1 degree 30:16,17 36:6 91:20 105:17 145:12 degrees 97:7 126:23 127:1,5,24 127:25 131:20 134:11 135:5,5 dehan 169:10,11 169:16 delay 11:1,2,8,11 11:15,16 39:3,6,19 73:25 74:6 76:10 124:13,17 125:5 127:19 130:25 131:2,3,7,11 132:8 132:9,13 133:19 133:21,21 134:10 136:2,4,14 137:5 148:25 163:21,24 179:11 180:21 191:2 197:5,5,8	delayed 115:24 116:2 135:3,6,7 183:13 delaying 41:2 delivery 154:8,15 155:7 156:23 demonstrates 11:25 198:21 199:8 dependence 103:25 104:1,3,6 dependent 23:12 depending 44:17 59:12 71:13 117:20 123:6 depends 27:5 35:12 38:1 41:25 57:18 75:2 77:18 82:12 89:25 102:5 105:1,1 109:18 126:14 129:12 147:21 165:1 179:13 deponent 4:2 deposed 7:9 deposition 1:17 2:1 5:8,13 7:15 8:14 9:3 45:23 70:6 88:14 94:23 122:12 148:20 149:9 159:2 162:16 184:9,14 189:11 206:12 208:7,10,16 describe 15:7 196:20 described 51:5 75:18 118:19 142:25 describes 13:4,5 86:11 158:7	describing 13:16 14:1 description 4:11 191:9,14,17,20 design 31:19 74:22 109:15 110:15,18 119:7 120:3,12,25 121:18 125:10 134:8 166:20 designed 26:8 86:23 90:11 113:21 114:14 133:10 179:14 designer 71:1 76:12 90:16 151:17 171:12 designing 29:22 71:5 107:7 112:14 desire 133:16 162:19 desired 38:12 48:20 123:13 125:3 136:5 177:10 desires 59:9 despite 132:2 detail 12:21 40:22 46:13 49:19 55:11 101:1 details 30:3 33:10 36:1 44:17 45:9 48:7 59:5,13 147:21 171:10 181:14 182:2 detect 106:9 determination 66:12 177:3 determine 63:14 66:8 67:15 69:1 81:3 126:17
--	--	---	---

[determined - edge]

determined 38:25 39:15 63:10 66:3 determining 154:4 162:21 detriment 182:10 detrimental 181:10,18 device 14:21 31:3 71:10 140:10 146:15,16 148:16 155:22 161:6,9 174:2,6 devoid 188:14,22 189:21 191:8,14 191:17,20 192:4 194:12 195:18 199:3,11,22 200:5 dial 29:11,20 44:20 162:24 dialed 63:25 dictionary 122:21 dictionary.pdf 4:14 die 115:19 difference 108:18 146:18 147:20 differences 38:20 different 38:20 41:23 46:6,11,12 68:19 71:7 74:4 75:15 76:16 81:10 81:11 82:5,6 84:12 97:8 103:19 108:6 110:19 115:23 117:12 119:6 125:18 135:13 148:5,13 161:6,12 164:9 168:3 169:13 differently 26:23 39:11 41:11 42:14	47:7 130:2 144:1 difficult 59:4 162:18 digital 105:23,24 134:15 147:8 directed 157:6,9 direction 109:10 112:7 125:21 126:11 208:13 disagree 74:7 85:10 100:19 110:16 140:9 disclose 39:12 41:15 55:8 97:20 99:7 156:7 166:6 193:12 disclosed 67:25 139:19 140:14,18 144:6 147:1 148:13 152:22 153:18 155:18 165:2 168:20 177:23 193:22 204:3 discloses 139:24 145:24 159:14,18 159:21 167:21 174:12 178:12 193:6 202:16 disclosing 121:2 154:24 161:10 disclosure 100:25 118:3 120:1 149:19 174:24 185:10 194:3,4 disclosures 143:10 discovery 105:9 discuss 21:9 23:3 35:19 66:17 176:19,20	discussed 9:19 56:21 58:10 77:12 83:2 112:21 144:9 150:19 153:4 166:21 186:15,22 187:8,24 189:2,8 190:17 202:14 discusses 145:24 discussing 20:4,16 35:7 36:5 136:22 discussion 12:18 50:20 70:14 96:11 104:21 126:22 161:19 dispute 136:20 disruptions 37:22 distracted 45:21 distribute 57:16 58:23 59:23 147:1 distributed 45:20 56:18 distributing 41:24 57:3 59:2,14 distribution 43:23 44:2 146:21 doctor 7:5 9:8 53:3 95:9 139:12 195:5 206:1 document 15:25 50:23 113:10 114:4 116:15 117:8 200:2 doing 7:7 14:6 30:1 31:16 49:24 86:1 87:13 111:12 114:21 121:1 138:16 146:22 159:23 167:24 168:2 179:10 198:7	dolphin 3:4 domain 182:19 dot 185:16,16,16 download 93:16 dr 184:8 189:15,20 198:19 drafted 203:19 drain 51:9 dramatically 41:13 71:6 draw 168:21 drawing 47:17 drive 3:4 driving 89:5 drop 102:10 103:1 111:15 130:22 dropped 16:15 dropping 120:16 drove 175:5 dsp 83:11 147:14 147:21,22 148:15 dsps 147:16,19 148:3 170:2,3 due 100:10 duly 6:21 208:7 dynamic 54:10 dynamically 144:11
e			
e 4:1,10 earlier 24:5,11 70:11 75:19 82:10 90:12 142:25 145:14 178:1 187:7 early 166:17 ease 54:19 62:11 easily 82:14 93:10 eat 94:1 edge 118:15 165:4 173:1			

[edges - exhibit]

edges 46:24 effect 117:18 118:23 123:5 124:12,21 130:1 131:14 133:12 198:9,10 effective 80:14 efficiency 58:7 either 62:24 63:23 71:23 85:19 90:22 94:4 100:1 121:13 130:10 146:6 153:15 183:9,11 185:20 205:25 electric 137:7 electrical 122:20 electronic 7:21 electronics 31:20 59:7 122:20 element 116:19,23 124:23 131:13 136:9 elements 65:20 71:1 74:14 83:1,4 83:4 101:1,14,14 144:9 197:1 elicited 70:4 149:1 ellis 2:11,17 6:2,4 emanuel 3:3 6:6 embodiment 43:24 57:4,17 58:23 59:3 62:4 65:12 66:23 68:10 68:14 69:20 146:24 embodiments 61:25 employs 49:10 enabled 15:14 ended 9:25 10:8 10:19,24 11:17	88:1 endemic 70:16 ends 10:11,13 11:7 115:12 engineer 11:10 72:20 engineering 29:22 119:7 120:3,11 122:21 engineers 26:10 85:13 ensure 74:11 75:19 81:21 201:4 enter 104:20 162:11 entered 103:12 161:25 entire 45:22 81:10 161:9 172:14 176:2 199:5 205:10 entitled 4:12 environment 25:15 26:4,15 83:7,8,14 91:14 100:3 103:9 environmets 99:24 envision 12:15 20:21 57:9,11,25 59:6 60:23 61:10 61:11 envisioned 45:7 66:19 147:7 170:1 envisioning 26:19 39:25 161:4 equal 91:15 92:15 93:3 errata 205:23 error 102:9	esq 2:11,12,17 3:3 essence 30:11 134:20 159:22 168:21 essentially 26:8 28:9 48:1,13 63:3 113:6 116:7 128:5 149:21 estimate 29:9 119:11 evaluate 59:24 evenly 56:18 57:3 57:15 58:22 59:2 59:14,23 63:13 event 11:12 208:20 events 87:7 everybody 203:3 evidence 185:10 196:6 ex 4:12,16,17,19 4:22 exact 117:2 119:15 119:19 121:6 173:17 exactly 12:24 18:19 50:1 57:20 63:12 81:16 121:3 121:9 141:16 145:21 165:16 167:10 examination 4:2 7:3 95:7 204:17 examined 6:22 208:6 example 16:23 21:10 27:11 29:10 39:13 40:23 51:13 71:19 72:16 75:4 76:9 79:18 82:13 83:20 86:24 88:16	88:18 90:7 91:17 92:20,21 96:15 98:25 100:22 102:7,14 104:20 123:10 125:1 126:2,21,23 127:22 128:20,22 129:22 130:7 134:12 137:2,17 137:23 138:8,10 138:11 141:6,16 142:17 143:6 144:11,23 145:23 146:1,23 158:18 160:23 161:9 166:15,18 170:13 178:25 179:13 180:12 examples 72:23 84:24 124:8 160:8 exceed 76:6 158:20 exceeding 157:9 exceeds 130:9 excellent 149:5 exceptions 45:15 excerpt 122:20 excuse 128:9 163:9 169:14 execute 39:17 executed 169:7,21 175:4,6 180:7 207:8 executing 174:4 execution 15:14 15:19 39:3 172:14 exhibit 4:11,12,12 4:13,13,15,15,17 4:17,18,18,20,20 4:22,22 8:1,4,24 8:25 9:3,8 95:16
--	--	--	--

[exhibit - fill]

122:10,12,16,17 122:19 123:21 148:19,20 149:7 159:1,2,6 161:15 184:9,12,14,17 185:3 186:5,7 188:10 189:9,11 189:14,17 190:2 196:23 204:20 exhibits 184:6 exist 43:15 189:4 existing 32:23 39:16 42:24 111:15 201:13 expands 163:11 expect 18:15,20 21:18,23 22:13,19 26:9,22 28:6 30:14 32:21 34:22 36:21 37:1 47:3 165:6,14 178:14 expected 16:17 expecting 87:22 89:13 experience 23:20 28:3 44:19 79:15 83:6 90:2 115:13 115:18 116:19 117:2 experienced 116:11 experiences 14:22 expert 4:19 110:24 expertise 42:3 expiration 92:14 expire 92:22 expiring 91:10 92:13 explained 9:19 explaining 9:17 18:9 29:6 32:3	explains 11:24 13:7 15:22 26:19 129:25 explanation 7:14 14:12 18:22 explicitly 153:17 188:25 extend 145:17 extendable 140:2 extendible 139:20 extent 38:22 85:7 87:11 extract 155:17 f facilities 80:9 fact 14:14 19:22 20:7 29:16 39:17 84:14 124:21 133:12 147:19 155:3 174:7 190:4 197:10,10 204:3 205:12 factor 38:4 factors 27:6,9 31:14 35:13 57:8 57:18 58:12 109:19 129:13 facts 12:13 16:10 17:1 21:7 48:3 56:19 63:1 64:11 75:1 76:19 98:3 98:20 109:13 120:9 153:2 fahrenheit 105:17 105:18 fail 49:9 72:1,5 86:8 91:15 118:18 119:1,2 121:20 122:2 failed 71:18 72:5 77:15 85:19	120:14 failing 73:23 114:24 120:7,23 fails 114:18 124:24 183:11 failure 71:23 76:7 76:11 120:15 fair 7:17,18 14:4 20:15 21:6 36:10 46:18 50:15 51:9 52:6,11,12 57:17 59:15,16 60:1,5 64:24 65:15 71:14 72:15 73:10 74:12 74:21 75:25 79:14 85:6 91:8 92:25 98:19 110:9 113:11 121:21 136:3 151:24 fairly 11:16 15:2 40:15 117:23 128:4 180:24 falling 120:22 familiar 7:16 9:7 fanatical 85:14 far 46:22 49:8 55:20 124:24 134:22 146:9 175:16 farther 92:18 120:11 145:9 faster 39:18 72:13 73:16 78:16 82:9 180:1,22 fatal 102:9 faulty 128:12 february 1:19 2:4 5:2,6 95:2 208:21 federal 208:16 feed 84:4 89:11	feel 27:7 31:11 101:9 152:10 194:7,9 195:12,14 feeling 55:4 fi 70:25 71:2 fight 138:13 figure 9:11,14,16 9:18 10:9,17,22 11:6,12,21,23,25 14:14,20 15:2,8,21 16:4,18,25 17:4,5 18:13 19:16 20:25 21:12,20 23:4,16 26:18 29:8 43:24 44:3 45:20 46:7 46:11 47:15,17 49:20 51:15 53:17 54:4,9,18 55:10,10 55:16 56:21,22 57:4,4,16,19 58:23 59:3,10,15 60:6 63:4,5 64:16 65:9 65:19,21,21,21 66:16,16 67:6,25 68:5 69:20,25 80:19 87:24 99:2 146:24 149:14,17 161:20,22 165:2 165:12 175:4 176:8 177:25 178:25 198:20 199:8 200:18,20 200:23 figuring 121:3 file 4:12,13,15,17 4:18,22 201:18 filed 5:10 filetitled 4:20 filing 203:18 fill 27:10 32:2 101:11
--	---	--	---

[final - furnace]

final 15:8,21 192:11 financially 5:18 find 124:1 196:3 196:13,24 197:14 200:18 finder 204:3 finding 196:5 fine 37:19 94:4 106:3,8 108:25 165:16 167:24 183:10 finer 106:2 finish 50:21 89:16 91:3,6 174:18 180:18 185:23 finished 20:2,9 finishes 177:2,11 finishing 92:23 finite 30:17 108:18 firm 5:14,16 92:6 first 6:21 19:12 33:11 47:20 54:20 112:21 124:8 132:17,21 149:13 151:9 162:15 163:10 179:5,22 180:1,18,20 183:12 201:6 202:2 203:5 fit 36:18 fits 55:14 142:3 five 50:4 206:10 fixed 13:24 72:19 75:7 170:4 176:9 flare 90:9 flexibility 25:1 flip 54:3 137:20 floor 3:4 79:4 flow 86:7	flower 2:18 fluctuations 120:8 flushed 45:9 focus 83:17 92:9 focused 17:8 147:13 200:22 focuses 17:11 focusing 19:12,16 147:11 175:21 follow 50:2 204:13 204:14 followed 36:7 following 25:5 83:17 84:21 97:14 172:2 195:9 follows 6:22 football 84:5 foregoing 207:6 208:7,15 foreign 49:25 forget 51:24 form 10:2 51:10 108:10 112:11 121:22 145:8 147:17 148:9 150:11 151:25 153:1 154:19 158:16 160:3 161:7 164:25 166:4 168:14 171:3,22 173:10 175:11 176:3 181:23 182:16 186:24 187:14 190:7 192:9 193:15 197:17 198:1 199:24 200:15 201:10 203:8 forth 108:5,7 120:7 198:8	forwards 204:1 found 9:17 121:17 196:24 199:15 200:23 four 91:5 194:17 fourth 7:10 fraction 174:13 francisco 2:14 frankly 76:20 94:4 157:25 177:4 free 41:6 93:14 frequencies 28:17 29:1 64:23 frequency 10:17 11:8 14:3,8 15:23 17:12,13,15,24 18:7 21:1,4,23 22:8,20 27:1,12 28:8,22 29:12,17 30:4,10,20 31:1,3 31:21 32:9,17 33:3,5 34:18 35:6 35:10 36:9,13,22 37:1,8 38:12,16,25 39:16,18,21 43:1 44:4,8,12,13,21 45:3,6,12,12,17 46:2,5,7,12,17 47:9,25 48:20 53:21,25 54:6,14 55:1,2,17 56:9 58:5,17 59:21 61:18 62:6,21,22 62:23 63:9,14,19 64:9,17 65:7,13 66:3,8,25 67:8,16 67:21 68:11,15,18 69:1,8 77:17,20 78:23 80:5 101:17 101:25 103:9,18 113:21 117:13	140:19 149:23 150:9 152:24 153:9,14,15,20 159:19 162:6,10 162:25 164:24 165:8 166:2,22,24 167:15,18 173:25 174:2,6 176:1,25 177:14 178:4,9,20 179:6,10,12,17,21 179:25 180:6,13 181:6,10,19 182:7 182:13,24 193:8 197:24 198:23 frequent 109:16 109:16 frequently 71:21 71:21,25 72:1 109:17 front 7:25 181:5 197:4 200:9 201:16 full 19:23 74:21 112:21 151:9 fulsome 187:17 function 38:11 99:22 179:10 functionality 148:5 functions 24:22 fundamental 38:3 162:17 170:12 fundamentally 31:19 43:12 48:19 78:13 107:8 148:13 169:13 furnace 109:11 125:20 126:25 129:9,14 130:15 130:23 131:25 133:9 134:15
--	--	---	---

[further - ground]

further 95:23 96:7 98:5,23 99:4 100:15 154:4 205:17,24 208:19 furthermore 23:7 132:4 fuse 156:18,25 158:19,23 future 92:18	gigantic 172:10 give 6:14 8:17,21 25:1 27:17 29:24 29:25 32:5 78:7 83:20 114:16 116:14 119:16,24 122:6 158:25 190:1 200:1 given 12:12 18:11 33:2 60:24 104:4 113:21 180:9 189:1 192:15 199:7 206:9 gives 28:4 go 11:19,19 14:14 16:18,19 18:16 19:23 20:24 23:25 27:16 29:9,13 39:10 44:16 51:19 58:12 59:18 61:24 70:10 88:8 89:11 93:25 101:1 104:22 108:11 115:9 118:17 120:10 121:17,24 123:25 130:13 131:4 132:7 135:14 138:25 139:16 140:4 145:9 147:3 149:15 151:9 152:17 154:2 158:11 159:11,12 160:12 170:8 182:2 183:23,24 185:22 186:5,7 189:10 195:2 205:19 goal 48:14 82:25 112:1 115:1	goals 180:9 goes 15:7 17:16,16 58:8 105:2,3 117:15 129:18,18 132:2 134:11 135:20 153:4,6 going 5:5 9:17 13:1,24 15:3 19:18 21:1 24:8 24:17,23 25:1 27:20 28:11 33:14 33:18,21 37:17 39:14 40:13 46:13 52:22 62:24 64:9 74:5 75:10 77:8 77:17 81:16 82:2 82:3,20 86:1 87:20 88:5 89:14 89:15,15 90:17,24 91:5,9,21,24 93:24 94:20 101:10 105:14,16,19 106:10,18 108:14 110:15 111:4,7,8 111:16,17 112:4,8 114:8 115:20 117:2,4,17,18 118:18 119:18 122:1,5,10,22 130:8,10,13,16 132:19 134:5,10 138:19,23,24,25 139:4,10,16 148:3 149:14 153:15,16 153:23 164:23 165:16,25 166:22 166:24 167:15,16 172:18,21 173:22 176:1,9 177:19 179:5,8,9,11 182:13 183:25	185:25 188:9 189:4 190:23,24 205:22 good 5:4 6:1 7:5,5 26:1,1 78:9,25 94:18 95:13 112:3 121:18 128:4,22 138:11,15 144:23 155:3 157:3 206:2 gotcha 31:9 41:18 41:18 72:7 146:4 169:14 183:18 gotten 174:7 grabbing 159:5 grand 71:4 granted 144:22 granular 37:7 117:20 175:9 177:21 granularity 27:11 28:2,4 30:9,13 32:14 36:6 97:8 105:13,25 108:17 108:21 109:22 111:6,8,10 175:7 177:19 graphic 142:1 143:18 graphics 141:22 142:8,13 143:7,12 143:19 146:6 161:1 great 8:23 49:19 70:1 159:10 greater 67:13 91:20 145:11 ground 38:5 61:25 62:4,10 63:3 65:12,20 66:23 68:10,14 69:20,24 87:16
--	---	---	--

[group - hysteresis]

group 62:13 68:1 grouped 62:5 67:20 guarantee 82:24 86:6,7 guaranteed 70:21 guarantees 132:5 guess 37:15 38:8 41:7 43:6 57:18 70:15 74:22 77:18 97:18 102:18 103:22 104:5 108:8,12 113:11 118:2 120:10 124:22 126:1 133:6,23 142:17 157:24 181:2,2 guiding 174:2 guys 94:13,14	happened 135:8 happening 87:6 135:11 happens 18:17 25:17 44:10 75:4 79:19 81:12,13 87:3,4 132:22 178:1 happy 56:24 hard 55:7 92:3 163:14 hardcore 87:17 harder 167:22 hardware 37:9 90:10,15 111:11 113:20 151:18 170:4 head 70:3 83:24 99:25 headings 9:23,23 headroom 27:21 27:24 28:15 55:19 56:9 59:20 119:9 hear 135:14,14 137:4 hearing 70:2 181:3 heat 127:24,25 heaviest 22:3,19 173:15 174:1 heavily 21:22 22:9 27:14 40:25 46:25 63:11 64:17,19,19 65:5,24 67:7 69:7 69:14,16 165:25 171:25 172:7 173:7,12,13 174:8 174:16 heavilyest 40:24 heavy 61:5 64:8 164:1	help 81:21 83:25 93:8 126:22 184:21 helps 12:18,18 185:4 hereto 9:4 122:13 148:21 159:3 184:10,15 189:12 hester 1:25 2:6 5:16 206:4 208:4 208:25 heterogeneous 66:15 high 23:11 36:16 45:15 46:5 80:10 80:11 111:3 132:10 134:15 higher 16:21 23:14 45:17,17 73:16,18 85:1 180:22 highest 10:18 46:24 47:1 54:13 66:7 80:20 178:7 highly 67:14 68:25 hindsight 43:17 hit 82:24 136:2,3 141:17 hitting 132:10,12 132:13 136:5 hold 15:9 32:6 41:5 77:6 holding 45:23 home 154:22 honest 97:19 155:13 honestly 23:15 hopefully 30:12 46:21 70:7 84:19 hot 102:18	hour 93:25 94:14 94:22 138:23 household 109:7 huge 41:9 49:1 163:25 197:6 huh 88:23 97:24 106:13 109:5 114:20 118:20 125:15 156:2 159:24 161:4 164:3 182:4 196:22 197:15 202:17 human 134:4 hundredth 105:17 hybrid 85:23 86:12 92:5 hypothetical 22:22 27:6 32:3 32:20 33:8,24 34:23 36:6,12 39:23 43:5 53:17 55:6,14,22 56:11 56:12 58:10 59:6 59:19 60:3,5,21,24 61:19 63:20 65:18 74:13 92:16 97:12 112:15 128:10,14 130:7 150:21 167:2,4 174:10 182:18,23 183:8 hypothetically 28:18 29:18 39:16 44:18 54:11 hysteresis 122:23 123:2,2,12,14,21 124:14,16,19,24 125:3,7,11,12,23 126:3,4,13,18 127:19 128:2,4,17 128:23 129:1
h			
h 2:11 4:10,16 159:8 ha 93:19 half 40:10,10 80:7 80:12,14 94:13 177:12 halfway 174:17,22 175:24 176:16 177:6,12 hand 6:11 21:19 110:7 208:21 handle 23:19 43:12 89:18 162:12 handling 146:21 happen 16:23 42:21 55:23 61:12 87:3,7 90:21 93:6 93:17,20 102:21 109:24 130:14 134:20 165:9			

[hysteresis - inherently]

131:13 133:13 134:14 136:8,23 137:1,6,16,25 138:7,10,12 148:25 168:17 188:15,22 189:1,8 189:22 190:11,11 190:13,15,17,19 191:9,15,18,20 192:5,21,23 193:9 193:13,19,20,20 193:22,24 194:13 195:19 196:4,12 196:15,20,21,23 197:1,7,9,12,12,15 197:20,21,24 198:9,10,21 199:4 199:9,12,14,23 200:6,14,17,18	98:7 104:16 106:1 109:3 115:17 147:18 171:13 immediate 109:8 immediately 72:13 168:5,11 impact 8:20 90:24 106:11 112:5 137:9 152:24 181:6 impacted 137:16 impacts 43:2 implement 51:4 140:10 145:15 170:25 181:4,4,21 182:11 implementation 59:6,12 60:6 73:14 74:24 128:16 145:19 166:25 implementations 41:23 implemented 50:11 140:11 144:2 145:4 150:21 168:4 implementing 58:22 76:14,17 120:4 146:16 158:5 166:19 181:17 implements 38:10 149:17 157:25 impliedly 192:2 important 38:6 40:2 42:19 72:9 74:3,10 78:15 129:12 167:17 inaccurate 190:6 199:21 203:1	inappropriate 194:22 195:1 inclined 40:17 41:3 51:16 52:14 68:21 177:13 include 187:7 included 173:5 includes 200:13 incomplete 22:21 33:7 55:5 60:2 97:11 167:1 174:9 incorporate 168:20 incorrect 10:1 increase 13:22 21:1,4,5,24 22:20 26:25 27:12,25 34:18 35:2 36:22 37:1,20 39:15 40:8,14 44:11,12 45:5,5,11,11 58:16 78:23 111:15 123:8 164:23 165:21,23 166:22 178:13,20,21 179:7,8,12,21 180:13 181:10,19 increased 12:4,8 13:6,11 16:5 21:18 39:7 44:9,9 44:14,14 45:6 64:23 increases 12:16 13:17,20 40:9 41:13 43:7 58:8 104:23 166:3 increasing 12:1 13:19 14:2 35:9 37:23 61:18 incredibly 110:22 110:23 162:18	increment 109:2 incremental 127:8 132:9 increments 29:25 43:1 independent 54:10 143:25 144:3 145:18 independently 44:3,4 160:17 165:13 indicate 10:12 15:6 16:7 24:7,12 25:9,13 67:20 indicated 85:2 95:21 96:9 indicates 11:7 16:12 indication 26:2 132:18 185:16 indicia 136:23 individual 46:15 160:6 induced 123:4 124:11,21 130:1 131:14 infer 98:8 infinite 35:21 influence 8:20 181:8 influenced 61:18 information 36:20 69:23 98:12 108:23 infringement 198:5,6 inherent 76:3,16 82:1 inherently 192:15 192:23 202:15
i			
idea 28:22 29:5 37:4 60:8 64:13 71:9 105:21 115:2 140:12 158:5,12 159:24 ideal 30:8 idealized 15:3 30:8,22 ideally 30:18 identification 9:4 122:13 148:21 159:3 184:10,15 189:12 identified 21:11 34:4 104:17 identify 114:22 ignore 89:15 90:11 196:7 ignoring 110:7 imagine 55:25 66:18 77:1 83:25			

[initial - know]

initial 16:3 injection 43:7 input 98:18 111:4 123:7 134:9 135:1 190:20 inserted 141:23 inserting 153:20 inside 36:20 155:22 158:23 170:10 insinuate 34:5 instance 23:13 34:16 74:18 76:17 91:2 123:5 141:22 175:14 182:5 instances 98:10 instantaneous 111:22 133:4,16 136:17 168:6,12 instantaneously 131:11 134:20 instruction 169:20 170:6,10,15 171:1 171:9,11,21 172:6 172:13,17 173:6,9 173:16 instructions 169:3 169:7,12,18,19,21 170:8 171:2,19,20 172:4,6,10,17 173:5,9 instrument 123:6 intel 1:5 5:9 6:3 7:10 141:6,17 186:19 189:18 intel's 4:20 184:17 186:11 189:15 intend 8:5 44:11 180:10 intended 26:3 61:14 155:16	intending 15:5 169:17 intent 47:15 interconnected 142:20 interest 111:23 147:3 interested 5:18 84:5 208:19 interesting 31:25 106:11 interface 142:14 intermediate 179:17 internal 185:11 186:16,20,22 187:3,25 205:1 interpret 150:7 interpretation 148:6 156:23 193:11 interprets 51:4 interrelated 81:11 interrupt 88:22,24 89:12,16,18 90:8 90:10,11,17,20 91:4 interrupted 105:8 interruption 45:25 interrupts 88:17 88:24 interval 123:17 introduce 23:23 37:13,17 70:7 148:18 179:9,11 188:10 introduced 16:20 61:23 64:14 184:5 introduces 125:5 introducing 14:25 22:25 37:16,16	67:23 129:24 130:3 introductory 7:20 invent 144:10 invented 145:25 invention 48:23 103:13 141:12,19 143:2 144:14 148:12 160:5 171:7 inventor 87:12 inverse 30:22 involve 69:3 ipr2020-00539 1:6 5:12 ipr2020-00541 1:8 irritates 129:17 isolated 83:7 isolation 65:19 143:19 issue 70:8 78:11 132:22 135:16 143:21 163:14 169:10 189:1 196:7 204:2 issues 31:17 38:1 40:21 104:18 115:22 132:15 180:2	114:23 118:24 136:17 138:18 180:1 keeps 179:5 keigo 3:8 5:14 key 24:25 203:22 kick 132:5 134:5 136:1 kicking 132:2 kicks 109:11,11 134:7 kind 7:22 23:19 71:16 74:25 76:15 87:23 109:9 111:14 128:16 129:3 136:22 144:21 156:24 181:1 182:4 190:18 kirkland 2:11,17 6:2,4 kirkland.com 2:15 2:15,20 klings 4:16 149:2,8 149:10,13,17 150:16 151:1,22 152:18 153:3 157:5,14,20 158:1 158:5,6,13 159:14 159:16 knew 52:17 102:25 know 12:20 16:11 16:14,21 18:23 19:2,16,17 20:17 20:22 23:2,9,13,15 23:17,25 24:7,14 24:15,23 26:13 27:2,15,23,24 28:1 28:7,13,19 29:5,23 30:2,12,15 31:11
		j	
		jargon 70:7 job 1:24 18:9 86:21 147:1 jump 8:23 45:22 jumping 172:1	
		k	
		kai 3:3 keep 13:1 48:1 56:17 58:13 70:2 94:12 107:2	

[know - little]

31:23 32:15 34:17 35:7,17,25 36:15 36:16 37:5 38:2,6 38:10,21 39:10 40:1 41:8,14 42:24 43:9,16,18 45:9,16 46:23 48:22,24 49:25 50:17 55:15 57:14 57:19 58:13,16 59:12 60:11,13 62:1,2 66:9 67:12 69:13 72:24 73:7 73:17,20 75:8,11 75:17 76:8 77:2,3 77:8,25 78:4,10 79:8,18 80:19 81:8,10,13,16 84:4 85:2,9,18,24 86:1 86:2,25 87:1,2,5,6 87:6,19,21 88:5 89:10,12 90:2,17 90:19 91:3,4 92:6 93:13,17 96:14 99:5,13,18 101:13 103:14 107:19 108:16 109:1,8 110:12,16 113:12 113:20 115:3 116:1,16 118:4,9 119:11,13,17,25 121:3,4,5,7,13,16 122:3,10 126:17 127:13 130:4,16 132:6,20 133:7,9 134:22 137:9 138:22 140:21 143:15,16 147:12 149:16 154:21,21 155:5 156:11 157:25 158:2,18	160:23 163:14 166:13,21 167:6 168:19 170:7,13 175:23 177:25 180:17 181:3,5 182:1,6,14,22,25 183:1,15 185:15 188:21 196:15,18 197:15,23 198:12 199:14 201:12,22 202:24 203:9,14 203:23 204:2 knowing 35:5,6 59:4 121:9 knowledge 42:5 42:24 56:6 103:4 103:12 107:21 known 17:10 19:7 19:8 20:21 23:6,8 43:11 75:6 76:23 77:6,7,16,23 79:3 79:5,6,12,23 80:7 81:5,20 90:4,5 96:19 99:23 101:18,20 104:19 140:15 158:14 160:7 163:11 170:11 knows 83:13 194:3 koruda 115:5,9 kyle 2:12 6:5 kyle.calhoun 2:15 I labeled 10:23 11:7 lack 24:5,11 25:8 25:11 lag 11:8 123:4 124:11,13,16,20 129:25 130:3,11 132:16,17 133:5,7 133:10,10 134:1,2	134:6,21,22 135:1 135:18,22 136:9 136:21,22,25 137:2,4 138:13 landing 26:6 72:18 language 133:25 196:16 laptop 144:16,19 144:21,24 158:19 161:9,11 large 11:16 17:23 36:6 46:4 64:4 108:20 123:16 138:12 168:17 170:7 178:10 largely 49:25 69:11 81:8 104:5 147:1,13 165:3 195:23 198:5 larger 66:4 67:1 largest 173:16 laughter 70:4 149:1 laws 207:5 leads 17:17 leap 185:9 learned 201:8 leave 166:24 leaves 127:25 left 54:21 160:13 177:1 legal 85:8 lesser 58:14 91:20 lessor 145:11 letting 195:2 level 82:20 97:8 105:13 107:19 111:3,6,8 138:9 164:5 175:7 177:19	leveled 12:17 light 27:2 62:18,25 64:3,4,8 105:12 163:23 201:7 likewise 63:16 limit 120:16 149:18,18,22 150:13,19,20 151:3,8 155:16 158:6,13,21 limitation 35:6 limitations 33:3 37:9 38:3 111:11 181:9 limited 108:21 limits 17:10 24:20 line 11:20,23 13:7 14:16 19:21 49:4 95:16,16,19 99:2 114:3 115:6 119:19 121:9 130:22 139:17 140:4 151:14 152:12 156:11 159:12 161:20 linear 172:3,4,10 linearly 176:25 lines 151:12 204:7 list 161:25 162:11 literally 126:3 187:19 191:23,24 little 7:12 9:18 11:4 14:15 15:4 17:21 21:9 24:24 29:17 37:3 38:7 39:2,6 43:22 54:17 55:19 78:12 78:21 87:23 102:17 119:9,10 119:12,16 120:10 122:6 123:13
---	---	---	---

[little - maxed]

125:16 129:15 130:9 140:4 149:13 157:15 158:9 161:16 163:14,22 165:7 168:24 169:9 170:18 184:7,19 191:2 195:3 live 117:23 llp 2:11,17 3:3 load 12:3,9,15,16 13:5,11,18,20,22 13:23 15:23 16:20 22:4 27:2 38:23 39:6,20 46:14,16 47:2,5,8 51:7 52:9 53:13 54:12 56:17 59:10,24,25 60:13 60:18,18,19 61:22 62:18,20,25 63:17 64:2,3,4,8,9,10,24 65:2,15 66:4,4,25 67:1,5,12,12 68:16 68:18 69:9,16 77:24 80:4,14,18 80:21,25 81:3 82:2,4 161:24 162:23 163:5,23 164:1,5,6,13,15 165:15,17 166:10 167:24 168:12 171:18 172:12,18 172:22 173:15,25 174:7 175:8 176:9 176:13,20 177:1,5 177:7,9,12,15,20 loaded 21:23 22:10,19 27:14 40:25 42:19 47:1 61:19 63:11,13 64:17,20 65:5,25	66:7 67:7,15 68:25 69:7,14,16 162:22 165:25 171:25 172:7 173:7,12 174:1,8 174:16 175:25 178:8 loads 66:10 local 49:7 117:10 lock 71:5 logic 109:7 185:9 logical 74:24 logically 172:2 long 24:7,23 83:22 89:21 119:11 134:23 163:21,24 longer 71:24 73:21 85:5 91:7 92:14 look 10:8 31:4,6,7 34:24 35:25 45:19 47:17 49:1 76:2 78:13 86:24 93:19 99:8 121:17 122:3 135:19 148:2,12 154:2 179:16 183:21 189:5,10 200:18 202:12 looked 115:4 186:2 looking 8:8,10,10 10:22 26:17,24 30:24 35:5 48:23 113:24 117:22 168:10 170:25 171:8 175:3 181:4 186:11 189:4 190:12 192:16,20 192:20,21 looming 92:17 los 2:19 208:2	lot 18:21 23:12 35:12 44:19 70:11 75:3,4 84:20 88:4 89:25 97:21 129:3 129:12,20 182:7 lots 38:1 love 138:21 low 23:11 30:4 36:15,17 46:18 47:25 50:14 51:8 51:20 52:10 53:13 53:19,19,22 62:20 63:18 132:10 136:3 159:25 160:6,9 172:12 lower 42:19 46:25 47:2,3 52:3 80:15 83:22 85:4 131:8 150:15,19,25 151:23 152:4,13 152:19,23 153:6 lowering 15:23 lowest 47:4,9 62:21 63:24 102:11 119:15 lunch 94:1,2,12,14 luncheon 94:22 m machine 72:18 144:25 madam 94:8 main 87:12 143:3 147:19 maintain 123:12 125:3 major 31:17 making 37:12 80:8 88:3 97:3 104:10 106:18 108:15 109:16 112:9 119:14,22 129:1	183:10 196:2 201:4 manage 176:10 management 157:15,18 160:15 mangione 1:18 2:2 4:3 5:8 6:20 184:8 206:10,13 207:4 207:14 manner 93:18 123:10 manufacturing 97:17 margin 36:24,25 47:13 119:10,24 120:5,22 129:2 margins 29:16 119:20 121:8 mark 3:3 6:6 22:14 132:10,10 205:20 marked 8:24 9:3 11:16 122:12 148:20 149:6 159:2 184:9,14 189:9,11 market 141:17 marktung 3:6 married 44:17 45:3 mars 26:7 72:18 matches 195:24 matter 5:9 17:23 35:22 111:7,9 168:19 178:9 198:4 202:22 matters 7:10 78:19 max 178:14 maxed 172:13
--	---	--	--

[maximum - moment]

maximum 54:6,25 55:2,17,19 59:21 61:6 79:6,12 111:15 112:9 150:5 155:21 156:14 157:2 178:13 mean 12:8,20,24 25:16 34:3 36:4 38:19 44:10 49:18 49:20 50:1 71:11 71:16,20 74:23 75:2 76:1 87:11 88:2 93:13 98:21 101:12 105:16,22 106:7 108:21 109:23 110:12 112:4 116:6 117:1 117:19 118:2,11 118:14 127:17,19 128:19 131:18 133:7 136:13,15 137:14 138:25 140:24 141:7 153:8 155:19 164:9 180:24 183:6 187:18 191:22 196:19 197:19,21 200:3 202:12 203:23 meaning 174:4 meaningful 40:8 70:8 77:4 107:22 110:8 142:20 143:11 148:14 153:9 197:8 means 15:17 71:16 83:9 100:5 110:13 138:14 151:7 164:5 180:22 192:22 197:23	meant 143:13 measurable 166:12 measure 160:25 161:12 163:5 172:18,22 177:20 measured 98:17 104:14 108:19 measurement 125:6 164:19 166:8,9 measurements 98:8 105:24 measuring 161:6 media 5:7 206:10 medication 8:19 meet 21:24 34:14 38:24 78:15,18 81:16 82:4 92:16 120:17 126:3 200:21 megahertz 13:10 13:12,17,17 14:3,3 15:24 16:5 29:9 29:10,13,19,25 30:14 32:5,8,9,12 32:15,25 33:14,18 34:2,11,13 77:12 78:5 99:3 175:6 178:19 179:1 182:24,25 memorized 196:17 memory 160:24 199:13 mentioned 24:4,10 70:13,13 143:8 177:24 mentions 96:2 merge 91:19 message 92:19	messages 74:3 met 48:13 74:12 77:14 method 154:1 mic 184:19 micro 12:10 middle 10:9,17 46:23 54:21 61:25 62:4,10 63:3 65:12,20 66:23 68:10,14 69:20,24 151:12 mikosz 2:17 6:5 milliseconds 73:21 73:22 74:20 75:9 75:11 77:9 85:15 87:3,4 88:20,22 mind 8:10 30:25 39:24 41:22 42:9 70:19,20 121:5 137:14 147:4 164:4 169:11 minimal 43:8 minimize 40:18 52:10 53:14 minimizing 145:6 145:10 157:6 minimum 111:14 112:9 165:23 minor 40:15 43:1 120:8 minute 97:6 111:25 166:2,7 183:20 minutes 50:4 78:6 78:7,9 85:16 97:1 127:7 194:18 mischaracterizes 69:10 129:5 137:18	misleading 152:11 missed 8:9 114:5 missing 80:23 mission 17:9 19:6 19:9,10 23:21 24:13,17 25:10,13 25:15,19,25 26:5 26:11,21,21 27:3 41:1,12 42:3 58:11,15 61:13 70:15,18,20 71:2,6 71:10,12,16,24 72:6,9,11,14,19 73:3 74:11 75:13 75:20 81:22 82:16 82:17,21 84:11 85:4,18 93:4,11 182:21 183:12 mistake 34:4 203:2,3,6 misunderstood 57:23 172:23 mix 23:15 77:3 mixed 43:13 101:3 170:18 mobile 144:20,22 145:4,7 mode 13:25 67:6 67:24 68:4 77:24 159:20 160:1 model 176:13 modem 70:25 83:11 modern 75:14 84:2 modifiable 151:17 152:14 module 138:25 moment 22:24 27:7 47:19 50:22 116:14 188:10
--	--	--	---

[moment - noon]

194:23 200:1 monitoring 157:19 months 105:10 morning 5:4 6:1 7:5 mouth 184:20 move 93:24 173:2 184:18 194:20 moving 91:7 126:22 136:4 multi 16:8 multiple 65:8 96:22 101:16 141:2,5,9,14,16,17 141:21 160:9,17 160:21 161:5,5,11 175:15 197:1 multiply 93:21 multiprocess 159:25 multiprocessor 12:4,10,12 13:6 139:20 157:21 muted 53:7	170:12 necessary 40:10 necessitate 40:7 need 17:10 21:9 27:10 29:16 32:17 33:10,12,21 36:9 39:15 42:6 45:9 72:12,14 73:3,6 77:23,24 78:5,5,6 78:7 79:19,20 80:10,13 82:9 86:19,25 88:19,19 94:14 103:8,16,19 106:15,17 110:14 117:1 118:22,24 126:17 130:23 149:15 179:12,21 182:6,14 183:2 203:7 needed 17:14,19 49:12,17 50:13 163:19 needing 42:18 needs 17:20 27:16 28:11,12 29:9 33:17 34:12 55:2 64:19 65:4 75:9 77:12,14 91:23 93:20 163:15 negative 43:2 neither 63:16 network 142:18 142:19 never 8:10 17:16 30:14 61:12 67:11 120:14 130:9,9,10 132:22 135:7,11 166:8 191:25 new 9:24,25 12:2 12:11 13:5 15:14 17:19,23 18:6	21:2 27:1 28:21 32:22,24 33:25 34:12,18 35:9 36:10 38:14,23 39:14,20 55:2 56:3,4,8 58:18 61:1,3 67:23 93:24 105:9 148:18 167:16 178:3,8 179:4,6 182:7 183:2,4,9,11 184:6 188:10 newly 61:23 nicol 4:12 9:11 10:11,16 11:20,23 13:4 17:8,11,22 18:6,9,22,23 19:1 19:11,24 20:14 21:9,20 23:2 26:18,25 28:24 29:5,8,23 30:2,8 30:25 31:15 32:17 33:4 35:5,19 38:9 38:10 39:3 40:13 40:20 41:15,22 42:5,17 44:18 45:8 46:13 48:6 48:23 49:3,6,16 51:6,13 52:8 53:17 55:8,23 56:16 58:10,22 59:8 60:6 62:2,3 66:17 76:14,21 77:20 78:12,13 79:25 80:4,16 81:21 85:23 86:11 87:11 95:14,19 96:2,13,20 97:2,2 100:9,13 112:18 113:6 116:12 121:1 139:16,24	140:1,10 142:24 143:10 144:2 145:3,15,16,24 146:3,3,19 147:8 161:16,17 163:9 164:4 166:1,6,19 167:7,8,13,20 168:10,20,21 169:1 170:25 171:8 172:9,11 174:5,11,18,22 175:7,25 176:5,15 177:19 178:11 179:10 180:2,10 181:5,13,17,24 182:19 185:10 186:15,20,22 187:3,8,25 188:14 188:22 189:3,8,21 191:20,24 192:4 192:12,21 193:6 193:12 194:12 195:18 196:4,23 199:3,11,22 200:5 200:13 205:1 nicol's 14:21 48:14 79:25 145:3 169:15,18 176:24 198:20 199:8 nicole 8:25 noise 14:8,15,21 15:1,4 37:13,17,18 37:21,24 43:7 nominal 98:25 non 25:12 27:3 41:12,12 137:16 185:10 nonreal 101:4 noon 93:25 94:17 138:17
n			
n 4:1 name 5:14 named 208:7,11 narrative 89:21 narrow 137:15,24 naturally 21:15 51:15 174:17 177:13 near 40:21 60:14 nearly 99:7 necessarily 31:7 35:1,9 42:18 43:6 48:4 92:7 107:1 115:18 126:14 135:2 144:10 153:19 155:5			

[normal - older]

normal 114:19 note 159:6 noted 191:7 notes 8:12 183:21 notice 74:5 noticing 5:25 noting 115:12 117:3 notion 49:24 75:8 77:22 78:20 80:3 82:1 87:24 99:21 110:22 115:22 118:20 119:21 130:15 133:17,18 141:16 160:4 168:17 170:10 176:12 177:5 novel 160:1 number 5:12 9:2 12:21 16:7 18:11 37:12 46:2,4 48:5 48:18 53:19 54:19 68:12 77:9 87:12 99:14 103:5 104:18 128:13 164:9 171:18 172:16 173:5 179:14 180:25 197:6 206:10	182:16 186:24 187:14 190:7 192:9 193:15 197:17 200:15 201:10 203:8 objecting 198:1 199:24 objection 9:15 10:2,20 12:13 14:10 16:10 17:1 21:7 22:11,17,21 27:4 33:7 34:21 35:11 36:11 40:19 43:4 48:3,16 50:16 51:10 54:7 55:5,24 56:10,19 57:6 60:2,22 61:9 63:1 64:11,25 65:16 67:3 68:20 69:10 75:1 76:19 82:11 85:7 93:1 96:17 97:11 98:3 98:20 99:20 100:12 102:4 103:21 106:20 107:17 108:9 109:13 112:11 118:1 120:9 123:24 125:8,24 128:18 129:5 137:18 142:16 143:4 145:8 147:17 150:11,17 155:11 156:5 157:23 162:14 163:7 164:25 167:19 169:22 170:17 171:3,22 174:9 188:2 194:22 195:3	objections 5:23 objective 32:16 objectives 102:6 observation 110:18 148:24 observations 110:12 observed 123:5 124:12,21 130:1 131:14 obvious 35:17 43:19 99:9 obviously 28:3 occupancy 173:16 occur 61:8 178:22 occurring 136:23 137:1 occurs 69:19 137:22 odd 85:10 offered 126:4 127:15 office 1:1 5:11 201:5,17 202:24 203:11 offloaded 75:5 oftentimes 88:25 141:7 171:25 oh 29:18 73:14 74:23 93:14 113:17 114:5 158:9 163:25 205:19 okay 6:8,10 7:25 8:7,12,23 9:10 10:8 11:4,19,23 12:7 13:1,15 14:1 16:22 18:3 28:20 29:13 30:15 32:9 32:13 33:1 37:22 39:22 43:22 45:1	52:18,20 53:10 55:13,22 57:13 58:20 59:11 61:16 61:24 62:4,8,11,17 64:5 68:7 70:1,10 75:17 79:1 83:16 87:19 90:18 92:8 93:23 94:11 95:13 99:16 100:7 101:19 105:6 112:17 113:2 114:5,11 115:3,11 121:17 122:8,15 123:20 125:1 126:6 128:25 129:23 131:23 134:9 135:12 138:2,14 139:16 139:24 142:9,23 144:19 145:2 146:4 148:2,18 151:22 152:17 153:21 158:8,12 158:25 160:12 161:15 163:3 164:12,17,19,21 168:24 170:20,22 173:22 180:5 182:6,9 183:18,18 184:23 185:2,6,15 186:10 187:12 188:8 189:9 190:1 190:22 191:1,4,19 193:3 196:10 198:9 199:16,19 200:12 201:2 204:9 205:16,24 206:7 old 144:24 older 38:7 141:23
o			
oath 194:10,15 195:15,21,25 object 84:3 108:9 121:22,22 123:22 123:24 148:9 151:25 153:1 154:19 158:16 160:3 161:7 166:4 167:1 168:14 173:10 175:11 176:3 181:23			

[once - patent]

once 15:18,18,22 88:8 136:15 ones 47:2 71:25 72:2 80:21 89:4,5 ooo 206:15 open 8:1,5 159:9 opened 8:4 opening 87:15 operate 39:10 41:11 46:11 47:3 63:4,5,7 65:22,23 69:24 82:3 114:18 operated 99:1 operates 113:6 114:19 operating 12:22 13:9,9 47:1 49:10 49:23,24 63:21 64:15 65:9 67:6 67:24 68:4 69:15 70:16 73:11 74:14 79:25 81:2,5 82:6 84:25 88:16 89:23 91:17 92:6,11 95:21 96:6 98:22 99:3 100:8,14 101:5,7,7 117:13 146:20,25 148:17 161:23 162:1,5,10 operation 15:4 68:12 operations 46:2,4 opinion 10:4 94:5 99:8 185:8 191:16 192:13 193:5 205:13 opinions 201:15 opportunity 119:8 opposed 22:25 134:15 176:10	opposite 173:17 ops 153:20 optimize 77:25 104:12 164:8 option 60:4 options 42:6,7,10 oranges 173:20 order 32:16 36:1 43:2 53:14 54:1 54:20 69:4 74:11 159:15,19 170:8 201:4,7 orders 206:5 ordinary 10:15,22 26:24 29:4 34:16 35:4 40:12,17 41:21 42:1,8,11,23 43:11,19 50:12 51:4,6 52:7 56:5 56:13 57:13 59:13 60:24 96:14 97:5 97:9 99:8,17 101:21,23 102:25 121:15,25 146:11 148:1,7,11 158:14 160:2 166:19 167:12 168:9 170:25 171:7 181:3,16 182:5 192:19 original 20:25 178:22 205:5 208:16 ostensibly 175:24 outcome 5:19 outlet 154:9,16,18 154:22 155:10 156:16,24,25 outlet's 156:18 output 123:6 126:20 127:11	135:6,7 190:20 outside 107:20 171:11 overall 16:20 58:6 58:17 overbroad 165:17 overestimate 119:12 overheating 103:2 overly 157:11 oversubscribed 87:9 owner 1:9 3:2	82:19,23 90:23 100:10 106:25 111:22 112:12 113:7,23 114:7 127:14 128:3,5,25 128:25 129:6 138:7 145:23 149:19 150:13 152:24 163:17 171:10,18 174:7 185:17 201:13 205:6,12 participants 94:5 particular 18:14 20:8 28:14 43:10 54:12 60:6 103:23 107:9 113:23 120:12 124:2 154:22 156:2 167:22 174:13 175:13 183:6 197:13 203:21 particularly 23:4 23:16 49:22 88:25 104:17 143:10 194:22 203:25 parts 97:21 161:12 party 5:17 pass 112:8 passage 159:21 187:1,19 189:6 passed 137:10 passes 135:25 136:1 passing 120:7 patent 1:1,3,7,9,9 3:2 4:21 5:11 9:2 102:24 144:15 149:7 159:7 189:16 191:8,14 201:5,17 202:24
		<p>p</p> p.m. 94:24 95:2 206:8,12 pact 1:8 5:10 6:7 7:10,23 53:5 139:13 pact's 95:11 204:13 page 2:25 4:2,11 9:12,22 22:5 68:8 79:9 122:21 185:4 186:8 198:16 painted 182:18 painter 3:8 5:14 paragraph 13:2 15:7 112:22 115:12 139:17 151:10 185:4 188:9,12 189:23 190:2 191:5 192:14,14 198:15 198:18 200:6,9,24 201:6 202:1 203:6 203:16 204:22,25 parameters 18:11 75:15 part 10:17 49:15 65:3 78:11 81:20	

[patent - plenty]

203:10 patents 31:16 87:12 158:15 path 114:13 paths 116:8,18 119:22 167:25 pause 15:9 135:11 pc 158:18 pci 141:23 142:15 142:18 pdf 4:21,22 pe 18:12,14,15 21:2,21 22:4,4,10 27:14 32:4,7,17 33:5 34:10 35:10 38:24 39:7,13 40:3,6,25 41:4 42:19 43:1 46:1,3 46:15,16 47:1,21 47:24 48:11,13 51:7,14 52:8,13 53:12,18 54:21,21 54:22,25 55:1,1,3 55:16,16,18 56:8 58:14 59:19,20,20 59:24,25 60:1,19 60:20,21 61:1,4,6 61:17,18,19,19 62:14,14 63:7,7,16 63:23 64:5,5,7,8,9 64:9,10,15,15 65:1 65:5,15,22 66:3,3 66:9,9,24 67:1,1 67:12,13,15 68:19 68:25 69:4,7,8,13 69:16 92:2 113:7 114:7,23 141:9,10 146:19 147:3 148:4 162:1,13,22 164:22,24 165:5 165:25 171:17	172:19 173:3,4,15 173:24 174:3,16 174:22 175:15,20 175:21,23 176:1 177:1 178:7,8,20 185:12 186:16,21 186:23 187:4,25 205:2 pe's 18:8 21:3 22:19 46:2 64:23 65:2,13 68:11,11 68:15 69:9 171:17 pedantic 110:11 penalty 207:5 pending 6:14 195:5 people 29:21 55:15 71:15 72:3 76:10,11 80:24 81:7,14 83:6 85:12,23 97:8 102:25 129:18 158:1,14 perceiving 134:6 percent 162:22,23 162:25 164:15,16 165:5,9,20 174:5 175:25 perception 135:18 percival 26:7 perfect 30:20 94:18 performance 21:25 24:18 70:22 81:17 82:25 84:6 97:18 98:9 104:1 performed 73:7 160:16 period 23:25 33:15,19 34:2 73:15,21,22 76:6	91:7 111:25 163:16 periods 85:5 perjury 196:1 207:5 permanent 132:17 permanently 151:15 person 10:15,21 26:24 29:4 34:16 34:24 35:4 40:12 40:16 41:21 42:1 42:4,8,10,22 43:11 43:19 50:11 51:3 51:6 52:7,14 56:5 56:12 57:13 59:13 60:23 96:13 97:4 99:8,17 100:2 101:21,23 121:15 121:25 146:11 148:1,7,10 160:2 166:18 167:4,12 168:9 170:1,24 171:6 181:3,16 182:5 192:19 personal 140:6,11 141:1,3,4,13,21,24 142:14 143:1,24 144:15 146:14,15 persons 94:24 perspective 126:9 pertains 208:15 pes 21:13,17 26:22 44:3,8 45:20 46:7 46:11 47:4,8,17,20 49:11,17 50:12 53:17 54:5,8,19 55:3 56:18 57:16 59:10,14,24 61:22 62:5,13,13,18,24 63:11 64:2,24	65:9 67:1,6,16,20 67:24 68:3 87:9 89:10 96:4 115:14 116:1,9,21 119:1,1 120:6 146:22 147:6,7,15 148:3 164:16 165:10,14 169:2,15,18 170:1 171:1 173:7 petition 4:20 184:13,17 185:18 186:6,7,11 187:13 189:18 205:5,9 petitioner 1:6 2:3 2:10 185:8 petitioners 6:3 ph.d. 1:18 2:2 4:3 6:20 206:13 207:4 207:14 phenomenon 123:3 124:10,20 phone 53:7 82:13 82:20 84:15 144:25 phonetic 26:7 91:23 phrase 177:4 187:7 196:12 phrasing 162:17 physical 161:2,12 picking 17:11 piece 23:24 92:2 place 116:3 130:20 137:7 208:11 play 180:25 player 84:5 please 5:24 6:9,10 113:1 158:11 194:20 195:7 plenty 170:14
---	--	---	--

[pll - process]

pll 104:6 plot 15:13 16:25 plug 142:18 158:18 plugged 102:17 154:10,16,22 156:17 plurality 68:3 point 7:16 10:10 12:19 16:25 17:16 19:23 26:9 29:3 29:11 30:16 49:9 56:24 70:25 75:25 115:7 118:6 130:5 132:19 135:11,13 136:6 140:25 155:3 166:10 171:5 172:11 177:14 196:8,11 204:15 pointed 152:2 187:1 200:25 205:4 pointing 14:19 34:8 113:18 197:13 199:17 points 14:17 122:3 pole 21:21 22:4,25 46:21,23,25 178:7 pop 140:19 portion 114:8 portions 161:3 posit 32:21 posita 28:24 30:24 31:4,11 32:15 33:3 48:23 76:14 76:21 100:1 186:13 193:5,23 196:13 position 178:2,3 199:10 204:9	positive 181:7 possibility 12:9 86:12 possible 16:22 17:2 28:4,9,12,19 29:7 30:4 31:11 34:23 35:15,16 47:9,25 48:6,10 52:3 53:14 54:11 54:13 56:14,18 58:9 61:21 62:20 62:21 63:24 87:16 102:20 104:7 106:22 109:1 124:23 136:18 147:25 148:6 162:20 166:25 174:15 181:1 189:5 possibly 96:24 potential 35:6 88:4 potentially 38:8 73:2 89:25 power 29:22 38:4 45:15 48:14 50:14 51:9,25 52:11,15 52:16 53:14,20 54:10 57:21 58:7 102:10 103:1 109:19 145:6,10 149:18,18,24 150:5,10 151:16 153:4 154:8,15,17 155:7,10,17,21,22 156:4,14,16,23,24 157:2,4,6,10,15,17 157:19 158:6,12 158:18,21 159:20 160:1,6,9 186:14 186:21 187:2,8,24	198:22 powered 102:15 prac 30:7 practically 30:23 31:4 practice 116:5 164:9 pre 103:13 141:18 precise 31:20 100:20 166:9 188:6 202:15 203:12 204:6 precisely 81:15 predetermined 154:6 preference 94:3,9 preferred 187:20 187:23 present 2:12,13,18 3:4,7,9 5:20 39:23 94:25 197:6 presented 200:17 presumably 39:5 52:2 63:12,20 65:8 66:11 107:18 107:24 196:5 presume 177:13 presumption 19:25 pretty 7:16 40:2 55:11 128:22 144:23 153:17 183:19 197:13 prevent 108:4 previous 29:10 90:9 123:8 162:16 202:10 previously 13:20 46:20 76:9 202:11 202:21	primary 145:17 146:8 principle 33:12 119:7 120:4,12,25 121:18 154:24 167:3 principles 139:19 140:1,13,14,18,23 166:21 prior 12:17 145:25 208:6 priorities 82:7 85:1 prioritize 74:10,15 91:6,13 prioritized 86:13 priority 83:22 85:4,17,20 91:15 92:8 93:3,4 probably 14:12 29:13,15 36:21 37:1 73:20 113:11 115:8 138:24 142:7 163:16 167:10,14 problem 34:7 43:16 66:14 132:23,25 203:4 203:17 problematic 202:25 problems 42:6 100:23 proceed 6:25 8:14 proceeding 5:24 95:1 proceedings 208:14,17 process 13:16 14:2 37:13 73:22 90:20 93:13 95:24 96:8
---	---	---	--

[process - reading]

97:17 98:6,11,24 100:16 115:22,25 174:3 201:23 processes 97:16 processing 74:14 77:8 90:18 91:2 147:8 processor 26:1 38:24,24 39:20 51:14 75:6 80:15 81:3 83:10 87:1 87:21 93:14 141:5 141:7,25 142:3,4 143:3,7,12,18,19 145:18 147:20 152:25 159:15,22 160:5,6,24 161:1 168:12 169:6 170:11,13 171:8 171:13 183:6 processor's 16:9 159:19 processors 66:10 80:20 141:2,14,21 142:7,10,13,13 144:4 159:25 160:9 162:4 170:14 172:1 professor 188:13 188:18 189:21 190:5 191:5 193:4 194:11 195:16 199:2,10,21 200:4 200:12 program 27:20 30:15 170:7 programmable 44:20 142:7 152:4 169:6 170:6,11 programmed 59:23	progress 90:12 properly 114:18 114:19 provide 28:2,4 156:25 provided 69:23 provides 62:2 96:3 125:1 providing 137:17 pull 92:8 pulling 189:14 punishing 157:11 purpose 25:21 148:16 push 92:17 138:21 183:2 put 25:19,25 27:13 27:19 29:19 38:23 44:20 46:14 50:13 51:8,23 52:9,14 58:18 61:1 67:13 72:23 80:18 82:18 83:6 113:15 120:4 122:10 135:11 158:25 159:19 180:16 183:9 184:19 197:4 198:8 201:15 puts 27:19 108:24 putting 39:6,20 61:3 92:20 159:24 160:5,9 200:8	97:14 100:18,24 102:3 107:3 113:4 114:25 126:8 133:1 137:10,11 168:15 170:17 176:6 187:15 192:10 194:17,19 195:5,10 197:18 198:2 199:25 200:22 202:4,21 questioning 194:25 questions 7:20 50:8 117:14 204:13 205:18,22 205:25 queue 16:9,24 18:8 21:4 40:5 169:20 171:2 172:17 173:9 queues 173:7 quickly 51:21 91:7 108:14 109:20,21 129:15 quinn 3:3 6:6 quinnemanuel.c... 3:6 quite 49:21 108:20 157:8 quote 185:20 186:1,3 187:9,10 187:13,21 204:25 205:6 quoted 187:24 205:12 quoting 185:17,19 186:11	raising 155:4 ramp 29:18 random 87:4 176:11 randomly 87:18 range 39:21 41:9 41:23 42:5 44:21 rapid 40:4,18 rapidly 42:18 129:9 rate 17:13 18:16 21:13 71:23 80:11 80:20 87:4 102:11 113:14 177:10 180:22 razor's 165:4 reach 60:25 167:22 reaches 38:15 154:5 react 161:23 read 11:24 13:7 15:10,11 19:24 20:6 49:6 86:25 95:20 105:10 112:25 116:17 117:9 123:2 124:6 124:9 137:4 139:18 151:14 152:12 153:25 154:3 156:12 160:14 161:21 185:7 186:12 188:12 190:1,15 191:4,6 193:3,4 194:6 195:6,9,10 198:19 204:25 205:9 readback 195:8 reading 10:16 28:24 29:5 30:25
	q qualcomm 83:10 quality 73:16,18 question 16:3 18:5 20:25 25:7 29:2 35:24 36:2 40:22 50:25 66:22 79:8 79:10 81:24 84:1 84:19 89:20 95:10	r r 147:20 raise 6:11 165:7,8	

[reading - remembering]

41:22 50:21 51:6 52:8 87:1 105:23 121:16 170:1 192:25 193:1 194:6 195:11 198:7 ready 122:11 180:18 real 17:8 23:21 24:16 25:12,15,18 26:4,14,20 41:10 42:3 70:16 72:17 76:23 78:14,14 79:16,18,25 81:2,4 81:5 82:6,22 83:5 83:8,14,18,19,21 84:2,9,12,25 85:3 85:13,15,17,21,24 86:5,8,13,17,18 87:17,17 88:5,16 88:25 89:8,12,23 90:1,3 91:18,18,22 92:5,6,11,21 93:12 99:24 100:3,8 101:3,5,7 120:17 146:20,25 148:17 182:20 realize 48:14 realized 20:19 really 26:10 31:2 31:18 48:6 49:20 55:8 56:1 66:13 67:11 71:15 73:23 74:5,5 77:21 79:3 79:24 83:5 85:10 85:21 86:21 89:19 90:2 97:13,20 100:25 103:12 110:3 118:3,11,16 135:17 137:14 141:8 150:4 164:4	164:5 170:5 172:9 175:8 176:7 177:18 180:2 182:1 183:6,14 197:7 198:3 realtime 202:13 202:18 reason 8:16 28:14 85:11 86:6 108:13 129:7 152:3 169:9 203:21 reasonable 51:17 76:15 98:12 110:13 130:21 148:1 reasonably 76:12 157:3 reasons 30:1 37:6 51:18 83:2 90:10 99:14 107:11,12 128:13 171:24 recall 19:12 38:9 56:23 62:3 141:19 150:20 151:4 156:7 179:1 186:1 188:24 196:17 205:7 receive 73:1 recess 52:24 94:23 recognition 42:12 recognize 37:11 103:10 recognized 179:16 recollection 14:12 19:11 23:3 56:20 96:10 104:25 113:16 150:18 151:2 152:1 153:18 200:16 record 5:5,22 9:1 52:23 53:1 69:18	94:21 95:5 122:19 139:5,8 149:6 159:6 170:19 183:23,24 184:1,4 195:9 201:13 202:11 206:5,8 recorded 5:7 reduce 14:8 50:14 51:16 52:3,15 53:20 95:22 96:7 98:5,22 100:15 104:23 174:6 177:14 193:8 197:23 reduced 11:9,18 15:23 49:8 159:20 208:12 reducing 52:16 redundancy 26:13 redwood 3:5 refer 67:23 149:7 159:7 169:12 191:24 192:12 reference 8:25 9:11,12 54:20 62:3 140:5 149:8 149:10 151:1,22 152:18 157:5 159:8 160:14 188:15,22 189:22 192:5 194:13 195:19 199:3,11 199:22 references 200:5 200:13 referring 8:13 140:13,22 160:22 170:5 174:21 197:11 refers 154:17	refined 133:15 reflected 171:18 refresh 113:1 refreshed 199:13 201:8 refresher 149:15 regardless 11:11 50:10 51:3 100:7 165:15 regards 113:24 regular 15:4 115:14 118:8 regularly 117:24 relate 157:17 related 5:12,17 104:18 155:17,21 163:18 168:18 relates 157:15 relating 155:23 relationship 31:21 90:5 103:7 106:11 107:23 144:12 173:19 relatively 22:8 46:5 62:18 64:3,3 64:8 80:10 94:13 108:20 reliability 108:23 reliable 179:18,25 180:8 reliably 70:21 156:15 remain 201:7 remember 99:25 141:15 198:12 204:21 remembered 152:5 remembering 202:13
--	---	---	--

[remind - right]

remind 204:24	208:18	result 37:18 52:16	53:22 54:6,22
remote 1:17 2:1	requirement 20:8	53:21 58:18 97:17	55:4,23 56:9,18
95:1	82:1 84:6 120:18	103:24 107:22	57:5 58:24 60:21
remotely 2:5 5:21	requirements	123:14 127:18	61:8,20 62:6,25
remove 102:10	21:25 22:9 23:10	135:1,2 136:11	63:19 64:1,6,10
103:1,4 201:6	36:18 38:25 65:24	174:18 178:8	66:2,5,21 67:21
repeat 50:25	73:11 75:22 76:16	resulted 123:7	69:9,21 71:11
repeated 194:24	81:9,17 84:8	results 180:8	73:4,9,25 74:18
repeatedly 40:13	86:14 162:3,13	resumed 94:24	75:22 76:4,7,18
42:25	requires 27:23	retained 206:11	77:9,16 79:3,10,15
rephrase 132:14	33:14 34:1 80:5	retrospect 194:1	80:1 86:14 89:4
171:4 178:5	91:6	203:13	89:18,24 90:23
replicate 114:7	requiring 21:11	reverse 152:5	92:14 94:19 95:9
report 199:6	36:19	review 11:20	95:18 96:5,16,23
201:19	reserve 205:22	56:25 115:9	98:2,15 99:19
reported 1:25	reset 32:6	208:17	100:11 103:3,20
reporter 2:4 5:15	respond 79:20	reviewed 115:8	104:15 107:5,16
6:9,10,13,18 94:8	106:4,8 108:14	149:10 188:18	109:12 110:2
94:10 184:18,23	109:3,8,21 110:19	reviewing 167:13	111:1,21 112:10
195:7,8 206:6	128:14 168:5,11	reviews 15:25	112:19 113:9,22
representation	174:19 175:8	50:23 113:10	114:19,24 115:16
105:25	responding 35:23	114:4 116:15	116:11,25 117:6
represented 199:2	132:12	117:8 200:2	117:21,25 118:14
representing 6:3	responds 11:13	rid 93:2	118:15,19,25,25
requested 6:12	response 34:18	right 6:11 7:11 9:5	120:8 121:3,6,18
118:7	36:10 37:21 40:14	9:13 10:1 11:22	122:16,18 123:11
require 21:4 23:12	63:10 102:10	13:17 14:9,13,22	125:2 127:21
32:24,25 33:15,18	104:18 111:18	14:23 15:1,19,24	128:8,17 129:4
35:9 45:16,17	115:15 122:2,4	16:16,17,25 18:19	130:14 131:9,22
48:19 107:15	124:17 132:9	19:3 20:4,5,10,11	132:3,4,16 133:5
172:12 178:4,20	174:6	20:24 21:5 24:8	135:3,9,22,23
required 18:25	responsive 105:14	24:13 25:3,3,10	137:1 138:2
19:1,4 20:3,14	107:1,4,13 108:3	30:21 31:3 32:18	139:10 140:2,11
21:6 22:7 23:6	110:4 176:25	32:19 33:6 34:19	141:3,14,25
24:5,11 25:8 34:9	rest 149:8 205:13	34:20 35:10 37:9	142:15 143:3,22
34:14 61:4,5	restricted 31:12	37:14 38:10,12,16	144:4,13,17,20
70:23 74:12,16	restriction 73:8	38:17 39:4 41:2	145:7,18,20
75:18,23 76:3	89:17	41:24 44:5,9,15	146:15,22 147:9
79:24 80:5 84:16	restrictions 74:4	45:1,6 46:9 47:10	148:8,23 149:19
86:20 90:25 93:13	restrictive 81:23	47:22 48:2,15	149:25 150:6,16
120:17 162:5,10		49:17 50:24 53:15	151:1,11,12

[right - second]

152:20,25 153:11 153:16,24 154:18 155:2 156:20 157:1,7,22 158:15 159:9,13,20 160:2 161:18 162:13 163:20 164:21 165:3 166:25 167:12,12,15,18 168:13 169:3,21 171:2,21 172:25 173:9 175:2,10,19 176:2,23,23 177:17,17 178:10 178:23 180:4,8 181:11,15 182:15 183:24 184:5,24 185:5,18,21 186:4 186:9,23,25 187:9 187:13 188:1,11 190:6 196:16 198:17 200:8,14 204:23 205:10,23 ripples 15:3 risk 14:25 110:11 118:12 role 143:2 roles 148:13 room 5:20 133:8 roughly 40:8 46:14 116:11 rtos 147:20 ruin 45:22 rules 64:16 run 25:14,22 26:3 26:14 29:20 32:12 34:13 53:13 54:25 58:11,16 71:20,25 72:2 75:10 77:12 83:12,13 88:19 142:18 148:15,16	183:11 runaway 102:8 running 18:14 21:14 23:14 26:11 26:22 28:10 30:13 32:4 33:13 36:14 39:13,18 41:1 48:1 51:14 52:13 54:5,13 55:1,17 63:18,23 77:2 80:20 84:5 88:10 102:16 113:8,13 146:20 147:20 168:2,4 175:13 176:15 179:2 180:2,7,14 181:7,8 181:11,17,20 runs 83:7,11,14 91:22 119:22,23 146:25 rush 50:3 s s 4:10 safety 29:15 36:24 36:25 47:13 119:10,16,19,24 120:5,22 121:19 129:2 sample 89:11 111:24 118:8 sampled 88:20 sampling 89:16,17 san 2:14 sarah 2:17 6:5 sarah.mikosz 2:20 satisfactory 58:18 satisfies 65:23 satisfy 75:15 saving 48:14 saw 197:4	saying 11:14 20:12 20:13 23:18 28:23 30:3 31:13 33:20 39:22 42:17 43:15 45:4 49:16 58:21 63:3 77:7,10 86:18,21 87:14,19 88:11,18 97:16 100:21 107:14 110:3 115:10 116:7 132:8,20 133:4 134:9 135:19 136:24 145:14,22 150:4 151:2 155:4,8,13 165:25 166:5 172:20,21 178:21 179:2 192:20,23 194:4,9 195:15 200:10,19 says 11:21 12:7 15:11 19:22,24 20:6 44:20 49:6 49:18,18 95:19 96:6,8 98:21,22 102:16 117:9 123:2 126:24 127:17 139:18 149:21 151:14 152:12 153:25 154:3 161:21 176:16 186:12 187:1,2,19 190:14 191:22,22 192:6 192:21 193:4,19 193:23 198:9 199:8 203:23,24 scale 77:17,19 149:23 scant 69:23 100:25	scenario 53:17 60:25 65:10 82:13 128:9,10 133:14 scenarios 131:18 181:1 schedule 20:18 23:5,22 50:3 64:13 81:15 86:19 87:5,19 89:24 90:1,21 93:5 162:20 scheduled 87:7 88:24 89:2 scheduler 43:10 55:9 56:12 57:22 59:7 60:25 schedulers 41:24 42:12,25 56:6 81:6 181:24 schedules 87:10 scheduling 23:16 40:21 41:10 66:18 101:2,2 140:15 180:24 183:14 scheme 71:4 186:15,21 187:3,8 187:24 schweiz 1:8 5:10 screen 7:24 84:3,6 149:3 sechen 4:22 188:13 189:21 193:4 199:3,10,21 200:4,12 sechen's 188:18 189:15 190:5 191:5 194:11 195:16 198:18,19 second 13:3 19:13 25:21 26:1 74:6 76:9 80:8,12,14
--	---	--	---

[second - situational]

91:3 132:23,25 151:6 179:20 180:17 183:3 185:6 190:1 195:8 200:24 seconds 74:21 78:6 89:10 91:5 129:9 see 7:5 10:14 12:5 13:13 14:15 15:15 16:1 17:21 30:1 34:6 35:1 39:24 49:13 55:14 93:15 93:23 95:25 106:17 113:17 116:23 117:7 122:24 123:1,18 132:13 139:22 140:7,16 143:9,21 143:21 151:20 152:3,15 154:11 160:19 162:7 164:23 165:10 171:5 176:15 177:22 183:21,22 185:13 186:10,17 187:18 188:16,17 189:24 190:3,4 191:11,12 197:8 198:24 202:20 203:21 seeing 120:6 133:2 186:1 sees 167:24 semiconductors 104:19 send 82:19 sense 25:4 33:12 34:1 69:13 76:13 76:15 78:12,21 97:21 105:4,7	110:20 111:19 138:20 146:9 148:14 163:10 168:18 sensitive 19:7 70:6 sensor 101:15,24 108:24 109:22 sensors 96:15,19 96:23 101:16 161:5,11 sentence 13:7 15:10 20:6 124:8 151:13 185:7,17 185:23 187:2 191:4,19,23 192:6 192:11 193:3,11 199:1,7 201:6 202:2,25 203:2,3,5 203:6,22 205:10 205:13 separate 83:9 126:8 135:9 161:2 sequence 169:8 172:3,3,4,10 sequentially 169:21 series 14:4 169:3 169:19 176:6 seriously 196:19 server 93:15 102:14 service 164:7 set 18:18 19:17 21:12,13 32:17 34:10,10 44:22 46:3,5,8,17,17,17 47:5,8,25 53:13,18 53:22 58:14 62:21 62:24 64:10,18 65:14,14 66:24 67:7 68:12,15,18	69:8,15 80:21 81:9,9 88:7,7,8,21 90:9 126:23 128:1 128:7 131:4,7 132:3 134:4,7 136:10 147:8 150:4,16,20,25 151:16,23 152:19 170:6,7 173:25 183:8 sets 65:6 setting 17:12 63:10 74:16 103:19 109:17 134:9 136:3 150:22 151:24 152:20 155:15 163:13 198:21 settings 174:12 share 8:1,4,25 62:5 63:9 sharing 67:20 shock 143:16 short 34:2 94:13 124:24 163:22 shorthand 208:11 show 11:15 15:13 39:6,19 54:9 193:22 showed 8:11 showing 145:23 150:2 197:12 shows 11:12 13:8 149:17 196:12 shut 49:11 shutdown 48:13 49:16 side 8:3 54:3 58:14 70:2 100:1 133:8 signal 147:8	signature 208:24 significant 11:1 21:11 28:15 58:4 73:24 80:8 silent 35:22 77:21 180:2 silicon 102:9 104:2 similar 112:17 158:23 similarly 130:19 172:8 simple 80:13 126:24 180:24 202:21 simpler 174:21 simply 11:14 16:21 39:17 56:23 65:4 103:14 104:19 155:20 158:2 172:1 174:20 simultaneously 169:23 single 71:10 84:15 84:22,25 167:16 sir 140:3 sit 81:14 103:23 186:1 sitting 169:19 situation 29:7 30:8 30:9,23 32:20 35:13,14 36:13 52:13 54:12 56:12 63:21 65:18 66:19 69:19 74:13 78:2 78:4 102:20 103:23 140:11 157:3 167:4 174:21 181:18 situational 168:6
--	---	---	--

[situations - stall]

situations 25:24 51:19 57:10,11,25 58:2 61:11 63:22 66:6 71:7 78:24 99:23 101:17 103:5,11,16 104:17 119:6 183:7 six 105:10 size 144:25 166:22 skill 10:16,22 26:24 29:5 34:17 35:4 40:12,17 41:21 42:2,8,11,23 43:11,19 50:12 51:4,6 52:7 55:15 56:5,13 57:13 59:13 60:24 96:14 97:5,9 99:8,17 101:21,23 102:25 121:15,25 146:12 148:1,7,11 158:14 160:2 166:19 167:13 168:9 170:25 171:7 181:3,16 182:6 192:19 skip 7:13,14 slack 122:6 slide 28:17 slightly 113:8,19 slip 27:24 slot 141:23 142:15 slots 15:18 slow 102:18 119:23 134:23 slower 72:15 113:8,19 114:14 114:18 119:23 slowest 114:8	slowly 37:20 135:25 small 17:23 18:11 21:5 22:8 27:23 36:7 37:12 40:9 40:15 43:1,7 46:1 46:16 47:8 107:15 108:7,19 109:20 111:22 134:25 136:18 164:20,22 165:15 166:11 178:2,10 182:9 smaller 21:16 37:17,18 47:5 165:20 smallest 109:2 smart 125:12 smartphone 75:14 smiling 70:1 smith 1:18 2:2 4:3 5:8 6:20 206:10 206:13 207:4,14 socket 155:18,24 socket's 156:3 software 26:10 67:11 90:15 92:2 111:12 151:18 168:4 169:5 solves 34:6 somebody 24:7 58:21 59:2 129:7 201:17 soon 130:17 sooner 78:23 91:10 92:13,22 93:6 sorry 22:14 33:21 41:14 45:20,24 57:23 60:9 79:7 105:8 106:15 108:11 121:14	123:24 132:11 135:6 158:9 159:16 161:20 173:13 184:22 185:22,24 188:4 190:22,25 205:20 sort 21:21 23:24 28:1 31:22 35:1 36:24 38:15 40:4 40:7,18 41:5 42:18 44:20 50:3 50:13 52:10 56:17 65:19 70:16 77:4 77:7,11,22 79:18 80:4,17 82:18 83:7 85:24 87:14 87:18 89:5 94:2 103:24 105:18 106:13 108:5 109:5 110:22 112:8 114:21 116:9 118:24 120:20,21 121:1 127:6,14,17 129:2 129:7 133:15 136:8 142:10 143:24 145:12,17 146:24 147:10,19 149:12 150:4 158:6 160:6 166:7 168:1 169:6 170:15 171:12 181:13 203:18 sound 85:10 sounds 94:18 172:24 south 2:18 space 36:18 146:14 speak 95:10 139:13 195:2	speaking 30:23 45:2 69:19 133:24 169:23 194:21 specialized 75:5 specific 36:1 84:24 93:20 130:5 specifically 13:8 19:13 69:3 109:15 115:23 140:12 190:10 specification 154:8,15 155:7 156:8,23 191:8,17 specifications 117:13 specified 31:15 60:15 126:15 155:15 181:25 specify 79:16 80:24 81:1 speculate 38:19 48:7,22 speed 11:18 65:23 107:23 113:25 134:15 143:14 speeds 39:18 spend 70:11 spent 155:14 spot 114:22 117:6 117:19,21 118:14 118:18 121:3,6,18 spots 105:2 ss 208:2 stabilize 153:16 stabilized 39:21 stable 15:12,18 stack 33:19 stage 13:24 15:8 15:21 stall 179:22 180:14,19,21
--	--	---	--

[standard - system]

standard 109:7 166:20 star 91:23 start 38:14 49:9 51:21 70:17 88:10 99:16 106:18 112:13 167:17 173:24 started 9:24 12:23 16:4,4,14 38:19 87:25 180:21 starting 88:3 95:16 139:17 180:17 startling 105:8,9 starts 151:13 179:1 state 5:21,24 50:14 51:8 52:10,15 69:15 105:22 116:24 118:7 120:7,7 127:19 129:4 160:7,9 200:13 201:15 207:6 208:1,5 stated 202:10 statement 140:3 189:20 190:14 194:14 195:21 statements 201:5 states 1:1 5:11 140:1 198:19 staying 202:5,9 steady 38:15 step 13:16 27:15 28:16 38:11 80:5 80:23 81:1 179:10 steps 13:12 14:4,7 27:14 110:24 stick 22:24 68:22	stop 72:5 92:3 107:2 153:15 stopping 159:23 store 171:1 story 70:2 street 2:13,18 stretching 46:21 strictly 100:2 stringent 73:11 strive 22:24 strokes 31:16 strong 10:4 structure 186:20 structures 88:7 185:11 186:16,23 187:4,25 205:2 studying 155:14 stuff 26:13 85:25 91:22,24 sub 12:11 submit 205:23 subsequently 44:12 45:13 153:6 193:8 substantially 74:4 succeed 91:14 success 75:15 suddenly 129:18 sufficient 55:11 200:20 suggest 50:18 suggested 12:19 33:25 60:10 66:13 136:15 143:12 190:24 suggesting 63:7 97:24 99:5 100:9 100:14 108:16 suggestion 145:3 suggests 85:24 127:17	suitable 124:23 suite 2:13,18 sullivan 3:3 summarize 29:2 68:23 sun 132:6,21 super 194:7 195:12 supplemental 201:19 supplied 49:23 supply 13:10 14:25 15:12,13,18 38:4 48:12 54:10 57:21 62:6 95:22 96:3,7 98:1,5,18 98:22 99:3,18,22 100:10,15 103:8 104:11,13,23 106:18 109:20 110:6 111:5 112:5 112:9 114:16,17 114:22 115:15 117:5,10 119:2,15 155:22 198:22 support 189:15,20 supported 44:22 supports 199:18 supposed 34:20 sure 9:21 16:12 24:25 25:6 29:3 32:18 34:11 40:23 50:6,6,9 51:2 84:1 84:18 87:8 91:22 92:23 93:9 96:24 97:19 103:12 113:23 114:1,6 116:4 119:14,22 119:23 120:13,22 121:19 122:1 129:2 133:24	140:20 141:11 147:24 152:6,9 153:17 155:13 158:20 184:22 187:17 201:25 202:13,19 205:24 surprise 141:15,18 surprised 63:21 158:22 survivable 72:22 survive 71:25 suspect 112:1 160:8 swear 6:9 sweet 114:22 117:6,19,20 118:14,18 switch 43:22 54:2 61:24 122:9 switching 123:15 sworn 6:21 208:8 synching 88:12 synonym 157:3 system 9:18 10:25 11:13,17 13:9 17:5 18:13,13,18 18:22 21:13,24 23:18,22 25:12 26:7 28:25 29:22 29:23 30:14,23 31:8 34:25 36:1 36:21 37:23 42:3 42:4 43:17,18 45:16 49:10,23,24 53:18 57:19,21 58:7,10,22 59:5,8 60:14 61:12 65:3 65:19 66:15 69:25 70:16 71:6,18 72:22,25 74:22,25 76:18 77:25 78:14
---	---	---	---

[system - tasks]

79:25 81:2,5,21	197:6	82:7,14 84:14	25:13 27:1,3,13,19
82:3 84:15,22,25	t	85:21 88:13	27:22 28:9,17
85:23 86:2,12,17	t 4:10 159:8	101:14 127:20	29:8 30:5 32:11
86:22 87:14 89:8	tab 4:12	131:20 138:7	32:22,24 33:13,17
89:23 90:3 95:22	take 9:10 19:18,21	147:11 161:17	33:25 34:9,12,19
96:6 97:21 98:22	24:8,23 31:24	162:16 163:9,14	34:25 35:9 36:7,7
100:14 101:2,6,7,8	49:3 50:9 52:19	165:2,20 166:7,16	36:10,17 38:14,18
101:16 102:6,7	72:21 73:19,21	167:8 169:24	38:18 39:1,13,16
106:22 107:7,21	74:20 77:9 78:8	178:1 182:11,22	40:2,24 51:14
109:15,17 110:15	79:13 81:10 83:6	196:6	52:13 55:2,9 56:3
110:19,23 112:14	94:1,1,12 95:15	talking 20:3 38:6	56:4,8 57:21
118:7 120:13,13	99:4 112:17 119:8	43:3 45:18 53:12	58:15 59:14 60:1
122:3 133:11	121:9 122:22	59:19 62:1,11	60:20 61:1,3,4,17
134:8,20 136:10	125:5 130:4	65:18 72:17 74:18	62:20 64:4,13
136:14 139:21	138:17,22 139:3	82:10 109:6,23	70:18,20,21 72:6
140:2,17 143:11	146:13 149:14	110:20,21 112:1	73:8,12 74:15
144:4,6 145:12,16	151:5 152:11	117:15,17 118:16	75:10 77:8 78:5
146:20,25 148:17	153:22 156:10	118:17 119:5,17	79:13 80:13 81:12
150:21 151:17,18	161:15,19 170:6	127:23 128:11,20	81:13 82:2 83:19
153:5 154:9,16	173:1,1 180:14	131:19 137:23	83:21,23 85:25
156:16,17 159:25	183:20,21 185:3	138:4 141:8 145:1	87:22,24,25,25
160:16,23 161:3	188:8 189:19	162:11 163:6	88:2 91:6,10
161:13,22,23,24	198:15 201:21	167:21 173:24	119:11 140:15
162:1 164:8 165:2	206:5	176:7 177:25	147:6,10 148:15
165:16 166:8	taken 2:2 5:8	198:6	148:16 163:15
173:3 176:17,21	17:20 25:2 48:18	talks 56:17 80:4	166:23 167:16
180:12,25 181:5	61:22 94:23	156:11 162:9	172:9,12 173:4,4,5
182:18,23 183:11	208:10	target 38:16 39:21	174:4,5,13,22
193:7 197:3	takes 85:15,16	136:10,11	175:4,6,8,8,22,24
systems 12:22	87:2 126:12 128:8	targeting 31:1	176:2,11 177:2,6,7
19:5 20:20 24:16	talk 22:3 38:18	34:20	177:9,11,20,20
25:18 26:12 41:10	43:23 48:24 62:10	targets 182:20	178:3,8,18,22
45:10 53:24 72:17	71:15 79:11 81:19	task 9:24,24,25	179:4,6,20 180:2,6
78:14 81:14 82:6	95:14 101:19	10:8,11,13,18,24	180:17,18,20
84:2,13 86:5	112:20 146:24	11:7,17 12:2,11,11	181:11,19 182:9
87:17 88:5,16	155:23 169:1	13:5,21,23 15:14	183:2,4,9,12,13
89:1,2 91:17 92:6	175:21 176:7	15:17,19,22 17:15	tasks 12:16,20,22
92:11,16 100:8	talked 19:13 20:18	17:17,20,23 18:7	12:23 16:8,19,24
103:6 105:23	28:21 41:8,20	18:10,14,15,18,18	17:9 18:24 19:1,3
112:15 129:11	46:20 53:11,23	21:3,10,14,15 22:6	19:17 20:1,9,15,20
157:21 179:14	66:7 70:11 76:25	24:17 25:9,10,13	21:2 23:5,12,19,22

[tasks - think]

24:13,21 26:21 38:23 40:5,15 41:12,24 42:19 43:13,14,23 44:2 47:10,18 57:16 58:11,18,23 59:3 61:23,23 63:22 70:15 71:12,20,21 72:9,11,14,19 73:3 73:6,8,19,19,23 74:10,11,19,20 75:7,13,20,22 76:4 76:5,5,16,23 77:2 79:17 80:24 81:2 81:9,10,22 82:6,8 82:10,22,23,24 83:6,12,12,13,18 85:1,3,13,15 86:13 86:14,19 87:18 88:6 89:24 90:4 91:1 92:12,13,17 92:22,22,24,24 93:5,7,10 101:4 140:15 146:21,22 147:2,2,7,8 161:24 162:4,11 163:11 165:24 169:2,2,5 174:16 175:13,17 176:8,14,14 178:2 178:19 179:2 181:7,8 182:7 teaches 167:6,7 175:7 teaching 121:2 technically 174:8 195:25 technique 49:22 115:4,9 techniques 48:5 48:18 49:11 51:5 100:4	technology 145:24 tell 9:14 11:10 140:22 202:24 203:10 tells 155:9 temperature 95:23 96:4,8,15,16 96:18,22 97:4,7,10 97:25 98:6,12,16 98:23 99:12,19,23 100:11,16 101:15 101:24 102:17 103:3,5,9,17,19,25 104:1,2,5,13,23 105:12,15,24 106:9,14,17 107:2 107:5,13,19 108:4 108:6,18 109:9,21 110:5,7 111:4,6,16 111:18 112:1,2,6 115:14,16,18,20 116:10,20 117:3,4 117:11,17,18,24 118:6,23 120:8 122:5 123:13,16 125:3,6,22 126:11 126:12,25 127:4 128:15 129:22 131:6,7,10,16,17 131:19,24 132:1,6 132:7 134:11 135:20,25 136:5 137:8 160:25 161:5,11,12 temperatures 115:14 130:8 temporarily 157:11 ten 50:4 88:6 111:25 183:20	tend 53:25 172:5 tent 21:21 22:4,25 46:21,23,24,25 178:7 term 51:24 67:22 67:23 68:2,2 93:3 130:22 137:2 141:6 164:13 terminology 62:15 terms 12:24 58:7 83:22 84:16 111:12 testified 6:22 178:17 testify 208:8 testimony 6:13 8:17,21 57:24 124:16 206:9 text 73:2,8 74:3,6 74:20 82:9,14,19 92:19,20,22,24 93:7,12,15 149:15 205:5 textbook 136:8 texts 83:1 thank 6:18,24 7:1 7:18 53:10 94:6 205:17 206:1,2 thanks 7:8 theories 117:16 theory 110:21 130:12 158:1 thermal 102:8 104:18 108:24 160:15,17,21 thermostat 109:6 109:7 123:11 125:2,4,10,11,17 125:19 126:3,10 126:22 127:23 128:1,14 129:8	131:5,15 133:8,16 134:5 136:9 137:23 138:8,10 thin 18:9 thing 26:11 54:16 54:18 78:9,15,19 78:25 96:2 128:6 168:2 170:4 177:22 181:20 190:18 194:25 201:12 things 24:4,21,25 29:20 35:15 39:10 48:10 71:4 72:4 72:12 84:2 87:15 88:13 92:15 102:18 108:22 110:25 129:20 133:22 141:9 159:11 164:10 165:3 180:21 think 7:15 10:15 12:14 17:3 20:25 21:8 24:6,10,15 25:3,3,5,11 26:25 27:5,9 28:14,24 31:4,6,15 32:20 33:12,24 34:3 35:12 36:8 39:8 39:24 41:20,25 43:10 44:23 45:7 46:19 51:12 52:6 52:12 54:8 59:16 60:4 62:2 65:17 68:7,7,21 69:11 70:24 71:3,22,24 72:4,24 73:10,12 76:21 78:3 80:16 81:25 83:16 84:21 87:13,25 88:12 92:10 94:13 97:5
--	---	---	--

[think - tough]

99:14 100:13,22 103:23 106:21 109:14 110:16 111:20 114:8 115:22 116:3 119:4,14 120:3,24 121:24 124:2,6 125:9 126:21 128:21 129:6 130:6 132:4,23,24 134:12,13,25 135:10 137:4,12 137:12 138:6,11 140:19 141:8 142:3 144:23 145:14,21 146:2,3 148:10 150:1 155:19 157:2,17 162:17 165:15 166:16 167:3,6,7,8 167:14,14,20 168:3,16 169:4,13 169:25,25 170:12 172:21 173:11,18 174:11,20,23,24 175:12 178:3,16 178:16 179:18 182:17,20 183:19 184:21 189:1 190:8 192:14,19 194:2 195:25 196:2,24 199:20 200:3,9 201:20 202:7,14,16,21 203:12,25 204:5,9 204:11,11,20 205:15 thinking 76:23 101:6 121:5 144:8 176:20	thinks 199:18 204:3 third 9:12 47:21 123:1 thought 30:20 121:7 124:22 126:1 three 13:11 23:1 47:17 74:21 173:3 173:7 194:17 threshold 107:10 111:13 128:7 130:10,13,16 131:8 136:3,11 138:9 149:22 150:3,25 151:13 151:15,23 152:13 152:19 153:5,6 154:5 166:23 181:21 183:1 thresholds 134:2 150:15 152:24 157:7 158:6,13 throttle 153:5,7,8 153:13,19 159:19 159:22 throttling 159:15 throw 41:11 86:1 147:12 178:14 thursday 1:19 2:3 5:2 95:2 tight 23:22 29:24 30:9 tighter 73:7 84:7 85:2 89:17 93:6 tightly 25:18,23 26:3,14 time 5:24 7:10 14:20,24 15:8 16:25 17:8,10,19 18:19 19:4,6,17	20:1,4,14,21 21:12 22:7 23:1,6,9,12 23:21 24:1,6,11,16 24:18 25:9,12,12 25:15,18 26:4,14 26:20 28:10 29:17 33:15,19 34:2,15 39:3 41:9,10,12,21 41:22 42:3,11 43:12,13,20 48:11 48:23 52:23 53:1 55:15 70:12,16 72:17,19 73:7,12 73:15 74:3 75:7 76:6,23 77:17,19 78:14,14 79:3,6,7 79:12,13,16,18,20 79:21,23,24,25 80:7 81:2,4,5,6,11 81:15,20,22,23,25 82:6,22 83:5,8,14 83:18,19,21 84:2,8 84:9,12,12,14,17 84:25 85:3,5,13,15 85:17,21,24 86:2,5 86:8,13,14,17,18 86:20 87:2,7,17 88:5,9,16,25 89:8 89:12,17,23 90:1,3 90:9,21,25 91:8,18 91:18,22 92:5,7,11 92:21 93:6,12,14 94:15,21 95:5 96:13,19 99:24 100:3,8 101:3,4,5 101:7,22,24 102:23,23 104:20 116:2 118:8 120:17 121:16 122:5 137:5,6,10 137:16 138:16	139:5,8 141:12,18 142:12 143:2,15 144:14,16 146:20 146:25 148:7,11 148:17 155:14 158:15 160:4 161:13 163:16 171:7 172:2 179:11 182:20 184:1,4 195:1 208:11 timely 93:18 timer 88:21 90:8,9 times 19:2,7,8 44:19 47:10 57:9 57:25 60:12 74:12 74:17 75:4,18,24 76:3,24 77:3,7 78:22 82:8 85:3 89:3 92:14 135:20 135:24 194:17 timing 11:25 74:2 tired 158:10 titled 4:13,15,17 4:18,22 today 8:16,21 26:7 49:22 72:18 104:17 141:4 today's 206:9 toggles 108:15 toggling 108:5 110:5 120:6 129:3 told 29:23 tool 168:10,16 tools 49:1 top 33:20 34:13 83:24 99:25 147:9 topic 93:24 total 155:9 206:10 tough 24:24
---	---	--	---

[track - understand]

track 84:7 96:15 tracking 84:3,5 95:23 96:7 97:25 98:5,23 100:15 118:8 tracks 117:11 trademark 1:1 5:11 traditional 86:5 transcript 208:14 208:16,18 trend 31:23 112:6 112:8 125:21 126:11 134:23 135:25 trending 132:20 trends 104:25 trial 1:3 trick 110:4 tried 53:6 70:6 trigger 136:5 triggering 131:2 trips 156:19 trivial 110:22 trouble 79:8 88:12 201:20 true 8:17 24:15 47:6 116:17,24 173:11,14,17 194:14 195:20 200:7 207:6 208:13 truth 6:15,15,16 208:8,8,9 truthful 8:21 try 26:12 28:3 41:18 59:9 66:21 68:8,8 72:21 77:25 80:18 87:15 92:16 93:25 94:16 113:3,3 114:17	122:5 130:17 132:14 136:17 163:4 164:8 165:3 167:9 180:14 trying 11:15 18:4 18:5,18 29:2 34:5 35:16 39:25 42:15 56:17 60:17 97:20 101:12 102:8 115:21 116:4,12 tune 82:3 165:3,16 tung 3:3 4:6 6:6,6 9:15 10:2,20 12:13 14:10 16:10 17:1 21:7 22:11 22:17,21 27:4 33:7 34:21 35:11 36:11 40:19 43:4 48:3,16 50:16 51:10 54:7 55:5 55:24 56:10,19 57:6 60:2,22 61:9 63:1 64:11,25 65:16 67:3 68:20 69:10 75:1 76:19 82:11 85:7 93:1 96:17 97:11 98:3 98:20 99:20 100:12 102:4 103:21 106:20 107:17 108:9 109:13 112:11 118:1 120:9 121:22 123:22,24 125:8,24 128:18 129:5 137:18 142:16 143:4 145:8 147:17 148:9 150:11,17 151:25 153:1 154:19 155:11	156:5 157:23 158:16 160:3 161:7 162:14 163:7 164:25 166:4 167:1,19 168:14 169:22 170:16,20 171:3 171:22 173:10 174:9 175:11 176:3 181:23 182:16 186:24 187:14 188:2,4 190:7 192:9 193:15 194:16,21 194:24 197:17 198:1 199:24 200:15 201:10 203:8 204:14,18 205:17,21 tuning 167:24 turn 76:22 125:19 125:20 126:24 127:2,4,23 129:14 130:17 131:5 153:13 204:19 turned 130:23 131:25 153:7 turning 80:3 92:24 129:9,10 twice 202:5 twin 3:4 two 12:24 23:1 25:17 47:18,20 62:13 64:2 65:9 66:4 67:1 74:6,20 76:9 77:4 84:12 85:14 91:1,19 100:23,23 108:21 113:7 114:9,13 115:12,23 116:18 132:12,13,15	135:9 138:9,23 173:19 174:16 183:7 184:6 201:15 type 7:22 51:8 65:10 67:6 144:15 144:19 147:7 typed 187:20 types 76:16 142:12 typewriting 208:12 typically 18:17 25:2,17 44:10 45:8,10,13 88:20 141:4,24 142:2 169:7
u			
u.s. 9:2 149:7 uh 88:23 97:24 106:13 109:5 114:20 118:20 125:15 156:2 159:24 161:4 164:3 182:4 196:22 197:15 202:17 ultimately 105:22 108:17 111:14 un 102:19 unbounded 23:25 43:13 77:2 uncomfortable 91:12 uncritical 43:14 understand 25:6 31:5 33:4 42:17 50:12 51:7 52:8 63:6 76:21 87:13 88:11 97:15 99:4 101:11 115:17 116:3 118:4			

[understand - voice]

124:15 126:6,8 132:25 146:3 149:13 153:3 164:7 166:6 169:16 188:13 200:4 understanding 11:6 14:6 17:4 21:19 28:6,13 30:12 44:7 46:10 47:12,14 51:13 53:16 63:2 64:12 64:14 67:5 69:22 78:13 79:2 104:15 114:25 132:16 137:13 145:20 152:21 154:20 176:5 178:11,24 196:1 201:12 understood 35:18 54:23 169:4 186:14 193:23 undetermined 102:19 undisclosed 44:17 unfair 46:19 unheard 179:24 unique 31:24 unit 5:7 17:12 77:13 united 1:1 5:11 unknown 77:2 100:4 unloaded 53:18 unnecessarily 110:5,6,7 unnecessary 37:13 unpack 11:4 17:21 37:3 86:11 125:15 140:24	unpredictable 89:3,4 unreasonable 80:17 110:16,17 112:13 164:6 170:24 171:6 unreasonably 110:13 unreliable 180:8 unsafe 157:9 unscheduled 89:5 unspecified 57:8 57:22 unused 58:14 updated 109:22 upper 149:18,22 150:3,13,15,20 151:3,8,13,23 152:3,19,23 153:5 155:16 urquhart 3:3 usage 50:14 usages 155:18 use 51:24 53:24 76:22 80:8 88:15 89:8 91:23 96:15 96:18,22 97:9 101:24 103:17 111:4 114:10 116:1 125:12 137:6 140:5 144:9 148:3 149:23,24 150:6 155:8 157:6 157:21 160:10 164:13 171:1 192:1 196:3 useful 9:17 84:19 84:21 124:2,25 127:14 142:4 173:19	user 136:3 150:16 150:22,25 151:18 151:23 152:14,20 154:7 155:6,9,15 156:2 uses 141:6 161:22 185:9 usual 7:14 47:12 usually 36:24 47:13 83:9 utilized 125:10 165:6,10 utilizes 123:11 utilizing 125:2 v vague 9:15 82:11 93:1 96:17 102:4 103:21 118:1 125:8,24 128:18 142:16 143:4 157:23 163:7,8 190:14 vaguely 85:24 valuable 145:11 value 63:13 123:9 154:7 155:6,9 156:3,13 values 12:2 variables 102:20 109:24 variation 96:5 98:11,24 100:16 106:10 107:19,22 109:1 115:13,16 115:19,22,25 variations 95:24 96:8 98:6 107:8 109:9,16 116:20 117:12 161:23 varies 71:6	various 100:1 122:3 vary 35:13 71:10 84:13,16 96:4 97:16 115:20 143:13,14 varying 82:7 97:18 140:19 vdd 49:7 117:10 verbatim 40:25 79:19 89:11 veritext 5:15,16 206:11 versa 89:18 versions 114:9 versus 5:10 130:4 vice 89:18 video 5:7 84:3,4 86:25 88:19 89:8 191:2 videoconference 2:6,12,13,18 3:4,9 5:1 videographer 2:5 3:8 5:4,15 6:8,24 52:22,25 94:20 95:4 139:4,7 183:25 184:3 206:4,7 videotaped 1:17 2:1 view 26:9 59:2 71:1 172:11 viewing 131:3 133:3 virtual 5:13 voice 73:1,6,19,19 73:23 74:10,19 75:3,20 76:5,5,10 77:8 79:17 82:8 82:14,17 83:4,18
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[voice - witness]

83:19 92:19,22,24 93:5 94:5 volt 15:12 17:12 40:10,11 voltage 10:18 11:17 13:10,16 14:9,16,16,20,25 15:13 29:12 31:21 35:2 37:12,16,23 38:11,12,16 39:4,9 40:8,14 44:4,9,11 44:14,23 45:3,5,11 45:13,18 46:12 47:1,3 48:12 50:14 51:8,16,23 51:25 52:10,14 53:13,19,25 54:10 54:14 56:9 58:5,8 61:6 62:6 63:9,10 63:18 64:17 65:6 67:8,15 69:2 80:10 95:22 96:3 96:3,7 97:3,6,10 98:1,5,18,23 99:3 99:11,19,22 100:10,15 103:8 103:18 104:11,13 104:24 105:12,20 106:12,19 107:23 109:19 110:6 111:5,17 112:5,9 114:16,17,22 115:15 117:5,10 117:21,23,23 119:3,15 120:16 120:23 122:4 137:8,11,17 140:19 143:14 144:12 165:8,13 179:6 198:22	voltages 108:6 vs 1:7 w wait 41:5 111:16 112:8 130:17 167:16 182:13 waiting 176:17 waits 109:9 125:17 125:19,20 126:10 177:1 wall 155:18,24 156:3 158:19 want 9:10 24:22 24:22,24 30:4,17 36:24 42:25 44:24 51:19,21 56:24 58:11,22 93:25 94:1 95:15 100:20 104:10 105:14 106:4,8 107:1,4,12 109:3 112:20,25 121:5 127:1,5 130:16,24 131:16 131:19 133:11,18 134:18 135:9 138:18,18 149:12 149:12 152:10 161:19 170:16 182:8 185:2,3 189:19 194:7 195:12 202:23,23 206:4 wanted 196:4 204:6,14 wanting 76:21 warm 132:21 way 10:4,6 26:8 30:2 31:25 42:1 67:13 71:16 73:12 75:18,19 77:4 79:16 80:24 98:16	104:22,24 105:22 106:3,7,23 109:18 109:23 111:2 112:13 113:15 125:18 131:6 133:22 135:4 137:20 142:5,21 142:25 143:11 144:3 153:9 155:16 157:20 159:17 162:2 166:24 167:10,20 171:11 174:13 177:4 179:9 183:8 195:3 ways 67:10 76:2 102:24,25 104:12 105:1 108:7 110:19 141:20 148:14 153:19 167:8 we've 58:9 85:25 88:13 190:17 weeks 7:11 welcome 53:3 95:9 139:12 went 16:6,15 west 70:2 whatsoever 181:7 whichever 64:16 65:24 66:7 67:14 67:24 wi 70:25 71:2 widely 49:21 84:13,16 width 36:14 wiggles 105:2 wild 23:24 176:11 wiley 4:14 122:20 william 1:18 2:1 4:3 5:8 6:20 206:9	206:13 207:4,14 window 8:2 140:16 windows 8:5 wish 45:11 withdraw 46:6 withdrawn 42:13 68:13 76:13 79:5 79:9 86:16 101:22 104:11 106:15 138:5 139:25 142:11 146:12 147:5 170:23 witness 2:4 6:9,12 6:12,17 9:5,16 10:3,21 12:14 14:11 15:25 16:11 17:2 21:8 22:23 27:5 33:9 34:22 35:12 36:12 40:20 43:5 48:4,17 50:17,23 51:11 52:21 54:8 55:7 55:25 56:11,20 57:7 60:4,23 61:10 63:2 64:12 65:1,17 67:4 68:21 69:11 70:5 75:2 76:20 82:12 85:9 93:2 94:16 94:19 96:18 97:13 98:4,21 99:21 100:13 102:5 103:22 106:21 107:18 108:12 109:14 112:12 113:10 114:4 116:15 117:8 118:2 120:10 121:23 123:23 124:1 125:9,25
--	--	--	--

[witness - zoom]

128:19 129:6 137:19 142:17 143:5 145:9 147:18 148:10 149:2 150:12,18 152:1 153:3 154:20 155:12 156:6 157:24 158:17 160:4 161:8 162:15 163:8 165:1 166:5 167:3,20 168:16 169:24 171:4,23 173:11 174:11 175:12 176:4 181:24 182:17 184:24 186:25 187:16 188:3,5 190:8 192:11 193:16 195:1,6,23 197:19 198:3 200:1,2,16 201:11 203:9 206:2 208:6 208:21 wonder 152:4 word 67:19 68:1 91:12 92:8 122:22 192:1,18 194:2 203:13 worded 79:10 words 101:12 187:10 work 12:21 20:17 45:19 46:8 47:19 47:21 48:11 51:20 57:3 59:23 66:21 72:21 75:5 77:23 90:22 101:25 102:2 116:5 181:1 182:19	working 40:3,3 147:6,7,15 148:3 178:6,17,18,22 workload 32:23 78:21 works 7:15 17:5 18:22 21:20 52:21 55:9 57:21 70:8 104:4 149:13 183:10 world 81:10 worried 103:2 worry 102:11 worse 182:10 worst 114:10 worth 58:4 wrap 204:12 writ 138:12 168:17 write 188:12 writes 191:6 written 10:6 170:7 wrong 119:2 124:3 124:6 202:13 wrote 195:24	110:18 114:11 115:21 116:6,16 117:9,14 118:11 119:4 120:15,20 121:5,23 124:1 128:19 131:11 132:14 136:19 137:2,12,12,19 138:17,24 139:1,3 141:20 144:7 146:11 147:15 149:2,21 151:5,5 152:6 156:10,21 158:9 164:12,18 166:15 175:16 176:12,19 177:18 178:16,24 180:23 181:2 184:21 187:6,17,20,21 194:6 195:10 197:10 198:15 200:3 202:20 203:1 years 179:15 yeh 3:3 yep 164:20 187:11
	x	z
	x 4:1,10 9:24 11:2 xpp 1:8 5:10 6:7	zero 119:19 zone 160:24 161:2 179:17 zones 160:18,21 161:6 zoom 1:17 2:1,5 2:12,13,18 3:4,9 5:1,13 8:2 95:1
	y	
	yada 116:22,22,22 yeah 7:12,19 9:16 18:19 19:20 30:18 31:14 33:9,23 34:3,4 36:21 49:15 50:7 51:2 52:5,17 56:14 68:21 70:5 75:25 90:16 96:12 97:13 99:6 104:7 106:5 108:2,12 109:14	

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.

DISCLAIMER: THE FOREGOING FEDERAL PROCEDURE RULES ARE PROVIDED FOR INFORMATIONAL PURPOSES ONLY.

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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