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Transcript of Asad Abidi, Ph.D.

Date: March 11, 2025

Case: Apple, Inc.-v- Theta, IP, LLC (PTAB)

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WORLDWIDE COURT REPORTING & LITIGATION TECHNOLOGY

IPR2024-00816

Theta EX2021

Transcript of Asad Abidi, Ph.D.
Conducted on March 11, 2025

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1	1	1	3
1	UNITED STATES PATENT AND TRADEMARK OFFICE	1	A P P E A R A N C E S
2	BEFORE THE PATENT TRIAL AND APPEAL BOARD	2	
3	-----APPLE INC.,	3	FOR THE PETITIONER, APPLE, INC:
4	Petitioner,	4	ERISE IP
5	v.	5	BY: PAUL HART, ESQ.
6	THETA IP, LLC,	6	717 17TH STREET
7	Patent Owner.	7	SUITE 1400
8	-----	8	DENVER, COLORADO 80202
9	Case IPR2024-00816	9	(720) 689-0679
10	U.S. Patent No. 7,010,330	10	PAUL.HART@ERISEIP.COM
11	Case IPR2024-00817	11	
12	U.S. Patent No. 10,129,825	12	FOR THE PATENT OWNER, THETA, IP, LLC:
13	Case IPR2024-00818	13	BUNSOW DE MORY, LLP
14	U.S. Patent No. 10,524,202	14	BY: COREY JOHANNINGMEIER, ESQ.
15	Case IPR2024-00819	15	701 EL CAMINO REAL
16	U.S. Patent No. 11,564,164	16	REDWOOD CITY, CALIFORNIA 94063
17	Case IPR2024-00820	17	(650) 351-7240
18	U.S. Patent No. 11,638,210	18	CJOHANNINGMEIER@BDIPLAW.COM
19		19	
20	DEPOSITION OF DR. ASAD ABIDI	20	
21	VOLUME I	21	
22	DENVER, COLORADO	22	
23	TUESDAY, MARCH 11, 2025	23	
24	REPORTED BY: NATALIE PARVIZI-AZAD, CSR, RPR, RSR	24	ALSO PRESENT:
25	JOB NO.: CSR NO. 14125	25	PARKER SIMPSON, VIDEOGRAPHER
	575262		
2	2	4	4
1	UNITED STATES PATENT AND TRADEMARK OFFICE	1	I N D E X
2	BEFORE THE PATENT TRIAL AND APPEAL BOARD	2	
3	-----	3	WITNESS PAGE
4	APPLE INC,)	4	DR. ASAD ABIDI
5	Petitioner,)	5	EXAMINATION BY MR. JOHANNINGMEIER 7
6	v.)	6	EXAMINATION BY MR. HART 95
7	THETA IP, LLC,)	7	EXAMINATION BY MR. JOHANNINGMEIER 97
8	Patent Owner.)	8	
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10		10	E X H I B I T S
11		11	(RETAINED BY COUNSEL.)
12		12	EXHIBIT NO. DESCRIPTION PAGE
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14	DEPOSITION OF DR. ASAD ABIDI, VOLUME I	14	EXHIBIT 2 DECLARATION OF DR. ASAD ABIDI IN SUPPORT OF PETITION FOR INTER PARTES REVIEW OF U.S. PATENT NO. 10,129,825 9
15	TAKEN ON BEHALF OF THE PATENT OWNER	15	EXHIBIT 3 DECLARATION OF DR. ASAD ABIDI IN SUPPORT OF PETITION FOR INTER PARTES REVIEW OF U.S. PATENT NO. 10,524,202 9
16	REMOTELY VIA ZOOM VIDEOCONFERENCING, IN	16	EXHIBIT 4 DECLARATION OF DR. ASAD ABIDI IN SUPPORT OF PETITION FOR INTER PARTES REVIEW OF U.S. PATENT NOS. 11,564,164 9
17	DENVER, COLORADO, BEGINNING AT	17	EXHIBIT 5 DECLARATION OF DR. ASAD ABIDI IN SUPPORT OF PETITION FOR INTER PARTES REVIEW OF U.S. PATENT NO. 11,638,210 9
18	10:14 A.M. AND ENDING AT 1:03 P.M., ON	18	
19	TUESDAY, MARCH 11, 2025, BEFORE	19	
20	NATALIE PARVIZI-AZAD, CERTIFIED SHORTHAND	20	
21	REPORTER NUMBER 14125.	21	
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Transcript of Asad Abidi, Ph.D.
Conducted on March 11, 2025

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5 1 E X H I B I T S 2 EXHIBIT NO. DESCRIPTION PAGE 3 EXHIBIT 6 A 2.4-GHZ LOW-IF RECEIVER FOR 16 4 WIDEBAND WLAN IN 0.6- 5 CMOS-ARCHITECTURE AND 6 FRONT-END; 7 JOHN C. LEETE PAPER 8 EXHIBIT 7 ADAPTIVE ANALOG IF SIGNAL 26 9 PROCESSOR FOR AWIDE-BAND 10 CMOS WIRELESS RECEIVER; 11 FARBOO BEHBAHANI PAPER 12 EXHIBIT 8 A BROAD-BAND TUNABLE CMOS 35 13 CHANNEL-SELECT FILTER 14 FOR A LOW-IF WIRELESS 15 RECEIVER; 16 WEEGUAN TAN PAPER 17 EXHIBIT 9 UNITED STATES PATENT 49 18 NUMBER US 7,010,330 B1 19 20 21 22 23 24 25	7 1 THE CERTIFIED STENOGRAPHER: Good morning. 2 My name is Natalie Parvizi-Azad. I'm a certified 3 shorthand reporter with the State of California, CSR 4 number 14125. 5 Will you please raise your right hand to 6 be sworn. 7 8 DR. ASAD ABIDI, 9 having declared under penalty of perjury to tell the 10 truth, was examined and testified as follows: 11 12 EXAMINATION 13 BY MR. JOHANNINGMEIER: 14 Q. Okay. Good morning. Thanks for being 15 here today. I'll start with an easy question. 16 Can you just state your full name for the 17 record? 18 A. Asad Abidi. 19 Q. Abidi, okay. And you are a -- currently a 20 professor at UCLA; is that right? 21 A. Yes. 22 Q. And have been there for 40-plus years; is 23 that right? 24 A. 40. 25 Q. Yeah, okay. All right. I was a USC
6 1 REMOTELY IN DENVER, COLORADO 2 TUESDAY, MARCH 11, 2025, 10:14 A.M. 3 4 THE VIDEOGRAPHER: Here begins the 5 videotaped deposition of Dr. Asad Abidi in the 6 matter of Apple Incorporated versus Theta, IP, LLC 7 in the United States District Court and -- Trademark 8 Office before the patent and -- Patent Trial and 9 Appeal Board, case number IPR2024-00816, '00817, 10 '00818, '00819, and '00820. Today's date is 11 3/11/2025. The time on the video monitor is 10:14 12 Mountain Time. 13 The remote videographer today is Parker 14 Simpson, representing Planet Depos. All parties to 15 this deposition are attending remotely. 16 Would counsel please voice identify 17 themselves and state whom they represent. 18 MR. JOHANNINGMEIER: Yes. This is Corey 19 Johanningmeier of Bunsow De Mory, representing 20 Theta, IP. 21 MR. HART: Paul Hart with Erise IP 22 representing petitioner, Apple. 23 THE VIDEOGRAPHER: The court reporter 24 today is Natalie Parvizi representing Planet Depos. 25 The witness will now be sworn.	8 1 person myself, but I won't get into college 2 rivalries because those are long ago. 3 So, again, thanks for being here today. 4 Now, have you been deposed before? 5 A. Yes. 6 Q. About how many times? 7 A. One that I remember. Maybe a long time 8 ago a second one, but one in the past several years. 9 Q. Okay. And was that also in the context of 10 an IPR or patent case? 11 A. It was an IPR, yes. 12 Q. All right. Well, so I'll trust that your 13 counsel has talked to you about all of the logistics 14 and won't go through all of that. The one thing I 15 always say to everyone is, I'm not interested in 16 finding out about conversations you've had with 17 lawyers. So if I ask you a question that seems like 18 it's calling for details about conversations you've 19 had with lawyers, it's not intentional. Those would 20 be privileged. 21 If you ever have any question during the 22 depo about whether something will be privileged, we 23 can stop and you can talk to your counsel there and 24 make sure we're clear on that. Otherwise, you know, 25 he may or may not object, but, you know, we'll just

9 1 go through the questions and answers. 2 If you need any kind of break, just let me 3 know and we'll take one. 4 So now I have -- I understand that you 5 have in front of you -- so you understand that we're 6 here today on five different IPR proceedings that 7 you filed declarations in; right? 8 A. Yes. 9 MR. JOHANNINGMEIER: Okay. And so, I 10 will -- and we're treating these all together and I 11 really -- there's a lot of similarities between the 12 declarations so it makes it efficient to do so. I 13 have gone ahead and put in the Zoom chat what I've 14 labeled as Exhibits 1 through 5. 15 (Exhibit 1 marked.) 16 (Exhibit 2 marked.) 17 (Exhibit 3 marked.) 18 (Exhibit 4 marked.) 19 (Exhibit 5 marked.) 20 BY MR. JOHANNINGMEIER: 21 Q. I understand that -- and those are 22 basically copies of your declarations in those 23 proceedings. I understand you also have paper 24 copies in front of you; right? 25 A. Yes.	11 1 wish to make to this declaration? 2 A. Nothing substantial. There might be some 3 typographical errors, but, yeah, nothing 4 substantial. 5 Q. Okay. I just wanted to give you a chance 6 since, you know, obviously it's been a while since 7 these have been signed, if anything has been 8 discovered in the meantime. 9 What about the other declarations? Are 10 you aware of any things with the other four 11 declarations that you want to correct on the record 12 or clarify? 13 A. Yes. This is the declaration on the 14 patent '210, which is Exhibit 5. 15 Q. Okay. Okay. 16 A. And this is page 90. 17 Q. Okay. 18 A. Paragraph 161. 19 Q. All right. 20 A. Item Number 2. 21 Q. So what needs to change about that? 22 A. It should read "decreases a DC bias 23 current which increases the noise floor." 24 Q. Okay. Right. All right. Okay. Now, are 25 there any others like that that you found, like in
10 1 Q. Okay. So I will refer to paragraph 2 numbers and page numbers, and feel free to use the 3 paper copies. And we'll just follow along. If 4 you -- you know, if we need to put something up on 5 the screen we can, but it probably will work to just 6 follow along on the paper. 7 To be clear, Exhibit 1 goes with the '330 8 patent. Proceeding Exhibit 2 goes with the '825 9 patent. This is just for the record. 10 Exhibit 3 goes with the '202 patent, 11 Exhibit 4 goes with the '164 patent, and Exhibit 5 12 goes with the '210 patent. And we'll likely spend 13 most of our time talking about the '330 and 14 Exhibit 1 to the extent there's commonalities. 15 Now, so let's just start with Exhibit 1. 16 Can you open up your declaration from the 17 IPR2024-00816 for the '330 patent? 18 A. Yes. 19 Q. Okay. And I want you to go to the end on 20 page 100 and just confirm for me that that's your 21 digital signature and that you signed this on 22 April 30th of last year; is that right? 23 A. Yes. 24 Q. Okay. Now, since you signed this, have 25 you discovered any errors or corrections that you	12 1 prep or in reviewing this since they were written? 2 A. No. 3 Q. Okay. All right. Well, thanks for that. 4 I'm glad to ask. I don't want to -- I always hate 5 having those fights around typos so it's good to fix 6 them. 7 So now, these were signed in April of 8 2024. About when did you start work on this case? 9 A. Probably at the beginning of 2024, 10 sometime then. Sorry, I don't have those dates 11 handy. 12 Q. I understand, and an approximate is fine. 13 Now, on page 3 of your declaration -- and we'll just 14 use Exhibit 1 again -- in the first paragraph, you 15 mention your compensation not being based on the 16 substance of opinions, of course, or the outcome. I 17 take it you're being paid at your hourly consulting 18 rate for work on this case? 19 A. Correct. 20 Q. What is that rate? 21 A. \$1,000 an hour. 22 Q. Okay. And roughly how many hours did you 23 spend working on these declarations before they were 24 signed? Roughly? 25 A. Altogether, probably around 20 hours.

13 1 Q. Okay. And so that was primarily reviewing 2 and editing the declarations before they were 3 signed; is that -- is that right? 4 A. Of course. And then reading the patents, 5 searching for prior art, all of that. 6 Q. Okay. Now, so I take it -- and of course, 7 I'm not casting aspersions by saying this, but I 8 take it that you didn't personally draft every word 9 of this declaration; right? 10 A. It was done jointly between Erise and 11 myself. 12 Q. Right. Okay. So there were -- there's at 13 least some sections that were written maybe in the 14 first draft by counsel there, and then you reviewed 15 and edited as necessary; is that fair? 16 A. Yes. And there was a fair bit of editing 17 that went on. 18 Q. Sure. Sure. Of course. Okay. And now, 19 since these declarations were filed, have you 20 reviewed -- well, did you review Theta's preliminary 21 responses in the IPR proceedings? 22 A. No. 23 Q. Okay. And do you understand that 24 Professor Larry Larsen submitted a declaration in -- 25 with those responses?	15 1 Q. Okay. Or Mr. Leete or Mr. Tan? 2 A. No. 3 Q. Okay. Are you still in touch with them? 4 A. Not really. It's been a long time. They 5 were my students 20-plus years ago, so, you know, 6 they've gone on to their own lives. Yeah. 7 Q. Okay. All right. And so, now, do you 8 know Professor Savidis (phonetic)? 9 A. Yes. 10 Q. And so, I was looking at your relative's 11 CVs and it looks like you might have overlapped in 12 your undergraduate or graduate studies at Berkley; 13 is that right? 14 A. No, we did not overlap. 15 Q. No? 16 A. No. 17 Q. Did you overlap at Bell Labs? 18 A. He was a consultant but I never saw him 19 come there. He was busy writing a textbook at the 20 time, so... 21 Q. Okay. So I take it, then, you just know 22 him from being in the same field and going to 23 conferences and all that? 24 A. Exactly. 25 Q. Okay. Have you ever worked together on
14 1 A. Yes, I do know that. 2 Q. Did you read Professor Larsen's 3 declaration? 4 A. No. 5 Q. Okay. So I was going to ask you if 6 anything about that changed your opinion, but I 7 won't. 8 So have you read anything else since you 9 submitted these declarations that has caused you to 10 want to change or modify any of your opinions? 11 A. No. 12 Q. Okay. Now, preparing for this deposition, 13 I take it you met with Counsel there in Denver; is 14 that right? 15 A. Correct. 16 Q. Okay. And now in preparing for this 17 deposition, did you talk to anybody who wasn't a 18 lawyer? 19 A. No. 20 Q. Okay. And in preparing your declaration, 21 did you talk to anybody who wasn't a lawyer? 22 A. No. 23 Q. So, for instance, you didn't talk to 24 Mr. Behbahani; right? 25 A. No.	16 1 any research? 2 A. No. 3 Q. What's your -- I sort of have to ask 4 because of the context. What's your general view of 5 Professor Savidis? 6 A. He's very highly regarded. 7 Q. His textbooks have been used quite a bit; 8 right? 9 A. Yes. 10 Q. As far as I understand? 11 A. Yes. 12 Q. Okay. Now -- so you don't have any issues 13 or negative opinions or anything about 14 Professor Savidis; right? 15 A. No. 16 (Exhibit 6 marked.) 17 BY MR. JOHANNINGMEIER: 18 Q. Okay. Now -- so I want to ask about the 19 prior art references that you relied on. So I'm 20 going to go ahead and put in the chat what's going 21 to be marked as Exhibit 6, and that's going to be 22 the paper that I think you referred to as the Leetes 23 paper? 24 A. Yes. 25 Q. The "2.4-Gigahertz Low IF Receiver For

17 1 Wide Band WLAN." I take it you have a paper copy of 2 that there? 3 A. Yes, I do. 4 Q. Okay. So there's basically three prior 5 art references that you refer to in your deposition 6 as the "Behbahani reference," the "Leete reference," 7 and the "Tan reference;" right? 8 A. Right. 9 Q. And now these are all students of yours at 10 the time; is that right? 11 A. Yes. 12 Q. Okay. And so -- and some of the -- like, 13 for instance, Behbahani is an author in all of these 14 papers, including the one that we're calling the 15 Behbahani reference; right? 16 A. Yes. 17 Q. Okay. And so -- and you are listed as the 18 sort of last author on these papers as well; right? 19 A. Yes. 20 Q. So can you just describe for me what was 21 your role in this research at the time? 22 A. I conceived of this project. I was a 23 coprincipal investigator on a research contract we 24 had to develop this. This is very early work on 25 wide band wireless receivers. And I was involved in	19 1 technology. And our first work was for relatively 2 narrow band transmissions, but we were ambitious and 3 we could foresee the day when mobile users would 4 need very high data rates, where they could transmit 5 video and so on wirelessly or large data transfers, 6 like big files. So we were interested in using wide 7 band modulation schemes like QAM and so on. And 8 we're talking now the year 2000, way ahead of 9 industry. So the question was, how do you build a 10 receiver for these things? And that's what we were 11 tackling. 12 Q. Okay. 13 A. Wi-Fi was in its very, very, very early 14 stages. I think it was just -- I think the term had 15 been coined around -- around that time. 16 Q. Okay. So -- and I noticed there was -- 17 sort of looking to see what happened to some of 18 these authors. A couple of them went to Broadcom; 19 is that right? 20 A. John Leete went to Broadcom, and I think 21 some of them went to Broadcom for a little while and 22 then struck out on their own, yeah, but John Leete 23 is still there. He's the one I know who is still 24 there. 25 Q. Well, so I guess my question is: Did this
18 1 directing this group of students in developing these 2 circuits. So I was involved in the conception 3 stages of the circuits and troubleshooting and 4 development of circuits as they evolved. The 5 students then, you know, broke up the work amongst 6 themselves and dug deep into them in their design 7 simulation, and the students did the IC layout and, 8 eventually, they were responsible for the testing. 9 So I knew what was going on at the circuit 10 level and I was responsible for conceiving this 11 entire wide band receiver project and roughly 12 architecting it and so on. So it was -- 13 Q. Okay. 14 A. -- a pretty typical advisor-advisee 15 relationship in a university environment. 16 Q. Right, right. And you said it was under 17 contract. Was that an industry contract or 18 government, or -- 19 A. I think it was a DARPA contract, if I 20 remember correctly. 21 Q. And so this was for, basically, 22 2.4-gigahertz Wi-Fi; is that right? 23 A. No. This -- Wi-Fi was just coming on 24 board at that time. This was -- we were ahead of 25 industry at UCLA, we sort of pioneered this RFC MOSS	20 1 research ultimately get commercialized at Broadcom 2 or somewhere else? 3 A. Not directly. But, indirectly, I think it 4 influenced many people -- many companies. But not 5 directly. No one took this and say, "Okay, let's 6 take it the way it stands and make a product." 7 Because there were no standards for this stuff, you 8 know, this -- advanced modulation schemes like QAM. 9 Only became standardized many years later after we 10 had done this work. 11 So without a standard you can't make a 12 product, and that was kind of showing the 13 feasibility of using those modulation schemes. 14 Q. Okay. So like a proof of concept sort of 15 thing? 16 A. Yes, right. Right. 17 Q. All right. And so it looks to me like 18 each of these three papers sort of covers a 19 different section of the receiver chain roughly; is 20 that fair? 21 A. That's right. 22 Q. Okay. Now -- and so you did -- obviously 23 you supervised and you said you had some -- a big 24 role in developing the architecture. Did you do 25 actual circuit design on this or was it more --

21 1 A. No, it was a large issue. So the way it 2 works in the circuit areas is that we sketch out the 3 concepts and then ask the students to develop them, 4 to investigate them, and they do the circuit 5 simulations which is our tool to -- to investigate 6 circuit ideas. 7 Q. Right. So there was simulation and then 8 at some point there was a -- there were some built 9 circuits; right? 10 A. Yes. 11 Q. Okay. Was the whole receiver chain built 12 or just portions of it? 13 A. Well, there's a chip photograph here. 14 That's what got built. 15 Q. Okay. 16 A. Yeah. So chip photo of integrated 17 receiver, that's in the Leete paper, Figure 15. 18 Q. Right. So what got built was the LNA 19 mixers, filters, basically the -- the whole analog 20 front end; right? 21 A. Yes, correct. 22 Q. Okay. And then, did you build the analog 23 to digital converter and digital filtering in that 24 as well, or no? 25 A. No. No, I did not.	23 1 A. Right. 2 Q. And then that's driving the -- that's here 3 shown as a BPF, or bandpass filter block; right? 4 A. Yes. 5 Q. All right. And then I understand from 6 other papers that that bandpass filter is actually 7 one of two low-pass filters feeding a high-pass 8 filter; is that right? 9 A. Yes, yes. 10 Q. Okay. And then there is a final voltage 11 control gain amplifier; right? 12 A. Yes. Variable gain amplifier, yes. 13 Q. Sorry, variable gain amplifier. And then 14 that would have been the edge of the chip that you 15 built, and that would have been intended, in a real 16 system, to drive an A to D converter and then a 17 digital base-band; right? 18 A. Yes, correct. 19 Q. Okay. So -- now, were you involved in the 20 testing of the built chip? 21 A. From a distance. 22 Q. You looked at the results, for instance? 23 A. Of course, of course, yeah. Lots of 24 things, yeah. 25 Q. And then what was your involvement in
22 1 Q. Okay. So -- so then if we looked at the 2 receiver chain on Figure 1 on page 2. 3 Do you see that? 4 A. Are we referring to the Leete paper? 5 Q. Yes. Yes, the Leete paper. 6 A. Yes. 7 Q. Okay. So what's shown here, this is a 8 receiver block diagram. Basically everything that's 9 inside that dotted line was what got built in the 10 chip; is that right? 11 A. Yes, yes. 12 Q. Okay. So there's an LNA and then it looks 13 like a mixer in the RF portion; right? 14 A. Yes. 15 Q. An then you got some polyphase filters in 16 another mixer stage; is that right? 17 A. Yes. 18 Q. Okay. And then it looks like there's some 19 amps in -- so in the IF2 portion of this, what's 20 labeled here is polyphase times one and polyphase 21 times 4. There was a chain of polyphase filters 22 that were used for image rejection; right? 23 A. Yes, yes. 24 Q. Okay. And then those drove a programable 25 gain amplifier; right?	24 1 actually writing these papers? Was it still 2 supervisory and review, or -- 3 A. I more or less wrote all of them myself, 4 more or less. 5 Q. Okay. Yeah, I just -- I was curious. 6 Some people have the students do most of the writing 7 and some people do it themselves. So I take it you 8 were the primary author on these; is that fair? 9 A. In reality, yes. 10 Q. Yeah, okay. Now, the other thing I wanted 11 to ask you while we were looking at that block 12 diagram, it says here, "All paths are differential." 13 So I take it this entire received chain was 14 differential signals; right? 15 A. Yes, yes. 16 Q. Okay. So the -- the inputs and outputs of 17 each of these blocks were differential INQ signals, 18 basically? 19 A. No, INQ is -- "I" was differential and "Q" 20 is differential, so -- 21 Q. Exactly, right. 22 A. -- two separate signals. Yeah, each one 23 differential. 24 Q. Sorry. Thanks for clarifying. So -- 25 but -- so each input and output on each of these

25 1 blocks, I mean, they would have been differential 2 signals; right? 3 A. Yes, yes, yes. 4 Q. Okay. And so, there is some amount of 5 impedance matching, I take it, that goes on in -- 6 in -- in the phases between these blocks; right? 7 A. No. On chip, we don't worry about 8 impedance matching. That's only done when you build 9 discreet circuits on printed circuit boards. 10 Q. Okay. 11 A. But on chip, things are so closely packed 12 together there's no fear of reflections or -- 13 usually, yeah. 14 Q. Okay. Okay. All right. So -- so it 15 looks like a large portion of this particular paper, 16 the Leete paper, is talking about the mixer and -- 17 with integrated polyphase filters; is that right? 18 A. Yes. 19 Q. Okay. So if you look at page 7 at the 20 top, there's a Figure 14. 21 Do you see that? 22 A. Yes. 23 Q. So that's basically showing the image 24 reject chain that I mentioned before; right? 25 A. Yes.	27 1 Q. And so, looking at -- well, start with -- 2 on Figure 2, at the top of page 2. This is covering 3 the -- well, it's showing the image rejection down 4 to the programmable gain amplifier, right, and then 5 the variable band with adaptive DR bandpass filter 6 block; right? 7 A. Right. 8 Q. Okay. And so, that bandpass filter block, 9 that's the one we talked about where it's basically 10 one of two low-pass filters and then a high-pass 11 filter; right? 12 A. Yes. 13 Q. Okay. Now -- so going back a page to the 14 very first page of the article on -- so Figure 1; 15 right? So this is showing, basically, just kind of 16 a rough diagram of an analog bandpass filter 17 response over the top of a frequency spectrum; 18 right? 19 A. Yes. 20 Q. And so the idea here is that you want to 21 use this thing to pick one of QAM channels; is that 22 right? 23 A. Yes. 24 Q. Okay. And so -- now this also shows a 25 digital FIR filter that would have in the receiver
26 1 Q. And then, the output of that figure would 2 have fed into the programmable gain amplifier; 3 right? 4 A. Yes, yes. 5 Q. Okay. And then that's basically the last 6 thing that's talked about in this paper; right? 7 A. Yes. 8 Q. Okay. So if we wanted to know about 9 the -- the next block, which is the low-pass filter, 10 then we'd have to go to a different paper; right? 11 A. That's right. 12 MR. JOHANNINGMEIER: Okay. So let's do 13 that. I'm going to go ahead and put in as Exhibit 7 14 what's Exhibit 1004 in the IPRs. This is the paper 15 titled "Adaptive Analog IF Signal Processer" and 16 this is the one that your declarations refer to as 17 "the Behbahani paper." 18 (Exhibit 7 marked.) 19 BY MR. JOHANNINGMEIER: 20 Q. Do you have that? 21 A. Yes. 22 Q. Okay. And so -- now this paper covers 23 a -- sort of another subset of the same receiver 24 chain; right? 25 A. Yes.	28 1 chain in the real product, but that wasn't actually 2 built; right? 3 A. Yes. 4 Q. Okay. So essentially, the low-pass filter 5 gives you the initial up slope of this analog BPF 6 curve; right? 7 A. That's the high-pass filter. 8 Q. Oh. Yeah, sorry. Right. And then the 9 down slope on the other side is sort of the low-pass 10 filter portion; right? 11 A. Yes. 12 Q. And why does the low-pass filter circuit 13 come first? 14 A. Why does it come first? Yeah, these are 15 engineering tradeoffs, and it has to do with signal 16 handling capabilities and all of that. So we have 17 decided that the interferers, which would lie to 18 the -- you know, the picture, Figure 1, starts from 19 DC, the interferers would lie at positive 20 frequencies. And there could be many of them. So 21 if we could suppress them first it will make the 22 design of the high-pass filter a lot easier. 23 Q. Okay. 24 A. So these are -- you know, the order in 25 which you cascade things is based on considerations

29 1 like that. 2 Q. Right. Right. And so -- so ultimately, 3 it ends up being a lower power or easier 4 configuration to do the low-pass filter first? 5 A. Right. Correct. For the high-pass 6 filter, it simplifies that. 7 Q. Okay. Right. Right. Now -- so, you 8 built in this circuit, basically, two completely 9 separate low-pass filter blocks; right? 10 A. Yes. 11 MR. HART: Object to form. 12 Q. And that was because one -- one filter 13 block wasn't going to give you sufficient dynamic 14 range to cover the worst case, basically; right? 15 A. That's the idea, yes. 16 Q. Okay. And so here on page 2, it talks a 17 little bit about the adjustments that can be made. 18 And so in Figure 4, there's what's shown as -- it's 19 basically a substitution of a scaled circuit block; 20 right? 21 A. That's the worst case condition, yes. 22 Q. Yeah. So when -- when the worst case 23 condition -- and that -- that's Exhibit 3-C; right? 24 That's the worst case condition? 25 A. Yes.	31 1 times higher, it wouldn't make much of a difference 2 if the low-pass filter was left on. But, yeah, you 3 can think of it roughly like that. 4 Q. So -- and then, when you did that switch, 5 basically, the signal pass was routed to run through 6 the other filter, essentially; right? 7 MR. HART: Object to form. 8 A. Yeah. The signal path, I'm not sure if I 9 would say it was "routed," because these two 10 together comprise a single functional block, which 11 is in Figure 2 labeled "Variable Bandwidth Adaptive 12 Dynamic Range Bandpass Filter." 13 So the adaptive dynamic range is achieved 14 by Figure 4B and the nominal operating conditions 15 are Figure 4A, and all of that is bundled into this 16 one block, which is the adaptive dynamic range 17 bandpass filter. 18 Q. I understand -- I'm sorry. 19 A. So -- so the signal path, as far as the 20 signal is concerned, it's flowing through what we 21 call the "filter." And that filter has, inside it, 22 circuits that can adapt dynamic range as needed. So 23 I would consider this as not switching the signal 24 path, but just offering the signal a variable 25 dynamic range on demand.
30 1 Q. Figure 23C? 2 A. Yes. 3 Q. Okay. So when that is detected, the 4 circuit would swap to the -- the higher power or 5 low-pass filter; right? 6 A. Yes. 7 Q. To get additional linearity, basically? 8 A. Yes. Well, dynamic range, lower noise. 9 Q. Right. I'm sorry. 10 A. Lower noise. Same maximum signal 11 handling, but lower noise. 12 Q. But that circuit was basically 10X of the 13 power consumption of the -- the other low-pass 14 filter; right? 15 A. Yes. 16 Q. Okay. So the idea was only switch to that 17 when you need it; right? 18 A. That's right. 19 Q. Okay. Now -- so this is describing that 20 as a substitution. So I take it when that occurred, 21 the low-power low-pass filter would be turned off 22 and the high-power low-pass filter would be turned 23 on, basically; right? 24 MR. HART: Object to form. 25 A. They would both be turned on, because ten	32 1 Q. Okay. But -- now, just as a matter of 2 actual wiring, I understand that we can draw a box 3 around any portion of the circuit and call it a 4 filter or call it a chip or call it whatever, but 5 what I'm asking about is the actual connections that 6 were in the chip. 7 Can you look, with me, at Figure 9 on 8 page 6 of this -- this -- what, Exhibit 7? 9 A. Yes. 10 Q. Okay. So just to get how this was wired, 11 right, this seems to show the polyphase output, and 12 then, basically, it's going to, basically, one of 13 two paths through different amplifier stages, and 14 there are switches on each of these paths. 15 Do you see that? 16 A. Yes. 17 Q. So essentially, when the higher power 18 filter is off, I take it these switches are open and 19 you're not jamming signal into it; right? 20 MR. HART: Object to form. 21 A. Well, it -- so in principle, if it's off, 22 you could give it a signal or not, it wouldn't make 23 any difference. 24 Q. Right, right. 25 A. But, yes, the intention is to route the

33 1 signal to the low-pass power filter, but that 2 doesn't necessarily exclude having a signal present 3 at the high-power filter, because it's off so it's 4 not going to respond. 5 Q. Right. I understand. So I just wanted to 6 be clear that the actual -- I mean, what's disclosed 7 here is fairly clear. You turn one on and then -- 8 then it's used -- the higher power filter is used. 9 But I wanted to just clarify that's how this 10 actually worked. 11 When you did the swap, the signal was, as 12 you said, rerouted to the other filter, and that 13 filter is turned on and used. And then, when you're 14 not using it, you turn it off to save power; right? 15 A. Correct. That's right. 16 Q. Okay. So now, so just looking at this, it 17 appears to me like this is set up to essentially not 18 drive the small -- to switch the signal, you know, 19 away from or not drive -- wait, sorry. Strike that 20 question. 21 So there's amplification shown here in 22 this Figure 9; right? 23 A. Uh-huh. 24 Q. So you have an amplifier that's basically 25 driving the high-power filter at the top; right?	35 1 can switch in and out one or more of these 2 amplifiers, depending on how much amplification you 3 want to drive into the filter, basically; right? 4 A. Right. 5 Q. Okay. Now, this -- this paper describes 6 the programmable gain driving the filter, but 7 doesn't actually describe the filter either; right? 8 That's the next one? 9 A. Yes. 10 MR. JOHANNINGMEIER: Okay. So let's look 11 at what I'll go ahead and put in the chat as 12 Exhibit 8, and this is Exhibit 1006. 13 (Exhibit 8 marked.) 14 BY MR. JOHANNINGMEIER: 15 Q. And it's what's been -- I think in your 16 declarations you refer to this as the Tan paper; 17 right? 18 A. Yes. 19 Q. Okay. So was it the case that Mr. Tan 20 worked on the filter part? 21 A. He had -- yes, he had major contribution 22 to the filter, yes. 23 Q. Okay. All right. And so this paper is -- 24 it's about the channel select filter portion; right? 25 A. Yes.
34 1 A. Yes. 2 Q. And then there's a different -- well, it 3 looks like two driving -- oh, I'm sorry. There's 4 one that -- so there's an amplifier that's only 5 driving the high-power filter, right, the HPW step 6 one; right? 7 A. But it also can drive the low-power 8 filter. If you look at the dashed line -- 9 Q. Oh, I see. 10 A. Yeah. So we use -- we basically got 11 amplifier, we use them in different ways. We try to 12 reuse stuff, so use them in different ways. We can 13 route things kind of all over the place as is 14 needed. 15 Q. Right. Okay. So this is -- this is 16 basically showing the programmable gain amplifier 17 block of the chain; is that -- is that right? 18 A. It's the pre-filter gain that came before 19 the filter, because it was, again, after the filter 20 as well. 21 Q. Right. So in the -- in the diagram, the 22 Figure 2, it's what's labeled as PGA1; is that 23 right? 24 A. Yes, yes. 25 Q. Okay. All right. And so, basically, you	36 1 Q. Okay. So here, if you turn to the page 2, 2 there is another block diagram up at the top in 3 Figure 1; right? It's the same one, basically; 4 right? 5 A. Yes. 6 Q. And so, again, here the -- what's shown is 7 the analog chip from the image reject down converter 8 through to the -- to where the A/D would be -- where 9 it was actually built; right? 10 A. We did not build the HD, but yes. 11 Q. Okay. Yes. Okay. So the -- the -- 12 basically, there was an analog output to this chip; 13 right? 14 A. Yes, yes. 15 Q. All right. And so the block, then, that 16 we've been calling the filter is what's labeled here 17 as the variable bandwidth or BW, BPF. 18 (Reporter seeks clarification.) 19 Q. Variable bandwidth or BW, BPF. That's 20 what you referred to as, sort of, the filter block; 21 right? 22 A. Yes. 23 Q. Okay. Now, on the next page, Figure 3 up 24 at the top, there's a -- what's basically described 25 as a simplified diagram of the variable

37 1 transconductor core of this filter; is that fair? 2 A. Yes. 3 Q. Okay. And so the inputs here are 4 differential and they're driving the gate of a 5 couple transistors; right? 6 A. Uh-huh, yes. 7 Q. All right. So now, does this diagram sort 8 of apply to both the high power and the low power 9 version? They were -- they have the same 10 architecture; right? 11 A. Yes. I -- I can't say that -- roughly, 12 yes. I can't say in every detail, but yes. This is 13 describing a -- a variable transconductor that's 14 using transistors and resistors. 15 Q. Right. And it's using the resistors, RS, 16 and then, I guess, to some extent, NM 3 and 4, it's 17 using that for degeneration; right? 18 A. Yes, yes. 19 Q. Okay. And so, basically, the resistor is 20 what's influencing the bias turn of this thing. Is 21 that a fair way to describe this? 22 A. Yeah, it's a combination of RS and the 23 transistors NM3 and NM4, which is nonradio 24 resistors. They're operating in their triode region 25 and that's what gives us controllability. So by	39 1 A. Yes. 2 Q. Okay. The -- the drain -- sorry, the -- 3 the resistors, the bias -- what we call the bias 4 resistors, RS and NM3 and 4, doesn't actually carry 5 signal, right, that's not part of the signal path? 6 A. No, they do. The signal flows from the 7 drain, through the transistor, into the source. So 8 just like this arrow indicates, there is a bias 9 current that flows through the transistor all the 10 way to ground. But simply, signal currents flow 11 through transistor to ground. So the signal can 12 flow in the load, through the transistor, through 13 RS, all the way down to ground. 14 Q. Sure, I understand. But I mean, I 15 guess -- you know, fundamentally, this is how 16 transistors work. But I guess what I'm getting at 17 is, sort of, the idea of the signal path. So when I 18 think about signal path, I don't typically talk 19 about the, you know, currents that go straight to 20 the ground as being the path of the signal. 21 The signal through this -- through this 22 transconducting core is basically coming in the 23 input and out through the load; right? 24 A. And -- 25 MR. HART: Object to form.
38 1 changing the voltage AFC, we can vary that 2 resistance. 3 Q. Right. So NM3 and NM4 are basically -- 4 can be thought of as a variable voltage variable 5 resistor; right? 6 A. Yes. In series with a fixed resistor, 7 yes. 8 Q. Sure. And again, this is basically what's 9 determining the -- the, sort of, bias current 10 through this circuit; right? 11 A. Yes. In the simplified circuit, yes. So 12 you would have a bias voltage applied at the input, 13 and then this would determine the resulting current. 14 Q. Right. Okay. Correct, correct. That's 15 clear. Yes. And so, again, the input of this is 16 differential; right? INP and INN; right? 17 A. Yes. 18 Q. Okay. And then the output of this, it's 19 basically not really shown, but it's a load 20 across -- well, there's a load connected between the 21 drains of these -- MN1 and MN2; right? 22 A. Yes. 23 Q. Okay. So, now -- so the signal passed 24 through this circuit is essentially into the input 25 and then out through the load; right?	40 1 A. Yes. It goes to the load, yes. And then 2 on to other stages. 3 Q. Right. Right. Just the next stage and 4 the next stage. Okay. So now, there's an -- 5 additional diagrams of the circuit (indiscernible) 6 simplified in Figure 6 on page 5. Can you turn 7 there? 8 A. Yes. 9 Q. Now -- so this is showing, I mean, 10 basically the degeneration network is little bit 11 more complicated for one of these. But this is 12 basically showing the two filters, the low noise 13 low-pass filter and the low power low-pass filter; 14 right? 15 A. These are the transconductors that 16 comprise those filters, so they're a building block. 17 Q. Right, right. And I'm -- I'm -- you know, 18 I'm talking about the transconductor portion because 19 that's the portion you identified in your 20 declaration as being the variable part. So I 21 understand it's not the whole filter, but -- so 22 what's shown here in 6A is the variable 23 transconductor circuit for the 24 low-noise-high-power-low-pass filter; right? 25 A. Yes.

41 1 Q. Okay. And so -- and essentially, it's got 2 a little more detail about the low, but it is 3 basically the circuit we were looking at in its 4 simplified form in 2 to 3; right? 5 A. Yes. 6 Q. And then, Figure 6B is showing the -- sort 7 of the low power low-pass filter; right? 8 A. Yes. 9 Q. The transconductor portion of it; right? 10 A. Yes. 11 Q. And I understand from reading this that 12 for that one you could vary the bias current by 13 basically picking one of the these sets of 14 transistors. So the VAFC1, VAFC2, VAFC3, only -- or 15 VFC4, only one of those is going to be active in a 16 given time; is that right? 17 A. That's correct, but they do not affect the 18 bias current. So VAFC1 through 3 are bridging 19 resistors. They do not affect the bias current that 20 runs vertically down to ground. 21 Q. Sure, yes. I'm sorry. But they're 22 selecting a bias current by controlling where you 23 put the bridge, basically; is that right? 24 A. No. They're selecting a degeneration. 25 They're changing the degeneration without changing	43 1 Q. Yeah, okay. Because, I mean, it doesn't 2 save as much power, but it does save power if you 3 turn it off when you're not using it; right? 4 A. Yes, yes. 5 Q. Okay. Now, I have a question about the 6 table -- so if we look back at page 4 -- well, I'm 7 sorry, before we go there -- let's just stay on 8 these figures. 9 So looking at these two circuits, the -- 10 for the transconductors, the -- the input of this -- 11 of this circuit is -- again, it's a gate of -- well, 12 it's a differential to the gates of the two 13 transistors; right? 14 A. Yes. 15 Q. So the input impedance -- if you look -- 16 if you're looking into the circuit at the input, the 17 input impedance is very high? 18 A. Yes. 19 Q. Okay. And that's -- it's the same for 20 both, basically; right? 21 A. Yes. 22 Q. Okay. Now, on page 4 section C in the -- 23 near the top of the first column, there is a -- 24 basically, it says, with the above bias voltages, 25 the GM over I bias of the transconductance is about
42 1 the bias current. 2 Q. I see. Okay. All right. Thanks. So 3 I -- I do have an electrical engineering degree, but 4 it's 25 years ago. So I -- you know, I apologize if 5 I'm getting a few of these things slightly wrong. 6 A. No problem, no problem. 7 Q. Okay. All right. So, now -- so, again, 8 these are -- within the bandpass filter blocks, 9 these are two separate low-pass filter circuits. 10 Basically, there's two separate low pass circuits in 11 there; right? 12 MR. HART: Object to form. 13 A. Yes, two filters. 14 Q. Right. And then we already talked about 15 how the one that's shown here at the top is 16 basically ten times the power; right? 17 A. Yes, correct. 18 Q. And so, it's turned off when not in use; 19 right? 20 A. Right. 21 Q. Okay. And so -- and for that matter, 22 the -- the lower one -- lower power one is turned 23 off when not in use too; right? 24 A. Right. I think that's the way we used it, 25 yes.	44 1 1. What is the GM over I bias figure, what does 2 that represent? 3 A. It's got to do with current efficiency so, 4 what you look to do is get as powerful a transistor 5 as you can with as low of a bias current so that you 6 save power. So this ratio is somehow an indication 7 of that. 8 Q. Right. Okay. And now looking at the -- 9 page 5 on -- there's a table, Table 2 at the top. 10 Do you see that? 11 A. Yes. 12 Q. So this is -- it says "characteristics of 13 the filter transconductance." And so, basically, 14 it's got a column here for high and low power. I 15 think this is referring to both filters; is that 16 right? 17 A. Correct. And it's referring to the 18 transconductance only, so it's referring to the 19 circuits in Figure 6. 20 Q. Right. Exactly. Okay. 21 And so -- so, basically, the GM over high 22 diff figure is the same for both; right? 23 A. Yes. 24 Q. The ratio is roughly one? 25 A. Right.

45 1 Q. And -- but the, sort of, nominal gain 2 is -- is obviously a factor of ten higher for one 3 than the other; right? 4 A. The transconductance, yes. 5 Q. Oh, I'm sorry. Yes, the transconductance. 6 Upper case G sub M is the transconductance; right? 7 A. Yes. The effective transconductance of 8 the circuit, yes. 9 Q. Right, okay. All right. And so, it's the 10 whole thing. And so, that is basically ten times 11 higher for the Figure 6 A circuit than the Figure 6 12 B circuit; right? 13 A. Yes. 14 Q. And now, the other thing here being the 15 input output swing is essentially the same for both; 16 right? 17 A. Yes. 18 Q. Okay. So the -- we talked about how the 19 input impedance, looking at this transistor, is 20 high; right? 21 A. Yes. 22 Q. If you're looking at the output impedance, 23 what's the output impedance of this transistor 24 circuit? 25 A. It's determined by the parallel	47 1 parallel. So at the input, we have five 2 transconductors in parallel. It gives a 3 transconductance with strength five times the unit 4 transconductance, and then there's -- inside the 5 filter, there are these triangles in opposing 6 directions. Those are two transconductors with 7 strength three each, and so on. 8 Q. Okay. And then what about these triangles 9 with the two in them, what are those? 10 A. Those are termination resistors. So if we 11 look at the picture on the very top which gives the 12 equivalent circuit, we have what are called 13 termination resistors at the input and the output. 14 This is called a "doubly terminated 15 filter." So there's a resistor at the input to 16 which you connect a voltage source and a resistor at 17 the output where you sense the output voltage. And 18 these two transconductors, whose output connects 19 back to its input, simulate resistors. 20 Q. Uh-huh. Right. And so -- and I guess the 21 other thing, then, is that, looking at these pairs 22 of negative feedback transconductors, the triangles 23 with "3" in them, each of those is meant to 24 basically function as an inductor, essentially; is 25 that right?
46 1 combination of the NMOS FET, the one that receives 2 the input, degenerated by the resistors in parallel 3 with the PMOS FET output resistance, in parallel 4 with this little block called "Negative Conductance" 5 which is there to boost the output resistance. So 6 three contributors. 7 Q. Right. And so, then the -- they would 8 obviously -- well, maybe not -- let me start again. 9 Is it the same or different output 10 impedance between these two circuits, 6A and 6B? 11 A. They -- they will be different because the 12 transistor sizes are different. 13 Q. Okay. Right. Okay. So -- now, I had 14 another -- I'm sorry, I'm just trying to ask 15 clarifying questions about this -- you know, looking 16 at Figure 9 on page 7. 17 A. Yes. 18 Q. So what is Figure 9 showing? 19 A. It's showing the architecture of the 20 low-pass filter. 21 Q. Okay. And so, how does that 22 transistor circuit that we just looked at fit 23 into that architecture? 24 A. So each of these triangles is a certain 25 number of these transconductors connected in	48 1 A. When -- when connected or when coupled to 2 capacitors. So, strictly speaking, starting from 3 the left side, if we move horizontally, we get one 4 pair of transistor size 3, a capacitor, 25-unit 5 capacitors, and then another pair of transconductors 6 size 3. And end-to-end which is the terminals of 7 where I started to where I ended, that simulator 8 floating conductor. So four transconductors and one 9 capacitor simulate a floating conductor as shown in 10 the circuit above. 11 MR. JOHANNINGMEIER: Okay, great. Thanks. 12 Now -- okay. I think that's -- those are 13 the questions I had on that. We can obviously refer 14 back to these as we need to. 15 I want to actually ask you some questions 16 about your declaration. Now, we've been going for 17 about an hour, do you want to take a quick break or 18 do you want to keep going? 19 MR. HART: This is Paul. I could use a 20 break, if you don't mind. 21 THE WITNESS: I could use one too. 22 MR. JOHANNINGMEIER: No problem. Let's 23 just take, like, a ten-minute break? 24 MR. HART: That's great, thanks. 25 THE VIDEOGRAPHER: Okay. We're going off

49 1 the record. The time is 11:16. 2 (Recess.) 3 THE VIDEOGRAPHER: We are back on record. 4 The time is 11:30. 5 BY MR. JOHANNINGMEIER: 6 Q. Okay. Welcome back. Now, I wanted to ask 7 you about your declarations. And so, let's use the 8 one -- Exhibit 1, basically, for the '830 patent. 9 And I understand you have a copy of the '830 patent 10 there as well -- or the '330 patent, sorry, up -- 11 A. Yeah. 12 Q. -- there as well? 13 A. Yes, I do. 14 MR. JOHANNINGMEIER: Okay. So I'm going 15 to go ahead and put that into the chat as Exhibit 9, 16 in case we need to refer to it. 17 (Exhibit 9 marked.) 18 BY MR. JOHANNINGMEIER: 19 Q. So actually, let's look at that right now. 20 And can you turn with me in the '330 patent to -- I 21 guess, it'll be page 23 of the exhibit, the bottom 22 of column 12. 23 A. Yes. 24 Q. Okay. So the bottom of column 12, 25 there's -- is where claim 1 is; right?	51 1 Q. Right. Right. Okay. I just wanted to 2 make sure I understand that was your -- your 3 interpretation. And I'm not saying it's wrong or 4 right. I just want to -- so your -- because the 5 Behbahani reference, for instance, has amplifiers 6 between the mixer and the filter; right? 7 A. Right. Right. 8 Q. Okay. But the -- the low-pass filter in 9 Behbahani is downstream from the mixer; right? 10 A. Through an amplifier, yes. 11 Q. Okay. And then, so, at the top of 12 page 47, you say -- you have a header that reads, 13 "Behbahani's LNA, Mixer, and Low-Pass Filter are 14 Components of an Integrated Circuit That Receives a 15 Signal"; right? 16 A. Yes. 17 Q. Okay. And so then, in paragraph 85, you 18 point to Figure 2, which depicts an analog chip that 19 includes the components, including a LNA, a mixer, 20 and a low-pass filter; right? 21 A. Yes. 22 Q. Okay. And so, here, you're referring to 23 the green box in Figure 2 as a low-pass filter; 24 right? 25 A. Yes.
50 1 A. Yes. 2 Q. Okay. And claim 1 is one of the claims 3 you analyzed; right? 4 A. Yes. 5 Q. Okay. So one of the things that claim 1 6 requires is that the signal path include a low noise 7 amplifier, a mixer, and a low-pass filter having an 8 input coupled to the output mixer; right? 9 A. Yes. 10 Q. So let's look at your declaration, then, 11 starting at paragraph 83 of Exhibit 1. 12 A. Yes. 13 Q. Okay. So this is the portion of your 14 declaration where you talk about the Behbahani 15 reference and you say that it has an -- a LNA, a 16 mixer, a filter topology; right? 17 A. Yes. 18 Q. And now, I understand from your 19 declaration that, you know, the claim when it says, 20 "coupled to," you're not reading "coupled to" as 21 requiring a direction connection with no intervening 22 circuitry; right? You're suggesting that "coupled 23 to" would allow for intervening things to be in 24 between; right? 25 A. Well, simple things like an amplifier.	52 1 Q. But actually, we already talked about how 2 that box includes low-pass filter components and 3 high-pass filter components; right? 4 A. Yes. 5 Q. Okay. But the claim here requires a 6 low-pass filter; right? 7 A. Yes. 8 Q. But you're referring to the low-pass 9 filter component of that block; right? 10 A. Yes, which -- 11 MR. HART: Object to form. 12 A. Which actually appears first, so the PGA 13 feeds into a low-pass filter. 14 Q. Right. Right. Understood. 15 Now, looking at page 49. At the top, 16 there's a figure. This is basically a layout of the 17 chip that we talked about earlier that your group 18 built; right? 19 A. Yes. 20 Q. Okay. And so, just so I understand, 21 there's -- basically, there's a purple section here 22 labeled, "Channel Select Filter" and "Auxiliary 23 Channel Select Filter." 24 A. Yes. 25 Q. Do you see that?

53 1 A. Yes. 2 Q. So is that the entirety of the bandpass 3 filter or is that just the two low-pass filters? 4 A. I am not sure, but it would seem... 5 It would -- yeah, I am not sure. I mean, 6 the high-pass filter might be on that box. Sorry. 7 I don't remember. 8 Q. Okay. Would you look with me at 9 Exhibit 8, which is the Tan paper. It might help. 10 On Figure 16, there's another micrograph 11 of a chip. 12 A. Yes. 13 Q. Okay. And I would -- now, is that the 14 same chip as what's in Figure 15 of Leetes or is 15 it -- is it something different? 16 A. It's a standalone chip that just tests the 17 filters. And you can tell that because the pads 18 surround the chip and that defines the periphery of 19 the chip. 20 Q. Okay. 21 A. So you see there's little white squares? 22 They -- they run on three sides, so that means 23 that's a standalone chip. 24 Q. Okay. So -- so there was a standalone 25 chip built with just the filters; is that right?	55 1 that is distinct from resistance," but basically 2 that they're both electrical characteristics of 3 current; right? 4 A. Yes. 5 Q. Now, how does -- well, okay. So then you 6 say that "a person of ordinary skill would have 7 understood that there's typically an inverse 8 relationship between transconductance and 9 resistance"; right? 10 A. Yes. 11 Q. Okay. But typically means not always; 12 right? 13 A. It will -- no. It would be -- okay. So 14 there's always an inverse relationship between 15 transconductance and resistance because they are two 16 separate concepts, but they are intimately related. 17 So resistance -- 18 Q. Right. Okay. Yeah. 19 A. Yeah. So resistance -- 20 Q. Sorry. My question was going be, 21 basically, because it says "typically." Like, what 22 the -- is there a circumstance where they're not 23 related, in your view, but it sounds like maybe not? 24 A. Yeah, there wouldn't be any such thing. 25 Transconductance is just a generalized conductance.
54 1 A. Yes. 2 Q. Okay. All right. 3 And then, those filters were also built in 4 an integrated chip? 5 A. Right. 6 Q. Okay. To test the whole analog portion of 7 the chain; is that right? 8 A. Yes. 9 Q. Okay. So here, looking at Figure 16 in 10 the Tan paper, basically the signal through the chip 11 is going to go through either what's labeled APF or 12 low-power LPF; right? And then, into -- from either 13 of those into the HPF block; right? 14 A. Yes. 15 Q. Okay. Now, let's look at -- go back to 16 your declaration. I wanted to ask you about 17 starting at paragraph 102. 18 So let me know when you're there. 19 A. Yes, I'm there. 20 Q. Okay. So this is part of a discussion 21 about the dynamically changing and impedance 22 element; right? 23 A. Yes. 24 Q. Okay. Now, so here in 102, you say, 25 basically, "Transconductance is a well-known concept	56 1 Conductance is the inverse of resistance, so a 2 generalized conductance is where you apply a voltage 3 on two terminals and you see the current in response 4 at another two terminals. That's called a 5 transconductance. 6 Whereas a conductance is where you only 7 have two terminals. You apply a voltage across them 8 and you see a current flow between the same two 9 terminals. 10 So, transconductance simply separates the 11 terminals where you apply the voltage and the 12 terminals where you receive the current, whereas 13 conductance unites those pair of terminals into one 14 pair. Otherwise, both obey what you might say is 15 Ohm's law. So in that sense, they are totally 16 related. 17 Q. Now, is it your understanding that people 18 use transconductance when referring to AC signals 19 and small signals as opposed to DC? 20 A. You can apply transconductance to 21 anything. It's nothing to with AC or DC. The 22 concept of transconductance is completely general. 23 Q. Right. But like, for instance, so 24 impedance has a real and a complex component; right? 25 A. Yes.

57 1 Q. And so, in a resistor there's no complex 2 component to an impedance, so it can be said that a 3 resistor has an impedance; right? 4 A. You can say it's got an impedance, but the 5 imaginary part is zero. 6 Q. Right. So how is the -- the -- does 7 conductance also have a real and imaginary part? 8 A. Of course. Conductance is simply the 9 inverse of resistance. 10 Q. Right. Right. Okay. But basically, the 11 conductance of a resistor is going to basically just 12 the resistance? 13 A. One over the resistance, yes. So a -- 14 Q. (Indiscernible). 15 A. Right. So a 10 ohm resistor is .1 siemens 16 of conductance. 17 Q. Mh-hmm. Right. Right. Okay. 18 So, but then, when you're -- okay. 19 So, now -- so you're essentially treating, 20 in this declaration, transconductance as an 21 impedance; is that fair? 22 A. No, I'm not saying that. I'm saying that 23 there is a relationship. So an impedance has a very 24 specific meaning. It applies only to two terminals. 25 A transconductance is four terminals, two pair of	59 1 the way I vary it is by changing the resistance of 2 NM3 and NM4 with a voltage AFC. 3 Q. Okay. So then that -- now, if you change 4 the voltage AFC, then you're basically -- you're 5 effectively changing the resistance of NM3 and NM4; 6 right? 7 A. That's right. And they degenerate these 8 two transistors on the top, NM1 and NM2. So if you 9 change the degeneration, you change the effective 10 transconductance. 11 Q. Okay. 12 A. So associated with the transconductance, 13 there is -- inside the transconductance circuit, 14 there is a resistor somewhere. And the two 15 resistances that are not fixed, but which change 16 with bias current and so on, and with voltages, are 17 the channel resistance. 18 Channel means the conducting path between 19 the drain and the source of NM3 and NM4, as well as 20 NM1 and NM2. So as we change the transconductance, 21 we are actually changing the resistance of those 22 channels. 23 The channels are a conducting layer, and 24 we are putting more carriers or fewer carriers into 25 them. And that's what changes the transconductance
58 1 terminals. 2 So you can't -- I can't treat them 3 equivalently, but they are in -- they are total 4 analogs of each other. They are -- transconductance 5 is a generalization of conductance. That's the way 6 I'm treating it. 7 Q. Okay. Well, so now, the claim of the -- 8 claim 1, for instance, of the '330 patent requires 9 dynamically varying impedance; right? 10 A. Yes. 11 Q. Now, you're pointing to a circuit where 12 you're saying the transconductance changes; right? 13 A. Yes. 14 Q. So how is changing the transconductance 15 changing an impedance? 16 A. So there's -- I would like to refer to one 17 of the figures that you had brought up in the papers 18 earlier. Let me just find it. 19 So this is the Tan paper, Figure 3. 20 Q. Okay. Right. This is the simplified 21 transistor diagrams that we talked about 22 earlier? 23 A. Yes. Yes. 24 Q. Okay. 25 A. So this is a variable transistor, and	60 1 of this circuit. 2 Q. Okay. So -- and just to be clear, the 3 thing that you're pointing to is changing the 4 transconductance is variation of the voltage at 5 AFC -- 6 A. Yes. 7 Q. -- right? 8 Which then causes to the variable resistor 9 trans -- well, the transistor NM3, which is 10 operating as a variable resistor, it causes that to 11 change its resistance and, therefore, the flow of 12 current through it; right? 13 A. And therefore, the effective 14 transconductance presented by this entire circuit 15 where the transconductance is measured from the 16 input voltage NP and NN to the -- to the switching 17 or AC current going into the load. That's the 18 transconductance. 19 So that effective transconductance changes 20 as a consequence of the changing resistance in NM3 21 and NM4. 22 Q. Right. So this would be true of any -- 23 sort of any generic degeneration resistor used with 24 a transistor; right? If you change the degeneration 25 resistance, you're going to change the current

61 1 through the signal varying transistor; right? 2 A. Yes. Yes. 3 Q. And so, then, you would be varying its 4 transconductance; right? 5 A. Yes. 6 Q. But the actual impedance that is changed 7 in -- in your -- what you're talking about here is 8 the impedance of NM3 and NM4; right? 9 A. Yes. And also as a -- as a result, if 10 there's a change in bias current, there would be a 11 change in NM1 and NM2, but only if the bias current 12 also changes. 13 Q. Right. Okay. So there's -- basically, 14 there is a change in the resistance value which, 15 then, causes a change in the bias current which, 16 then, obviously, changes the behavior of NM1 and 17 NM2; right? 18 MR. HART: Object to form. 19 A. Yes. In this case, yes. But in Figure 6 20 of the same paper, there are transistors used which 21 do not affect the bias current. And so, in 22 Figure 6(a), if I change the voltages VAFC1 through 23 VAFC3, the bias currents aren't changed, but the 24 degeneration does change. 25 Q. Okay.	63 1 give a variable transistor that gives 2 different -- you know, this is a pretty wide ranging 3 transconductance. The GM variation in the low power 4 given in Table 2 is 50 percent. It's a very large 5 change of transconductance. So that change is kind 6 of divided up in these changes and various 7 resistance, VAFC1 through VAFC4. 8 Q. Right. Right. Okay. Understood. 9 So then, going back to the declaration, 10 paragraph 103. I mean, you have this diagram there 11 as well. 12 So, do you see paragraph 103? 13 A. Yes, I do. 14 Q. So, I mean, it looks like it has been 15 slightly rearranged, but this is basically a 16 reproduction of Figures 6(a) and 6(b) from the Tan 17 paper; right? 18 A. Yes. 19 Q. Okay. And it's been highlighted with blue 20 and -- and red; right? 21 A. I have a black and white print, so... 22 Q. Oh, okay. 23 A. Yeah. 24 Q. All right. So the -- the ratios here -- 25 A. Yes.
62 1 A. So now, I'm counting on the resistance of 2 these pairs of transistors associated with VAFC1, 3 VAFC2, VAFC3. That resistance is changing up the 4 transistors and that's changing the degeneration, 5 and that's changing the overall transconductance of 6 the entire circuit. 7 Q. Okay. So in -- in Figure 6(b), then, by 8 changing VAFC1, 2, or 3, you're effectively changing 9 the resistance that's on the -- sorry -- is it the 10 drain of the -- of INP2 and IN and -- is that right? 11 Sorry. I think I butchered that. 12 So what you're basically saying is by 13 changing VAFV1 through 3, you're affecting the 14 amount of degeneration resistance that's present? 15 A. Yes, that's right. When -- differently 16 between two transistors, yes. 17 Q. Okay. And then, so that will -- the 18 change in the amount of resistance that's there 19 going to ground will -- will cause -- well, does it 20 or does it not cause a change in the bias to 21 transistor INP? 22 A. No, it doesn't change the bias current. 23 Q. Okay. Now, what about AFC4 here? 24 A. AFC4 is used for slight changes in the 25 bias current, but yeah. So all of these are used to	64 1 Q. -- like, 190 over 3, 122 over 3, that's 2 the transistor with the length ratio, so that's the 3 size of the transistors; is that right? 4 A. Yes. 5 Q. Okay. And then, the -- the values that 6 are highlighted in red on mine, like 740 and 6K, 7 those are the resistor values; right? 8 A. In ohms, yes. 9 Q. Ohms. Okay. 10 And so, in the Figure 6(a), what you're 11 pointing to as the, sort of, lever that changes the 12 transconductance is VAFC; is that right? 13 A. Yes. 14 MR. HART: Object to form. 15 Q. So then that would basically, as we 16 discussed, changes the effective resistance of 17 the -- of the degeneration transceivers there and 18 changes the bias current; right? 19 MR. HART: Object to form. 20 A. Yes. Although, it's in series with a 21 fixed resistor, so its effect is kind of dampened by 22 that. Yes. 23 Q. Sure. Sure. Sure. But, I mean, that it 24 will affect the changes to the bias current, you 25 know, to the extent it's -- correct. Okay.

65 1 Understood. 2 Now -- 3 A. And I do want to point out that these 4 transistors didn't -- that connect to ground are 5 always acting as resistors. They are in their trial 6 region of operation. 7 Q. Right. 8 A. So they act like resistors. 9 Q. Right. Okay. Right. 10 So it's a way of essentially creating a 11 voltage-controlled resistance, essentially; right? 12 A. Yes. 13 Q. Okay. And so that's true of VAFC in 14 Figure 6(a), and then also VAFC4 in Figure 6(b); 15 right? 16 A. As well as all the other VF -- VAFs because 17 they're all changing resistance. 18 Q. Right. Right. Okay. I see. Right. 19 But as we discussed, changing VAFC1 20 through 3 is basically affecting the degeneration 21 without changing the bias current; right? 22 A. That's correct, yes. 23 Q. And changing VAFC4 would have -- would 24 have -- maybe relatively small, but would have an 25 effect on the bias current; right?	67 1 teachings confirm Behbahani's switch from high-power 2 to low-pass filter does in fact increase the signal 3 path impedance"; right? 4 A. Yes. 5 Q. So when the signal path is going through 6 the low-pass filter, it has a certain impedance; 7 right? 8 MR. HART: Object to form. 9 A. It flows to a certain impedance; correct. 10 Yes, signal current flows through a certain 11 impedance. 12 Q. Correct. And then, when the signal path 13 is flowing through to the high-power filter, it has 14 what you're saying is a different impedance; right? 15 MR. HART: Object to form. 16 A. Yes. 17 Q. Okay. Now, the actual claim language here 18 says, "Changing -- you have to dynamically change an 19 impedance of a component in the signal path"; right? 20 That's what the claim requires? 21 MR. HART: Object to form. 22 Q. If you look at the '330 patent with me at 23 the bottom of column 12. 24 A. Yes. 25 Q. Okay. So, "Dynamically changing an
66 1 A. Yes. 2 Q. Okay. All right. Now -- so, can you turn 3 with me to paragraph 124? 4 A. Yes. 5 Q. All right. So this is still talking about 6 the claim elements requiring -- sorry. One second. 7 Hold on. 8 Going back to the beginning of the 9 section, this is claim element 1(b), "reducing a 10 switching current in the single path by dynamically 11 changing an impedance of a component in the signal 12 path"; right? 13 A. Yes. 14 Q. Okay. And so here, you're kind of summing 15 up and basically talking about the switch between 16 the two filters. One of which has, essentially, a 17 higher transconductance by a factor of ten; right? 18 A. Yes. 19 Q. So then, therefore, a higher capacitance 20 and higher bias current; right? 21 A. Yes. 22 Q. So then, at the very end here, you say, 23 basically, if "a POSITA," a person of ordinary 24 skill, "would have understood, consistent with the 25 '330 patent and Dr. Tsivdis' 2003 paper, that Tan's	68 1 impedance of a component in the signal path." 2 So, in your opinion, what component in the 3 signal path has its impedance dynamically changed? 4 A. The transconductors. 5 Q. Of the low-pass filter? 6 MR. HART: Object to form. 7 A. Yes. 8 Q. Okay. Now, you're saying this occurs upon 9 the switch from the low- to the high-power filter; 10 right? 11 A. Yes. 12 Q. Now, when you do that switch, one set of 13 conductors is turned on and another set is turned 14 off; right? 15 MR. HART: Object to form. 16 A. Another set is turned on, yes. 17 Q. And the set that's turned on has a 18 different transconductance than the set that's 19 turned off; right? 20 A. Yes. 21 Q. Okay. Now, in that operation, the 22 transconductance of set one does not change; right? 23 A. Set one being the low-pass filter? 24 Q. Yeah. Let's just say the low-pass filter. 25 So we're running through the low-pass filter. We

69 1 have a transconductance. We turn it off. We 2 haven't changed the transconductance of the low-pass 3 filter; right? 4 MR. HART: Object to form. 5 A. Yes. Okay. 6 Q. Okay. 7 A. And we substitute the high-power filter, 8 yes. 9 Q. Right. So then, if you look at the 10 high-power filter, it's sitting there off. It has a 11 certain theoretical transconductance. You turn it 12 on and now, you're using that transconductance; 13 right? 14 A. Yes. 15 Q. But by turning it on, you haven't changed 16 its transconductance; right? 17 A. But you have changed the transconductance 18 of the filter functional block. 19 Q. Okay. So -- but this is why I asked you 20 the question: What component in the signal path are 21 you alleging is -- has its impedance changed; right? 22 Because you'll agree with me that the 23 low-pass filter, the impedance doesn't change by 24 virtue of it being turned on or off; right? 25 MR. HART: Object to form.	71 1 right? It's -- it's irrelevant what a circuit 2 that's off may be doing. It's -- the important 3 thing is what does the signal experience. And it's 4 experiencing a high impedance when it's flowing 5 through the low -- low-power transistor. And 6 then, it experiences a ten-times lower impedance 7 when it flows through the high-power transistor. 8 So the signal is -- 9 Q. I understand. 10 A. Yeah. 11 Q. So, the -- but what it says in the claim 12 is that what matters is that a component in the 13 signal path changes impedance? 14 A. The transconductance changes impedance. 15 Q. But no component in the signal path 16 changes. What you're talking about is a rerouting 17 of the signal path; right, to a different component? 18 MR. HART: Objection to form. 19 A. The signal experiences a filter. It 20 doesn't know that you're using switching or any 21 other means to, you know, to -- to alter the 22 properties of that filter. 23 The filter preserves its shape, but lowers 24 its noise, and the signal is unaware of that. So it 25 enters a transistor, and the high-power
70 1 A. Well, if you turn it off, its impedance 2 changes. 3 Q. It's not working, so I guess -- well, 4 the -- the -- okay. So that's interesting. 5 Sorry. I didn't mean to interrupt you. 6 What were you going to say? 7 A. Nothing. I was just responding to what 8 you were just pointing out. 9 Q. All right. Well, so I guess what -- the 10 claim requires that something in the signal path 11 have its impedance changed; right? 12 A. Yes. 13 Q. Okay. And so, what I'm pointing out is 14 that there isn't a change to the impedance of either 15 the low-pass filter or the high-pass filter by 16 virtue of the swap; right? 17 A. No. The signal encounters a totally 18 different impedance. 19 Q. Oh, I -- I understand. But neither of -- 20 the impedance of those transconductors don't change 21 by virtue of the swap; right? 22 A. But the impedance experienced by the 23 signal does change. 24 Q. Uh-huh. 25 A. We're talking about what the signal does;	72 1 transistor, it encounters lower noise. 2 So if we look at it from the point of view 3 of the signal processing, the signal is seeing the 4 same filter -- the same filtering action, the same 5 frequency response of the filter, but just 6 experiencing lower noise when the power is ten times 7 higher. 8 Q. Well, so I guess what -- I mean, you 9 understand that what has to be disclosed is the 10 actual claim language; right? 11 I mean, what we're talking about here is 12 whether or not the actual language of the claim is 13 what is -- was done in the -- these references or 14 not; right? 15 A. To me, the component is a transistor. 16 And how I modify its values is a matter of 17 engineering design. There are numerous ways to 18 modify its values. And what we have chosen to do is 19 for convenience, for actually good performance, we 20 simply substitute a bigger transistor for a 21 smaller one. 22 These kind of substitutions are 23 commonplace in analog CMOS technology, and all 24 modern analog circuits use these kind of switches 25 to -- because MOSFETs make very good switches, so we

73 1 can exploit that property to preserve many good, you 2 know, aspects of a particular circuit design and 3 scale it, in this case, by ten times. 4 So the signal is flowing and it is unaware 5 of how we've changed the transconductor that 6 comprises the filter, but it encounters a 7 transconductor of lower noise, and the component in 8 question is the transconductor. 9 It's a function. That transconductor 10 makes up a filter. That filter is an affixed 11 function. It gives the same frequency response. 12 So the signal is unaware that we have done 13 these switching things, and it just sees a 14 transconductor of lower noise and -- and higher 15 transconductance. 16 Q. I understand. But I mean, the -- the way 17 that your -- your circuit worked was, basically, it 18 was to switch a different filter into the path; 19 right? 20 I mean, we can agree on that much; right? 21 The way that it worked was the switch from going 22 through one filter to going through another filter; 23 right? 24 MR. HART: Objection to form. 25 A. When the filter has the identical	75 1 I've changed the impedance of the bulb that's in use 2 and I've changed the amount of light in the room; 3 right? 4 A. Yes. 5 Q. Okay. Now, what if I just have one bulb 6 that's dimmable and adjust a dimmer switch? I can 7 change the impedance of a dimmable bulb with a 8 variable resistor dimmer switch; right? But I 9 haven't swapped the bulb. 10 A. Yes. But you have done something to the 11 dimmer switch. 12 Q. I understand. But, I mean, so what I'm 13 getting at is there is a difference, potentially, 14 between swapping one circuit for another and 15 changing the internal architecture of a particular 16 circuit; right? 17 A. So in the case of a dimmer, there may be 18 switching of elements that's going on that enables 19 that same light bulb to put out a different amount 20 of light. What you've done is simply shifted the 21 switching action from the light bulb itself to the 22 dimmer. 23 Q. Uh-huh. Right. Well, what I'm saying 24 is -- what I'm suggesting is that these are 25 different approaches. So to apply it to your
74 1 frequency response. 2 Q. Yes. 3 A. So the -- the filtering function is 4 unaltered. 5 Q. Uh-huh. Right. 6 A. The detail of the filter might change, but 7 the filtering function is unaltered. It's still the 8 same filter as appears in the receiver block 9 diagram. 10 Q. But the signal is traveling through 11 different components? 12 MR. HART: Object to form. 13 Q. Right? 14 A. Yeah, but it's traveling -- that's true 15 for, you know, other parts of the circuit as well. 16 So yes, it's traveling through different components, 17 but it's seeing the same function. 18 Q. Understood. I mean -- so I guess you 19 understand -- well, just to use a simple analogy, I 20 guess. 21 A light bulb. You can have a 10-watt 22 light bulb, a 50-watt light bulb; right? Those have 23 different impedances; right? 24 So I mean, just to use the analogy. If I 25 unscrew a 10-watt bulb and screw in a 50-watt bulb,	76 1 circuit, instead of having two filters, you could 2 have had one filter with a variable attenuator in 3 front of it and used the attenuator to vary the 4 amount of signal going in; right? 5 MR. HART: Object to form. 6 A. Yes, but that would not have been a good 7 solution to the problem of a receiver. 8 Q. I'm not suggesting that it would. I'm 9 saying that that's a possible approach; right? Just 10 to vary, you know, use a variable impedance in front 11 of one filter in order to adjust the level of signal 12 going in is something that could be done; right? 13 MR. HART: Object to -- object to form. 14 A. It's hypothetical and does not serve our 15 purposes. 16 Q. Right. Okay. So I guess then -- so to go 17 back to the original question here. If the claim 18 requires an impedance of a component in the signal 19 path to change, what, in your view, is the component 20 that changes? 21 A. The transconductor and the capacitors. 22 Q. Okay. And when you say the 23 "transconductor," you mean a particular 24 transconductor, or you mean you've swapped in a new 25 transconductor?

77 1 A. I mean, the transconductor through which 2 the signal flows to experience filtering. 3 Q. Okay. Right. Right. So if the -- the 4 transconductor that the signal is flowing through 5 has changed; right? 6 A. The -- 7 MR. HART: Object to form. 8 A. The impedance of that transconductor has 9 changed. 10 Q. Well, I guess I -- I -- I -- maybe we're 11 running in circles, but the actual -- when I say 12 "changed," I didn't mean that it has -- the 13 particular transconductance circuit that the signal 14 is going through has been substituted for a 15 different one; right? 16 A. But the signal can't tell the difference. 17 Q. I -- that may be -- that may be true, 18 but -- but actually what had happened in the 19 disclosed circuit is that the -- the 20 transconductance block that the signal is 21 experiencing has been swapped -- 22 A. Yes. 23 Q. -- for another one; right? 24 A. Yes, which is a very common technique. 25 Q. No. Understood. I mean, I'm not -- and	79 1 We are looking at the combined action of 2 sensing signal strength are composite 3 (indiscernible) values or RMS values at four points 4 in this block diagram; AI, A0, DI, D0. 5 Q. Uh-huh. 6 A. So the idea is that we can make very, very 7 sharp selective filters, as shown in picture on top 8 of page 50, the adjacent page -- the previous page. 9 We can make a very sharp digital filter 10 that isolates one channel or the desired signal, and 11 that's what comes out at D0. 12 Q. Uh-huh. 13 A. Now, this is a digitized signal, and the 14 HD converter is like a voltage ruler. It measures 15 the height of the signal or the amplitude of the 16 signal with respect to its full-scale reference. 17 Usually, that's one volt. 18 So the digitized signal that comes out at 19 D0 is telling you the peak values that you can pick 20 up there. Tell you the actual amplitude of the 21 desired signal relative to one volt. It's a 22 fraction of one volt. 23 So this way we can measure the desired 24 signal. Now, if we also make a measurement at AI 25 which is the entire band that's entered the receiver
78 1 I'm not -- I'm just basically trying to make sure we 2 agree on what's happening in the circuit and -- and 3 what you're pointing to. I'm just trying to clarify 4 all of that. So -- and I'm not -- okay. 5 So now, can you pull up the declaration 6 for the '825 patent? It's what I've marked as 7 Exhibit 2. It's the proceeding IPR2024-00817. 8 A. Yes. 9 Q. Okay. So now, would you go with me to 10 paragraph -- well, page 50. Right around paragraph 11 91. 12 Let me know when you're there. 13 A. Yes, I'm there. 14 Q. Okay. So now, these claims -- a slightly 15 different language. And here, you're talking about 16 the claim element that requires a circuit for 17 determining a signal strength of an interferer and a 18 circuit for determining the signal strength of the 19 desire signalled; right? 20 A. Yes. 21 Q. And so, what are you saying is the circuit 22 for determining the signal strength of an 23 interferer? 24 A. Okay. So we have to look at the combined 25 action. I'm now referring to the figure on page 51.	80 1 through the band pass filter and -- which is passed 2 through all the mixer and so on, that comprises the 3 desired signal and all the interferers. And we can 4 measure the composite value of everything at AI. 5 Between these two points, there is a 6 programmable gain amplifier, PGA2, whose gain we 7 know because it is a digital control magnifier, and 8 we know what gain it's going to give for a given 9 digital word. 10 So we measure the desired signal alone at 11 D0. We then divide that by the gain of known gain 12 of the amplifier of PGA2. 13 That gives us the desired signal strength 14 before amplification. Then, we compare it with the 15 total measured strength at AI. And when we 16 subtract, D0 divided by the PGA2 gain from AI, what 17 remains is all the interferers. 18 Q. Okay. So you're identifying, then, the D0 19 measurement as the desired signal measurement; is 20 that right? 21 A. Yes. 22 Q. Okay. And then, the sort of subtraction 23 of -- well, so then, you're basically -- with the 24 known gain, you're taking that back to what's shown 25 in this diagram as A0, basically; right?

81 1 A. Yes. 2 Q. Okay. And then subtracting A0 from AI to 3 get -- that's what you're saying the interferer -- 4 A. Well, strictly speaking -- right. So 5 strictly speaking, I'm subtracting -- here's the 6 actual operation. I look at AI minus D0 over the 7 gain of PGA2. That's the calculation I'm doing. 8 Q. Okay. So -- 9 A. And that -- 10 Q. Yes. 11 A. Yes. Go ahead. 12 Q. I'm sorry. 13 A. Yeah. 14 Q. Sorry. I don't want to talk over you, but 15 I -- I just want to make sure I understand. 16 The -- so what you are saying is that 17 there was -- or at least contemplated a measurement 18 at AI and a measurement amount D0; right? 19 A. Yes. 20 Q. And then, what's shown here is A0 would 21 have been, essentially, a calculation because of the 22 known gains rather than a separate measurement; is 23 that right? 24 A. A0 is simply the -- so these measurements 25 are used for many purposes, but A0 gives some sense	83 1 MR. HART: Object to form. 2 A. I'm not sure what you mean. Could you 3 elaborate, please? 4 Q. Well, would you turn with me to the 5 Behbahani paper, Exhibit 7 or, basically, EX 1004? 6 A. Yes. Yes. 7 Q. Okay. And then, on page 3... 8 A. Yes. 9 Q. So here, there is the discussion in the 10 first column here about the algorithm to sense the 11 input signal and determine instant dynamic range; 12 right? 13 A. Yes, yes. 14 Q. So this is the part of the paper that 15 actually talks about AI and A0, and D0 and DI; right? 16 A. Yes. 17 Q. Okay. So now, essentially what's 18 contemplated -- and so here, in the middle of this 19 paragraph, it does talk about the desired signal as 20 measured by power D0 minus the gain; right? 21 A. Yes. 22 Q. That's what you were talking about? 23 A. Yes, yes. 24 Q. D0 minus -- okay. All right. And then -- 25 so basically this, here, at the end of this
82 1 of how effective the analog filter was. 2 So we are going back to the figure on the 3 previous page, labeled Figure 1. The analog filter 4 is somewhat selective, but it can't be anywhere as 5 selective as the digital. 6 So nearby interferers will make their way 7 through that filter, and A0 gives us a measure of 8 that, as to how effective the filtering has been. 9 Q. So now, I -- we talked about before the -- 10 how the digital part of this -- the GSG chip part of 11 this was never actually built; right? 12 A. Yes. 13 Q. So I mean, you know, and these 14 measurements -- what we're talking about here is, I 15 mean, you -- you've obviously shown them on the 16 diagram, but we're talking about, basically, 17 theoretically, how these could be used; right? You 18 didn't build this full functionality; right? 19 A. Yes. 20 MR. HART: Object to form. 21 Q. Okay. So -- so really, though, because 22 we're talking about what's obvious from the 23 references, we need to look at what the -- like, for 24 instance, the Behbahani paper says about how this is 25 done; is that right?	84 1 paragraph is talking about the condition for 2 determining when the worst case shown in Figure 3(c) 3 exists; right? 4 A. Yes. 5 Q. Okay. And it says that it's looking at 6 whether the signal levels are significantly 7 different at either pairs AI and A0 or DI and D0; 8 right? 9 A. Yes, that's one way. There are numerous 10 ways of doing it. Yes. 11 Q. Uh-huh. Well, so I'm just trying to focus 12 on the way of doing it that's -- that we're -- we're 13 alleging is taught here; right? So you're saying 14 that -- I mean, because this is -- this is a portion 15 of the reference that you are referring to? 16 A. Yes -- 17 Q. -- teaching; is that right? 18 A. Yes. So if there is a big difference in 19 the signal levels at D0, adjusting for the amplifier 20 gain compared to AI, that means the entire 21 interferers are very strong compared to the desired 22 channel. That's in plain words. That's what 23 triggers the worst case condition. Sensing the 24 worst case condition. 25 Q. All right. Now, this doesn't say -- well,

85 1 and it also says then -- it goes on to say there has 2 to be a weak signal at D0; right? 3 A. Yes, that's right. 4 Q. Because the worst case isn't just high 5 interferers. It's high interferers with low signal; 6 right? 7 A. That's correct, so that difference has two 8 lows. 9 Q. All right. Now, how did -- or how was 10 this circuit contemplated -- well, okay. Let me put 11 it this way: So this tells us how you detect the 12 worst case scenario; right? 13 A. Yes. 14 Q. How do you detect that you've gone out of 15 the worst case scenario? 16 A. Well, for example, if A0 and AI are 17 comparable, then that means that the interferers 18 after the analog filtering are -- are -- you know, 19 they have been suppressed so much that you can't 20 even detect them. 21 So that's a case where the input signal 22 and the interferers are comparable, but again, you 23 can use -- you can use the relative values at D0 and 24 AI as well to detect that. 25 So if the analog filter suppresses the	87 1 disclosed here would go into a worst case condition 2 based on the -- what we talked about. And then, at 3 some point, when the interferers were determined to 4 be less, it would come out; right? 5 MR. HART: Object to form. 6 A. Yes. Sorry, I can't follow that one. 7 Would you repeat that or rephrase it? 8 Q. Well, so if you're in -- if you're in the 9 worst case condition, you're using the high-power 10 filter, what I'm asking is: How would you know to 11 come out of that condition? And it looks like what 12 this is saying is you would look for AI and A0 to be 13 comparable, for instance; is that right? 14 MR. HART: Object to form. 15 A. Or D0 and -- and AI to be kind of in the 16 right ballpark, yes. So there are numerous ways of 17 doing it. 18 Q. Right. But what this is talking about 19 looking at is, essentially, that the interferers 20 have gotten -- have decreased. And the way you're 21 look -- looking for that is by looking for AI and A0 22 or DI and D0 to be similar; right? 23 A. Yeah. DI and D0 measure close interferers 24 nearby because the analog filters have already done 25 something. AI and A0 look at the whole thing, and
86 1 interferers to the point that, at its output, the 2 total signal level is not very different from its 3 input, then that means the interferers are benign 4 and the analog filter was very effective in 5 suppressing them. 6 So they would be kind of far away and not 7 usually different from the signal itself. So when 8 you have access to signal levels at different points 9 along the signal change like this, you have a lot of 10 information that you can use with various algorithms 11 to make these decisions. 12 Q. Understood. And so, what I'm trying to 13 focus on is what -- which way this thing teaches. 14 And so, I read this sentence -- it says, "If the 15 total signal power is comparable at AI and A0 and DI 16 and D0, the condition is like Figure 3(a) or 3(b)." 17 Do you see that? 18 A. That's right. Yes, that's correct. 19 Q. This is basically what, I guess, you 20 started by saying if -- if the signals at AI and A0 21 are close to the same, then that's how you would 22 know that you didn't have significant interferers; 23 is that right? 24 A. Yes. Yes. 25 Q. Okay. So basically, this -- what's being	88 1 so, they really focus on the far away interferers. 2 And yes, that's a good starting measure is 3 AI and A0 being comparable. 4 Q. Okay. 5 A. That would mean interferers are not so 6 great, that they'll cause trouble to the filter. 7 THE CERTIFIED STENOGRAPHER: Counsel, 8 whenever you get to a good point, if we could take a 9 restroom recess. 10 MR. JOHANNINGMEIER: Oh, yes. Let's -- 11 let's do that. 12 THE VIDEOGRAPHER: Okay. We are going off 13 the record. The time is 12:30. 14 (Recess.) 15 THE VIDEOGRAPHER: We are back on the 16 record. The time is 12:41. 17 BY MR. JOHANNINGMEIER: 18 Q. Okay. Welcome back. I wanted to ask you 19 about a different part of your declaration for the 20 '825 patent. This is -- would you go with me to 21 paragraph 101 on page 58? 22 A. Yes. 23 Q. Okay. So this is a section talking about 24 the circuit for measuring the signal strength; 25 right?

89 1 A. Yes. 2 Q. Okay. 3 A. Yes. 4 Q. And so, this says that the -- the details 5 aren't given in the Behbahani paper, but you point 6 to a circuit that's in Figure 8 of the Tan paper; is 7 that right? 8 A. Yes. 9 Q. Okay. And so, this circuit is essentially 10 disclosing it's a peak detector; right? 11 A. Yes. 12 Q. So it can detect when a signal goes above 13 a preset threshold, basically; right? 14 A. Yes. 15 Q. And so, now, the figure that's actually 16 shown in Figure 8, here, it isn't being used just 17 for raw measurement. It's being used as part of a 18 gain control loop for the PGA block; right? 19 A. Yes. 20 Q. Okay. So it's essentially trying to 21 get -- now, why are there multiple peak detectors 22 here? 23 A. We are trying to address a practical 24 problem associated with these active filters, and 25 that is that although the filter gain in its	91 1 A. Yes. 2 Q. Now, in actual fact, in the circuit, there 3 wasn't -- there was no such circuit there; right? I 4 mean, the -- the -- these peak detectors weren't 5 actually used. They were used for a different 6 purpose; right? 7 MR. HART: Object to form. 8 A. You mean at AI and AO? 9 Q. Well, right. So we just talked about 10 the -- what you're showing is Figure 8 where you're 11 using peak detectors to measure signals within this 12 active filter? 13 A. Yes. 14 Q. In order to control the gains; right? 15 A. Yes. 16 Q. Okay. And then, you're saying a person 17 would have thought to use those peak detectors to 18 measure AI and AO; right? 19 A. Yes. 20 Q. Okay. But there weren't actually peak 21 detectors at AI and AO in the -- the actual circuit; 22 right? 23 A. Our prototype, just to contain the amount 24 of labor involved, we didn't put them in because we 25 had developed -- not peak detectors, but signal
90 1 passband is one, that is if you apply a sine wave at 2 the passband frequency, it flows through the filter 3 and emerges on the other side without changing 4 amplitude. The transmission gain is one. 5 You can could have gains internal to the 6 filter which are greater than one, and that only 7 happens with active filters. With these things that 8 simulate inductors. 9 So there is the fear that you could have 10 internal saturation of nodes if you have these 11 unscaled swings internal to the filter. So the 12 purpose of these peak detectors is to monitor every 13 node inside the filter and look for that possibility 14 of some voltage swing getting to dangerously high 15 levels where it could saturate the transconductor 16 and -- and thereby ruin everything in the signal 17 path. 18 And so if the signal levels start to 19 approach this VRef, the PGA is turned down to make 20 the signal smaller to keep everything under control. 21 Q. Okay. So here at -- now, looking at 22 paragraph 102, you say, "A person of ordinary skill 23 would have been motivated to utilize these signal 24 strength measurements circuits to measure nodes AI 25 and AO"; right?	92 1 strength measurement circuits in the past, and we 2 knew how to build them. 3 Q. Right. 4 A. And so, we -- we decided, just to cut down 5 on the amount of work, not to put them on the chip. 6 Q. Understood. But there are also -- you 7 know, they're not discussed in the papers either 8 though; right? 9 A. Correct. Correct. 10 Q. Okay. So your opinion here, as I 11 understand it, is that basically what is discussed 12 in the peak detectors in the gain and a person of 13 ordinary skill would have used those -- or could 14 have used those to measure the -- the -- the AI and 15 AO, for instance; right? 16 A. Yes. But also in 103, I go on to say that 17 depending on the situation, you can also use a 18 different kind of signal strength measurement 19 circuit that we had published beforehand, which is 20 shown on page 61, which can cover much wider ranges 21 of signal strengths. 22 Q. Okay. Well, so let me ask you, then, 23 about that. Are you saying that this Khorram 24 reference is part of your opinion or necessary to 25 your opinion?

93 1 MR. HART: Object to form. 2 A. It's -- it's just a -- kind of a -- 3 pointing out that you can use different types of 4 circuits depending on the range of signal levels. 5 That's all it's saying. So -- 6 Q. So -- 7 A. -- we -- 8 Q. Yeah. What you're saying is -- 9 A. Yeah. The point is that signal detection 10 is well known at the time this circuit was 11 developed. And I gave an example of a signal 12 detection circuit in the filter and, later on, an 13 example of a logarithmic signal detection circuit 14 that we had used in a previous chip as ways of 15 measuring the signal. 16 Q. Okay. But, to be clear, you're not saying 17 that this -- is it Khorram paper -- 18 A. Yes. 19 Q. You're not saying that this Khorram paper 20 is somehow referenced by Behbahani or Tan; right? 21 A. No, no, no. Because we assumed it was 22 sort of obvious by then. 23 Q. Okay. All right. But, if we're just 24 looking at what's taught by Tan, for instance, it 25 doesn't mention this -- this additional paper that	95 1 I may have some redirect. 2 MR. JOHANNINGMEIER: Okay. 3 THE VIDEOGRAPHER: Okay. We're going off 4 the record. The time is 12:50. 5 (Recess.) 6 THE VIDEOGRAPHER: We are back on record. 7 The time is 13:01. 8 EXAMINATION 9 BY MR. HART: 10 Q. Right. Dr. Abidi, I'd like to refer you 11 back to some questions about language in claim 1 of 12 the '330 patent. Counsel for patent owner referred 13 you to the last limitation in claim 1 of the '330 14 patent, which discusses changing an impedance of a 15 component in the signal path. 16 Do you recall that line of questions? 17 A. Yes. 18 Q. Now, you talked a lot about changing 19 transconductance and changing capacitances incident 20 to scaling between a low-pass filter branch and a 21 high-power filter branch. 22 Do you recall that? 23 A. Yes. 24 Q. What have you mapped to the claimed 25 component in the signal path cited in this last
94 1 you did; right? 2 A. Yes, that's right. It does not. 3 Q. All right. Now -- so if you didn't put 4 the signal detection circuits into the -- the -- the 5 chip, how did you -- or did you measure the signal 6 strength at all in there? 7 A. Yes, we did. We had analog buffers that 8 by bought out to -- 9 Q. Okay. 10 A. -- so we measured on oscilloscope. 11 Q. Okay. So you just -- you basically just 12 put in a test point where you could go in with a 13 scope and measure it? 14 A. Right. 15 Q. So I take it then that there was no -- 16 because there was a test chip, there was no 17 automatic switching based on signal levels -- 18 A. Correct. 19 MR. JOHANNINGMEIER: Okay. All right. 20 Okay. All right. Well, good news is this being 21 cross-examination, I don't have any additional 22 questions for you now, so unless your counsel wants 23 to do something, in which case I might have some 24 more, but otherwise, that's it for me right now. 25 MR. HART: Give us just a couple minutes.	96 1 limitation of claim 1? 2 A. It's -- 3 MR. JOHANNINGMEIER: Objection. 4 A. It's the adaptive bandpass filter in the 5 receiver. 6 Q. I see. Is that the block depicted in 7 Behbahani that is a variable bandwidth adaptive 8 bandpass filter? 9 A. That's correct. 10 MR. JOHANNINGMEIER: Objection. 11 Q. And -- and can you explain what components 12 within that filter block component cause the 13 impedance seen by the signal to change? 14 A. Well, this -- 15 MR. JOHANNINGMEIER: Objection. 16 A. This is an active filter, and it's made 17 up, as shown in one of the diagrams we looked at, 18 with transconductors and capacitors. 19 So the impedance levels are defined by 20 both of those quantities. The transconductors can 21 be scaled up in size and bias current, and their 22 transconductance goes down in inverse proportion. 23 The capacitors can be sized up and their reactance 24 goes down in inverse proportion. So those are the 25 impedances that change.

Transcript of Asad Abidi, Ph.D.
Conducted on March 11, 2025

25 (97 to 100)

97 1 MR. HART: Okay. That's all I have, 2 Corey. 3 EXAMINATION 4 BY MR. JOHANNINGMEIER: 5 Q. Now, when you say "those are the things 6 that change," those are the things that change when 7 you swap the two filters; right? 8 A. Yes. 9 MR. JOHANNINGMEIER: Okay. No further 10 questions. 11 THE VIDEOGRAPHER: All right. If there's 12 nothing further, this concludes the deposition of 13 Dr. Asad Abidi. The time is 13:03. 14 (Deposition concluded at 1:03 P.M.) 15 -oOo- 16 17 18 19 20 21 22 23 24 25	99 1 STATE OF CALIFORNIA) 2) SS. 3 COUNTY OF LOS ANGELES) 4 5 I, DR. ASAD ABIDI, HEREBY CERTIFY UNDER 6 PENALTY OF PERJURY UNDER THE LAWS OF THE STATE OF 7 CALIFORNIA THAT THE FOREGOING IS TRUE AND CORRECT. 8 EXECUTED THIS ____ DAY OF _____, 9 2025, AT _____, CALIFORNIA. 10 11 12 13 14 _____ 15 DR. ASAD ABIDI 16 17 18 19 20 21 22 23 24 25
98 1 ERRATA SHEET FOR THE DEPOSITION OF: 2 3 CASE NAME: APPLE, INC V THETA, IP, LLC 4 CASE NUMBERS: IPR2024-00816,-00817, -00818, 5 -00819 and -00820 6 DEPO DATE: TUESDAY, MARCH 11, 2025 7 DEPONENT: DR. ASAD ABIDI 8 9 CORRECTIONS 10 PG. LN. NOW READS SHOULD READ REASONS 11 _____ 12 _____ 13 _____ 14 _____ 15 _____ 16 _____ 17 _____ 18 _____ 19 _____ 20 _____ 21 _____ 22 _____ 23 _____ 24 25 SIGNATURE _____ DATE _____	100 1 CERTIFICATE OF SHORTHAND REPORTER - NOTARY PUBLIC 2 3 4 I, NATALIE PARVIZI-AZAD, REPORTER AND 5 NOTARY PUBLIC WITHIN AND FOR THE STATE OF 6 CALIFORNIA DO HEREBY CERTIFY: 7 THAT DR. ASAD ABIDI, THE WITNESS WHOSE 8 DEPOSITION IS HEREINBEFORE SET FORTH, WAS DULY 9 SWORN BY ME BEFORE THE COMMENCEMENT OF SUCH 10 DEPOSITION AND THAT SUCH DEPOSITION WAS TAKEN 11 BEFORE ME AND IS A TRUE RECORD OF THE TESTIMONY 12 GIVEN BY SUCH WITNESS. 13 I FURTHER CERTIFY THAT THE ADVERSE PARTY, 14 PETITIONER, WAS REPRESENTED BY COUNSEL AT THE 15 DEPOSITION. 16 I FURTHER CERTIFY THAT THE DEPOSITION OF 17 DR. ASAD ABIDI OCCURRED REMOTELY THROUGH ZOOM 18 VIDEOCONFERENCE ON TUESDAY, MARCH 11, 2025, 19 COMMENCING AT 10:14 A.M. TO 1:03 P.M. 20 21 22 23 24 25

Transcript of Asad Abidi, Ph.D.
Conducted on March 11, 2025

26 (101 to 104)

101

1 I FURTHER CERTIFY THAT I AM NOT RELATED
2 TO ANY OF THE PARTIES TO THIS ACTION BY BLOOD OR
3 MARRIAGE, I AM NOT EMPLOYED BY OR AN ATTORNEY TO
4 ANY OF THE PARTIES TO THIS ACTION, AND THAT I AM
5 IN NO WAY INTERESTED, FINANCIALLY OR OTHERWISE, IN
6 THE OUTCOME OF THIS MATTER.

7 IN WITNESS WHEREOF, I HAVE HEREUNTO SET
8 MY HAND THIS 17TH DAY OF MARCH, 2025.
9 MY COMMISSION EXPIRES:
10 NOVEMBER 30, 2025

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14 NOTARY PUBLIC IN AND FOR THE
15 STATE OF CALIFORNIA

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