1 UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE PATENT TRIAL AND APPEAL BOARD
2

3 APPLE, INC.,)
)
4 Petitioner,)
)
5 vs.) Case No. IPR2024-00816
) Patent No. 7,010,330
6 THETA IP, LLC,)
)
7 Patent Owner.)
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13 VIDEOCONFERENCE DEPOSITION OF LAWRENCE E. LARSON, PhD
TAKEN ON BEHALF OF THE PETITIONER
14 JUNE 11, 2025
15 VIDEOCONFERENCE DEPOSITION OF LAWRENCE E.
16 LARSON, PhD, produced, sworn, and examined on the 11th
17 day of June 2025, between the hours of 9:00 o'clock in
18 the forenoon and 6:00 o'clock in the evening of that
19 date via Zoom videoconference, before KARA D. INCE,
20 Registered Professional Reporter within and for the
21 National Court Reporters Association, in a certain
22 cause now pending in the UNITED STATES PATENT AND
23 TRADEMARK OFFICE, BEFORE THE PATENT TRIAL AND APPEAL
24 BOARD, wherein APPLE, INC., is the Petitioner and
25 THETA IP, LLC, is the Patent Owner.

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EXHIBITS NOT ATTACHED

1 APPEARANCES

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11 Also present:

12 Mr. Ryan Johnson - intern (via Zoom)

13 The Court Reporter:

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1 * * * * *
2 (The deposition commenced at 10:02 a.m.)
3 THE COURT REPORTER: We are on the record.
4 My name is Kara Ince. I am a Registered
5 Professional Reporter, RPR License No. 965098.
6 Today's date is June 11, 2025. Will the witness
7 please raise their right hand.
8 LAWRENCE E. LARSON, PhD,
9 of lawful age, being produced, sworn, and examined
10 on behalf of the Petitioner, deposes and says:
11 EXAMINATION
12 BY MR. HART:
13 Q. Good morning, Dr. Larson. My name's
14 Paul Hart. I represent Apple in these IPR
15 proceedings. Joining today, just for experience, is
16 one of our summer interns, Ryan Johnson.
17 To get us started, can you state your full
18 name for the record.
19 **A. Yes, Lawrence Ernest Larson.**
20 Q. All right. Very good.
21 And have you been deposed before,
22 Dr. Larson?
23 **A. I have been deposed before, yes.**
24 Q. About how many times have you been
25 deposed?

1 **A. Well, I would say fewer than 10, and more**
2 **than 6. I can't give you an exact number, but**
3 **somewhere between 6 and 10.**
4 Q. All right. Very good.
5 Let me just go over the most important
6 ground rules as a refresher, then. It's my job to
7 ask clear questions today. If you don't understand
8 a question, please, let me know; so I can rephrase
9 or clarify my question.
10 Does that make sense?
11 **A. It does make sense, yes.**
12 Q. The court reporter can only capture one of
13 us at a time. I will do my best not to speak over
14 you, and I ask that you try not to speak over me.
15 To this end, if I do cut you off before -- while
16 you're still answering a question, please, let me
17 know; so I can allow you to finish your answer.
18 Is there --
19 **A. I will, and vice versa, if I cut you off,**
20 **please, don't hesitate to ask me to be quiet until**
21 **you finish.**
22 Q. Okay. Very good.
23 Is there any reason, medical or otherwise,
24 you might be unable to answer my questions fully and
25 truthfully today?

1 **A. No, none whatsoever.**
2 Q. Okay. What did you do to prepare for
3 today's deposition?
4 **A. Well, I read -- or I should say reread --**
5 **the patents. I reread my dec- -- my recent**
6 **declaration. I reread the papers that I've been**
7 **referred to in the declaration. I think that's the**
8 **extent of it.**
9 Q. Okay. Did you meet with counsel to
10 prepare for today's deposition?
11 **A. Yes, I met with Mr. Johanningmeier to**
12 **prepare. We met yesterday.**
13 Q. Okay. And, approximately, how long did
14 you meet to prepare for today's deposition?
15 **A. I would say, roughly, four hours.**
16 Q. Okay. Was anybody else present in your
17 preparation?
18 **A. Well, we prepared in my house here and my**
19 **wife was present in the house, but she wasn't**
20 **present while we were preparing.**
21 Q. Okay. Fair to assume she did not
22 contribute to the subject matter of the deposition?
23 **A. Not at all. Not in any way whatsoever.**
24 Q. All right. Very good.
25 Dr. Larson, your declaration states that

1 you're currently a professor of engineering at the
2 School of Engineering at Brown University; is that
3 right?
4 **A. That's correct.**
5 Q. Okay. How long have you served in that
6 role?
7 **A. I came to Brown in 2011; so, roughly,**
8 **14 years.**
9 Q. And what are your responsibilities as a
10 professor of engineering at Brown?
11 **A. Well, I teach courses in electrical**
12 **engineering to our undergraduates and graduate**
13 **students, and I also conduct research in electronic**
14 **circuits and systems, and then, as all faculty**
15 **members do at all universities, I serve on various**
16 **committees and have various co-leadership roles**
17 **within the school.**
18 Q. Have you had any title changes in your
19 time at Brown?
20 **A. Yes. I was brought to Brown in 2011 as**
21 **the dean of engineering, and so I was dean of**
22 **engineering, as well as a professor. Those are**
23 **titles that go together. And I was dean of**
24 **engineering from 2011 until 2022. And, then, in**
25 **2023, I served as interim provost at Brown, and that**

1 **ended in -- at the end of 2023, and since then, I've**
2 **continued in my role as professor.**
3 Q. Okay. And what were your responsibilities
4 as provost?
5 **A. Well, the provost is the chief academic**
6 **officer for the entire university. So, you know,**
7 **academic -- maintaining academic standards, faculty**
8 **hiring, budget issues, new initiatives, you know,**
9 **accreditation, you know, many personnel issues**
10 **associated with all of those efforts. That was my**
11 **fundraising -- those are the chief responsibilities,**
12 **I think, as provost.**
13 Q. Okay. In your career, is that the only
14 period of time you were not focused on engineering?
15 **A. In that time, do you mean as the time that**
16 **I served as interim provost?**
17 Q. And maybe I should lay a little
18 foundation. It sounds to me like your time as
19 interim provost was not focused on engineering.
20 Is that a fair characterization?
21 **A. Yeah. I mean, it was -- that was a brief**
22 **period of time, but I would say, you know, I -- I**
23 **had -- you know, when you're provost, you focus on**
24 **many things all at once; so engineering was one of**
25 **the things that I focused on, but there were lots of**

1 **other things as well.**
2 Q. Okay. And at all other periods in your
3 career, have you been more focused on engineering
4 than you were when you served as interim provost?
5 **A. Yes, very much so. And, you know, even**
6 **when I was dean of Engineering, I continued to teach**
7 **undergraduates and conduct research; so I really**
8 **stayed kind of focused on engineering for the**
9 **entirety of my career, except for, as you suggest,**
10 **that brief period as provost.**
11 Q. You have, prior to these IPRs that Apple
12 filed, offered opinions relating to certain Tsividis
13 patents; correct?
14 **A. Well, I believe the answer is -- to your**
15 **question's correct; there are other parties involved**
16 **around these patents, and I've -- I've been in those**
17 **cases as well, if that's what you're referring to.**
18 Q. What was the -- what was the earliest case
19 you worked on involving the Tsividis patents?
20 **A. Well, I believe I started working with**
21 **Mr. Johanningmeier's firm, perhaps, 2020. It might**
22 **have even been late in 2019 -- I can't remember the**
23 **exact time -- but it was roughly in the late 2019,**
24 **early 2020 -- pardon me -- 2020 period.**
25 Q. And do you recall who the parties were at

1 that time in the legal matter involving the Tsividis
2 patents?
3 **A. Yes, this was also another legal matter**
4 **involving the Tsividis patents; correct.**
5 Q. And do you know who the parties were? Who
6 was on the other side, opposite Theta, at that time?
7 **A. Yeah, I hope it's okay for me to say that.**
8 MR. JOHANNINGMEIER: Oh, yes.
9 **A. That was -- that was Samsung. I just want**
10 **to be careful I don't betray any confidentiality.**
11 MR. JOHANNINGMEIER: That's fine.
12 **A. So that's, in that case, Samsung.**
13 BY MR. HART:
14 Q. Got it. And I -- to be clear, feel free
15 to ask for guidance any time you think you may be
16 asked a question that you're not sure if you can
17 answer. You know, I'm not trying to elicit anything
18 here that I shouldn't have.
19 What was your role in the Samsung case?
20 **A. Well -- hmm -- you know, my role in the**
21 **Samsung case was to, you know, look at the patents**
22 **that were in dispute, you know, look at, you know,**
23 **the -- you know, kind of how they operated and what**
24 **their background was and what they did, and then see**
25 **how that was -- you know and then compare, I guess,**

1 **the patents themselves to some of the accused**
2 **products, and see if there was a match between what**
3 **was in the patents and what was the accused**
4 **products, and I just kind of went through all of**
5 **those issues with Mr. Johanningmeier's firm as part**
6 **of that action.**
7 Q. That sounds to me like what we refer to as
8 an infringement analysis in the patent world.
9 Did you do anything, other than assessing
10 infringement in the Samsung case?
11 **A. You know, it's a good question, and I'm**
12 **trying to remember if there was a -- there were some**
13 **questions about invalidity as well, and, like, I**
14 **just can't remember in that detail. You know, it**
15 **was four years ago at this point; so I'm -- I**
16 **apologize if I can't remember.**
17 Q. Okay. So you may have addressed
18 invalidity, but you definitely addressed
19 infringement; is that accurate?
20 **A. I believe that that's correct, yes. And I**
21 **would maybe like to, you know, review the documents**
22 **to refresh my memory [indiscernible] super accurate**
23 **answer, but I believe that's correct.**
24 Q. Okay.
25 (Reporter clarification.)

1 **A. Yeah. But I believe that that's roughly**
2 **correct.**
3 BY MR. HART:
4 Q. What -- other than the Samsung case that
5 we just spoke about, and the Apple IPRs that we're
6 here today to speak about, what other legal matters
7 have you been involved in related to the Tsividis
8 patents?
9 **A. And let me just check with**
10 **Mr. Johanningmeier.**
11 MR. JOHANNINGMEIER: Yeah.
12 **THE WITNESS: Is it okay that I mention**
13 **the other matter as well?**
14 MR. JOHANNINGMEIER: Yeah. And I think
15 just on -- for purposes of, you know, privilege and
16 all of that, I mean, speaking generally, you know:
17 Were you involved, did you do infringement or look
18 at invalidity, that's fine. I don't want to get
19 into too many details because some of this is, you
20 know, pretrial litigation work that, you know,
21 getting into the details might contribute to issues
22 of privilege; so -- but his questions are fairly
23 general; so if I think something's too specific,
24 I'll let you know.
25 **THE WITNESS: Okay. Thank you. Yeah.**

1 **A. So, yeah, Mr. Hart, there was another,**
2 **similar in some ways, case involving**
3 **Motorola/Lenovo, and I have also, you know, done**
4 **some work there and -- you know, involving looking**
5 **at the Tsividis patents, and then, you know, trying**
6 **to understand the issues of infringement and**
7 **invalidity, potentially, as well.**
8 BY MR. HART:
9 Q. I see.
10 **A. Right.**
11 Q. So you're involved in the Motorola/Lenovo
12 case both on the litigation side for infringement
13 issues, as well as on the IPR side for validity
14 issues; is that right?
15 **A. I believe that's correct, yes.**
16 Q. Very good.
17 Do you recall when you first learned of
18 the Tsividis patents?
19 **A. Well, I think that I first learned of it**
20 **when I was contacted back, as I said, in 2019-2020**
21 **to become involved in this case, and I was -- I'm**
22 **trying to remember who contacted me, but it was**
23 **someone either from -- I believe it was someone from**
24 **Theta contacted me -- and that was when I first**
25 **became aware that there were a set of patents that**

1 had been -- that were, I guess, under dispute;
2 so ...
3 Q. Okay.
4 A. That's, I think, when I first became
5 aware.
6 Q. And when you say --
7 (Reporter clarification.)
8 A. Of the patents, yes.
9 BY MR. HART:
10 Q. And when you say you were contacted by
11 somebody from Theta, is that an attorney from the
12 Theta legal team?
13 A. Possibly.
14 Q. Okay. Who else might of --
15 A. [Indiscernible.]
16 Q. Who could you --
17 (Reporter clarification.)
18 BY MR. HART:
19 Q. Who else might have contacted you, if not
20 a lawyer from the Theta legal team?
21 A. Well, I'm -- and, once again, I can't, you
22 know, remember. You know, Professor Tsividis and I
23 know each other. We've known each other for many,
24 many years, and he might have contacted me and just
25 said, you know: There's someone -- we'd like to

1 talk to you about this, but I can't remember if that
2 was before I had the initial contact or after, and
3 that's why I'm hesitating.
4 Q. I see.
5 Did you -- I believe you testified that
6 you learned of the Tsividis patents for the first
7 time when you were contacted about the legal matters
8 we've discussed; is that right?
9 A. I believe that's correct, yes.
10 Q. Do you recall whether you were aware of
11 Dr. Tsividis -- Tsividis' work in this space before
12 being contacted about these legal matters?
13 A. Yes, you know, I was aware, and he's --
14 he's written several kind of general articles on
15 these issues over the years that appear in
16 professional magazines, and I remember seeing those
17 articles and kind of skimming through them.
18 And so -- and, you know, I ran into him
19 maybe in 2011, and we had a nice talk about what he
20 was doing in his research, and he kind of mentioned
21 that he was doing this kind of work then; so I --
22 you know, from my personal, you know, conversations
23 with him, as well as reading what he's written,
24 that's how I sort of was aware that he was doing
25 this work.

1 **I was not aware of that there were any**
2 **kind of [indiscernible] and that just didn't come**
3 **up.**
4 Q. Okay.
5 (Reporter clarification.)
6 THE COURT REPORTER: I'm sorry, Zoom cut
7 out at the very end.
8 "I was not aware" ...
9 **A. That there were any patents in this, and**
10 **it just didn't come up.**
11 BY MR. HART:
12 Q. Do you recall -- and I'm just trying to
13 get a sense of scale of the conversation in 2011
14 that you alluded to -- how long you might have
15 spoken with Dr. Tsividis in 2011 about the work he
16 was doing in this space?
17 **A. Yes. I mean, I was at an ivy league**
18 **dean's meeting at Columbia, and I just stopped in to**
19 **say, Hi, and found him in his office, and we**
20 **probably spent 15 minutes, you know, talking about:**
21 **Hey, what are you doing? And, you know, he -- he**
22 **has this long-standing research agenda to try to,**
23 **you know, like, do computation -- analog computation**
24 **at a lower and lower power levels and higher and**
25 **higher dynamic ranges, and it reaches into all kinds**

1 **of interesting areas, including communication, as we**
2 **see from these patents. So I think we were -- it**
3 **was more of a general discussion about: Hey, what**
4 **are you doing on low-power analog computation?**
5 **Not -- it was in no way, you know, about wireless**
6 **stuff in particular.**
7 Q. Aside from that conversation in 2011 and
8 your awareness of his articles that may have been
9 related to this work and the years that might have
10 followed, can you recall ever discussing
11 Dr. Tsividis' work in this space with anybody else
12 before being contacted to work on the legal matters?
13 **A. No, you know, I can't recall any**
14 **conversations about that particular work with other**
15 **people.**
16 Q. Do you know Dr. Asad Abidi, who is Apple's
17 expert in these proceedings?
18 **A. Yes. I know him very well. In fact, he**
19 **was on my PhD committee many years ago at UCLA.**
20 Q. Small world.
21 **A. I know it's -- I know. It is a small**
22 **world.**
23 Q. The -- I believe you refer to them as the
24 "Behbahani papers" in your declaration, the three
25 academic articles that Apple has relied on as prior

1 art in these IPR proceedings.
2 Can we refer to those three collectively
3 as the "Behbahani papers"?
4 **A. Yes, that's fine.**
5 Q. Okay. Were you familiar with Dr. Abidi's
6 work described in the Behbahani papers before your
7 involvement in Apple's IPRs?
8 **A. Yes, very much. I remember reading those**
9 **papers when they came out. They were very**
10 **high-profile, very important papers; so I recall**
11 **reading them very carefully at the time.**
12 Q. Okay. Have you had any conversations with
13 Dr. Tsividis about Dr. Abidi?
14 **A. As far as I know, never.**
15 Q. Okay. Have you ever discussed with
16 Dr. Tsividis the work described in the Behbahani
17 papers?
18 **A. No, never.**
19 Q. Okay. All right. Okay. And have you had
20 any -- since engaging on the Samsung matter back in
21 2019 or 2020, have you had any conversations with
22 Dr. Tsividis?
23 **A. The only conversation at the Samsung**
24 **trial, he showed up and we were in a big room, and**
25 **I -- I saw him and I walked over and I said: Hi,**

1 **Yannis, how are you doing?**
2 **And he said: Fine.**
3 **And I think that was literally the extent**
4 **of it.**
5 Q. Okay. Okay. Very good.
6 Let's turn to the substance of these IPRs.
7 And just to do a little table setting
8 here, am I correct that you have submitted a- -- an
9 initial declaration covering all five IPR
10 proceedings filed by Apple in support of patent
11 owners' preliminary response -- or responses?
12 **A. Yes, I believe that's correct.**
13 **I mean, you called it a preliminary**
14 **declaration, and I don't quite know what**
15 **"preliminary" means in that context, but, perhaps,**
16 **that's a legal term I'm not familiar with.**
17 Q. I meant to say initial declaration --
18 **A. Okay.**
19 Q. -- in support of a preliminary response?
20 **A. Oh, and maybe I -- sorry.**
21 Q. I may have said "preliminary" twice.
22 And, then, you've also submitted a -- a
23 second kind of omnibus declaration covering all five
24 proceedings in support of the patent-owner response;
25 correct?

1 **A. Correct.**
2 **And I think that the one that you're**
3 **referring to, the second one, is the one that was**
4 **just recently submitted within the last few months.**
5 **I just want to make sure we're talking about the**
6 **same things here.**
7 Q. That's right.
8 **A. Okay.**
9 Q. That's exactly right, and that's the one I
10 will be focused on today. It's been marked as
11 Exhibit 2020 in all of the proceedings; so I will
12 focus on that document. And, you know,
13 conveniently, it is given a single exhibit number
14 across all five IPR proceedings.
15 **A. Thank you.**
16 MR. JOHANNINGMEIER: And just so you know,
17 Counsel, we have a paper copy here to refer to to
18 make it easier than trying to put stuff on the
19 screen. You can do whatever you want, but we have
20 paper copies of his declaration and the five
21 patents, if -- if that helps.
22 MR. HART: That does, and that was going
23 to be my next question.
24 BY MR. HART:
25 Q. So what -- what is your preference

1 Dr. Larson? If we are talking about your
2 declaration or the patent in this case, would you
3 prefer to use your local printed copies?
4 **A. I would, if you would not mind, yes.**
5 Q. I think that would be easiest. And let me
6 just -- there will not be any surprise exhibits
7 today -- so let me just make sure you have what I
8 will be talking about, and if not, I can send PDFs
9 of those.
10 Do you have a copy of the '330 Patent?
11 **A. I believe so. Let me reach over. Yeah.**
12 **And, Mr. Hart, I want to also assure you none of**
13 **these have any markings on them whatsoever.**
14 Q. Okay.
15 **A. Yes, I have the '330 Patent right here.**
16 Q. Okay. And I believe you said you also
17 have a copy of Exhibit 2020, your declaration?
18 **A. That's correct, I do.**
19 Q. Okay. Do you have a copy of Exhibit 1011,
20 the 2003 Tsividis article?
21 (Deposition Exhibit No. 1011 was marked
22 for identification.)
23 **A. Yes, 1011, I have it here.**
24 BY MR. HART:
25 Q. All right. And do you have a copy -- --

1 copies of the Behbahani papers, Exhibits 1004, 1005,
2 and 1006?
3 (Deposition Exhibit Nos. 1004, 1005, and
4 1006 were marked for identification.)
5 **A. Yes, I have them all here.**
6 BY MR. HART:
7 Q. All right. I think we are all set then.
8 I will -- I will just presume that you are
9 using your local copies when I ask a question about
10 this. If there's any reason to share a screen and
11 have me put up something that we are all looking at
12 at the same time, for your convenience, just let me
13 know.
14 **A. I will.**
15 Q. Very good.
16 I'd like to get started discussing the
17 challenged patents. The -- all five challenged
18 patents in these proceedings share a specification;
19 so I'm going to use the '330 Patent, the earliest of
20 the five that issued, just as representative for my
21 questions about the specification in these patents.
22 Can I have you turn to Figure 6 in the
23 '330 Patent.
24 **A. Yes.**
25 Q. I'm going to start by asking questions

about Figure 6 in the challenged patent's description of the depicted circuitry, which in the '330 Patent is in Column 7, Lines 44 to 67. So I think switching back and forth between Figure 6 and Column 7 is going to be required here for some of these questions, potentially.

A. Okay. So I'm -- I think I've -- you said Figure 6; right?

Q. Yes, Figure 6, that's right.

A. So Figure 6 and Column 7. Okay. I think I can manage to switch back and forth.

Q. All right. Very good.

So just starting with Figure 6 itself, on the left side of Figure 6, there's a triangular component labeled, 612.

Do you see that?

A. Yes, I see that.

Q. What is Component 612 in Figure 6?

A. Well, it's meant to represent kind of an abstract stage. Probably a -- a voltage buffer, which may or may not have some gain, that's -- which has some gain associated with it; so I would say a voltage buffer with some associated gain.

Q. The patent refers to it as a "driver."

Is that term consistent with your

1 description of "a voltage buffer with associated
2 gain"?
3 **A. Yes, that's consistent with my**
4 **interpretation.**
5 Q. Okay. At Column 7, starting at Line 53 --
6 **A. Okay.**
7 Q. -- the patent notes that The output stage
8 of the driver may be a Class A emitter follower
9 formed by an emitter follower connected to a current
10 source.
11 Do you see that?
12 **A. Yes, I do see that.**
13 Q. Okay. Is that a transistor-based circuit
14 being described by the patent?
15 **A. Well, in this particular paragraph, yes.**
16 **This is describing a- -- an emitter follower is a --**
17 **is a -- you know, An emitter is one terminal of a**
18 **transistor, and emmiter follower is a -- kind of a**
19 **term of the art for a transistor-based circuit that**
20 **is a- -- an output stage.**
21 Q. Okay. Can the output stage have an
22 associated gain?
23 **A. In general, an output stage can have an**
24 **associated gain, sure, which is not specified here.**
25 Q. Okay. And so this description of a

1 emitter follower is part of Buffer 612; is that
2 right?
3 **A. Yes -- I mean, I would say, yes. I mean,**
4 **the -- I mean, I think the intention -- or**
5 **[indiscernible] sort of is that the output stage**
6 **is -- yeah.**
7 (Reporter clarification.)
8 THE COURT REPORTER: I'm sorry to
9 interrupt you, Zoom is cutting out. I just need to
10 make sure I get your full testimony.
11 You said "I think the intention" ...
12 **A. I mean, of this paragraph is to describe**
13 **the entire output stage as being an emitter**
14 **follower, but, of course, an output stage could, in**
15 **general, be much more complicated than that.**
16 BY MR. HART:
17 Q. I see.
18 In the use of the term "emitter," suggests
19 bipolar transistors; correct?
20 **A. Yes, an emitter is the terminal of a**
21 **bipolar transistor.**
22 Q. Is the general discussion in the context
23 of Figure 6 limited to bipolar transistor-based
24 circuits?
25 **A. No, I don't believe so. I believe that**

1 **Figure 6, as drawn and kind of as described here in**
2 **the specification, could be bipolar or MOS or a**
3 **combination of bipolar and MOS.**
4 Q. Okay. Does the patent describe any other
5 specific circuits that Driver 612 might represent?
6 **A. Well, I'd have to kind of review it here**
7 **very briefly. Let me just take a look.**
8 (Witness is reviewing document.)
9 **A. So, you know, at the very end of the**
10 **paragraph that starts at Line 60 in Column 7, you**
11 **know that the patent says, Many other examples where**
12 **drive currents and possibly bias currents may be**
13 **reduced, will be appreciated by one skilled in the**
14 **art. So I think that that's kind of referring to**
15 **lots and lots of different ways where a driver could**
16 **be implemented. That's my interpretation of that**
17 **sentence.**
18 BY MR. HART:
19 Q. Would circuits involving op-amps be
20 consistent with the teachings related to Figure 6?
21 **A. An op-amp could certainly be used as a**
22 **driver. I think that's a good example.**
23 Q. How about operational transconductance
24 amplifier circuits? Would those also be consistent
25 with the Figure 6 teachings?

1 A. Well, that's a -- that's kind of an
2 interesting question, and I think it would depend a
3 little bit on the context of the circuit. And if
4 you look at Figure 6, it's kind of assuming that the
5 output impedance of the -- he calls it "the
6 driver" -- The output impedance of the driver is
7 very low, compared to R, and so that -- like, the
8 output impedance of the driver kind of has no affect
9 on the circuit.
10 That would not be the case for an OTA.
11 And so, like, an OTA -- in the particular context of
12 Figure 6 might not be a very good driver. You
13 could, I imagine, rearrange Figure 6; so that an OTA
14 would be okay, but then it would be a different
15 figure.
16 So I guess an operational transconductance
17 amplifier would not be a great example of a driver
18 in the context of Figure 6.
19 Q. Okay. Is the circuit depicted on the left
20 side of Figure 6 single-ended or differential?
21 A. Yeah, this shows a single-ended driver
22 circuit.
23 Q. Are the challenged patents limited to
24 single-ended circuits, or do they also capture
25 differential circuits?

1 **A. Oh.**
2 MR. JOHANNINGMEIER: I'll just object to
3 the extent that -- as a legal conclusion.
4 But you can answer, to your understanding.
5 **A. Yes. I mean, you know, I would probably**
6 **want to review, you know, every claim in some detail**
7 **before I gave a definitive answer, but I don't think**
8 **that the distinction is made between single-ended**
9 **and differential in the patents. And that's a --**
10 **kind of a- -- an irrelevant distinction. It seems**
11 **to me that these techniques would work quite well in**
12 **either context.**
13 BY MR. HART:
14 Q. What is Component 614 on the left side of
15 Figure 6?
16 **A. So 614 is a resistor labeled with Value R.**
17 Q. And what is Component 616?
18 **A. That's a -- a capacitor, whose value is**
19 **labeled "C."**
20 Q. On the right side of Figure 6, there's an
21 identically-structured circuit.
22 Do you see that?
23 **A. Yes, I see that.**
24 Q. Okay. The driver component is 622, the
25 resistor is 624, and the capacitor is 626 on the

1 right side.
2 Do you see that?
3 **A. Pardon -- yes, I see that.**
4 Q. Okay. Very good.
5 At Column 7, Line -- starting at Line 48,
6 the patent states that Driver 622, quote, drives an
7 impedance of 2R, 624, and C over 2, 626.
8 Is this suggesting that the right side
9 resistor is double the value of the left side, and
10 the right side capacitor is half the value of the
11 left-side capacitor?
12 **A. Yeah, I believe that's my interpretation.**
13 **In other words, yes. You know, 624 is double the**
14 **value of 614. They're both resistors. And 626 is**
15 **half the value of 616, and they're both capacitors,**
16 **yes.**
17 Q. Okay. At Line 50 in Column 7, the patent
18 notes that The impedance of the load seen by
19 Driver 622 is double that seen by 612, thus, the
20 output current required by the Driver 622 is reduced
21 by one half.
22 Do you see that?
23 **A. Yes, I see that.**
24 Q. Why is the load impedance seen by
25 Driver 622 double that seen by Driver 612?

1 A. Well, you know, the -- the -- you know,
2 the impedance of the circuit -- let's maybe start
3 with 6- -- the 614/616 combination.
4 The impedance seen by the driver, in this
5 case, the Driver 612, is "R" -- I'm going to give an
6 algebraic expression here -- R plus 1 over FC, and
7 so that's, like, some number. You know, let's call
8 it "5." On the right-hand side, the impedance will
9 be 2R plus 1 over FC over 2, and that -- you could
10 rewrite that as 2 times R plus 1 over FC. So the
11 impedance on the right is double the impedance on
12 the left.
13 The impedance on the -- the resistor on
14 the right is double the impedance of the resistor on
15 the left, and the impedance of the capacitor on the
16 right is double the impedance of the capacitor on
17 the left.
18 Q. What does it mean when the patent says
19 that, The output current required by Driver 622 is
20 reduced by one half?
21 A. Well, in electrical -- in electrical
22 engineering, you know, we have this eq- -- this
23 equation -- this famous equation known as Ohm's Law,
24 which says that the current required is the voltage
25 divided by the resistance or the impedance. And, as

1 **I said before, the impedance in this case is**
2 **doubled. So if the current is V divided by Z and Z**
3 **doubles, then the current is halved. So this is**
4 **just a -- really, just a restatement of Ohm's Law.**
5 **As you increase the impedance or the resistance, the**
6 **current drops.**
7 Q. So to obtain the same level output, you
8 need half as much current if you've doubled the load
9 impedance?
10 **A. To get the same voltage level, if you've**
11 **doubled the impedance, you have the current.**
12 Q. Got it. Okay.
13 MR. HART: And I apologize for asking for
14 a break this early in the deposition, but I'm --
15 I'm --
16 **THE WITNESS: No.**
17 MR. HART: -- I need to do it.
18 Can we take a quick five minutes?
19 **THE WITNESS: Of course, sure.**
20 MR. HART: Very good. We'll be back in
21 five.
22 **THE WITNESS: Okay.**
23 (A recess was taken from 10:39 a.m. to
24 10:45 a.m.)
25

1 BY MR. HART:
2 Q. Very good. Welcome back, Dr. Larson.
3 At Column 7, Line 55, the -- starting at
4 Line 55, the patent explains that The emitter of
5 Driver 622 needn't supply only one half the drive
6 current as Driver 612. In this way, an impedance
7 can be scaled in order to decrease a circuit's
8 required drive circuit.
9 Do you see that?
10 **A. Yes.**
11 Q. Okay. I may have been one line off there.
12 Does the patent describe the relationship
13 between Driver 612 and 622?
14 **A. I'm sorry, could you repeat your question.**
15 Q. Yes.
16 Does the patent describe the relationship
17 between Driver 612 and Driver 622? And maybe to add
18 a little flavor there --
19 **A. Oh.**
20 Q. -- are they different circuits designed to
21 drive different loads? Are they the same circuit
22 modified to drive different loads? What does the
23 patent say about those two circuits and their
24 relationship?
25 **A. Well, I think I'm just kind of reading**

1 this. From a common-sense perspective, basically,
2 what it's saying is that the 622 driver, which is
3 driving a higher impedance, does not need to drive
4 as much current as the driver on the left, 612,
5 which is driving a lower impedance. So it's just --
6 it's expressing a relationship of the requirements
7 of that driver -- maybe the minimum requirements of
8 that driver, as a function of the different circuits
9 that are being driven.
10 Q. Okay. Could Driver 612 be a different
11 circuit than Driver 622 based on the description in
12 the '330 Patent?
13 A. It could be different. It could be the
14 same. The patent is silent on this issue.
15 Q. If they were the same circuit, does the
16 patent describe how the driver circuit, 612, would
17 be modified to scale its drive current in response
18 to a scaled load impedance?
19 A. Yeah. I -- the wording is a little
20 unclear -- but I think that what is being referred
21 to here is the fact that the biased current through
22 the emitter follower -- and if you read the first
23 sentence of that paragraph, it says, you know, The
24 output stage of each of these drivers may be a
25 Class A emitter follower fol- -- formed by an

1 emitter follower connected to a current source --
2 current -- to a current source, yeah. I'm sorry,
3 the type is very small.
4 So I think that what is being referred to
5 here is that that current source that was referred
6 to in the first sentence could be a different value
7 between 612 and 622. It can be the same circuit,
8 but it could be simply a different value of the
9 current source.
10 Q. If you were to take a single circuit
11 consistent with this emitter follower description
12 and decrease that current source, would you have to
13 make any other modifications to the driver circuit
14 in order to decrease its drive current by half, as
15 the patent contemplates?
16 A. So if I understand your question
17 correctly, you're taking the circuit from 612 and
18 you're using it in the 622 case, but reducing the
19 so-called bias current? Is that -- and then you're
20 asking: Do any other modifications need to be made?
21 Is that what --
22 Q. That is exactly -- that is exactly what I
23 was attempting to ask.
24 A. Thank you.
25 To a first order, I think there would not

1 need to be any modifications. At the extremes,
2 things become a little less clear, but over this
3 range of simply a variation of one half, you could
4 probably use the same -- you wouldn't need to make
5 any other modifications.
6 Q. Okay. If Driver -- if the Driver 612 --
7 but let's -- let's build in those presumptions that
8 you clarified in that last question -- if instead of
9 bipolar transistors, we had a driver that was MOSFET
10 technology, would you need to make any other changes
11 beyond dropping the bias current by half?
12 A. I think the same answer, basically,
13 applies in the MOS transistor case. You know, once
14 again, at the extremes of current variation, there
15 would be other considerations that might become
16 important. But within this range of just a half,
17 it -- I think no other physical modifications would
18 be required.
19 Q. And when you talk about the extreme ends,
20 you run into distortion issues at some point with
21 these transistor-based circuits; correct?
22 A. That's a good way to express it.
23 Distortion noise, both of those could become
24 problems at extremes.
25 Q. Does the patent describe these issues --

1 you know, specifically, what happens inside the
2 driver if anything, other than adjusting the bias
3 current?
4 **A. I'm sorry, do you mean --**
5 Q. Yeah, let me ask it in a more affirmative
6 way.
7 **A. Yeah.**
8 Q. Does the patent expressly describe not
9 needing to make modifications to the
10 transistor-based circuit when the biased current is
11 changed?
12 **A. Well, I guess, I'd have to review, you**
13 **know, all of the little, you know, word- -- all the**
14 **wording in the specification. I mean, I -- I think**
15 **that, generally speaking, the patent talks about**
16 **changing the bias current, but it doesn't talk**
17 **about, like, the physical changes in the circuit**
18 **that are needed to change the bias current. I'd**
19 **want to kind of maybe take a look a little bit -- it**
20 **depends on what you mean by "changes" -- but I don't**
21 **recall any, I guess, is, perhaps, the simple answer.**
22 Q. That's -- that was going to be my next
23 question, do you --
24 **A. Yeah.**
25 Q. Okay. Very good.

1 Why don't we -- why don't we move on to
2 your declaration, Exhibit 2020.
3 (Deposition Exhibit No. 2020 was marked
4 for identification.)
5 BY MR. HART:
6 Q. And I'd like you to turn to Paragraph 45
7 in that exhibit.
8 **A. Okay. Yes, I'm there.**
9 Q. All right. Very good.
10 So in Photograph 45, you state that The
11 Tsividis patents teach various implementations of
12 these inventions, referring to prior paragraphs.
13 Then you state, Information about the desired signal
14 and interferer signal is used to adjust the
15 operating characteristics of circuits or their
16 components in the receiver signal path; for example,
17 the amplifiers, mixers, and/or filters relative to a
18 worst-case condition.
19 Do you see that?
20 **A. Yeah, that's the first, like, sentence in**
21 **Paragraph 45.**
22 Q. Sure. Sure.
23 **A. Yeah. Got it.**
24 Q. And I'm just laying a little foundation;
25 so I can ask questions about your more substantive

1 opinions here.
2 So jumping down to the next paragraph,
3 Paragraph 46, you note that The Tsividis patents
4 teach these adjustments as changes affected in a
5 single-circuit block.
6 Do you see that?
7 **A. Yes.**
8 Q. Okay. And in support, you cite the
9 '330 Patent at Column 8, Lines 20 to 25, quote,
10 Functional Block 820, like the functional blocks in
11 the following diagrams, may be a filter, fixer,
12 amplifier, or other circuit.
13 Do you see that?
14 **A. Yes, I do.**
15 Q. And there's another reference to a
16 Function Block in Figure 9A there.
17 Am I correct that the challenged patents,
18 the Tsividis patents, teach dynamically adjusting a
19 filter circuit by changing it's bias current and/or
20 its impedences?
21 **A. Well, I mean, I think that -- you know, I**
22 **think you'd have to kind of look at the patent.**
23 **And, like, let's look at claim -- you know, claim --**
24 **you said the Tsividis patent; so let's look at the**
25 **'330, Claim 1, and -- if I have it here -- yeah, I**

1 got it here.
2 So it -- I'll get to your answer, I
3 promise -- so, you know -- you know, Claim 1 says --
4 skipping to Preamble -- Determining a first signal
5 strength at a first node and signal path and in the
6 integrated circuit and reducing the switching
7 current --
8 (Reporter admonishment.)
9 THE WITNESS: Sorry. Sorry.
10 A. So in Claim 1, skipping down to the claim
11 language, it says, Determining at first signal
12 strength at a first node, in the signal path in the
13 integrated circuit and reducing a switching current
14 in the signal path by dynamically changing an
15 impedance of a component in the signal path based on
16 the first signal strength.
17 So, Mr. Hart, I guess, to answer your
18 question, you know, yes, a filter, you know, could
19 be an example of a circuit that is dynamically
20 changed, you know, by -- and that would -- and doing
21 that -- you would do that by, you know, measuring a
22 signal strength, and then reducing the -- the
23 switching current in a signal path, and a filter's a
24 great example.
25

1 BY MR. HART:
2 Q. When you use the phrase, "single-circuit
3 block" in that first sentence in Paragraph 46, and
4 then you quote the patent -- the patent's recitation
5 of a "function block" or a "functional block," are
6 those analogous, the -- is a single-circuit block
7 analogous to a function block or a functional block,
8 in your view?
9 **A. Yes, I would say so. I mean, I think**
10 **that, you know, someone of ordinary kind of skill in**
11 **the art, an average engineer reading the patents**
12 **would kind of think of a -- a functional block, you**
13 **know, like, a filter, a mixer, or an amplifier, and**
14 **those -- yeah, I guess, they're single-circuit**
15 **blocks in my declaration, and those are,**
16 **essentially, equivalent.**
17 Q. Continuing down in Paragraph 46 in your
18 declaration, in Exhibit 2020, you state, The patents
19 refer to adjustments in or to a single circuit, and
20 you cite The patents discussion of Figure 6, which
21 we've already covered?
22 **A. Okay.**
23 Q. You, quote, The patent is saying Figure 6
24 is an example of how a circuit's impedences may be
25 scaled.

1 Do you see that?
2 **A. Yes, I do.**
3 Q. Is the combination of a driver, resistor,
4 and capacitor in Figure 6 a function block or a
5 functional block consistent with the terminology
6 we're discussing here?
7 **A. Yeah, I think that's a very nice**
8 **representative example. It's a driver with a**
9 **resistor and a capacitor. So, yeah, I believe**
10 **that's a pretty good example.**
11 Q. What type of function block is Figure 6?
12 We have examples here of a filter, a mixer, or
13 amplifier, or other circuits. What -- what is
14 Figure 6 describing?
15 **A. Yeah, I think the simplest way to describe**
16 **Figure 6 is it's a -- it's a low-pass filter. It --**
17 **it allows low frequencies to go through and**
18 **attenuates high-frequency signals.**
19 Q. Okay. Aside from the Figure 6 example, do
20 the Tsividis patents describe any other specific
21 circuit blocks that have their impedance or bias
22 current dynamically adjusted pursuant to the
23 described invention?
24 **A. So let me just quickly look through the --**
25 **the -- all the various figures here.**

1 Well, I think, you know, specifically --
2 if your question is specifically at the level of --
3 you know, the resistor/capacitor level that Figure 6
4 describes, I think the patent doesn't have any other
5 examples of that kind of thing.
6 I think someone, you know, of ordinary
7 skill in the art would understand that, you know,
8 once you kind of get Figure 6, you don't need to
9 repeat these because they're all of the same type,
10 you know, of -- and Figure 6 is a- -- is an example
11 of an impedance scaling. So you don't -- I wouldn't
12 think you would need to repeat it, necessarily.
13 Q. Are there any specific mixer circuit
14 functional blocks described in the patent?
15 A. Well, you know, if you look at, you know,
16 Figure 14, for example, you know, it's a drawing of
17 a mixer, and I think Figure- -- yeah, I guess,
18 Figure 14 is an example of a -- of a more complex
19 circuit with a bunch of little, you know, functional
20 circuit blocks within it, and a mixer is one of
21 them.
22 Q. Okay. And the -- the level of detail in
23 Figure 14 for the mixer is just the standard symbol
24 for a mixer; correct? There's no lower-level
25 circuit description of that mixer; correct?

1 **A. Yeah, that's correct. That's the**
2 **standard -- high-level symbol for a mixer.**
3 Q. I remember something from the late
4 '90s ...
5 **A. Very good. Very good.**
6 Q. How about amplifier circuits? Are there
7 any specific amplifier circuits described by the
8 Tsividis patents?
9 **A. Well, I -- I think your question -- there**
10 **seemed to be a presumption to your question, which**
11 **is at the -- maybe at the transistor level or at the**
12 **component level, and, of course, there are many,**
13 **many, many amplifiers drawn throughout these patent**
14 **drawings, but none of them are at the transistor**
15 **level, which is what I think your question was**
16 **referring to.**
17 Q. And may be not that -- quite that narrow,
18 but something lower level and more detailed than
19 simply a triangular amplifier symbol.
20 Are there -- are there any specific
21 circuits that get more detail than just this is an
22 amplifier in the Tsividis patents?
23 **A. Yeah, not that I'm aware of. And, I mean,**
24 **I think that the next lower level would have to be**
25 **at the transistor -- sort of at the transistor level**

1 **and the -- the patent does not have any of those**
2 **drawings.**
3 (Reporter clarification.)
4 THE COURT REPORTER: "Does not have any"
5 ...
6 **A. Of those drawings.**
7 BY MR. HART:
8 Q. All right. Let's -- let's turn, next, to
9 Exhibit 1011, the 2003 article from Dr. Tsividis.
10 **A. Yes, I have it here.**
11 Q. Great.
12 **THE WITNESS: And, Mr. Hart, I apologize I**
13 **have a dog in the background and he may bark from**
14 **time to time; so ...**
15 MR. HART: You know, I -- I have not heard
16 it -- I have two small kids and a dog in my
17 household, and I'm constantly self-conscious that
18 people are hearing them through Zoom, and it's never
19 the case; so I can't hear your dog, and we can hear
20 you just fine?
21 **THE WITNESS: Oh, good.**
22 BY MR. HART:
23 Q. All right. I'm actually going to -- so
24 you have Exhibit 1011 out, and I'll get it -- into
25 more detail about its disclosure, but I kind of want

1 to start and piggyback on this line of questions
2 we've been going on by using your discussion of this
3 article in the declaration, Exhibit 2020.
4 So let's -- let's turn to Paragraph 71 in
5 Exhibit 2020, your declaration, to start.
6 **A. Yes.**
7 Q. All right. So here in Paragraph 71, you
8 state, The approach shown in Figure 12 of Professor
9 Tsividis' 2003 article is an example of what is
10 claimed in the patents.
11 Do you see that?
12 **A. I do.**
13 Q. Okay. I'd like to scroll back up. You
14 have, in Paragraph 68, some annotated versions of
15 that circuit, Figure 12, from the 2003 article,
16 which is Exhibit 1011.
17 Do you see those annotated figures,
18 Figure 12?
19 **A. I do.**
20 Q. All right. So let's use your discussion
21 here in Paragraph 68 for this next line of
22 questions.
23 In paragraph 68, above those annotated
24 Figure 12 examples, you state that Impedance R that
25 is in the signal path can be dynamically changed to

1 R over 2 by adding in a second parallel R to the
2 existing signal path.
3 Do you see that?
4 **A. I'm sorry, which paragraph are you looking**
5 **at?**
6 Q. 68.
7 **A. I apologize.**
8 Q. Actually, let's just starlight a little
9 better foundation here.
10 Can you just give me a high-level
11 description? What is the circuit in Figure 12 that
12 you discuss here in your declaration?
13 **A. Yeah. Figure 12 is a op-amp-based, active**
14 **RC, low-pass filter who- -- whose frequency -- whose**
15 **impedance can be changed -- I'm sorry -- I should**
16 **maybe say that the impedance in the signal path --**
17 **the impedance in the signal path can be changed by**
18 **switching resistors and capacitors in and out to**
19 **effect that change. And the one on the left is a**
20 **high-impedance version to the one on the right, is a**
21 **low-impedance version, as we've drawn it in my**
22 **declaration.**
23 Q. So there's just one Figure 12, and you
24 have annotated the version on the left to indicate a
25 high-impedance version of this circuit, and you've

1 annotated the one on the right to indicate a
2 low-impedance version of the circuit; is that
3 accurate?
4 **A. That's correct, and the -- yes, that's**
5 **correct. I've annotated that to show the**
6 **differences between the two.**
7 Q. How does this active filter circuit differ
8 from what we saw in Figure 6, in the Tsividis
9 patents?
10 **A. Well, this is an op-amp-based RC, low-pass**
11 **filter, whereas the Figure 6 was a -- I believe we**
12 **called it a buffer- -- buffer-based RC circuit; so**
13 **that's -- I would have to say the major difference.**
14 **You know, they both switch impedences in the signal**
15 **path to low -- you know, raise or lower the**
16 **impedance; so that they have that similarity, that**
17 **they both, you know, switch impedences, resistors,**
18 **and capacitors in the signal path. So there are**
19 **differences and similarities.**
20 Q. So jumping back to the portion of
21 Paragraph 68 that I read in before -- and let me
22 reread this into the record -- so the last -- your
23 last full sentence in Paragraph 68 starts in
24 Figure 12, for example.
25 Do you see that?

1 **A. That's the next-to-last sentence, yes.**
2 Q. Sorry, the -- the last sentence that you
3 wrote separate from the citation in support?
4 **A. Oh, thank you. I'm sorry.**
5 Q. Lawyer brain.
6 Okay. So in Figure 12, for example,
7 impedance R that is in the signal path can be
8 dynamically changed to R over 2 by adding in a
9 second parallel R to the existing signal path.
10 Do you see that?
11 **A. I do.**
12 Q. So the upper resistor depicted in this
13 circuit is switched into the circuit parallel to the
14 lower resistor; is that right?
15 **A. Yeah. It's switched, you know, in and out**
16 **in parallel with that lower resistor; correct.**
17 Q. And when both resistors are switched into
18 the circuit, their collective resistance or
19 impedance is lowered; correct?
20 **A. Yes, it's one half the original.**
21 Q. If they are equal value resistors?
22 **A. Correct.**
23 **And I -- I guess, I assumed that they were**
24 **because they're both labeled "R" --**
25 Q. Sure.

1 **A. -- in this case.**
2 Q. The -- sure, the convention of
3 assigning --
4 **A. Yeah.**
5 Q. -- numerical value of the letters. I see.
6 **A. I apologize, maybe I'm being too pedantic.**
7 Q. No, no, no. That's what patent lawyers
8 are all about.
9 Okay. So when both -- and on the right
10 side, you have indicated with red annotations an
11 example in which both resistors are, in fact,
12 switched in and passing signal; is that right?
13 **A. That's right.**
14 **And, you know, the -- since there was only**
15 **one figure, that -- you know, that -- that second**
16 **annotation that you mentioned, assumes that the**
17 **switch is closed, even though it's not closed in**
18 **Figure 12, but that was the assumption we made for**
19 **illustrative purposes.**
20 Q. And so when that switch is closed, as you
21 presume on the right side, red annotation, both
22 resistors are switched into the circuit, and the
23 impedance experienced by the signal that passes
24 through that circuit is lower than the left side
25 example when that switch is open, and only one

1 resistor passes the signal; correct?
2 **A. Yeah. I mean, the signal -- the -- the**
3 **signal path -- sorry -- the impedance of the signal**
4 **path is reduced to R over 2; correct.**
5 Q. So this is an example that you say is
6 consistent with the Tsividis patents; right?
7 **A. Yes, I believe this is -- this is**
8 **consistent -- this is, perhaps, one example of**
9 **a Tsividis patents in use.**
10 Q. So the Tsividis patent claims Capture
11 circuits in which impedance is dynamically adjusted
12 by switching components in and out of operation;
13 correct?
14 **A. Yes, as long as they're in the signal**
15 **path, that is correct. This is a dynamic switching**
16 **of the -- of the signal path.**
17 Q. Are you familiar with a potentiometer?
18 **A. Yes, I'm familiar with a --**
19 Q. Okay.
20 **A. -- potentiometer.**
21 Q. Okay. What is a potentiometer?
22 **A. Well, potentiometer is, essentially, a**
23 **variable resistor, and, you know, in the old days,**
24 **it would be a mechanical -- you would literally,**
25 **like, turn a dial, and there would be a metal plate**

1 **that would land on the resistor and touch it at**
2 **different spots, and create a variable resistance.**
3 **More modern versions have, you know, similar --**
4 **maybe different characteristics, and then the old**
5 **ones still are used very frequently.**
6 Q. So a component where the resistance can be
7 varied along a scale continuously.
8 Is that generally right?
9 **A. Yes, that's a great way to put it. Under**
10 **maybe mechanical -- historically, at least,**
11 **mechanical turning.**
12 Q. Do the Tsividis patents capture changing
13 component values by that means, by continuously
14 variable components, like a potentiometer?
15 MR. JOHANNINGMEIER: Then, again, I'll
16 just object to the extent that's asking for a legal
17 conclusion.
18 But you can answer to your technical
19 understanding.
20 **A. Yeah, I -- I guess is -- and is your**
21 **question: Would something like a potentiometer to**
22 **vary an impedance be a -- to reduce switching**
23 **currents in the signal path be covered by Tsividis**
24 **patents?**
25

BY MR. HART:

Q. Yes.

A. I believe so, yeah. I mean, I think that that's -- I mean, the physical mechanism for that variation is -- is a little unusual for these applications, but I believe something like that could be consistent with the patents.

Q. Why is it unusual in this type of application?

A. Well, you know, this patent is, you know, just sort of directed to microelectronics, it seems to me. I don't think it's particularly limited to it, but those are the examples that are given. And the potentiometer is this big, physical thing that you see on a wall or connected to a motor, and so the scale of sizes is very different from, I think, what is kind of discussed in the patent, but that's not to mean that it's limiting.

Q. And would you expect applications that these patents target to use a technique like Figure 12, where you are switching in and out circuit components in order to change values, rather than something like a potentiometer, where you have a continuously variable component?

A. Yes. Well, I think that that would

1 **certainly be -- I mean, I think the answer to your**
2 **question is both are anticipated by the patent, and**
3 **both would be perfectly fine.**
4 Q. Turning back to the annotated Figure 12
5 examples here in your declaration at Paragraph 68,
6 on the left, you indicate the signal path in yellow,
7 and on the right, the signal path in red; correct?
8 **A. Correct.**
9 Q. The yellow signal path on the left is an
10 example of the upper transistor switch being open
11 taking that resistor out of the circuit; correct?
12 **A. Taking that -- upper resistor out of the**
13 **circuit, yes; correct.**
14 Q. When that upper resistor is switched out
15 of the circuit, no signal flows through that
16 resistor; correct?
17 **A. That's correct.**
18 **When the switch is open, no signal will**
19 **flow through that switch -- or through that**
20 **resistor; correct.**
21 Q. Now, you have annotated that upper
22 resistor that is switched out of the circuit yellow
23 here; correct?
24 **A. Correct, yes.**
25 Q. Okay. Why have you colored it yellow,

1 suggesting its part of the signal path, if no signal
2 flows through that resistor?
3 **A. Well, I think -- you know, I think that**
4 **the -- the -- you know, the simple answer is: I**
5 **want to make a comparison between what's going on on**
6 **the right and what's going on on the left. And, you**
7 **know, on the right, the signal goes through both**
8 **resistors, and on the left, it only goes through**
9 **one. So it -- you know, and I think the key**
10 **difference between the two is that, you know, on**
11 **the -- the -- the signal path is the same for the**
12 **bottom resistors in both cases, but the one on the**
13 **left, the signal doesn't go through that top**
14 **resistor; so I just wanted to show kind of the**
15 **difference between what's happening with that**
16 **resistor on the left, and what's happening with the**
17 **resistor on the right.**
18 Q. Can components be part of a signal path
19 even when they are switched out of the circuit, such
20 that they are not passing signal?
21 **A. Well, I think that they -- all right.**
22 **Maybe the best way to answer is that the signal --**
23 **if they're switched out, the signal won't go through**
24 **them, and when they are switched in, the signal does**
25 **go through them. So the -- the question of whether**

1 they're in the signal path or not depends on whether
2 they're switched in or switched out.
3 Q. Now, in Paragraph 68, you, quote, in that
4 sentence I read into the record, "in the signal
5 path."
6 Now, are you suggesting that -- you know,
7 that is claim language that the parties are,
8 obviously, disputing and debating in these
9 proceedings.
10 Do you consider the upper resistor part of
11 the signal path or in the signal path, even in the
12 left example annotated yellow?
13 A. Well, maybe a way to put it is that
14 it's -- it's not in the signal path when it's open,
15 but it is in the signal path when the switch is
16 closed. And, you know, that's a little bit
17 different from, like, taking something entirely out
18 of a -- like, a component -- like, a -- like, a
19 changing the signal path completely. You're simply
20 adding something in parallel with the signal path or
21 taking something out of being in parallel from the
22 signal path. So -- but your point is correct, that
23 when the switch is open, there's no signal flowing
24 through that resistor.
25 Q. If -- if the switch were placed upstream

1 of those two resistors and those two resistors had
2 different values, and changing an impedance chose
3 one resistor or the other, is that consistent with
4 the Tsividis patents?
5 **A. Hmm ... Could you -- could you explain**
6 **what you mean by "upstream."**
7 Q. To the left.
8 **A. Oh, to the left.**
9 Q. Upstream of the -- the signal flow.
10 **A. Yeah. So -- and I'm sorry, could you ask**
11 **the question again now that I understand what you**
12 **mean.**
13 Q. Yes. If -- if you moved the switch to the
14 left of both transistors -- I'm sorry -- both
15 resistors, such that changing impedance chose one
16 resistor or the other, presuming they have different
17 values, is that consistent with the Tsividis
18 patents?
19 MR. JOHANNINGMEIER: Again, objection to
20 the extent it calls for a legal conclusion.
21 **A. Yeah. Well, once again, I'm -- and I'm**
22 **not trying to be obtuse. I'm genuinely a little**
23 **unsure -- are you saying to take that upper resistor**
24 **and switch the R in the switch, or -- or how -- I**
25 **don't quite understand how you're trying to**

1 **reconfigure the circuit.**
2 Q. And I -- sir --
3 **A. And, really, I'm generally confused; so**
4 **yeah.**
5 BY MR. HART:
6 Q. No, no, no. I can tell.
7 I -- if -- if -- if there was no switch to
8 the right of the upper resistor --
9 **A. Oh.**
10 Q. -- and there was a switch to the left of
11 both resistors that had two positions, either it
12 made the upper resistor in circuit or the signal
13 flow through the upper resistor, or it was low -- it
14 was in a down position to push all of the signal
15 flow through the lower resistor, and they have
16 different values, let's say one is 2R, and one is R,
17 is that process of changing the resistence at that
18 point in the filter circuit consistent with the
19 Tsividis patents?
20 MR. JOHANNINGMEIER: Same objection.
21 **A. Yes. And I think I see what you're saying**
22 **now. So the signal -- so if you had two switches,**
23 **and you -- let's call it the -- I'm going to try**
24 **to -- you know, R1 and R2 are these two resistors,**
25 **and if you added another switch; so that the only**

1 one of the two switches was open, you know, I -- I
2 believe that's consistent with the Tsividis patents.
3 In other words, the -- the -- the impedance through
4 the signal path is -- is either R1 or R2 in that
5 case.
6 BY MR. HART:
7 Q. That's right.
8 A. And, as you say -- and as you say, one of
9 the resistors will not have any signal going through
10 it.
11 Q. At any given time, one resistor will not
12 have signal going through?
13 A. As you're -- as you described this
14 particular --
15 Q. Yes.
16 A. -- scenario, yeah.
17 Q. So you're either -- the signal's either
18 flowing through R1 or it's flowing through R2 before
19 it reaches the negative terminal of that op-amp?
20 A. Yeah, in the scenario you described, as I
21 understand it, I believe, that's correct.
22 Q. Okay.
23 A. And I believe that's consistent with the
24 Tsividis patents.
25 Q. Okay. And so even though there's no

1 continuity in that example -- so R1 is only passing
2 signal in either the high-impedance or the
3 low-impedance mode, and R2 is only passing signal in
4 either the high-impedance or the low-impedance mode,
5 that's still captured by the Tsividis patents?
6 MR. JOHANNINGMEIER: So same objection,
7 and we're talking about a hypothetical circuit here;
8 so let's make sure we're on the same page.
9 **A. Yeah, I mean, I think, the way to think**
10 **about that is that I use this word "continuity," and**
11 **I think that the continuity -- well, I'm not quite**
12 **sure what you mean by "continuity." There would**
13 **be -- anytime you switch a switch, there's an abrupt**
14 **transition, and that would be true in both cases.**
15 BY MR. HART:
16 Q. Right.
17 So in Figure 12, as it sits, the lower
18 resistor is always passing signal; correct?
19 **A. If Figure 12, as drawn, the lower resistor**
20 **is always passing the signal, yes, yes.**
21 Q. And in my hypothetical, that would not be
22 true; right?
23 MR. JOHANNINGMEIER: Well, object --
24 **A. So in your hypothetical, you have added --**
25 (Reporter clarification.)

1 MR. JOHANNINGMEIER: Yeah, I just said
2 objection. Yes.
3 **THE WITNESS: Yeah.**
4 **A. You know, I -- your hypothetical added a**
5 **series switch, and series with that low resistor,**
6 **and if that switch is open, then no current would**
7 **flow through it.**
8 BY MR. HART:
9 Q. Let's scroll up to Paragraph 55 in your
10 declaration, Exhibit 2020.
11 **A. Okay. I'm there.**
12 Q. So --
13 **A. [Indiscernible.]**
14 Q. Sorry. Go ahead, Dr. Larson. I missed
15 what you said.
16 **A. No, I'm -- I'm there.**
17 Q. Yeah.
18 Starting in Paragraph 55, you're
19 discussing Exhibits 1004, 1005, and 1006, which you
20 collectively refer to as the "Behbahani papers"; is
21 that right?
22 **A. Yes, correct.**
23 Q. Going down to Paragraph 57, you discuss
24 the -- well, let me just read it into the record --
25 Behbahani and his colleagues address this challenge

1 of designing a filter that can handle sufficient
2 dynamic range by instead including two filters; one
3 a version of the other, but scaled up 10 times, and,
4 then, there's a block quote discussing a bandpass
5 filter from the Behbahani papers.
6 Do you see that?
7 **A. Yes, I do.**
8 Q. This -- the internals of that bandpass
9 filter are really the focus of your analysis in the
10 parties' dispute; is that accurate?
11 **A. Well, I don't quite know what you mean by**
12 **"internals." I would have to say that the -- I**
13 **would say -- have to say the deployment of those two**
14 **filters is, perhaps, a better way to -- for this --**
15 **the deployment of those two filters for this**
16 **application is, perhaps, a better way to describe**
17 **it.**
18 Q. What -- what -- what is inside Behbahani's
19 variable band-pass filter?
20 **A. Well, Behbahani's band-pass filter is a --**
21 **it's a so-called GMC filter. "GM" stands -- is a**
22 **terminology for transconductance. You referred**
23 **earlier to the operational transconductance**
24 **amplifiers or OTAs.**
25 **So this filter is full of a bunch of OTAs**

1 **and capacitors, and these OTAs and capacitors mimic**
2 **inductors, and inductors, along with capacitors, are**
3 **how traditional filters are designed. And the**
4 **problem is you can't build an inductor on an**
5 **integrated circuit that is very good. So we use**
6 **OTA-C filters as substitutes for inductors. And so**
7 **the -- I'm sorry, my cat just jumped on the table**
8 **here.**
9 Q. So --
10 **A. Also, you know, what's inside these**
11 **filters, are a bunch of operational transconductance**
12 **amplifiers and capacitors that mimic an inductor**
13 **capacitor filter.**
14 Q. And just backing out to a slightly higher
15 level, what are the kind of constituent components
16 of that variable band-pass filter?
17 **A. Well -- I -- you know, once again, I'm not**
18 **sure what you mean by "constituent components."**
19 **Transistors, capacitors, resistors are the -- like,**
20 **the basic building blocks of those filters.**
21 Q. If we scroll down to Paragraph 58 in your
22 declaration --
23 **A. Yes.**
24 Q. -- you have a- -- an annotated figure here
25 that appears to indicate a signal path enters

1 Behbahani's variable band-pass filter, and takes one
2 of two paths; either a low-power-filter signal path
3 or a high-power-filter signal path.
4 Do you see that?
5 **A. Yes. The -- the signal routes -- the**
6 **signal path is switched to the left to go through**
7 **the low-pass -- low-power filter in yellow and/or**
8 **the signal path is added to the right to go into the**
9 **high-power filter, and that's annotated in red.**
10 Q. Can you scroll down to -- or I suppose
11 turn pages to Paragraph 82 in your declaration.
12 **A. Yes, I'm there.**
13 Q. All right. And in here, you have similar
14 annotations. You have a high-power-filter signal
15 path annotated in yellow on the left, and a
16 low-power-filter signal path annotated in red on the
17 right; correct?
18 **A. Yes, correct.**
19 Q. In here, it's superimposed over the
20 Silicon Imaging of a prototype chip from the --
21 described in the Behbahani papers; is that right?
22 **A. Yes, that's correct.**
23 Q. Okay. For the yellow path, the signal
24 passes through that high-power low-pass filter, and
25 then through a high-pass filter; is that right?

1 **A. That's correct.**
2 Q. And the signal path in red first passes
3 through a low-power low-pass filter, and then a
4 high-pass filter; correct?
5 **A. That's correct.**
6 Q. Is the high-pass-filter block the same for
7 both pass -- does the red signal path and the yellow
8 signal path, do they both traverse the same
9 high-pass filter?
10 **A. Yes, they do.**
11 Q. In these -- this annotated figure in
12 Paragraph 82, you have indicated example
13 impedences -- is that right? -- or relative
14 impedences?
15 **A. And I think you're referring to the Z**
16 **equals X and Z equals 10X --**
17 Q. Yes.
18 **A. -- designation that I've given.**
19 Q. Yes, that's --
20 **A. Yes, that's correct.**
21 Q. And you've indicated that the high-power
22 low-pass-filter impedance is "X"; correct?
23 **A. Yes. It's labeled, Z equals X, yes.**
24 Q. And the high-pass filter you have
25 designated an Impedance Y; correct?

1 **A. Yes, correct.**
2 Q. And so the impedance of the yellow path
3 going through the variable band-pass filter is X
4 plus Y; correct?
5 **A. Well, I believe, the premise of your**
6 **question, perhaps, takes my designation a little**
7 **more literally than what is intended, and you're not**
8 **wrong. I think all I really meant was that the --**
9 **the impedance of the low-pass filter or the**
10 **high-power low-pass filter was "X," and the**
11 **impedance of the high-pass filter is "Y." It's not**
12 **totally clear to me that, like, the overall**
13 **impedance would be X plus Y in that circumstance.**
14 **It depends a little bit about how the filters are**
15 **interconnected. So I would just say that it's maybe**
16 **not X plus Y, but X and Y.**
17 Q. X and Y?
18 **A. Some combination of X and Y, yeah.**
19 Q. And the red, asking the same question, and
20 I'll phrase it consistent with your answer: The red
21 signal path that you've indicated here or annotated
22 here, the impedance through the variable band-pass
23 filter would be 10X and Y?
24 **A. Yes. That's -- so that -- that other**
25 **signal -- that signal path that's been created for**

1 **the low-power low-pass filter would be 10X and Y,**
2 **some combination of them.**
3 Q. Got it.
4 So the impedance of the low-power low-pass
5 filter is -- let me -- let me start that question
6 over.
7 The experience -- the impedance
8 experienced by a signal flowing through the
9 low-power low-pass filter is 10 times higher than
10 the impedance experienced by the signal flowing
11 through low- -- the high-power low-pass filter; is
12 that right?
13 **A. Yeah. I think that the -- the -- the**
14 **signal will experience different impedances, and**
15 **it's very much like -- you know, sort of, like,**
16 **Figure 6 in Tsividis; right? There's a -- we talked**
17 **about different impedance levels, and so that would**
18 **be, in this case, a 10X difference.**
19 Q. Okay. Can I have you scroll up to
20 Paragraph 76 in your declaration. So here,
21 you're -- you're talking about the high-power
22 low-pass filter branch, and the low-power low-pass
23 filter branch in Behbahani's variable band-pass
24 filter, and you state, Each filter is described as
25 having been designed for a particular impedance and

1 current consumption.
2 Do you see that?
3 **A. Sorry, this is Paragraph 76?**
4 Q. Yes. Page 32 and 33 in your declaration,
5 Exhibit 2020.
6 **A. So could you read the quote again.**
7 Q. Yes.
8 Each filter is described as having been
9 designed for a particular impedance and current
10 consumption.
11 **A. Oh, yes, I see that. Thank you.**
12 Q. Okay. You -- you quote the Tan reference,
13 Exhibit 1006 to -- page 46 as describing a drain 5.4
14 and 56 milliamps from 3.3 volts, respectively.
15 Do you see that?
16 **A. I do.**
17 Q. Is it correct that these two filter
18 branches will have approximately 10X bias current
19 applied to them -- a 10X difference in their bias
20 currents?
21 **A. Yes, as reported here of 5.4 and**
22 **56 milliamps, respectively.**
23 Q. Okay. So the -- let me see if I can get
24 this right -- the high-power low-pass filter will
25 have an impedance -- will have a different impedance

1 and a different bias current than the low-power
2 low-pass filter; right?
3 **A. It will -- I mean, it'll have different**
4 **impedance levels throughout it, yes.**
5 Q. And if they are scaled 10X, as the
6 Behbahani papers suggest, the differences in
7 impedances and the differences in bias currents will
8 be approximately 10X between those two?
9 **A. Yes, roughly.**
10 Q. Okay.
11 MR. HART: I am going to transition to a
12 new topic with the next line of questions; so why
13 don't we take a break now and go off the record.
14 (A recess was taken from 11:38 a.m. back
15 BY MR. HART:
16 Q. All right. Welcome back, Dr. Larson. I'd
17 like to turn, next, to Exhibit 1011, the 2003
18 article from Dr. Tsividis that you discuss in your
19 declaration. And I will be referring specifically
20 to the paper itself this time, rather than your
21 discussion of it from the declaration.
22 So I understand you have a copy of 1011 in
23 front of you. Can you, please, turn to page 8 of
24 Exhibit 1011.
25 **A. Yes, I'm there.**

Q. All right. Very good.

So on page 8, the paper introduced -- starts to introduce multiple different techniques. There's a Technique 2, referred to as Dynamic Impedances Scaling; Technique 3, referred to as Dynamic Biasing, and then on the next page, a Technique 4, referred to as Dynamic Structure Variation.

Do you see those?

A. I do, yes.

Q. And are you familiar with these three techniques that are described in Exhibit 1011?

A. Yes, I am.

Q. Okay. Let's start with Technique 2, Dynamic Impedances Scaling.

So this section begins as follows: Consider a system designed to handle very small signals in the worst case, as in Figure 4A, due to the large UDR, the capacitance values will be large, as seen from Reference 6. However, this worst-case-signal situation may not be present -- be present continuously part of the time. The same system may be called to handle large signals with limited UDR or SNR Max. This, for example, can be the case in wireless systems when the desired signal

1 happens to be strong, and no blocker is present,
2 with a cite to Reference 32.
3 At those instances, the very low-noise
4 floor of the system is unnecessary and can be
5 allowed to increase by scaling, see down, cite
6 Reference 33, resulting, for example, in the
7 situation shown in Figure 4B.
8 Now, to start us off, just a quick
9 terminology clarification, "UDR," is that "Useable
10 Dynamic Range" in Exhibit 1011?
11 **A. Yes, that's correct.**
12 Q. Am I correct that this introduction is
13 proposing a system that is designed with a large
14 UDR, and realizes that large UDR in part by using
15 large capacitance values?
16 **A. Well, are you referring to the paragraph**
17 **that you just quoted?**
18 Q. I am, yes.
19 **A. So I -- actually, I think that this --**
20 **that particular paragraph is referring to a system**
21 **with a limited or rather small UDR, and the reason I**
22 **say that is that he says This, for example, can be**
23 **the case in wireless systems when the desired signal**
24 **happens to be strong, and no strong blocker is**
25 **present. And so, actually, the dynamic range**

1 **required in that situation is relatively modest.**
2 **And, then, Professor Tsividis, you know, mentions**
3 **that you can actually raise the noise floor and --**
4 **or -- and/or lower the capacitance, and, actually,**
5 **what that kind of does is lowers the dynamic range,**
6 **and improves the power dissipation.**
7 Q. I did read a large portion of the paper
8 into the record; so maybe we'll take it in more
9 bite-size pieces here.
10 So let's start again in the very beginning
11 of this Technique 2, Consider a system designed to
12 handle very small signals in worst case, as in
13 Figure 4A, due to the large UDR, the capacitance
14 values will be large.
15 So this is describing a system designed
16 with a large, useable dynamic range, and it realizes
17 that large UDR, at least in part, with large
18 capacitance values; correct?
19 **A. Yes. So thank you.**
20 **The -- it's just, as you say here, due to**
21 **the large UDR, the capacitance values will be large.**
22 Q. And the rest of that portion that I read
23 into the record is suggesting that there may be
24 instances in which that large UDR is not required,
25 and the UDR can be narrowed in part by scaling the

1 capacitance values down; correct?
2 **A. In certain situations; correct, yes.**
3 Q. And that is what is being proposed here in
4 this beginning portion of Technique 2; right?
5 **A. Yes, that's correct.**
6 Q. So picking up where I left off reading
7 this into the record, it continues, Of course, the
8 transconductances or conductances of the filter will
9 have to be scaled together with "C" in order to
10 leave the frequency response unchanged.
11 Why do you have to scale the
12 transconductances together with "C" in order to
13 leave the frequency response unchanged in this
14 example?
15 **A. Well, from circuit theory, we know that**
16 **the frequency response of the filter depends on the**
17 **ratio of GM, the transconductance divided by the**
18 **capacitance, GM over C. And so if you want to -- as**
19 **is suggested here, Change the capacitance in order**
20 **to, you know, accommodate situations of lower**
21 **dynamic range, you might want to reduce the**
22 **capacitance, but you wouldn't want to change the**
23 **frequency response of the filter. And so you would**
24 **have to reduce the GM by an equivalent amount to**
25 **keep the GM over C constant.**

1 Q. Continuing on in this section, the paper
2 states, The reason one may want to do such
3 impedances scaling becomes clear from seven,
4 lowering capacitances and transconductances allows
5 one to also lower I, bias, and, thus, the total
6 power dissipation can be made small.
7 Do you see that?
8 **A. Yes, I do.**
9 Q. So this is proposing as we transition from
10 a large UDR to a smaller UDR, making three
11 adjustments; one, scaling down capacitance values,
12 two, scaling down transconductances, and, three,
13 scaling down bias current; correct?
14 **A. In this particular case, that's correct,**
15 **yes.**
16 Q. And the result of those three scalings is
17 power savings?
18 **A. Power -- power saved, yes.**
19 Q. Power saved.
20 **A. Uh-huh. DC power is saved.**
21 Q. I'm sorry, TC power [sic]?
22 **A. Yeah, DC power is saved.**
23 Q. DC power. Understood.
24 **A. Yes.**
25 Q. And that's because the bias current is a

1 DC current?
2 **A. Yes, the bias current is a DC current, and**
3 **that's what is saved when we go through all of this.**
4 Q. Okay. The final sentence in this
5 paragraph states, In principle, for every three dB
6 reduction in UDR, the power dissipation can be cut
7 to half.
8 Do you see that?
9 **A. I do see that.**
10 Q. So you're giving up useable dynamic range,
11 but you're saving power in exchange; correct?
12 **A. DC power in exchange, yes; correct.**
13 Q. Is this approach of scaling a filter in
14 these three specific ways consistent with the
15 Tsividis patents?
16 MR. JOHANNINGMEIER: Objection, if that's
17 a legal conclusion.
18 But you can answer.
19 **A. Well, I mean, I think that the -- you**
20 **know, Tsividis, you know, talks about, you know,**
21 **scaling impedances and scaling bias currents in the**
22 **signal path, and so, in general, I would have to say**
23 **this is consistent -- it's written in a rather high**
24 **level; so it's -- it's consistent, but, you know,**
25 **it's not -- I would say it's consistent with what**

1 **Tsividis is -- has been describing; changing**
2 **impedance scaling, bias current scaling in the**
3 **signal path.**
4 BY MR. HART:
5 Q. In the next paragraph in this section,
6 Technique 2, the paper states, One way to achieve
7 the above scenario would be to use two filters
8 designed with different capacitance values and place
9 one or the other in service, as required, it has a
10 cite to Reference 34, turning the other filter off.
11 Do you see that?
12 **A. I -- I do see that, yeah.**
13 Q. This is a reference to the scaled filter
14 approach described in the Behbahani papers; correct?
15 **A. Correct, yes, that's, I believe,**
16 **Reference 34 is the Behbahani. Let me just confirm,**
17 **but -- yes, that's correct.**
18 Q. Do you agree that in Behbahani's approach,
19 when the system is switched from Behbahani's
20 high-power low-pass-filter branch to its low-power
21 low-pass-filter branch, the capacitance values,
22 transconductances, and bias currents are all scaled
23 down?
24 **A. Well, I mean, they're two completely**
25 **different circuits. Now, those two completely**

1 circuits will have different capacitor values and
2 different transconductance values and different DC
3 bias currents; so they're -- I mean, they are -- you
4 know, they're different, for sure, scaled, to use
5 your words, but they're also two completely
6 different circuits; so ... I sort of agree with
7 that proviso.
8 Q. You would agree that Behbahani's approach
9 accomplishes power savings contemplated by
10 Technique 2 described here, by scaling the same
11 three variables between its two separate filter
12 branches?
13 A. Well, I think, actually, Behbahani's a
14 little different from that --
15 Q. Okay.
16 A. -- and it- -- it's part of what you say,
17 but also they're two completely different filters.
18 Now, they both have transconductances in them and
19 capacitors, but I'm not sure that the individual
20 elements are scaled by the same values in every
21 case. In other words, I mean, the -- I think the
22 virtue of Behbahani's approach is that you can have
23 completely different topologies, completely
24 different circuit approaches because one is
25 high-power and the other's low-power, and so because

1 they're these two completely different circuits,
2 they may not simply be just scaled version of each
3 other. They may actually have quite a few
4 differences apart there scaling. Now, I'd have to
5 get into the details of the circuit, but that's --
6 so you're partially correct, but I think that
7 there's also an additional element that is a
8 potential advantage of the Behbahani approach,
9 you're switching between two completely different
10 circuits, which can each be separately optimized.
11 Q. The last sentence in this paragraph
12 states, This, however, causes transients at the
13 output, which may take a long time to die out,
14 especially, in the case of filters with high Q
15 poles, the result may be a loss of data?
16 A. I see that.
17 Q. Is this describing a potential downside of
18 switching between two filter branches, like
19 Behbahani does?
20 A. Yes, this describes a potential downside.
21 You're turning one complete filter off, and another
22 complete filter on, and they take a while to settle
23 down -- they take time to settle down.
24 Q. And what does that mean for the output of
25 the filter as those transients exist and are

1 settling down --
2 A. Well --
3 Q. -- practically?
4 A. Yeah, I mean, perhaps, the best way to
5 think about it is that when you -- when you turn on
6 a filter -- a filter has been off for a long time,
7 you turn it on suddenly, for example, you turn on
8 the high-power filter, and you apply a input signal
9 to it suddenly, the output takes a fair amount of --
10 the output goes through what we call a transient
11 phase before it finally reaches its steady state and
12 that transient phase -- that transient time period
13 will result in, you know, bit errors in the
14 communications system, and as I think Professor
15 Tsividis mentions here, these filters are very
16 selective, they're very sensitive, and so these
17 actual transient periods can be quite long.
18 So I -- I think the simple answer is:
19 It'll cause a lot of bit errors when you try to
20 measure the signal.
21 Q. Okay. Does Exhibit 1011 identify any
22 other downsides, other than transients, associated
23 with the Behbahani approach of switching between two
24 scaled filter branches?
25 A. Not that I'm aware of. I think I'd have

1 **to read the paper a little more carefully. I mean,**
2 **I think we're sort of talking about Technique 2**
3 **here, in particular, and I believe that this, you**
4 **know, output transient problem is the -- is the**
5 **major that one that's mentioned.**
6 Q. Okay. In the -- just continuing on in the
7 Technique 2 discussion, there's a next section with
8 a subheading, Avoiding Output Transients.
9 Do you see that?
10 **A. Yes, I do.**
11 Q. Okay. There's a first paragraph titled,
12 Delayed Output Switching.
13 **A. I see that.**
14 Q. It describes an approach as -- its
15 approach as, To prevent the system from seeing the
16 output transients, one can use the approach in
17 Figure 11. Before the output is to be switched,
18 both filters -- apologies, phone call coming in --
19 both filters are switched on. After the outputs of
20 both filters become the same, the output can be
21 handed off to the second filter, and then the first
22 filter can be turned off.
23 Do you see that?
24 **A. I do see that, yes.**
25 Q. So in this approach, both filter branches

1 are switched in, and both are passing signals for a
2 period of time; correct?
3 **A. Well, they're -- they're the inputs are**
4 **switched in, but the outputs are not -- only one**
5 **output is switched in. And both filters are -- are**
6 **turned on, if you will, from a DC perspective.**
7 Q. So if we look at Figure 11, there is a --
8 a first point in time where Switch Filter 2 is on,
9 and then it looks like a period of time where both
10 filters are passing signals to VO, until Switch 1
11 is, then, filter -- or Switch Filter 1 is, then,
12 turned off? Do I have that right, that there will
13 be a period of time where the output is the
14 combination of both the Filter 1 output, and the
15 Filter 2 output?
16 **A. Well, it- -- it's a little ambiguous in**
17 **the way the paper's written. That, which you**
18 **suggest, is certainly possible. Another possibility**
19 **would be, you know, only one is connected in any**
20 **given time, and there's a -- so, like, if you look**
21 **at kind of the right-hand side of Figure 11, when**
22 **you switch Filter 1 off, you open the switch at the**
23 **output of Filter 1, and then close the switch at the**
24 **output of Filter 2. And so it could be, in some**
25 **ways, either way, and the paper is kind of silent on**

1 **this.**
2 Q. At the very least, there is a period of
3 time where both filters are powered on; correct?
4 **A. Yes, that's correct.**
5 Q. How -- how does this approach avoid the
6 transient issues associated with Behbahani?
7 **A. Well, I think the Figure 11, which is what**
8 **you're referring to here, actually has a very nice**
9 **illustration of this. You can see that both V1 and**
10 **V2 have transients associated with them, but as --**
11 **as V2 turns on, these -- you know, as V2 turns on,**
12 **the output, which is V0, is isolated from the**
13 **transients that -- that V2 experiences, and only**
14 **after those transients have settled down, is the --**
15 **is the V2 output available at the output, which is**
16 **V0.**
17 Q. So you allow all of the capacitors and
18 other components in the filter to reach a steady
19 state before you assign the output to that, now,
20 steady, state filter?
21 **A. Yes, that's, I believe, the intention in**
22 **Figure 11; correct?**
23 Q. What is the downside of the method
24 depicted in Figure 11?
25 **A. Well, there are a couple of potential**

1 downsides. I think, first, you know, you're -- you
2 know, you're doing this to save some DC power,
3 presumably, but, actually, during this period where
4 they're both on, it's, like, the worst possible case
5 because both filters are on. So there's a --
6 there's a DC power consumption disadvantage here,
7 which, depending on the wireless standard, could be
8 pretty substantial, you know, because they -- you
9 know, you will often train these -- these thing- --
10 these systems on the preamble, and the preamble can
11 be rather short; so you can spend an awful lot of
12 time with both filters on. So there's certainly a
13 DC power consumption issue.
14 And, then, I think, you know, once again,
15 to anyone with familiarity in the arts, you know,
16 you've got, basically, two filters; so the areas --
17 there's a considerable area of penalty from having
18 two filters, only one of which is in use at any
19 given time. So that's -- that's not a transient
20 issue. That's a -- kind of a area issue.
21 So I think in this -- you know, this
22 particular solution, I think that the -- there's a
23 DC -- there's a DC power disadvantage, in
24 particular.
25 Q. Okay. I see.

1 So this delay associated with Figure 11,
2 turning both on to transition from Filter 1 to
3 Filter 2, you take a longer period of time -- if
4 you're -- if you're transitioning to the smaller UDR
5 filter, you take a longer time to get to that
6 power-saving filter, but you also bump up your power
7 usage in that transition period; is that right?
8 **A. Yeah. I mean, during the transition**
9 **period, I think the way to think about it is that**
10 **both filters are on. Both filters are consuming**
11 **DC power. You really only need one to be on at any**
12 **given time, but because we're using the switching**
13 **scheme, both have to be on at least for a period.**
14 Q. What is the time period we're talking
15 about? And let me break that question down.
16 So in a wireless system implementing the
17 techniques that are described in Exhibit 1011, how
18 frequently would you expect the system to transition
19 between the high -- large UDR scenario and the small
20 UDR scenario?
21 **A. Hmm ... Really, really good question.**
22 **It -- it totally depends on the wireless**
23 **environment, and -- and it can be very frequently or**
24 **very, very infrequently. And, you know, think about**
25 **a typical Wi-Fi, you know, chip that you have in**

1 your laptop or in your phone, and if you're in an
2 environment where there aren't a lot of other Wi-Fi
3 people around, it could be very infrequently. If
4 you're in a very crowded environment with lots of
5 stuff going on, it could be, you know, almost on a
6 frame-by-frame basis.
7 So there's no simple answer to your
8 question. It's very much context dependent.
9 Q. The next paragraph in this section is
10 titled, Individual Element Switching.
11 Do you see that?
12 A. Yes.
13 Q. It starts off, One can diminish the delay
14 involved above by switching individual filter
15 elements, rather than the entire filters. An
16 example is shown in Figure 12.
17 So this approach -- well, let me ask you
18 this: Does this approach in Figure 12 avoid the
19 transient issues identified with the Behbahani
20 technique?
21 A. Yes. It's a great question, and I think,
22 once again, the answer, it depends a little bit on
23 the individual circuit involved, but you would
24 expect it to be much, much better. And, you know,
25 the reason for that is, you know, if you look at

1 **Figure 12 as an example, the op-amp is on all the**
2 **time; so you don't have to, like, bring the op-amp**
3 **up and get it running and get it to settle down.**
4 **It's already up and running and everything is great.**
5 **So I would expect that the transient**
6 **behavior in this scenario -- I guess, we call it the**
7 **individual element switching -- should be a lot**
8 **better. As I said, it depends a little bit on the,**
9 **you know, individual circumstance, but, in general,**
10 **you would expect a big improvement.**
11 Q. So if you're keeping the same op-amp in
12 the circuit and you're adjusting resistance values,
13 capacitance values around it, you might expect less
14 transient error than switching between two
15 completely separate filter branches; is that right?
16 **A. Well, compared to, like, two completely**
17 **separate filters that are turned on or off -- and**
18 **these filters have all kinds of op-amps or OTAs in**
19 **them -- so, yeah, I would expect this to be much,**
20 **much better.**
21 Q. In terms of the "delay," comparing the
22 delay of the Figure 12 approach to the delay
23 associated with the Figure 11 approach, how -- how
24 much is -- does this improve the delay penalty
25 imposed by Figure 11?

1 A. Well, I'm not sure what you mean by the
2 "delay penality." If you mean the DC power
3 consumption penalty that I was referring to earlier,
4 I think it probably does. Once again, it's --
5 it- -- it's -- it would be very sort of -- you'd
6 have to actually do some circuit simulations to
7 really quantify the improvement, but kind of,
8 intuitively, you can see that these amplifiers are
9 on all the time, and -- so that the settling
10 behavior is going to be much, much better. So if
11 that's what you mean by the "delay," I would expect
12 it to be a lot better.
13 Q. Well, let me -- let me come back to what
14 the expressed language is.
15 So this sentence that I read in says, One
16 can diminish the delay involved above by switching
17 individual filter elements, rather than the entire
18 filters.
19 What does the paper mean by "diminish the
20 delay"?
21 A. Well, I think that that's a -- so -- so if
22 you -- if you -- if you look at, like, Figure 11,
23 and you look at V2, like, you can kind of see that
24 there's a delay -- that there's a time period where
25 it takes the output of V2 to reach its final value.

1 And so I think that that's -- I'd have to reread the
2 paper again -- but I think that the delay that
3 Professor Tsividis is referring to here is the delay
4 in the -- kind of that transition between, you know,
5 one impedance value and another impedance value.
6 Q. So the time it takes that Filter 2 to
7 reach a steady state is the delay being referred to
8 here?
9 A. Yeah. I mean, the -- you know,
10 Filter 2 -- in Figure 11, Filter 2, there's a delay,
11 you know, that -- before Filter 2 really gets going,
12 and as we said before, that raises the DC power
13 consumption of the overall circuit considerably.
14 You know, in Figure 12, that, quote/unquote, delay,
15 which is really a -- kind of a transient is,
16 presumably, much shorter, and I think that's what
17 Professor Tsividis is referring to here.
18 Q. So there is still some delay involved in
19 the Figure 12 technique; correct?
20 A. Yes, there will be a little, short delay
21 or transient as the circuit of Figure 12 settles to
22 its final value as well. It's just that it'll be
23 much shorter.
24 Q. Okay. And let's walk through that -- this
25 paragraph. I think -- I think this paragraph

1 describes it, but I want to make sure I understand
2 what it -- what is being described here.
3 So in this paragraph that we've been
4 discussing, the paper states, Here, when it is
5 acceptable to increase the noise floor, the upper
6 resistor and upper capacitor are switched out of the
7 circuit, and the op-amp's bias can be reduced. See
8 also, Dynamic Biasing below. The system now
9 performs as in Figure 4B.
10 Do you see that?
11 **A. I see it. Let me just check what**
12 **Figure 4B is saying.**
13 (Witness is reviewing document.)
14 **A. Yes, I see it. Thank you.**
15 BY MR. HART:
16 Q. And so that's how you use the Figure 12 to
17 obtain a power-saving, smaller, useable dynamic
18 range; right?
19 **A. Yes, as shown in Figure 4B.**
20 Q. And Figure 4B is just a visual indication
21 of a small, useable dynamic range; correct?
22 **A. That's correct.**
23 Q. So to decrease the useable dynamic range
24 in Figure 12 and save power as a result, the upper
25 resistor and upper capacitor are switched out of the

1 circuit; so they don't pass signal current; correct?
2 **A. That's correct.**
3 Q. And the op-amp's bias current is also
4 lowered as part of this process saving DC power;
5 correct?
6 **A. Yes, that's what Professor Tsividis is**
7 **referring to.**
8 Q. If the op-amp's bias current is not
9 lowered in this example -- so only the resistor and
10 the capacitor are switched out of the circuit -- are
11 there any power savings realized?
12 **A. Pardon me.**
13 **If the -- if the -- yeah, if the DC**
14 **current is -- and the op-amp isn't changed, there**
15 **are no power savings realized.**
16 Q. Okay. And --
17 **A. DC power savings realized, yeah.**
18 Q. Sure.
19 So the impedance -- dynamic impedance
20 scaling and the dynamic biasing are treated as
21 separate concepts, but it seems like they're always
22 tethered together.
23 So is it correct to say that dynamic
24 impedance scaling must be combined with dynamic
25 biasing in order to realize power savings?

1 MR. JOHANNINGMEIER: Well, objection to
2 the extent that it's calling for a legal conclusion.
3 **A. Yeah. So you're saying dynamic impedance**
4 **scaling and DC power always have to be realized**
5 **together in order to realize DC power savings?**
6 BY MR. HART:
7 Q. What I just read is --
8 **A. Is that your question? I'm sorry.**
9 Q. Yeah, I think so. I say it one way; you
10 say it the other.
11 **A. Yeah.**
12 Q. I think we can get on the same page, and
13 let me rephrase it a little bit.
14 This paragraph is describing taking the
15 upper resistor and the upper capacitor out of the
16 circuit, which, as I understand from your analysis,
17 changes the impedance of the circuit. That
18 paragraph says you can also, when you do that,
19 decrease the op-amp's bias current to save power.
20 So the first step of the process is
21 changing the impedance. The second step of the
22 process is changing the DC bias current.
23 Those are two separate techniques in
24 Dr. Tsividis' work; correct? One is dynamic
25 impedance scaling, and the other is dynamic biasing;

1 right?
2 **A. Yeah. Both are referred to**
3 **in Professor Tsividis' patent; true.**
4 Q. And only the dynamic biasing part of the
5 changes -- so changing the DS -- DC bias current --
6 realizes power savings; right?
7 MR. JOHANNINGMEIER: So I'm going to
8 object to that as outside the scope, and calls --
9 calling for a legal conclusion.
10 **A. Well, I guess, let me provide maybe a -- a**
11 **simple answer to your question: The only way to**
12 **save DC power in any circuit is to reduce the DC**
13 **current, and so these -- reducing DC current and**
14 **reducing DC power are inextricably related to each**
15 **other. So I think the answer to your question is,**
16 **yes, but it's -- it's kind of adding an extra step**
17 **that's not necessary.**
18 BY MR. HART:
19 Q. I'm sorry. What do you mean by adding in
20 a step that's not necessary?
21 **A. Well, I guess, I mean, the impedance**
22 **variation is -- you can or cannot, you know, change**
23 **the impedance, but changing the DC bias current will**
24 **always reduce the DC power consumption.**
25 Q. Is it fair to say that the -- changing the

1 impedance allows to you change the DC bias, thereby
2 realizing power savings?
3 MR. JOHANNINGMEIER: Same objections.
4 **A. I'm sorry, could you ask the question**
5 **again.**
6 BY MR. HART:
7 Q. Is it fair to say that changing impedances
8 allows you to change the DC bias, thereby realizing
9 power savings?
10 **A. Let's see here. The reason I'm hesitating**
11 **a bit is that there are a variety of circumstances**
12 **here, and I'm just trying to under- -- you know,**
13 **like, for example, if you increase the impedance and**
14 **decrease the DC current, you save DC power**
15 **consumption. And what this allows you to do is keep**
16 **the voltage swing in the circuit the same, and that**
17 **is a wonderful thing to do if you're in a**
18 **voltage-limited situation.**
19 **If you're in a noise-limited situation,**
20 **you might not want to decrease the impedance and**
21 **keep the DC current the same to improve the noise**
22 **performance, and -- but I'd have to kind of think**
23 **through all of these steps very, very carefully, but**
24 **in -- certainly, I -- I will say in one scaling --**
25 **in one -- sorry -- interference scenario, increasing**

1 **the impedance and decreasing the DC current will**
2 **reduce the DC power consumption, and those two, in a**
3 **voltage-limited scenario, would be inextricably**
4 **linked.**
5 **And I'm sorry, there are just so many**
6 **different scenarios here that it's -- I don't want**
7 **to make a blanket statement about a particular**
8 **scaling approach without understanding all the**
9 **different possibilities.**
10 Q. Understood.
11 Let's pick back up in this paragraph that
12 we were just walking through.
13 So the conclusion of the sentence that I
14 read in previously, The system now performs as in
15 4B. So we've taken the resistor out -- the upper
16 resistor out, we've taken the upper capacitor out,
17 we now have a small, useable dynamic range.
18 The paragraph picks back up When the
19 system is needed to process, again, signals with a
20 low-noise floor, the above two elements should be
21 switched in. In order to avoid output transients,
22 the op-amp bias is first increased, then the upper
23 capacitor is switched between output and ground; so
24 that its voltage becomes equal to that of the lower
25 capacitor, and, finally, the two capacitors are

1 connected in parallel. The system now performs as
2 in 4A.
3 Do you see that?
4 **A. I do.**
5 Q. This is describing the process of
6 increasing the useable dynamic range to, again,
7 process worst-case conditions; correct?
8 **A. Yeah, this is sort of returning to the**
9 **original state.**
10 Q. Okay. The higher power consumption with a
11 largable [sic] useable dynamic range; right?
12 **A. I believe so. Yeah, that's correct.**
13 **Yeah.**
14 Q. So in this --
15 **A. And I think Professor Tsividis also has a**
16 **very clever way here of reducing these transients by**
17 **the switching capacitor action that he mentions.**
18 Q. It's a -- you're effectively trying to get
19 the upper capacitor to a steady state; so that when
20 it's switched into parallel with the lower
21 capacitor, there is no transient; is that right?
22 **A. Or as small as possible, yes, and this is**
23 **a very effective technique for doing that.**
24 Q. Okay. And so the upper capacitor in this
25 process is not immediately switched into the circuit

1 when you're making this change; right?
2 **A. I don't know what you mean by**
3 **"immediately."**
4 Q. Sure. So there are sequence of steps.
5 Let me just walk through them.
6 So, first, the op-amp bias is increased;
7 correct?
8 **A. Correct.**
9 Q. Then the upper capacitor is switched
10 between the output of the op-amp and ground to
11 equalize it with the lower capacitor; correct?
12 **A. Correct.**
13 Q. Okay. And, then, finally, those two
14 capacitors are connected in parallel, bringing the
15 system into a steady state that has the larger,
16 useable dynamic range; right?
17 **A. Correct.**
18 Q. Okay. And it is the process of bringing
19 that upper capacitor into -- as close to a steady
20 state as possible that avoids transients when it's
21 finally connected and parallel with the lower
22 capacitor; right?
23 **A. It reduces them, significantly, yes.**
24 Q. There is a delay associated with going
25 through these steps to avoid or minimize transients;

1 correct?
2 **A. Ah. Correct, and a very, very good point.**
3 **However, these -- I expect these**
4 **transients to be much, much less than the previous**
5 **case, and, you know, the reason for that is the**
6 **op-amp is already on, you know, so you're just**
7 **increasing its bias, you know, a little bit, and**
8 **that op-amp that you're switching, it's not in the**
9 **feedback loop. So you're not, like, tweaking --**
10 **this is a circuit issue -- but it -- I would expect**
11 **it to converge much, much more rapidly than in the**
12 **previous case.**
13 Q. The -- so this is a process of
14 transitioning between a lar- -- a small UDH [sic]
15 state to a large UDH state.
16 In the reverse, are you worried about
17 transients when you switch the capacitor out of
18 circuit?
19 **A. So you're -- I think what you're now**
20 **considering -- I just want to be clear -- is your --**
21 **let's see -- sorry -- we're going from a -- you said**
22 **when we're going from a high UDH -- UDR -- sorry --**
23 **to a low UDR?**
24 Q. I'll restate the question.
25 **A. Yeah.**

1 Q. Try and add a little clarity here.
2 So the process we just described of kind
3 of getting that upper capacitor to a --
4 **A. Uh-huh.**
5 Q. -- close to a steady state before we
6 switch it in parallel with the lower capacitor to
7 avoid transients, that is the --
8 (Reporter admonishment.)
9 BY MR. HART:
10 Q. So the process we just described of
11 getting the upper capacitor to close-to-steady state
12 before it is switched in parallel with the lower
13 capacity, which avoid -- largely avoids transients,
14 that is the process involved in transitioning
15 between a power-saving, small, useable dynamic range
16 and a power-hungry, large, useable dynamic range;
17 correct?
18 **A. Yes.**
19 Q. And in the reverse, when we're going from
20 the large, useable dynamic range to a small, useable
21 dynamic range, we are taking that upper capacitor
22 out of the circuit; correct?
23 **A. Yes.**
24 Q. Are there transient issues associated with
25 taking the upper capacitor out of the circuit as we

1 transition to that small, useable dynamic range
2 mode?
3 **A. Yes, I think that there will be a little**
4 **bit of transient associated there as well, and, you**
5 **know, if these switches aren't current when you open**
6 **up --**
7 (Reporter clarification.)
8 THE COURT REPORTER: Sorry, Dr. Larson,
9 sorry, Zoom cut out.
10 You said "if these switches" ...
11 **A. Open up, they inject charge into the input**
12 **and output of the op-amp, and that charge will cause**
13 **a voltage transient, a very short one, and then,**
14 **eventually, settle out.**
15 **So even when you open those switches and**
16 **pull the top capacitor out of the circuit, there**
17 **will still be a small, very brief transient, but**
18 **it's probably very, very brief because the charge**
19 **injected by those switches is going to be so much**
20 **less than the charge on the capacitor. It'll be**
21 **just a tiny, tiny, tiny, little transient.**
22 BY MR. HART:
23 Q. So it's possible in that state that you
24 could have data loss, but it would be minimal
25 compared to the other direction?

1 **A. And by "the other direction," do you mean**
2 **when you switch the capacitor in?**
3 Q. Yes.
4 **A. You know, that's an interesting question,**
5 **and, once again, the Tsividis technique that's**
6 **presented here of pre-charging that top capacitor**
7 **probably makes that transient really, really small**
8 **too. I would have to just say the detailed circuit**
9 **simulations would be required to answer your**
10 **question: Precisely, which of the two is shorter?**
11 **They're both going to be very short.**
12 Q. So the next section in this paper is
13 titled, Technique 3, Dynamic Biasing.
14 Do you see that on page 8?
15 **A. I do.**
16 Q. And I'd like you to turn to page 9. In
17 the left column, there's a first full paragraph that
18 starts, We note that dynamic biasing is also
19 encountered.
20 Do you see that?
21 **A. I do.**
22 Q. So that sentence states, We note that
23 dynamic biasing is also encountered in the course of
24 applying companding references to 27, 20, 28,
25 Figures 9 and -- 7 and 9, and/or dynamic impedance

scaling, in parentheses, Figure 12.

Do you see that sentence?

A. I do.

Q. So it --

A. If I could just take a look at Figures 7 and 9 here.

Oh, yeah.

Q. And I'm -- I'm not going to get into the details of Figures 7 and 9, just to ease your mind a little bit.

A. Oh.

Q. But I do want to note that when it references "dynamic impedance scaling," it points specifically to Figure 12; correct?

A. That is correct.

Q. Do you agree that Figure 12 is an example of a circuit that is consistent with Technique 2's dynamic impedance scaling?

A. I'm sorry, could you ask that question again.

Q. Yes. Do you agree that Figure 12 is an example of a circuit that is consistent with Technique 2's dynamic impedance scaling?

A. Yes, I think that that's simply consistent with the wording of this sentence that says that

1 **dynamic biasing is, you know -- uses companding**
2 **and/or dynamic impedance scaling, and refers to**
3 **Figure 12; so I think it's consistent with that**
4 **sentence.**
5 Q. Okay. The next section is titled,
6 Technique 4, Dynamic Structure Variation.
7 Do you see that on page 9?
8 **A. I do.**
9 Q. This section is only a few sentences long
10 and starts out by noting that A fourth possibility
11 is to dynamically vary the very structure of the
12 circuit, e.g., change the architecture of a filter
13 dynamically.
14 **A. Uh-huh. I see that.**
15 Q. It continues, A straight-forward way to
16 accomplish this is to use two or more filters with
17 different structures, and make sure the output
18 transients are avoided using the technique in
19 Figure 11.
20 **A. Yes, I see that.**
21 Q. Now, as we've discussed, Figure 11 is an
22 approach that, like Behbahani, switches between two
23 filter branches; correct?
24 **A. Yeah, Behbahani's a great example of two**
25 **different filters being switched in and out.**

1 Q. Would you agree that Technique 4 in the --
2 in this paper, Exhibit 1011, captures this type
3 approach in which the system switches between two
4 filter branches?
5 MR. JOHANNINGMEIER: Objection.
6 **A. I think that that -- it's consistent**
7 **with -- it's consistent with that, yes. Yes.**
8 BY MR. HART:
9 Q. The paragraph continues, It may also be
10 possible to use a single filter and vary its
11 structure dynamically using techniques related to
12 the one's discussed. This approach has not been
13 investigated to any extent yet.
14 Do you see that?
15 **A. I do.**
16 Q. What's the difference between this
17 proposal that has not yet been investigated and
18 Figure 12's approach?
19 **A. Well, I -- I don't think that they're**
20 **unrelated to each other, and, you know, perhaps, the**
21 **way to think about it is that this last sentence**
22 **here, It may be possible to use a single filter and**
23 **vary its structure dynamically using techniques**
24 **related to the ones discussed, and Figure 12 could**
25 **be, like, you know, one of the things -- you know,**

1 like, a part of that large -- a part of that circuit
2 that would have this, you know, varied structure.
3 So I guess Figure 12 would be an example, one of,
4 perhaps, many different examples of how something
5 like that would work.
6 So I guess I would say that it's --
7 Figure 12 is consistent with this, but it's not
8 meant to be -- like, that's all it is. There are
9 many other things that could be done as well.
10 Q. Would -- how do you interpret the
11 statement, This approach has not yet been
12 investigated to any extent yet?
13 A. Well -- I -- I think I interpreted that to
14 mean, there haven't been a lot of published papers
15 yet that describe this, and I just -- you know --
16 and, you know, in science, we sort of, you know,
17 rely on published papers to provide a record of
18 what's being investigated in the field, and I don't
19 think that there were any papers published at this
20 time in -- that -- examined this.
21 Q. So Figure 12 is an example of Technique 2,
22 and Figure 12 also incorporates Technique 3. So
23 Technique 2 being Dynamic Impedance Scaling,
24 Technique 3 being Dynamic Biasing; right?
25 A. Well, I guess, if you -- I'm sorry, could

1 you ask that question again.
2 Q. Sure.
3 So Figure 12 is an example of a circuit
4 that captures both Techniques 2 and Techniques 3 in
5 this paper; right?
6 A. Yes, I -- because I think
7 Professor Tsividis refers to Figure 12 in both of
8 those sections.
9 Q. And is it your testimony that in
10 Technique 4, dynamically varying the structure of
11 the circuit, is -- is also represented by Figure 12?
12 A. It could be.
13 Q. Okay.
14 A. Sure.
15 Q. What else might that capture?
16 A. Oh, well, I mean, you know, there are --
17 you know -- let me just read this -- you know --
18 (Witness is reviewing document.)
19 A. You know, there are many, many ways to
20 build a filter. This is an op-amp RC filter. You
21 could use OTAs. We've talked about those
22 extensively in capacitors, and you could, you know,
23 vary the bias of an OTA. You could, you know, have,
24 you know, little sections of -- of OTAs that are
25 running in parallel and vary, you know, their values

1 of transconductance; so, I mean, Figure 12 is a
2 very -- kind of a simple building block of a filter,
3 but filters have, like, so many different components
4 in them and different circuit approaches that I just
5 interpreted this section, Technique 4, to mean it
6 could encompass any of those.
7 BY MR. HART:
8 Q. So you don't interpret Technique 4
9 suggesting that there is additional research to be
10 done that is different from Figure 12?
11 A. Well, I mean, I guess, I just -- I just
12 meant, you know, I think this -- this sentence --
13 you know, this approach has not been investigated
14 yet to any extent is merely meant to imply that
15 there is a rich vein of potential research here that
16 has just begun, and there are many different ways
17 that it could go and, you know, be examined.
18 Q. Okay. So just kind of a catchall
19 statement: There may be lots more to come?
20 A. Yeah, I think that, you know, there is --
21 there's a lot more to do here.
22 Q. Is --
23 A. You know, I would -- in how I would
24 interpret that.
25 Q. Do you consider Figure 12, switching in

1 and out a resistor and a capacitor, to be -- to vary
2 the structure of the circuit?
3 **A. Yeah, it's an interesting question.**
4 **I would have to say it varies the --**
5 **the -- it doesn't vary the structure of the circuit,**
6 **but it varies the elements within the structure of**
7 **the circuit. And -- and, once again, this is -- you**
8 **know, a person of ordinary skill in the art would**
9 **kind of look at this and say: Oh, this is a**
10 **low-pass RC -- sorry -- this is actually an**
11 **integrator -- I apologize -- this is an**
12 **integrator -- op-amp-based integrator. They all**
13 **have the same structure, a resistor at the input and**
14 **a capacitor around the feedback loop, and what**
15 **you're changing is you're changing the elements that**
16 **determine the performance of that integrator, the R**
17 **and the C. So, the -- you know, the structure of**
18 **it -- of the circuit doesn't change. It's the**
19 **element values that are changing.**
20 MR. HART: I have one last section to get
21 through that should be half an hour or less. We're
22 about an hour in on this one.
23 Do you guys want to push through for
24 another half an hour after a short break, or is
25 lunch called for at this point?

1 **THE WITNESS: I'm perfectly happy powering**
2 **through.**
3 MR. JOHANNINGMEIER: Yeah, let's just take
4 a 10-minute break.
5 (A recess was taken from 12:45 p.m. to
6 12:56 p.m.)
7 BY MR. HART:
8 Q. Welcome back, Dr. Larson. Can I have you
9 turn to page 6 in the Exhibit 1011 that we've been
10 discussing.
11 **A. Page 6.**
12 Q. Yes, please. And I'm sorry, branded
13 page 6, which would actually be native page 68.
14 **A. Yes, I see it.**
15 Q. All right. So there's a section here
16 titled, Avoiding Output Transients in the right
17 column.
18 Do you see that?
19 **A. Yes.**
20 Q. Okay. About halfway down that first full
21 paragraph there discussing a "dynamic gain change,"
22 the article flags The possibility of a gain changing
23 too soon and creating an undesirable transient at
24 the system output.
25 And I'll give you a second to read the

full discussion there for context. Just let me know when you're up to speed and ready for my question.

(Witness is reviewing document.)

A. Okay. Yes, I'm sort of familiar with this section.

BY MR. HART:

Q. Very good.

So this section there, halfway through that paragraph, says, In some applications, this is not a problem, as these changes may occur before the time comes to process the useful signal, for example, during the preamble slot in certain wireless protocols.

You see that?

A. I do.

Q. How does making a dynamic change to a circuit during a preamble solve the problem of transients?

A. Well, so it gets to the definition of what a "preamble" is. And if I -- I guess, if I could back up for a second, you know, like, you have this wireless receiver, which is sitting there in space and it doesn't know necessarily when a signal is going to be coming in, and when the signal comes in, it doesn't know how big it's going to be or, you

1 know, what the local interferes are or anything,
2 it's, essentially, blind. And so in wireless
3 standards, what we typically do is, we send what's
4 called a preamble ahead of the actual data, and the
5 preamble is usually a known set of bits that doesn't
6 actually contain any information but it allows the
7 system -- the receiver system to get ready to
8 receive the real data. It's, essentially, a
9 training -- it's a set of known bits that is
10 transmitted over a known period of time, and it's
11 sufficiently long that if there's some uncertainty
12 in the acquisition of the signal by the receiver,
13 that there's enough time for any uncertain to be --
14 any uncertainty to be resolved.
15 So to answer your question, the reason
16 that this preamble period helps this problem a
17 little bit is that -- well, you know, perhaps, these
18 transients that we've been talking about so far are
19 within the period of the -- of the preamble or maybe
20 the transients are much shorter than the preamble,
21 and then there's enough time for the system to have
22 settled down and still complete the training that
23 happens during this preamble period.
24 So I think that's what's meant by this
25 section here.

Q. Okay. And so if you get some bit errors in your reception of the preamble, it's not as critical as if you get bit errors in the data reception after the preamble; is that fair?

A. I think that's a -- that's a fair way to put it. I mean, there are -- there are a variety of quality metrics, other than bit errors, but that's a -- that's a good one. That's kind of a catchall for all this other stuff that's going on.

Q. Can I have you turn back to the '330 Patent.

A. Yes. Okay.

Q. And specifically to Column 12.

A. I'm there.

Q. Okay. So starting at Line 33 in Column 12, the '330 Patent is -- states, Since the gain impedance in biasing of these blocks are being dynamically varied, care must be taken to not negatively affect the signal being processed, for example, specific embodiments of the present invention perform some or all of these variations during the preamble.

You see that?

A. Yes, I see that.

Q. Consistent with what we just saw in

1 Dr. Tsividis' Exhibit 1011, would a POSITA
2 understand making dynamic adjustments during a
3 preamble, as described here in the '330 Patent, as
4 beneficial because it avoids issues associated with
5 transients?
6 MR. JOHANNINGMEIER: Objection.
7 **A. I'm sorry, could you ask the question**
8 **again.**
9 BY MR. HART:
10 Q. Yes.
11 Consistent with what we just saw in
12 Dr. Tsividis' paper, Exhibit 1011, would a POSITA
13 understand that making dynamic adjustments during a
14 preamble, as described here in the '330 Patent, is
15 beneficial because it avoids issues associated with
16 transients?
17 **A. Yeah. I mean, I'm not sure that I would**
18 **use the word "beneficial." If you're going -- maybe**
19 **another way to state it is that if you're going to**
20 **make these changes -- these dynamic variations, the**
21 **preamble is probably the best time to do it. If you**
22 **have to do it some time, that's probably the best**
23 **time to do it.**
24 Q. And the reason that's the best time to do
25 it is because you may have bit errors resulting from

1 transients when you make those changes; correct?
2 **A. That's one way to put it. Another way to**
3 **put it would be that the -- the preamble period is**
4 **meant to accommodate uncertainties in the receiver**
5 **performance. And one of those uncertainties would**
6 **be the transient behavior that we talked about**
7 **earlier. Now, whether, you know, this -- you know,**
8 **once again, it depends on specific implementations,**
9 **how long is the preamble, and how long are the**
10 **transient periods, but, in general, it would be more**
11 **beneficial to do it during the preamble than at**
12 **other times.**
13 Q. Can I have you scroll down to Claim 2 in
14 the '330 Patent.
15 **A. Yes, I'm here.**
16 Q. Okay. Claim 2 states, The method of
17 Claim 1, wherein the signal comprises a preamble
18 portion and a data portion, the impedance of a
19 component is changed while receiving the preamble
20 portion, and the method further comprises receiving
21 the data portion of the signal.
22 Do you see that?
23 **A. I do see that, yes.**
24 Q. Okay. Is this claim getting at that
25 transient issue, making your changes during the

1 preamble to avoid any issues that might result from
2 transients associated with the dynamic changes?
3 **A. Possibly, yes. You know, I think that**
4 **the, you know, as I said, I -- I kind of think so.**
5 **You know, the -- as I said before, you know, if**
6 **you're going to make these changes, the preamble is**
7 **probably the -- you know, wireless standard, the**
8 **preamble's the right time to do it. So that is, I**
9 **think, consistent with what we were saying before.**
10 Q. Okay.
11 MR. HART: All right. I think that's all
12 I have for you, Dr. Larson. Thank you very much for
13 your time today.
14 **THE WITNESS: Well, thank you. It's been**
15 **a pleasure. Good talking with you.**
16 MR. JOHANNINGMEIER: All right.
17 **THE WITNESS: Corey, do you have any --**
18 MR. JOHANNINGMEIER: Oh, no. Sorry, I
19 have no questions.
20 THE COURT REPORTER: Dr. Larson, would you
21 like to read and sign your transcript?
22 **THE WITNESS: Sure.**
23 MR. JOHANNINGMEIER: We'll read it.
24 That's fine.
25 **THE WITNESS: I'd like to get a copy.**

1 MR. JOHANNINGMEIER: Just make sure we
2 don't have any unintentional --
3 **THE WITNESS: Yeah, yeah.**
4 MR. JOHANNINGMEIER: -- but, yeah, that's
5 fine.
6 **THE WITNESS: Yes, I would like that**
7 **opportunity, thank you.**
8 MR. JOHANNINGMEIER: Oh, I mean, just
9 the -- the regular delivery's fine. I don't --
10 yeah.
11 (The deposition concluded at 1:08 p.m.)
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