

**UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE PATENT TRIAL AND APPEAL BOARD**

META PLATFORMS, INC.,

Petitioner,

v.

JAWBONE INNOVATIONS, LLC,

Patent Owner.

CERTIFIED COPY

Case IPR2023-01291 (US Patent No. 8,467,543)

VIDEOCONFERENCE DEPOSITION OF

DR. AKBAR M. SAYEED, PH.D.

SEPTEMBER 16, 2024

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10:02 a.m. - 2:48 p.m. EST

REPORTED BY:

Tamara L. Houston

CA CSR No. 7244, RPR, CCRR No. 140

Job Number 142175

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REMOTE VIDEOCONFERENCE DEPOSITION OF DR. AKBAR M.
SAYEED, PH.D., taken on behalf of the Petitioner,
commencing from 10:02 a.m. to 2:48 p.m., Eastern
standard time, Monday, September 16, 2024, before Tamara
L. Houston, CSR No. 7244, CCRR, RPR.

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MONDAY, SEPTEMBER 16, 2024, 10:02 a.m.

--o0o--

(Whereupon AKBAR M. SAYEED, Ph.D., having
been called as a witness was sworn to
tell the truth, the whole truth,
nothing but the truth.)

--o0o--

EXAMINATION BY MS. WANG:

Q. Good morning, Dr. Sayeed.

A. Good morning.

Q. It's nice to see you again.

A. Nice to see you too.

Q. Can you please state and spell your name for
the record?

A. My name is Akbar Muhammad Sayeed, A-K-B-A-R,
M-U-H-A-M-M-A-D, S-A-Y-E-E-D.

Q. Dr. Sayeed, have you been deposed since we
last spoke in July of this year?

A. No.

Q. So this is your third deposition?

A. This is my third.

Q. And it looks like you're -- are you -- is that
your home office again?

A. Yes, yes. I am in Madison, my home office.

Q. Do you have any papers in front of you?

1 A. Well, I basically have some hard copies, yes,
2 a table of contents of the petition; table of contents
3 of Dr. Anderson's declaration; table of contents of my
4 own declaration; and then I have a hard copy of just the
5 claims of -- two pages of the claims of the '543 patent
6 and then a hard copy of the three figures, Figures 1,
7 1B, and 1A from the patent.

8 Q. On any of the hard copies in front of you, do
9 you have any annotations or sticky notes or print?

10 A. No, they are just clean. No, no notes or
11 annotations.

12 Q. Do you have any hard copies in front of you
13 that you haven't stated in your previous answer?

14 A. No. Those are the only hard copies I have.
15 Then I have some pdfs open, three different windows.
16 One has my own declaration. One has, again, the
17 petition, Dr. Anderson's declaration, and a copy of his
18 deposition. And a third window has four of the relevant
19 patents, Exhibit 1001, which is the '543 patent; and
20 then Exhibit 1005; Exhibit 1006; Exhibit 1007. So there
21 are four of those patents.

22 And basically just before this, I did one
23 folder in which all of the unmarked copies of all the
24 documents relevant to this case are in there, and that's
25 the one I have open in front of me too so that I can

1 access any documents that may come up.

2 Q. Are there any markings, annotations on any of
3 the pdfs that are -- that you have open?

4 A. No. They are completely pristine.

5 Q. Do you have anything else open or -- sorry.
6 In the folder that you have open --

7 A. Yes.

8 Q. -- do you have anything other than unmarked
9 copies of documents relevant to this case?

10 A. No.

11 Q. Do you have any other applications or programs
12 open?

13 A. Well, I just have this Google thing open, but
14 that's it.

15 Q. If at any point during the deposition if you
16 have another program or application open or if you do
17 have another piece of paper in front of you, just please
18 let us know.

19 A. Okay. I will.

20 Q. So same rules as before, but I'll go over them
21 for the sake of clarity and the record.

22 For today, I'll be asking questions, and
23 you'll be answering them. And if you don't understand a
24 question, please do ask, and I will try to clarify the
25 question.

1 Is that okay with you?

2 A. Yes.

3 Q. This way, if you answer a question, then we

4 will know that you understood the question that was

5 asked.

6 That's fair to you?

7 A. Yes.

8 Q. If you need a break at any time, just let me

9 know. Okay?

10 A. Okay. Thanks.

11 Q. And I just ask that, if there's a pending

12 question, that you answer that question, and then we can

13 proceed to do the break.

14 Is that okay?

15 A. Yes.

16 Q. Is there anything that prevents you from

17 testifying completely, truthfully, and accurately today?

18 A. No.

19 Q. Are you on any medications that would prevent

20 you from providing complete, accurate, and truthful

21 testimony today?

22 A. No.

23 Q. Is there anyone else in the room with you

24 right now?

25 A. No.

1 Q. You understand that you are here to testify
2 about your opinions in the proceeding IPR 2023-01291
3 regarding U.S. Patent Number 8,467,543?

4 A. Yes, that's my understanding.

5 Q. You've reviewed Dr. Anderson's declaration in
6 this proceeding?

7 A. Yes.

8 Q. And before this proceeding, were you familiar
9 with or aware of Dr. Anderson?

10 A. Well, I think, you know -- I can't remember
11 exactly, but I have seen some of his declarations in all
12 of these cases, so I have -- I don't know if his -- I
13 can't remember if it was his particular declaration in
14 the previous two or not.

15 But, yeah, I don't know him personally, but I
16 have seen his name before possibly, yes.

17 Q. What about outside the context of this set of
18 IPR proceedings between Meta and Jawbone?

19 A. No, I was not aware of Dr. Anderson or his
20 work.

21 (Court reporter requested clarification.)

22 BY MS. WANG:

23 Q. When were you retained by Jawbone for this
24 case?

25 A. Oh, I think I should remember this. I think

1 sometime in the beginning of last year.

2 Q. Did you prepare for today's deposition?

3 A. Yes, I did.

4 Q. How much time did you spend preparing?

5 A. 10, 15 hours, something like that.

6 Q. What did you do to prepare?

7 MR. COWELL: Objection to form.

8 Just one second, Akbar. I'll instruct you not
9 to divulge the contents of any conversations with any
10 attorneys or anything discussed within those
11 conversations.

12 THE WITNESS: Yes. Thank you, Rich.

13 Well, I just reviewed the material and had
14 some discussions with Mr. Cowell.

15 BY MS. WANG:

16 Q. Other than Mr. Cowell, did you speak with
17 anyone else while preparing for today's deposition?

18 A. No.

19 Q. Before you were retained by Jawbone, had you
20 ever heard of the term "voice activity detection"?

21 A. Probably. Yeah. Yeah, I'm sure because I
22 worked in signal processing and stuff, and detection is
23 a big part of it, so -- and speech processing systems,
24 so I'm sure I heard of the term, yes.

25 Q. But you have no teaching experience with voice

1 activity detectors; is that correct?

2 A. Not directly, no. But I've taught, you know,
3 things related to detection of signals generally, and --
4 yeah.

5 Q. Not all signals are voice, are they?

6 A. No. No.

7 Q. You have no research experience with voice
8 activity detectors; is that correct?

9 A. That is correct.

10 Q. You've never written any papers on voice
11 activity detectors; is that correct?

12 A. Yes, that is correct.

13 Q. I'm going to use the acronym VAD, V-A-D, to
14 refer to voice activity detectors. Is that okay with
15 you?

16 A. Yes.

17 Q. Is it fair to say that VAD is used to detect
18 whether voicing activity is present or absent?

19 MR. COWELL: Objection to form.

20 THE WITNESS: I don't know. That sounds like
21 a trick question. Can you repeat the question again?

22 Sorry.

23 BY MS. WANG:

24 Q. It's not meant to be a trick question. I will
25 repeat it.

1 A. Okay.

2 Q. Is it fair to say that a VAD is used to detect
3 whether voicing activity is present or absent?

4 MR. COWELL: Objection as to form.

5 THE WITNESS: Well, the only tricky part to me
6 is voicing, you know, whatever that means. So voice
7 detection, yes, I would concede that. But voicing,
8 depending on how you interpret it, it may be nuanced.
9 Voicing.

10 BY MS. WANG:

11 Q. So depending on how you interpret it, a VAD
12 may or may not be used to detect whether voicing
13 activity is present or absent?

14 MR. COWELL: Objection.

15 THE WITNESS: Well, what kind of -- so let's
16 cut to the chase. I think one of the things is the
17 unvoiced versus voiced speech. That's -- so that's the
18 only -- you know, whether we interpret it to include
19 that or not.

20 (Court reporter requested clarification.)

21 THE WITNESS: There are two types of, you
22 know, voiced or unvoiced speech, so that's what I'm
23 getting at. In some cases, you know -- you know,
24 whether it's going to include the VAD can detect both or
25 not is a matter of debate or contention here in

1 particular, it seems to me. Having too much
2 information.

3 BY MS. WANG:

4 Q. Do you disagree with the statement that a VAD
5 is used to detect whether voicing activity is present or
6 absent?

7 MR. COWELL: Objection to form.

8 THE WITNESS: A VAD is used to detect whether,
9 you know -- you know, voice of -- voice activity
10 detection. So I would just say voice and keep voicing
11 out.

12 BY MS. WANG:

13 Q. So do you agree with the statement that a VAD
14 is used to detect whether voice activity is present or
15 absent?

16 A. I agree with that, yeah.

17 Q. Is there a distinction you were drawing
18 between voice and voicing?

19 A. Maybe not. I was splitting hairs there. I'm
20 not entirely sure. I already explained whether it was
21 unvoiced or voiced speech. There is a distinction
22 between that -- those kinds of speech.

23 Q. Is unvoiced speech -- sorry. Strike that.

24 Is it your testimony that unvoiced speech is
25 voice?

1 MR. COWELL: Objection to form.

2 THE WITNESS: I don't know how relevant that
3 is. But, you know, there are two different kinds of
4 speech mechanism. The vocal cords are vibrating.
5 That's the difference between voiced and unvoiced.

6 So that's all I'm going to say on that, this
7 right here for this question.

8 BY MS. WANG:

9 Q. Is unvoiced speech the same as voicing
10 activity?

11 A. I don't know what that means.

12 Q. What part of that question do you not know
13 what it means?

14 A. I don't know what you mean by "voicing
15 activity." I think -- yeah. We can -- yeah -- or
16 what's the -- what's the -- yeah -- intent or purpose of
17 the question? I'm not sure.

18 Q. The intent or purpose of the question is not
19 relevant. I think that -- I think the purpose of today
20 is for you to answer the questions to the best of your
21 ability, which you --

22 A. Okay. Yes. Yes.

23 Q. Do you understand that?

24 A. I don't understand what the question is you're
25 really asking.

1 Q. Could we agree for today that the -- you parse
2 the words of the question to the best of your ability
3 and ask for clarification when needed, but there's no
4 need for you to ask about the intent or purpose behind a
5 question.

6 A. Okay.

7 MR. COWELL: Objection to form.

8 THE WITNESS: Okay. I'll try my best.

9 BY MS. WANG:

10 Q. So -- thank you.

11 Is unvoiced speech the same as voicing
12 activity?

13 MR. COWELL: Objection to form.

14 THE WITNESS: I really don't -- is unvoiced
15 speech the same as voicing activity; is that the
16 question?

17 BY MS. WANG:

18 Q. Yes.

19 A. Unvoiced speech is a form of voice or, you
20 know -- so as much as voicing activity includes, you
21 know, production of voice, as we commonly understand,
22 yes, that would be part of it.

23 It's not the same necessarily because they
24 could be -- as I said before, voicing or voice could
25 include both unvoiced and voiced speech and -- and the

1 difference is whether they are -- you know, the main
2 difference is whether, in the production of that speech,
3 the vocal cords are vibrating or not.

4 Q. So is it your testimony that unvoiced speech
5 is a form of voice?

6 A. Yes. Yes.

7 Q. Is it also your testimony that unvoiced speech
8 is a form of voicing activity?

9 MR. COWELL: Objection to form. Asked and
10 answered.

11 THE WITNESS: Back to the square one.

12 While I'm trying to answer -- you know, I've
13 tried to -- I'm not -- I'm agreeing to that with the
14 caveat that, you know, voicing activity could include
15 both of them. So I hope -- you know, I think we -- I
16 hope it's clear to you as well. I don't know why do we
17 have to keep repeating the same thing.

18 BY MS. WANG:

19 Q. When you say voicing activity could include
20 both of them, what are you referring to?

21 A. Oh, the unvoiced and voiced speech, or
22 unvoiced and voice -- yes. Mechanism for generating
23 voice or speech, those are the two.

24 Q. Is voice detection the same as voice activity
25 detection?

1 MR. COWELL: Objection to form.

2 THE WITNESS: Yeah. Well, you know, I
3 can't -- voice is -- voice detection is the same as
4 voice activity detection. You know, I think some form
5 of the duty is needed to produce voice. So, yes, in
6 that regard, it's the same, I guess.

7 BY MS. WANG:

8 Q. Is it fair to say that a VAD detects
9 physiological activity related to speech production?

10 MR. COWELL: Objection to form.

11 THE WITNESS: Not necessarily because I think
12 there are some, which are -- some VADs are aimed at
13 directly detecting physiological mechanisms which
14 generate the speech.

15 Others are just detecting, you know --
16 especially microphones are detecting the resulting sound
17 waves which are generated by a voice. So I think not
18 all VADs detect the physiological mechanisms.

19 BY MS. WANG:

20 Q. Are there -- strike that.

21 For the VADs that are aimed at directly
22 detecting physiological mechanisms which generate the
23 speech, do those -- can those VADs detect vibration of
24 tissue?

25 A. Yes.

1 Q. Do you have an understanding of what tissue
2 vibrates during voice activity?

3 A. I think there's -- you know, it's discussed in
4 the patents as well. That's the main context in which
5 I'm going to have my discussion, and I think the vocal
6 cords is one part of it.

7 And let me refer to my own declaration
8 where -- it is starting from paragraph 36. So, for
9 example, in paragraph 38 of my declaration, I say --
10 starting on line 4, "It was well known in the art that
11 voice" --

12 (Court reporter requested clarification.)

13 THE WITNESS: So this is paragraph 38 of my
14 declaration starting from line 4. "It was well known in
15 the art that voiced speech occurs when the vocal cords
16 are vibrating, and unvoiced speech occurs when the vocal
17 cords are not vibrating. For example, Holzrichter
18 explains the differences between voiced and unvoiced
19 speech in similar terms."

20 Exhibit 1007, Column 12, 60 to 65, quotes,
21 "There are two major types of speech, 'voiced' where the
22 vocal folds open and close rapidly" --

23 (Court reporter requested clarification.)

24 THE WITNESS: "There are two major" -- in the
25 quotes. "There are two major types of speech, 'voiced'

1 where the vocal folds open and close rapidly providing
2 periodic bursts of air into the vocal tract, and
3 'unvoiced' where constriction in the vocal tract cause
4 air turbulence and associated modified-white air flow
5 noise."

6 Yes, and I think there are other -- yeah,
7 vocal cords is the main one that vibrates, but as -- and
8 along with that, you know, some other tissues may also
9 vibrate since it's sound pressure that's being
10 generated.

11 BY MS. WANG:

12 Q. What other tissues may also vibrate?

13 A. I think Holzrichter goes into a lot of details
14 on that, so we can look at Holzrichter a little more.
15 If you give me a little time.

16 Glottal tissue, motion, this is on page --
17 Column 19, line 49. Vocal fold motions, glottal tissue,
18 that's all I'm seeing. Tongue sometimes -- tongue can
19 also vibrate in response to, you know, parts of it as
20 the vocal cords are vibrating.

21 So many -- I'm not a -- yeah. I think I'll
22 limit it to that at this point.

23 Q. Okay. So you were referring to the
24 Holzrichter reference, Column 19 --

25 A. Yeah.

1 Q. -- line 49, as referencing motion of glottal
2 tissue?

3 A. Yes.

4 Q. Do you have an understanding of whether
5 glottal tissue is the same as vocal folds?

6 A. I don't know exactly how different it would
7 be, but it would be the tissue which is -- you know,
8 physically speaking, your vocal cords are moving, and
9 some tissue surrounding that area, because of changes in
10 air pressure, would also vibrate.

11 So that's my understanding. And -- and
12 that's -- yes.

13 Q. Are you -- sorry. Strike that.

14 Are vocal cords the same as vocal folds?

15 A. No. I think they could be slightly different.
16 I'm not entirely sure of that.

17 Q. Do you have an understanding of the difference
18 between vocal cords and vocal folds?

19 A. Yeah, I think vocal folds is more -- it seems
20 to me, based on the discussion of these files, they are
21 related to controlling the overall airflow.

22 For example, you know, the -- by -- again,
23 going to my declaration -- you know, so this is
24 Column 12 and 13 of Holzrichter, so let's go there.

25 The first is Column 12, line 60 to 65. So

1 that, I've already said, "There are two major types of
2 speech, 'voiced' where the vocal folds open and close
3 rapidly providing periodic bursts of air into the vocal
4 tract, and 'unvoiced' where constrictions in the vocal
5 tract cause air turbulence and associated modified-white
6 airflow noise."

7 And then there is the vocal folds on
8 Column 32, which is line 44 and 51. "The vocal folds,
9 which open but do not vibrate open and closed, during
10 whispered and unvoiced speech."

11 So -- but, yeah, it is saying, "In the cases
12 of onset of whispered or unsounded speech, additional EM
13 sensor information is required. The same single organ
14 arguments used to describe vocal fold motions and the
15 use of the single organ tongue (or tongue-jaw coupled
16 motion) discussed above are used as" --

17 (Court reporter requested clarification.)

18 THE WITNESS: I'm just reading from 44 to 51
19 of Column 32 in Holzrichter, Exhibit 1007. And so I was
20 reading, "The same single organ arguments used to
21 describe vocal fold motions and the use of the single
22 organ tongue (or tongue-jaw coupled motion) discussed
23 above are used as onset indicators. This includes the
24 vocal folds, which open but do not vibrate open and
25 closed, during whispered and unvoiced speech."

1 So, yeah, I think there is some overlap
2 between them, and this also kind of touches on some of
3 the earlier comments, you know, what other physiological
4 aspects or what other parts of physiology may vibrate,
5 so tongue-jaw, as I mentioned earlier as well.

6 BY MS. WANG:

7 Q. Just to be clear, Dr. Sayeed, I would like --
8 my question was asking if you have an understanding of
9 the difference between vocal cords and vocal folds. And
10 in your previous answer, you just read from
11 Holzrichter --

12 A. Yes.

13 Q. -- various sections that talk about vocal
14 folds. But do you have an understanding of the
15 difference between vocal cords and vocal folds, if any?

16 A. Yeah, I think my main understanding is that
17 vocal cords would be vibrating to generate sound, you
18 know, so rapidly; whereas, vocal folds are a smoother
19 motion for constricting the flow of air, which is used
20 in the generation of speech or voice.

21 Q. Is it your testimony that vocal cords vibrate
22 and vocal folds do not vibrate?

23 MR. COWELL: Objection to form.

24 THE WITNESS: I'm not entirely sure that I
25 think air could vibrate too because, as I said, in 49 to

1 50 of Column 32, it seems there's -- that this includes
2 vocal folds, which open but do not vibrate open and
3 closed. So they could potentially be doing both, but
4 mainly they are opening and closing and not vibrating.
5 BY MS. WANG:

6 Q. Is it your testimony that vocal folds mainly
7 do not vibrate?

8 MR. COWELL: Objection to form.

9 THE WITNESS: Yes. Let's go with that.

10 BY MS. WANG:

11 Q. What is vibration?

12 A. Vibration is when -- in the context of -- it
13 could be many things, but in this particular context,
14 it's a tissue or vocal cord moving back and forth
15 rapidly, and that changes the air pressure which
16 produces sound or speech or voice.

17 Q. And it's your testimony that it's the
18 vibration of the vocal cord that moves back and forth
19 rapidly, not the vibration of the vocal fold, that
20 changes the air pressure to produce speech or voice?

21 MR. COWELL: Objection to form.

22 THE WITNESS: I think it's mainly -- again, I
23 think -- I'm not entirely -- I don't know how to
24 differentiate between -- mainly it's the vibration of
25 the vocal cords which is producing the voice speech, and

1 the folds are controlling the amount of airflow.

2 BY MS. WANG:

3 Q. Do you have an understanding of the
4 physiological difference between vocal cords and vocal
5 folds?

6 MR. COWELL: Objection --

7 THE WITNESS: I'm not an expert on that, so I
8 think for me it's more about, you know, how it's
9 related -- my understanding is more related to the
10 mechanism of how -- the speech that's produced,
11 specifically voice versus unvoiced.

12 (Court reporter requested clarification.)

13 MR. COWELL: I'm sorry, I just said objection
14 to form.

15 BY MS. WANG:

16 Q. Is there a difference between vibration and
17 movement?

18 A. Yes, in a sense that movement -- you know,
19 vibration is a special type of movement, if you will.
20 It's more back and forth so that it produces -- the
21 pressure is raised to generate sound, so it's
22 literally -- sound waves are changes in pressure back
23 and forth in the air, and so --

24 Yeah, movement could be in one direction or
25 any arbitrary motion; whereas, vibration is a very

1 specific back-and-forth kind of movement. It's creates
2 waves, if you will.

3 Q. What is an electromagnetic sensor?

4 A. Electromagnetic sensor is a sensor which can
5 sense or detect electromagnetic waves, or signals, if
6 you will.

7 Q. Can I use EM to refer to electromagnetic?

8 A. Yes.

9 Q. Does an EM sensor detect vibration?

10 A. It can. I think an EM sensor, going back to
11 your earlier question, it could detect vibration or
12 motion or many things, yes.

13 Q. How does an EM sensor detect vibration?

14 A. Well, one way in which it could detect
15 vibration is by just looking at measuring the reflected
16 signal, just like in radar.

17 There's, you know, signals -- or one way of
18 thinking about is that you -- a transmitter sends a
19 signal, and it gets reflected from an object, and you
20 detect that reflected signal.

21 And when some -- when the object is vibrating,
22 that detected signal or electromagnetic signal will have
23 changes related to the motion. And they'll -- they'll
24 also be detected.

25 Q. How does an EM sensor detect movement?

1 A. Well, it's the same mechanism. One way -- you
2 know, so it goes into more technical aspects.

3 One is movement by itself changes the phase of
4 the electromagnetic waves that you receive, and so --
5 and then if the movement is a constant speed, as in
6 Doppler radar when a -- you know, those Doppler guns
7 that cops use to measure your speed, that's -- that's
8 included in the phase changes as well.

9 So the simplest answer I would give is that,
10 you know, an electromagnetic sensor detects the
11 electromagnetic wave reflected from an object, and it's
12 the changes in the phase of the wave that would be
13 motion or that represents the motion of the object.

14 Q. Does a vocal fold EM sensor detect movement of
15 the vocal fold?

16 MR. COWELL: Objection to form.

17 THE WITNESS: I don't know what is a vocal
18 fold EM sensor.

19 Can you repeat the question again?

20 BY MS. WANG:

21 Q. Does a vocal fold EM sensor detect movement of
22 the vocal fold?

23 MR. COWELL: Objection --

24 THE WITNESS: Yeah. First of all, I don't
25 know -- I don't know what that -- an EM sensor

1 specifically aimed at vocal fold, but it could. The
2 movement of a vocal fold, if you -- if the, you know,
3 parameters of the sensor were appropriately -- or it was
4 designed appropriately, for example, the frequencies and
5 so on, yeah.

6 BY MS. WANG:

7 Q. Sorry. Were you done?

8 A. I was just gonna say it will detect -- I mean,
9 if it's aimed at detecting the movement of the vocal
10 fold, then, yes, that's what it would be trying to
11 detect.

12 Q. How would a vocal fold EM sensor detect
13 movement of the vocal fold?

14 MR. COWELL: Objection to form.

15 THE WITNESS: Well, the general principle is
16 the same as before, as I said, that you send a signal,
17 electromagnetic signal. That's a -- you know, there
18 will be a -- a sensor will be transmitting. Just like
19 in radar, you send a signal, and then the signal
20 reflects from the object. In this case, it will be a
21 vocal fold.

22 And then you compare, you know, what you sent
23 to the reflected signal and -- and comparing those,
24 especially the failures of those signals, allows you to
25 give information about the movement of the object that

1 you're trying to sense; in this case, the vocal fold.

2 BY MS. WANG:

3 Q. Are you aware of any sound that is produced
4 during movement of the vocal fold?

5 MR. COWELL: Objection to form.

6 THE WITNESS: Can you repeat the question,
7 please?

8 BY MS. WANG:

9 Q. Are you aware of any sound that is produced
10 during movement of the vocal fold?

11 MR. COWELL: Objection to form.

12 THE WITNESS: Yeah, I think this goes back to,
13 you know, I think, if we interpret vocal folds
14 comparable to vocal cords, which, you know -- which we
15 discussed earlier.

16 Regardless, if it's a tissue and if it's
17 moving rapidly back and forth, then it could -- you
18 know, it could create changes in pressure and create a
19 sound that would be detected or heard.

20 But if it's just a movement that's opening or
21 closing, you may not hear it. You may only detect it
22 with a sensor like an electromagnetic sensor which is
23 aimed at, you know, the physiologic -- detecting the
24 physiological mechanisms.

25 So to make it clear, I think if it's -- again,

1 if it was rapid movement, that will change pressure --
2 air pressure, and that is the physical mechanism for
3 creating sound or speech, in this case, and we would be
4 able to hear it.

5 Whereas, if it just moves opened or closes and
6 it's not rapid back and forth, that would not produce a
7 sound that we can hear. That would require detection
8 using some other kind of sensor; for example, an
9 electromagnetic sensor.

10 BY MS. WANG:

11 Q. Is it your testimony that unvoiced speech does
12 not produce a sound that we can hear?

13 A. No, unvoiced speech --

14 MR. COWELL: Objection --

15 THE WITNESS: -- does produce a sound that we
16 can hear. Actually that's what I was thinking that, you
17 know, maybe that's where you were getting at.

18 So here, as a perfect example, I'll give you a
19 voice and unvoiced speech. So here's (sound). That's
20 vocal cords vibrating. And (sound), that's voiced --
21 unvoiced speech where it's just airflow going through my
22 mouth and creating a sound; whereas, in the first case,
23 there were vocal cords that were vibrating.

24 So, no, both of them create sound that we can
25 hear. But, you know, it's harder to detect in some

1 situations, especially when there's noise in the
2 background, using, you know, microphones, unvoiced
3 speeches.

4 BY MS. WANG:

5 Q. A couple of minutes ago, your answer -- a
6 couple of minutes ago, you stated, "If we interpret
7 vocal folds comparable to vocal cords."

8 Are you saying that they are comparable to
9 vocal cords?

10 MR. COWELL: Objection to form.

11 THE WITNESS: Well, I -- you know, again, I
12 can't -- I don't have the full, nuanced distinction
13 between them right now. I think the main thing that I
14 want to focus on, which is relevant to this deposition,
15 I think, is, you know, the physical mechanism in the way
16 the speech or voice is generated.

17 And one involves vibration of the cords or
18 folds, which changes the air pressure and produces a
19 sound. And the other is where you just have airflow
20 coming in and -- and then, you know, with the other
21 parts of the mouth, it's -- you know, it's modulated,
22 the airflow. And you create a sound which is not
23 related to vibration or the folds or cords, if you will.

24 So those are the two different ways in which
25 the voice or sound can be produced by us. And that's

1 what I want to focus on, or that's what I'm trying to
2 get at.

3 (Court reporter requested clarification.)

4 BY MS. WANG:

5 Q. Dr. Sayeed, what is an electromagnetic field
6 disturbance sensor?

7 MR. COWELL: Objection to form.

8 THE WITNESS: Can you -- can you refer me to
9 specifically where you're looking at? Maybe I can get a
10 little more context because that seems broad. I can go
11 on for a long time on that.

12 BY MS. WANG:

13 Q. Have you heard of an EM field disturbance
14 sensor before?

15 A. Yes. In some ways, all of the -- you know,
16 that's what electromagnetic sensors are doing at a very
17 fundamental level. Yeah.

18 Q. Are all EM sensors EM field disturbance
19 sensors?

20 A. I really don't know. To me, that's -- I'm not
21 entirely sure what that question -- is there a specific
22 place where you're referring to electromagnetic field
23 disturbance sensor? Can you give me a little more
24 context?

25 Q. Well, in your prior answer, you stated that's

1 what all -- that's what electromagnetic sensors are
2 doing at a very fundamental level.

3 A. Yes. I think, you know, it depends on what
4 you mean by "field" that, you know -- it gets more into
5 technical rabbit holes, if you will. So if you -- you
6 know, disturbance field and disturbance are two really
7 loaded, technical terms that can mean a lot of things.

8 So in a very general sense, yes, you could
9 construe it that way, you know, but in context of
10 this -- the discussion of air, it's simpler things we
11 are doing that we're looking at electromagnetic signals,
12 and the parameters are changing.

13 You know, in particular, you may have -- you
14 may be sending particular frequencies of pulses and, you
15 know, looking at the changes in the parameters. That's
16 why I'm asking for a little more specificity in terms of
17 what you're asking.

18 Q. That's okay. We can move on for now.

19 A. Okay.

20 Q. Have you heard of speech recognition?

21 A. Yes.

22 Q. What is speech recognition?

23 A. Well, that's, again -- well, speech
24 recognition, you know, again, in the context of air
25 or -- it is, you know, when you are recognizing what

1 words are being referred to. Or, you know, for example,
2 you know, these applications which take a speech and,
3 you know, spit out text corresponding to what you said.

4 Or, you know, that's what Holzrichter is aimed
5 at, part of it too, to recognizing speech or components
6 of it and parsing it into sentences and so on.

7 Q. Does a speech recognition system recognize
8 voiced speech?

9 A. No. It can recognize voiced or unvoiced. For
10 example, you can whisper and, you know, say words and so
11 on, and that is typically unvoiced speech. So it can be
12 construed as unvoiced speech too. Or unvoiced speech is
13 part of, you know, some utterances of the words,
14 components of it.

15 So recognition would involve both. And even
16 in Holzrichter, that's why he has electromagnetic
17 sensors and the acoustic sensors to detect both of them,
18 especially in the case of unvoiced.

19 Q. So just in your previous answer, you said
20 Holzrichter has EM sensors and acoustic sensors to
21 detect both voiced and unvoiced speech; is that --

22 A. Yes. So maybe I can --

23 Yeah, I think, you know, Holzrichter is --
24 basically, one of the things is that, you know, it's
25 hard -- his electromagnetic sensors that he's construing

1 or envisioning are -- do not detect unvoiced speech, and
2 that's where he needs microphones to complement that.

3 Q. Does a speech recognition system recognize the
4 difference between voiced and unvoiced speech?

5 MR. COWELL: Objection to form.

6 THE WITNESS: To the extent of parsing words
7 accurately, so I think, you know, the -- the unvoiced
8 speech sound, if it doesn't detect them correctly, then
9 it may parse the -- or recognize the words incorrectly.

10 BY MS. WANG:

11 Q. In order for a speech recognition system to be
12 accurate, does it have to recognize the difference
13 between voiced and unvoiced speech?

14 MR. COWELL: Objection to form.

15 THE WITNESS: It -- no, it doesn't necessarily
16 have to recognize the different -- from a speech
17 recognition perspective, it doesn't necessarily have to,
18 you know, label it the same.

19 But it has to accurately detect, you know,
20 whether it was -- you know, whatever was being uttered
21 so that it doesn't miss -- you know, mislabel the
22 component of speech, and that could happen if it is --
23 if it thinks it's -- if it detects it as voice when it
24 was unvoiced or the other way around.

25

1 BY MS. WANG:

2 Q. In order for a voice recognition system to
3 accurately label the component to speech, does it have
4 to recognize the difference between voiced and unvoiced
5 speech?

6 MR. COWELL: Objection to form.

7 THE WITNESS: No, I would say, again, I think
8 it's -- you know, implicitly you may argue that it is,
9 but in the end, it's voice -- a speech recognition
10 system, to work effectively, has to correctly identify
11 what was being uttered.

12 And -- and the risk is that, you know, if
13 you -- and in some cases, it's only relying on, you
14 know, sensors which only detect one part or the other.
15 It may miss it.

16 So that's -- that's what I would -- I think
17 it's -- it's -- so that's not -- the focus is not
18 necessarily whether it's voiced or unvoiced but, you
19 know, to correctly identify what was being uttered.

20 BY MS. WANG:

21 Q. So just to be clear, I'm not asking what the
22 focus of the speech recognition system is. I'm just
23 wondering if it's kind of a component of the speech
24 recognition system.

25 So I'm going to ask -- I'm going to try to

1 rephrase this question.

2 In order for a speech recognition system to
3 correctly identify what was uttered by a speaker, does
4 the speech recognition system have to recognize the
5 difference between voiced and unvoiced speech?

6 MR. COWELL: Objection to form.

7 THE WITNESS: Well, I'm going to say the same
8 thing. It doesn't have, you know -- well, let me think
9 for a second.

10 I think I'm going to say it doesn't have to
11 necessarily recognize the difference between the two
12 kinds of speech, but it could make errors if it didn't
13 have the ability to detect both kinds because there's so
14 many different ways in which you could combine it, you
15 know, using algorithms where it's not necessarily
16 labeling it one way or the other. But it is critical
17 for getting the correct labeling, if you will, or
18 correct recognition of what was uttered.

19 And so at the core, it must have the ability
20 to detect all kinds of speech. If it just had one, then
21 it may -- would be more likely to make errors, but that
22 does not mean that it intrinsically has the ability to
23 distinguish between voiced and unvoiced.

24 That may or may not -- you know, that's how
25 artificial machines are learning algorithms, for

1 example, or signal processing algorithms. So that may
2 not make sense, but I think, yeah, that's the best
3 answer I can give to your question.

4 BY MS. WANG:

5 Q. Do you have an understanding of the difference
6 between a phoneme and a word?

7 A. A phoneme is a component of a word, I would
8 say.

9 Q. So if we're talking about a speech recognition
10 system for detecting a phoneme, in that context, in
11 order for a speech recognition system to correctly
12 identify what phoneme was uttered by a speaker, does the
13 speech recognition system have to recognize the
14 difference between voiced and unvoiced speech?

15 MR. COWELL: Objection to form.

16 THE WITNESS: Phoneme, so -- and that can --
17 I'm trying to -- phoneme is a component, and I'm trying
18 to remember what our -- I don't know of the different --
19 what are different kinds of phoneme? Can you give me
20 some examples? Is Z a phoneme or zh sound and sh sound?

21 BY MS. WANG:

22 Q. If we take for granted, for purposes of today,
23 that a phoneme is like -- just like you said, just a
24 portion of the word --

25 A. Yeah.

1 Q. -- not necessarily the full word but, like,
2 the sound of a letter like you distinguished --

3 A. Yeah. So I think, if the phoneme involved --
4 again, if the phoneme involved unvoiced versus voiced
5 generation of speech, then you -- the system has to be
6 able to detect that.

7 And, again, it's not necessarily that it has
8 to be able to distinguish it -- you know, I'm going to
9 say the same thing -- to distinguish between the two, it
10 has to correctly detect it, and the problem is that, you
11 know, unvoiced speech generally has less strength, just
12 by the nature of the generation of speech. And that's
13 why it's hard to detect in the presence of background
14 noise.

15 So, again, I would say that the emphasis is on
16 being able to correctly detect it rather than
17 intrinsically differentiating voiced versus unvoiced.

18 MR. COWELL: Grace, we've been going about an
19 hour. Do you think we could take a break?

20 MS. WANG: Yeah. This is a good time. Let's
21 go off the record.

22 (Recess: 8:03 a.m. to 8:13 a.m.)

23 BY MS. WANG:

24 Q. Welcome back, Dr. Sayeed.

25 A. Thank you.

1 Q. Did you speak with anybody during the break?

2 A. Nope, just myself.

3 Q. Does a speech recognition system detect both
4 voiced and unvoiced speech?

5 MR. COWELL: Objection to form.

6 THE WITNESS: Yes. Well, implicitly, yes.
7 Yes.

8 BY MS. WANG:

9 Q. So a speech recognition system detects voiced
10 speech?

11 A. Well, again, it has to detect both because, in
12 order to have correct recognition, there are parts which
13 are going to be voiced and others which are unvoiced, so
14 it has to be both to be able to correctly recognize
15 speech.

16 Q. Are you aware of in the English language two
17 sounds, one is unvoiced and one is voiced, but the shape
18 of the vocal tract is the same?

19 MR. COWELL: Objection to form.

20 THE WITNESS: Shape of the vocal tract is the
21 same -- yeah, I don't know. You know, I think there
22 could be. Maybe even, you know, ss and zh -- the shape
23 of the vocal cord could be the same but the generation
24 of the mechanism is different. Yeah. Not sure.

25

1 BY MS. WANG:

2 Q. So in your answer just now, you made a sound
3 that sounded like the S in --

4 A. Yes.

5 Q. -- Samantha --

6 A. Yes.

7 Q. -- versus the Z --

8 A. The Z --

9 Q. -- sound -- the Z sound in zebra.

10 A. Yes.

11 Q. Just so the transcript is clear.

12 MR. COWELL: I hate to break in. Doctor,
13 please let Ms. Wang finish her question. You're jumping
14 in.

15 THE WITNESS: My apologies. Thank you for
16 reminding me, Rich.

17 BY MS. WANG:

18 Q. So if we stick with these examples, the S
19 sound in Samantha and the Z sound in zebra, is it your
20 understanding that the shape of the vocal tract is the
21 same in the production of these two sounds?

22 MR. COWELL: Objection to form.

23 THE WITNESS: I was speculating. I'm not
24 sure. Those are two -- yeah, to me, those are two
25 similar sound -- you know, similar sounds. But, you

1 know, one is -- those are examples of, you know, voiced
2 versus unvoiced speech or generation of speech.

3 And so because of the similarity, I'm
4 speculating that the shape of the vocal cord -- of the
5 vocal tract may be similar.

6 BY MS. WANG:

7 Q. And in order to correctly identify the phoneme
8 that was uttered, does a speech recognition system have
9 to be able to distinguish between the S, in "Samantha,"
10 and the Z, in "zebra," sounds?

11 MR. COWELL: Objection to form.

12 THE WITNESS: Well, I mean, it has to detect
13 it as S versus Z. Otherwise, the transcription would be
14 incorrect.

15 BY MS. WANG:

16 Q. Is there a difference between a speech
17 recognition system and a voice activity detection
18 system?

19 A. Yes, there are different purposes. I mean,
20 speech recognition is trying to, you know, recognize
21 speech and the content of words and so on; whereas,
22 voice activity detection is a more primitive function
23 just detecting whether a voice activity did occur or
24 not.

25 Q. Does a speech recognition system first have to

1 detect presence of speech?

2 MR. COWELL: Objection to form.

3 THE WITNESS: And, again, you know, the goal
4 there is speech recognition, so it may -- you know, it
5 may not -- well, I think to some extent, yeah,
6 implicitly again it has to detect whether it's occurring
7 or not, but that's not the focus of -- that's not what
8 the system is aimed at doing. But implicitly it will do
9 it.

10 BY MS. WANG:

11 Q. I'll just ask it again so the record is clear.
12 Does a speech recognition system first have to
13 detect presence of speech, "yes" or "no"?

14 MR. COWELL: Objection to form.

15 THE WITNESS: First detect the presence of
16 speech.

17 I would say no because it depends on how the
18 system was built. I mean, it could be built in a way
19 that it doesn't necessarily have to detect it first. It
20 may just be directly so it doesn't necessarily have
21 to -- but, again, implicitly, it is when it -- you know,
22 when it recognizes and it spits out, it has detected it
23 as well.

24 BY MS. WANG:

25 Q. So when the --

1 A. The --

2 Q. Sorry. Go ahead.

3 A. No, no. That's okay. You go ahead.

4 Q. In order for a speech recognition system to
5 recognize speech accurately, does it have to detect the
6 presence of speech?

7 MR. COWELL: Objection to form.

8 THE WITNESS: Well, again, to me, you know,
9 I'm thinking in terms of more signal processing terms,
10 technical terms. Again, I'm going to repeat the same
11 answer that, you know, your algorithm may not be built
12 in terms of --

13 (Court reporter requested clarification.)

14 THE WITNESS: The algorithm or the system --
15 the algorithm system may not be designed to specifically
16 detect it first explicitly. But once it recognizes
17 speech, it is implicitly telling you that, yeah, that it
18 detected it as well.

19 So in other words, there may not be a separate
20 module for detecting speech or, you know, activity in
21 the system, per se.

22 BY MS. WANG:

23 Q. When a speech recognition system accurately
24 recognizes the speech, is it also detecting the presence
25 of speech?

1 A. Yeah, of course, it is. You know, it -- it's
2 not again explicitly doing it, but it is telling you
3 that, hey, something -- speech did occur.

4 Q. When a speech recognition system accurately
5 recognizes speech, is it also detecting the presence of
6 voice?

7 MR. COWELL: Objection to form.

8 THE WITNESS: I'm -- I'm going to keep giving
9 the same answer. It's implicitly or indirectly telling
10 you that, yeah, speech occurred. So it is detecting it
11 too, but it may not be an explicit function aimed at
12 detecting speech, per se.

13 BY MS. WANG:

14 Q. Just to be clear, my previous question was
15 asking about detection of the presence of voice.

16 A. Okay. So can you please repeat the question
17 again?

18 Q. I'll repeat it.

19 When a speech recognition system accurately
20 recognizes speech, is it also detecting the presence of
21 voice?

22 MR. COWELL: Objection to form.

23 THE WITNESS: Yeah, implicitly it is detecting
24 the presence of voice because, you know, some voice must
25 have produced that speech.

1 BY MS. WANG:

2 Q. Are voice and speech the same thing?

3 A. Well, not necessarily. A voice could be, you
4 know, just uttering, screaming. That won't necessarily
5 be speech. No. I mean, a voice -- I'm thinking of
6 human voice, again, and that may be just an utterance.
7 It may not be any legible speech, per se. May not be a
8 word. It could be, yeah, some other sound.

9 Q. Is voiced speech a type of speech?

10 A. Yes.

11 Q. When -- strike that.

12 The presence of -- sorry, strike that.

13 Does the presence of voiced speech mean that
14 speech is present?

15 MR. COWELL: Objection to form.

16 THE WITNESS: I'm sorry. That's -- can you
17 please repeat the question or -- is the -- yeah.

18 BY MS. WANG:

19 Q. Does the presence of voiced speech mean that
20 speech is present?

21 MR. COWELL: Objection to form.

22 THE WITNESS: Sounds tautological. Does the
23 detection of voiced speech mean that speech is present?
24 Yes, I guess. Yes.

25

1 BY MS. WANG:

2 Q. Are you able to provide some examples of
3 voiced speech, in the English language, preferably.

4 A. Well, you know, I can try my best -- I mean, I
5 think, in voiced speech, you know, the vocal cords are
6 vibrating. And so I think -- I don't know. In most of
7 these situations, there's voice. I think it's only the
8 parts of it which could be, you know, unvoiced segments
9 where, you know, I said "Z versus S" earlier.

10 So most of what I'm saying right now, for
11 example, is I think voiced speech with components which
12 are unvoiced and -- or unless I go whispering (speaking
13 sotto voce.)

14 So I think whispering, to my understanding,
15 is -- you know, the main difference is vocal cords
16 vibrating versus not as it being voiced and unvoiced.

17 And -- and whispering can also -- you can kind
18 of utter the sounds without making your cords vibrate,
19 so that may be the closest to unvoiced versus voiced
20 difference. And it also exemplifies that, you know,
21 it's harder to detect because it's weaker.

22 Q. During voiced speech, you said earlier that
23 the vocal cords vibrate?

24 A. Yes.

25 Q. Is there any other part of the speaker's head

1 or neck area that moves during the production of voiced
2 speech?

3 A. Well, you know, I think, yes, it can, and it's
4 all those secondary vibrations. So as I'm speaking, if
5 I, for example, hold -- you know, you can feel it in
6 your neck. And so there are, you know, throat, you
7 know --

8 Yeah. So there will be other parts of your --
9 you know, it is physically vibrating. So, yes, there
10 could be parts of your head and neck which could vibrate
11 correspondingly as well.

12 Q. Other than the throat and vocal cord, what
13 other parts would vibrate or move during the production
14 of voiced speech?

15 A. I don't know. I don't have an exhaustive
16 list. I think -- I think, again, if I -- you know, if I
17 spoke really loud, chances are more parts of my head and
18 body would vibrate. So it's a secondary mechanism. So
19 I couldn't really give you a list, per se. Yeah.

20 Q. Does the tongue move during the production of
21 voiced speech?

22 A. Well, again, secondary vibrations, the tongue
23 could move but not -- not -- it's not causing it.

24 Q. So other than secondary vibrations, just
25 talking about movement, does the tongue move during

1 production of voiced speech?

2 A. In the utterance, yes. I think the
3 different -- I think, you know, as I'm speaking, I'm
4 just noticing it. Yeah, the position of your tongue
5 changes. So, yes, I think the tongue would move.

6 But it's not -- yeah. It's not necessarily
7 the source of the generation of sound waves, if you
8 will.

9 Q. During the production of voiced speech, does
10 the jaw move?

11 A. Again, yes. I think, you know, as I'm
12 speaking, I'm noticing that my jaw is moving as I'm
13 uttering different parts of my speech.

14 Q. During the production of voiced speech,
15 does -- do the lips move?

16 A. Yes. Again, as different parts of the word
17 and sentences are uttered, the lips move too. Again,
18 not necessarily generating the pressure waves but
19 modulating it to make the right sounds.

20 Q. Have you heard of abduction in the context of
21 vocal cords or vocal folds?

22 A. Abduction?

23 Q. Yes.

24 A. I can't -- no, I can't remember. Could you
25 give me a specific context to jog my memory or

1 something? I don't think I have.

2 Q. Have you heard of adduction in the context of
3 vocal cords or vocal folds?

4 A. Abduction, A-B-D --

5 Q. That was the first question. That was the
6 first word, and then the second word is A-D-D.

7 A. Adduction?

8 Q. Like adduction.

9 A. Adduction. Yeah.

10 No, I have -- no, I must have missed it. It
11 probably is somewhere.

12 Q. Do you have an understanding of what state are
13 the vocal cords in when the speaker is at rest?

14 A. Resting? I don't know. What state?

15 Q. Sorry. Let me clarify.

16 A. Yeah.

17 Q. Do you have an understanding of whether the
18 vocal cords are open or closed when the speaker is at
19 rest?

20 A. I think they are open.

21 Q. Are the vocal folds also open when the speaker
22 is at rest?

23 A. Yes.

24 By the way, I should correct myself. Cord and
25 fold are the same thing. I did Google it while we were

1 taking a break. So I feel pretty silly. They are the
2 same thing.

3 Q. Did you say you went on Google during the
4 break?

5 A. Yes. Just to look at vocal cord -- folds
6 versus cords.

7 Q. Okay. And what did --

8 A. It said that they are the same thing.

9 Q. And what did Google tell you?

10 A. That they are the same thing.

11 Q. Did Google tell you anything else?

12 A. No.

13 Q. Did you look up anything else during the
14 break?

15 A. No. No.

16 Q. Did you navigate to any other website during
17 the break?

18 A. No.

19 Q. How did you look up Google during the break?

20 A. I just -- vocal fold versus cord, and it says
21 the same thing. So I was just curious.

22 Q. As you were -- and what browser window did you
23 use for that? Was that Chrome?

24 A. Chrome, yes.

25 Q. So -- and do you still have Chrome open now?

1 A. No.

2 Q. Okay. So you opened it during the break and
3 then closed it during the break?

4 A. Yeah.

5 Q. So now being informed by Google that vocal
6 cords and vocal folds are the same thing, do you have an
7 understanding of how vocal folds move to produce voiced
8 speech?

9 A. Well, again, I'm not -- those -- you know, I
10 don't know. That was my understanding that they are --
11 there's a lot of similarity between them. So it's --
12 they vibrate. You know, mainly for vocal cords. I'm
13 still going to stick with vocal cords.

14 They vibrate, which is back-and-forth
15 movement, to produce changes in sound pressure that are
16 sound waves, actually, longitudinal waves. So back and
17 forth, and that's how voice speech is generated.

18 Whereas folds or cords can also just close or
19 open to constrict or change the amount of airflow to the
20 vocal tract. And that's -- and that fold is -- is
21 opening or closing is kind of when we do, you know, part
22 of unvoiced speech or when we whisper, for example.

23 Q. So just for now sticking with voiced speech,
24 when the vocal folds vibrate, do they move back and
25 forth in an open and closed manner?

1 A. Yes. Yeah. Opening and closing, yes.

2 Q. And what causes -- or sorry. Strike that.

3 Do you have an understanding of what causes
4 that vibration?

5 A. Well, it seems some kind of muscle would be
6 moving, causing the vibration of the cords.

7 Q. And when the vocal folds vibrate open and
8 closed, does air move through the vocal folds?

9 A. Yes, it -- well, I'm trying -- I'm thinking --
10 now I'm observing myself. Yes.

11 Q. And you testified earlier that a vocal fold's
12 EM sensor can detect voice speech by detecting the
13 vibration of the vocal folds.

14 Do I have that right?

15 A. Let me think for a second.

16 Yes. I -- yeah, I think that it's aimed at
17 directly detecting the motion, yes. I did say that, I
18 think.

19 Q. What is unvoiced speech?

20 A. Unvoiced speech is when the vocal cords are
21 not vibrating, and (sound) -- that sound is a good
22 example where, as you -- you just control the vocal
23 folds, only control the amount of airflow, and then it's
24 modulation of that airflow in the position of your
25 tongue and so on that creates the sound.

1 So the vocal cords are not vibrating. It's --
2 you know, as -- so I think that's a good -- you know, as
3 I say in my declaration, or quote, you know -- go back
4 to it again. Again, in paragraph 38 from Holzrichter,
5 the last two lines, "And 'unvoiced' where constrictions
6 in the vocal tract cause air turbulence and associated
7 modified-white airflow noise."

8 So modified white is kind of like, you know,
9 white noise kind of sound, and then you modify it with
10 the position of your, you know, tongue and whatnot to --
11 but the main thing is that the vocal -- vocal cords are
12 not vibrating.

13 (Court reporter requested clarification.)

14 BY MS. WANG:

15 Q. Dr. Sayeed, instead of -- or in addition to
16 making the S or the C sound, if you say, "S, like an S
17 sound," or something --

18 A. Yes. Yes. Thank you. Thank you. Yes.

19 Q. -- that will be -- thank you.

20 Are you aware of examples of unvoiced speech
21 in the English language?

22 A. Well, I think -- so here is -- let me just --
23 so I think it's -- again, my understanding is that it's
24 the part of sentences or speech that are unvoiced or,
25 you know, phonemes, if you will.

1 And so one place, for example, in -- in
2 Holzrichter, it's on page 31 -- or column 31, sorry.
3 Line 54 is -- you know, he's talking about his own
4 algorithm, and he refers to some of them, and I'll read
5 it.

6 "The issue for this algorithm is that some
7 words begin with unvoiced sounds such as S in 'Sam' or
8 in 'sixteen.' Thus, the algorithm must be able to back
9 up to catch sounds that may be missed by the vocal fold
10 motion onset detection by the EM sensor."

11 So this is from 54 through 57, lines.

12 So I think it's, you know, again, that S
13 sound, and I think F is also an unvoiced part of speech.
14 Yeah. And there are --

15 Again, the vocal cords are not vibrating words
16 with that when they are. And you can literally feel it.

17 Q. Are there portions of the speaker's head or
18 neck area that move during the production of unvoiced
19 speech?

20 A. Don't think so. They don't have to.
21 Certainly not in the primary mode that, you know, the
22 head or neck has to move to produce that --

23 (Court reporter requested clarification.)

24 THE WITNESS: I said, I don't think so, that
25 the head or neck have to move to produce unvoiced

1 speech, certainly not in some primary fashion that it's
2 necessary for the -- for head or neck to move to produce
3 unvoiced sounds or speech.

4 BY MS. WANG:

5 Q. Okay. And just to be clear, the question was
6 about portions of the head or neck.

7 A. Oh.

8 Q. Are there any portions of the head or neck
9 that move during the production of unvoiced speech?

10 A. Not sure. I don't think so. Or don't have
11 to.

12 Q. Does the tongue move during production of
13 unvoiced speech?

14 A. Yes. The tongue can move to, you know -- you
15 know, to modulate that airflow, yes.

16 Q. Does the jaw move during production of
17 unvoiced speech?

18 A. You know, I think the jaw could also move,
19 yes.

20 Q. Do the lips move during production of unvoiced
21 speech?

22 A. Possibly. Yes.

23 Q. Do the teeth move during production of
24 unvoiced speech?

25 A. Yes. It's possible, yes.

1 Q. Do you have an understanding of what position
2 the vocal folds are in during production of unvoiced
3 speech?

4 A. Yeah. I think they are partly closed to, you
5 know, constrict the airflow. So, again, I'll refer
6 to -- yes, I'll refer to my paragraph 38, again, from my
7 declaration, the second to last line.

8 "And 'unvoiced' where restrictions in the
9 vocal tract cause air turbulence and associated
10 modified-white airflow noise."

11 And that is, in turn, quoting from
12 Holzrichter. Column 12, 60 to 65.

13 Q. So it's your understanding that the
14 constrictions in the vocal tract are due to closure of
15 the vocal folds?

16 MR. COWELL: Objection to form.

17 THE WITNESS: Part of it is related to the
18 vocal fold movement, but other -- could be the tract may
19 also -- muscles may contract around there too.

20 But the vocal folds also are not entirely
21 open. They close to some extent or open, depending on
22 if they were closed to stop it. But they don't vibrate.
23 BY MS. WANG:

24 Q. What do you mean when you say "vocal folds are
25 not entirely open" in your previous answer?

1 A. What I'm saying is, you know, they could be
2 fully opened or fully constricted, and during unvoiced
3 speech, they could be somewhere in the middle as well.

4 Q. Are they touching each other?

5 A. No, that would be almost closed. So, no, I
6 don't think so.

7 Q. So are they open?

8 A. Yes, they're open, at least partly.

9 Q. During production of unvoiced speech, is there
10 airflow through the vocal folds?

11 A. Yes.

12 Q. In order for air to flow through the vocal
13 folds during production of unvoiced speech, are the
14 vocal folds open?

15 A. Yes.

16 Q. When transitioning from voiced speech to
17 unvoiced speech in an utterance, do the vocal folds have
18 to move from a closed position to an open position?

19 MR. COWELL: Objection to form.

20 THE WITNESS: So in your question, the
21 transition is from voiced to unvoiced?

22 BY MS. WANG:

23 Q. Yes.

24 A. And did you say that the -- the vocal cords
25 are in the transition from closed to open?

1 Q. I asked about vocal folds. Do the vocal
2 folds --

3 Let me just repeat --

4 A. Okay. Yes.

5 Q. I think you have it right.

6 When transitioning from voiced speech to
7 unvoiced speech in the same utterance, do the vocal
8 folds have to move from a closed position to an open
9 position?

10 A. Yeah, I think it's a little bit, you know --
11 they have to open for sure to avoid -- for unvoiced
12 speech. But in voiced speech, they are vibrating, so
13 where they started -- you know, at what point -- so they
14 opened and closed rapidly, or vibrating.

15 So I don't know whether they started in the
16 open or closed position. It's kind of hard to say. But
17 certainly they have to open for unvoiced speech. They
18 have to go into that state, yes.

19 Q. During the voiced speech, the vocal folds
20 vibrate open and closed; is that correct?

21 A. Yeah. That's -- yeah, that's in my quote from
22 Holzrichter as well.

23 Q. And the degree to which the vocal folds open
24 during the voiced -- during the production of voiced
25 speech, is it fair to say that that degree is smaller

1 than the degree to which the vocal folds open to produce
2 unvoiced speech?

3 MR. COWELL: Objection to form.

4 THE WITNESS: I'm sure -- can you repeat the
5 question?

6 BY MS. WANG:

7 Q. Yeah. Is it fair to say that the degree to
8 which the vocal folds open during voiced speech is
9 smaller than the degree to which the vocal folds open to
10 produce unvoiced speech?

11 A. No. I don't -- not necessarily. I don't
12 think so.

13 Q. Are you aware of any examples of voiced and
14 unvoiced speech in which the degree to which the vocal
15 folds open during voiced speech is larger than the
16 degree to which the vocal folds open for unvoiced
17 speech?

18 MR. COWELL: Objection to form.

19 THE WITNESS: No, I don't -- no. I -- I'm
20 not -- yeah. I'm not aware, but I'm just thinking in
21 the physical mechanism and -- yeah. No, I'm not aware.

22 BY MS. WANG:

23 Q. Are you aware of any examples of voiced and
24 unvoiced speech in which the degree to which the vocal
25 folds open during voiced speech is the same as the

1 degree to which the vocal folds open for unvoiced
2 speech?

3 MR. COWELL: Objection to form.

4 THE WITNESS: Yeah. It's possible, but I'm
5 not specifically aware of any particular conditions.

6 BY MS. WANG:

7 Q. Is there any speech that is neither voiced or
8 unvoiced?

9 A. That's a good question.

10 I don't know. I think it -- really a matter
11 of what you mean by, you know, "speech." Either the
12 vocal cords are vibrating or not, and you are making
13 sound. You know, not entirely sure.

14 I think this would cover most of it. I think
15 it's a question of what -- what mechanisms are you
16 producing the sound and whether it's construed as speech
17 or not. I'm not entirely sure.

18 Q. So sitting here today, you are unaware of
19 whether there's any speech that is neither voiced or
20 unvoiced?

21 A. Yeah. I'm not entirely sure what is relevant
22 to this particular --

23 (Court reporter requested clarification.)

24 THE WITNESS: Sorry. Okay. Yeah, I'm sorry.
25 I'm not directly aware, but, you know, it

1 didn't seem particularly relevant in this context.

2 BY MS. WANG:

3 Q. Earlier, Dr. Sayeed, you described a whisper
4 as unvoiced speech.

5 Do you recall that?

6 A. Yes.

7 Q. Do you have an understanding of what position
8 the vocal folds are in during whispering?

9 A. I think the way I -- you know, in some cases,
10 yeah, maybe a whisper is not the best example. I think,
11 in some cases, it might even vibrate, but I think it --
12 you know, if you -- the vocal cords may vibrate, but you
13 can whisper.

14 What I was intending was more in the context
15 like an unvoiced speech where it's not vibrating but
16 you're basically modulating the airflow to whisper the
17 word.

18 Q. Is it your testimony that the vocal folds can
19 vibrate during whispering?

20 A. I think, in some situations, it can if it's
21 not too -- yes, because it's -- again, it's a natural
22 tendency to how we speak, so if it's loud enough, your
23 vocal cords may vibrate. But I think, if you're
24 conscious enough, you could utter the words without them
25 vibrating.

1 Q. Is all whispering unvoiced speech?

2 A. No. I don't think so. I think it's more,
3 again, related to the mechanisms whether the vocal cords
4 are vibrating or not. Again, referring to what I quote
5 from Holzrichter in my declaration, again, paragraph 38,
6 end of it, and this is Holzrichter, Column 32, lines 44
7 to 51.

8 And specifically the quote I've listed there
9 is, "The vocal folds, which open but do not vibrate open
10 and closed, during whispered and unvoiced speech."

11 So there could be other distinctions, but the
12 commonality here is that they are not -- or you can do
13 it, whispered speech, in a way that the vocal folds are
14 not vibrating.

15 Q. Sorry, did you say that you can whisper so
16 that the vocal folds are not whispering -- are not
17 vibrating?

18 A. Yeah. Specifically whispered speech when the
19 vocal folds or the vocal cords are not vibrating, yeah.
20 So it's more, you know -- yeah. So not all whispered
21 speech is unvoiced.

22 Q. There is some whispered speech that is voiced?

23 A. Could be. I think, yes. If your vocal folds
24 vibrate, if your whisper gets a little louder.

25 Q. Is that the only instance in which your vocal

1 folds would vibrate during whispered speech is if the
2 whisper is a loud whisper?

3 A. I think generally it could get louder when
4 your vocal cords are vibrating because it takes a
5 certain amount of energy to vibrate, make the vocal
6 cords vibrate, and that corresponds to a certain amount
7 of sound that will be produced.

8 Q. So, Dr. Sayeed, do you remember the rules that
9 I kind of gave you at the beginning of the deposition,
10 asking you not to open any applications during the
11 course of this deposition?

12 A. Or to let you know or -- I didn't -- yeah. I
13 do remember -- yeah. I'm sorry. Yeah. I didn't
14 realize that they applied to the break as well. And I
15 was just curious. I just -- yeah.

16 Q. Understood. Understood.

17 I'll just ask that, going forward, you ask in
18 advance if you want to look something up or look at
19 some -- open something or look at another piece of
20 paper --

21 A. Understood.

22 Q. -- that we haven't previously talked about,
23 and that definitely applies to the breaks as well.

24 A. Okay.

25 Q. So with that said, would you like another

1 break?

2 A. Sure.

3 MS. WANG: Okay. Let's go off the record real
4 quick.

5 (Recess: 9:03 a.m. to 9:15 a.m.)

6 BY MS. WANG:

7 Q. Welcome back, Dr. Sayeed.

8 A. Thank you.

9 Q. Did you speak with anyone during the break?

10 A. No.

11 Q. Did you Google anything during the break?

12 A. No, I did not. I stand corrected.

13 Q. Dr. Sayeed, what does "generating" mean?

14 A. Generating. Well, in the context of this
15 discussion, I think it involves calculating, as I
16 state -- let me just go to the right place in my
17 declaration. And that is -- let me see. Yeah, so this
18 is on page 15, paragraph 42 of my declaration.

19 "In my opinion, a POSITA would understand
20 'generating'" --

21 (Court reporter requested clarification.)

22 THE WITNESS: -- "'a noise waveform estimate
23 associated with noise of the acoustic signals' to mean
24 'calculating a noise waveform estimate based on the
25 noise associated with all the acoustic signals.'"

1 So that's maybe, you know, a little more
2 specifically in the context, but generally generating
3 is -- involves some kind of calculation or processing of
4 the signals. And in this particular case, it had a very
5 specific meaning, you know. Yeah.

6 BY MS. WANG:

7 Q. So is it your testimony that, in the context
8 of the '543 patent, "generating" means "calculating"?

9 MR. COWELL: Objection to form.

10 THE WITNESS: Yeah, that's one -- you know,
11 to -- in terms of what the patent teaches. Generating
12 noise waveform estimates -- I should be clear about
13 this. I'm talking about generating in the context of
14 generating a noise waveform estimate.

15 BY MS. WANG:

16 Q. You're not referring to the other instances of
17 generate in the claims?

18 A. I'm trying to see which other specifically it
19 could be referring to.

20 Claims. Yeah, I think there are only two. In
21 the claim, at least, is control signals and generate
22 denoising of acoustic signals. So in all of those,
23 there's some calculation involved.

24 Q. So it's your testimony that when the claim --
25 for example, in Claim 1 where it says "automatically

1 generate control signals and generate denoised acoustic
2 signals," that's referring to calculate?

3 MR. COWELL: Objection to form.

4 THE WITNESS: Certainly in the context of
5 generate denoise acoustic signals and -- let me think
6 for a second. Not necessarily the control signals.
7 That could be just a bad output.

8 Well, strike it. Yeah.

9 BY MS. WANG:

10 Q. Just to make -- just to make the record
11 clear --

12 A. Yeah, definitely --

13 Sorry. Go ahead.

14 Q. Okay. To make the record clear, when the
15 claim -- Claim 1 refers to automatically generate
16 control signals, is that the same as automatically
17 calculate control signals?

18 A. Not necessarily. I think what I stated was
19 more in the context of generating a noise waveform
20 estimate.

21 Q. What about where Claim 1 recites, "Generate
22 denoised acoustic signals"? Is that the same as
23 calculate denoised acoustic signals?

24 A. Yes. Correcting that, yes, because that will
25 involve removing of a noise estimate, and that would

1 involve -- that would be a calculation as well.

2 Q. What's the difference between generate and
3 calculate?

4 A. Well, it is more than just a -- you know, just
5 the representation of the signal, especially in this
6 context where you don't -- you know, that it involves
7 some kind of processing of the signal that was at hand.

8 So whether it's generating a noise waveform
9 estimate -- and in this particular case, it involves,
10 you know, multiple signals when you generate a noise
11 waveform estimate.

12 So just beyond this, taking a signal directly
13 from a microphone, for example, and using it in some
14 context, that would not be generation.

15 Q. So generation requires processing?

16 A. Some form of processing, yes, and -- which is
17 a form of calculation, if you will.

18 Q. But in the context of Claim 1, only if that
19 generation is of a noise waveform estimate or generation
20 of the denoised acoustic signal?

21 A. Yes. Well -- but more so than, yes, than the
22 control signals.

23 Q. So generation of control signal does not
24 require processing?

25 MR. COWELL: Objection to form.

1 THE WITNESS: I was -- you know, I think
2 it's -- let me think for a second.

3 I'm -- you know, the reason why I'm thinking
4 that is that it's in the context of what's taught in the
5 specification as well in this patent, and I'm just
6 trying to think for a second about the control signal
7 and whether that involves calculation or just -- sorry,
8 I'm just thinking.

9 BY MS. WANG:

10 Q. Yes.

11 A. Just give me --

12 Well, I think, yeah, I'm going to say it's a
13 little less so, but there's still some calculation
14 involved in generation of control signals too because it
15 is -- you know, it basically involved the training of
16 the denoising algorithms, and so some calculation is
17 involved there too. Somewhat less compared to the
18 actual denoising of the waveform.

19 Q. Just to be clear, is it your testimony that
20 generation of control signals involves training of the
21 denoising algorithms and that's why it involves some
22 calculation?

23 MR. COWELL: Objection --

24 THE WITNESS: No --

25 Sorry.

1 No, that's not what my -- what I'm saying is
2 that generation of control signals -- or those control
3 signals dictate what is a -- you know, training of the
4 denoising algorithms in which those are updated and so
5 on.

6 So that's what I was saying. And so that
7 generation of control signals would also involve some
8 calculation but not as much.

9 BY MS. WANG:

10 Q. What calculations are involved in that
11 generation of control signals?

12 MR. COWELL: Objection to form.

13 THE WITNESS: So I'm trying to kind of refresh
14 my memory just quickly in terms of -- actually, varied
15 control signals -- let me just make sure.

16 BY MS. WANG:

17 Q. May I ask what you're looking at?

18 A. Yes, I'm looking at Claim 1, the language.

19 Q. All right.

20 A. Specifically the last part of -- the last
21 part.

22 Yeah, I think -- I would say -- minimal thing
23 I'd say -- it's basically taking the VAD signals, voice
24 activity, and VAD is generating the output control
25 signals to the denoise system.

1 So there could be -- you know, so there's some
2 calculation involved there too. So I'm looking at that.
3 There is calculation involved in that as well.

4 Q. The question was: What calculations are
5 involved in that generation of control signals?

6 A. Well, you know, to determine whether it's --
7 you know, voice is present or not so that you can adapt
8 the corresponding filters, H1 or H2 in the denoising
9 system.

10 Q. So the calculation that's involved in the
11 generation of control signals is the calculation of
12 whether voice is present or not?

13 A. Yes.

14 Q. Does that mean that the control signals
15 themselves are the voice activity detection signal?

16 MR. COWELL: Objection to form.

17 (Court reporter requested clarification.)

18 THE WITNESS: I noticed -- I was frozen, so
19 that's why I was -- there we go.

20 (Whereupon the certified court reporter read
21 the record.)

22 THE WITNESS: Second...

23 Yeah, they will be the signals coming out of
24 the VAD, yeah.

25

1 BY MS. WANG:

2 Q. Okay. Is it possible to generate something
3 without calculating it?

4 MR. COWELL: Objection to form.

5 THE WITNESS: Actually, you know, again,
6 generate -- you know, it's not in the -- in a general
7 context, it could be a different thing. But here, it's
8 a specific instruction of this term within the context
9 of this patent. So that's where calculation is involved
10 or the best way of interpreting it.

11 BY MS. WANG:

12 Q. So is your --

13 Sorry, were you done?

14 A. Yes.

15 Q. Is it your testimony, then, that, in the
16 context of the '543 patent, that it is not possible to
17 generate something without calculating it?

18 MR. COWELL: Objection to form.

19 THE WITNESS: Well, again, specifically in the
20 context of generating the denoised waveform estimate
21 associated with the acoustics, the noise of the acoustic
22 signals, that particular phrase, is part of the claim.

23 BY MS. WANG:

24 Q. Is that answer a "yes"?

25 MR. COWELL: Objection to form.

1 THE WITNESS: In that context, yes, generating
2 would involve calculation as I've articulated in my
3 declaration.

4 BY MS. WANG:

5 Q. So it is your testimony that, in the context
6 of the '543 patent, that it is not possible to generate
7 a noise waveform estimate without calculating it?

8 A. For the purposes of what is -- you know, what
9 noise waveform estimate means in the context of the '543
10 patent, yes. In particular, I will refer you to, you
11 know -- you know, paragraphs 42 through 50 -- 57. 42 to
12 57 of my declaration which explains what that means.

13 Q. Is it possible to calculate something without
14 generating it?

15 MR. COWELL: Objection to form.

16 THE WITNESS: I don't know what that question
17 means. Can you repeat the question?

18 BY MS. WANG:

19 Q. Is it possible to calculate something without
20 generating it?

21 A. I assume. Is it possible to calculate
22 something without generating it?

23 I don't know. I'm trying to understand the
24 linguistics. Is the question: Is it possible to
25 calculate without generating?

1 Q. Correct.

2 A. Generating what? Calculating the same thing
3 without generating it? Yeah. I have a hard time
4 processing that question. I'm sorry.

5 Q. Are you aware of any example in which
6 something is calculated but not generated?

7 MR. COWELL: Objection to form.

8 THE WITNESS: That's a very -- calculated, not
9 generated. I mean, when you calculate something, you
10 are generating something different than what you started
11 with. So in that regard, every calculation would
12 generate a new result, so perhaps not.

13 BY MS. WANG:

14 Q. Is multiplication calculation?

15 A. Well, again, you know, multiplication is a
16 simple operation and not necessarily a calculation. In
17 the context of this, you know, same construction, if you
18 will. One part of it involves -- the calculation
19 involves multiple signals, not just one signal, per se.

20 And multiplication is just --- you know,
21 unless it's -- yeah. If it was multiplication of two
22 signals, maybe it would be, but multiplication by a
23 number would not. It's a -- it's just an operation.

24 Q. So it's your testimony that multiplication of
25 a signal by a number is not a calculation?

1 MR. COWELL: Objection to form.

2 THE WITNESS: It's an operation.

3 BY MS. WANG:

4 Q. And an operation -- it's an operation that is
5 not a calculation?

6 A. Yeah, because the calculation here is
7 involving more than one signal, at least two.

8 Q. Is division a calculation?

9 A. No, because, again, if you're dividing just
10 one signal by a scale, that's not a calculation. So,
11 you know, this --

12 Just to help clarify things, as I state in
13 Paragraph 43, "The claim language, as well as the
14 specification, makes clear that the noise waveform
15 estimate is calculated using all the acoustic signals
16 received by the microphone array. First, the
17 surrounding language draws a distinction between the
18 acoustic signals and the acoustic signal. For example,
19 the relative portion of Claim 1 reads: 'Wherein the
20 denoising method includes generating a noise waveform
21 estimate associated with noise of the acoustic signals
22 and subtracting the noise waveform estimate from the
23 acoustic signal when the acoustic signal includes speech
24 and noise.'" Exhibit 1001, Column 1.

25 So it's very -- you know, a big part of this

1 claim construction is that it involves multiple signals,
2 and division and multiplication of just one signal by a
3 scaler does not involve calculation as construction of
4 this term.

5 Q. So when the claim says "generating the noise
6 waveform estimate associated with noise of the acoustic
7 signals," is it your testimony that this requires a
8 calculation that involves all of the acoustic signals of
9 the microphone array?

10 A. All of the relevant ones. More than one, so,
11 yes.

12 Q. Are there any acoustic signals of the
13 microphone array that are not relevant?

14 A. No, I think there are -- you know, so, for
15 example -- and, you know, as I mentioned earlier, for
16 example -- no, all of them will be relevant. Let's just
17 leave it at that.

18 Q. Is addition a calculation?

19 MR. COWELL: Objection to form.

20 THE WITNESS: You know, I think that a
21 calculation -- yeah, an addition, again, if it involves
22 two signals -- let me just -- you know, it's -- so in
23 this context, there's an -- in relation to your earlier
24 question as well, there's, you know, multiplication, you
25 know, of different signals.

1 In fact, crossing on them, just
2 multiplication, and then addition or subtraction that
3 involves a calculation. So an addition or subtraction
4 by itself, again, would be an operation which makes up a
5 calculation but not a calculation, per se, especially
6 the way it's being constructed here.

7 BY MS. WANG:

8 Q. In order for addition to be a calculation in
9 this context, it would have to add two signals together?

10 MR. COWELL: Objection to form.

11 THE WITNESS: Well, you wouldn't -- not just
12 adding two signals together. Even those signals may be
13 individually processed as well. So I'll -- for
14 example --

15 Let me give you an example from the
16 specification, which is also in my declaration, is -- it
17 is in paragraph 53, which says, "Thus, the denoised
18 signal can be calculated as $S(z)$ equals $M1(z)$ minus
19 $M2(z)$ multiplied by $H1$."

20 And so there is the subtraction, which is same
21 as addition of two signals, but then one of the signals
22 is also multiplied by the filter $H1$. So that's an
23 example of a calculation.

24 BY MS. WANG:

25 Q. So in order for addition to be a calculation

1 in this context, it would have to add two signals
2 together, including processing of either signal?

3 THE WITNESS: Yes.

4 MR. COWELL: Objection to form.

5 BY MS. WANG:

6 Q. And in order for multiplication to be a
7 calculation in this context, it would have to multiply
8 two signals together, including processing of either
9 signal?

10 MR. COWELL: Objection to form.

11 THE WITNESS: I think we are getting into
12 hypotheticals to some extent now, I feel.

13 I think the main purpose of this construction
14 is that it's just -- you know, we can't just use a
15 representative -- representation of a microphone signal
16 added, you know, as an estimate. An estimate involved
17 some kind of calculation, and that's what we're trying
18 to get at.

19 So I think -- I feel like we are getting away
20 from what the -- what this claim construction is aimed
21 at.

22 BY MS. WANG:

23 Q. I understand that you have points that you
24 want to make, but that answer was not responsive to the
25 question. So I'm just going to ask it again.

1 A. Okay.

2 Q. In order for multiplication to be a
3 calculation in this context, it would have to multiply
4 two signals together, including processing of either
5 signal?

6 MR. COWELL: Objection to form.

7 THE WITNESS: Possibly. Yes, at least in the
8 context it involves two signals and then processing --
9 yes. Yeah, I'm willing to concede that.

10 BY MS. WANG:

11 Q. Is it your opinion that, when the claims refer
12 to -- or sorry. Strike that.

13 Is it your opinion that, when the independent
14 claims of the '543 patent recite acoustic signals,
15 plural, that is referring to all of the acoustic signals
16 generated by the microphone array?

17 MR. COWELL: Objection to form.

18 THE WITNESS: Yes. I think it -- at least
19 it's referring to more than one.

20 BY MS. WANG:

21 Q. Is it referring to all acoustic signals from
22 the microphone array?

23 MR. COWELL: Objection to form.

24 THE WITNESS: Let me just -- yes. It is
25 referring to all of the signals in the microphone array

1 because in general that could involve all of them, yes.

2 BY MS. WANG:

3 Q. So when -- for example, in Claim 1, if
4 you're -- if you're looking at the patent, I can give
5 you the line number. Column 4, line 24. "Processing
6 the acoustic signals using the selected denoising
7 method."

8 Do you see that?

9 A. Column 4, line what?

10 Q. Sorry. Column 24, line 24.

11 A. Column 24, line --

12 Q. 24.

13 A. -- 24. Oh, it's the claim. Never mind.

14 Q. Yeah. Do you see that Claim 1 recites
15 "processing the acoustic signals"?

16 A. Yes.

17 Q. Is this portion of Claim 1 referring to
18 processing of all the acoustic signals from the
19 microphone array?

20 A. Yes. In general, yes.

21 Q. What do you mean by "in general"?

22 A. Well, what I mean -- yeah -- yes, all of them.
23 Strike that.

24 All of them.

25 Q. And then line 25, "generate denoised acoustic

1 signals," plural, is that referring to generating
2 denoised acoustic signals for all of the acoustic
3 signals provided by the microphone array?

4 MR. COWELL: Objection to form.

5 THE WITNESS: No. This does not refer to all
6 of the acoustic signals and the microphone array. This
7 would be -- denoised acoustic -- well, no. This is --
8 strike that.

9 This is -- that plural is referring to the
10 signal of the different subbands.

11 BY MS. WANG:

12 Q. So to be clear, Dr. Sayeed, when you say
13 "strike that" -- so I'm allowed to say "strike that"
14 because it means --

15 A. I can. I can.

16 Q. Well, you can say whatever you want, if it's
17 part of your answer, but it will be helpful for the
18 transcript, if you want to start over your answer to the
19 question, rather than saying "strike that," you can say,
20 "Let me -- let me start" -- or something. Or if you're
21 going to say "strike that," if you can please say what
22 you are striking.

23 A. Thank you. Yes. Yes. Yes. I'm learning as
24 we go along. I appreciate that.

25 Q. Yeah.

1 A. Yes. So let me re-answer --

2 Q. Well, let me first re-ask the question, if
3 that's okay --

4 A. Yes.

5 Q. -- so that we have a clean transcript.

6 When Claim 1 recites "generate denoised
7 acoustic signals," is that referring to generating
8 denoised acoustic signals for all of the acoustic
9 signals provided by the microphone array?

10 MR. COWELL: Objection to form.

11 THE WITNESS: No. It was -- no, it's not
12 referring to all the signal in the microphone array. It
13 is specifically referring to the signals in the
14 different subbands, the noise signals of the different
15 subbands off the main signal, which includes primarily
16 the signal of interest.

17 BY MS. WANG:

18 Q. Going down to line 36 of Column 24, do you see
19 Claim 1 recites "denoise the acoustic signals from the
20 microphone array"?

21 A. Yes.

22 Q. Is this portion of Claim 1 requiring that all
23 the -- all the acoustic signals from the microphone
24 array are denoised?

25 MR. COWELL: Objection to form.

1 THE WITNESS: I think, again, my understanding
2 is that this would apply to the subbands. And, again,
3 it was specifically -- you know, there's a main signal
4 which has the signal of interest corrupted by noise, and
5 that would be denoised to get it cleaned up for, you
6 know, the speed signal. And here, the plural is
7 referring to the subband signals.

8 BY MS. WANG:

9 Q. So the acoustic signals at line -- recited at
10 line 36 are referring to the acoustic signals of the
11 subbands?

12 A. Yes, that is my --

13 MR. COWELL: Objection to form.

14 THE WITNESS: That is my understanding.

15 BY MS. WANG:

16 Q. And the acoustic signals at lines 25 to 26,
17 those are also the acoustic signals of the subbands?

18 MR. COWELL: Objection to form.

19 THE WITNESS: Yes, that's my understanding.

20 BY MS. WANG:

21 Q. And the acoustic signals at line 28 in the
22 column of -- in Column 24 of the '543 patent, is that
23 referring also to the acoustic signals of the subband?

24 MR. COWELL: Objection to form.

25 THE WITNESS: Line 28. Let me just see -- no,

1 these are -- these acoustic signals are the microphone
2 array signals. So whenever a noise waveform estimate
3 is -- that's microphone signals.

4 (Court reporter requested clarification.)

5 BY MS. WANG:

6 Q. And just to clarify, the acoustic signals
7 recited in line 24 of Column 24 in Claim 1 of the '543
8 patent, is that referring to the acoustic signals of the
9 microphone array or the acoustic signals of the
10 subbands?

11 MR. COWELL: Objection to form.

12 THE WITNESS: Yeah, I think that -- so line 24
13 is what you're asking for, right?

14 BY MS. WANG:

15 Q. Correct.

16 A. Okay. So one, two, three, four. So what it
17 states there is, "At least one frequency subband of the
18 acoustic signals using the control signals and
19 processing the acoustic signals using the selected
20 denoising method."

21 So give me a minute. I'm just trying to
22 read --

23 Q. Yep.

24 A. -- the whole thing just to make sure.

25 This one is referring to the microphone array

1 signal. So it's -- "appropriate to data of at least one
2 frequency subband of the acoustic signal."

3 So it's already reported to the specific
4 subband off the acoustic signal. So this is the
5 microphone array signals in 24.

6 Q. And the acoustic signals recited in line 23,
7 are those of the microphone array or of the subband?

8 MR. COWELL: Objection to form.

9 THE WITNESS: Wait a minute. I may have
10 looked at a number incorrectly. I know that's what I
11 was answering. 23 -- 23 and 24. One -- no.

12 BY MS. WANG:

13 Q. Okay. Let's maybe -- let's -- let me make
14 sure. Let me just reread part of the -- so the portion
15 of the claim starting at line 22 is, "Denoising method
16 appropriate to data of at least one frequency subband of
17 the acoustic signals."

18 A. That one is microphone array.

19 Q. Okay. Let me keep reading. "Using the
20 control signals and processing the acoustic signals," is
21 that microphone array or something --

22 MR. COWELL: Objection to form.

23 THE WITNESS: That's also microphone array.
24 My apologies.

25

1 BY MS. WANG:

2 Q. Okay. I'm going to keep reading, if that's
3 okay.

4 "Using the selected denoising method to
5 generate denoised acoustic signals."

6 Microphone array or subband?

7 MR. COWELL: Objection to form.

8 THE WITNESS: Well, here, I would interpret it
9 for the subbands because really there is one main signal
10 that is being denoised.

11 BY MS. WANG:

12 Q. Okay. I'm going to keep going.

13 "Wherein the denoising method includes
14 generating a noise waveform estimate associated with
15 noise of the acoustic signals."

16 A. That's microphone array.

17 Q. Yes. Okay.

18 MR. COWELL: Objection to form on that
19 question.

20 BY MS. WANG:

21 Q. "And subtracting the noise waveform estimate
22 from the acoustic signal when the acoustic signal
23 includes denoise," blah, blah, blah. Keep going.

24 And then going down to the end of the claim,
25 starting at line 36, "use the control signals to denoise

1 the acoustic signals."

2 Is that microphone array or subband?

3 MR. COWELL: Objection to form.

4 THE WITNESS: Yeah, I would interpret it as
5 the subbands for, again, one main signal to denoise.

6 BY MS. WANG:

7 Q. What's the difference between acoustic signals
8 for the subband versus acoustic signals -- all the
9 acoustic signals coming from the microphone array?

10 A. That's a great question.

11 I think -- yeah. So I think it's -- you know,
12 especially the specific, you know, main -- the
13 specification primarily talks that they're focused on an
14 embodiment for two microphones. So one microphone, and
15 that's also another -- yeah.

16 So one microphone is the main signal, which
17 has the signal of interest corrupted by noise, and the
18 second microphone is what's maybe referred to as
19 reference microphone, which has less of the signal --
20 some signal, but mostly noise.

21 And so -- so then to the microphone array, so
22 the noise estimate involves processing all the
23 microphone -- both of the microphone signals; whereas,
24 the other plural, you know, of the subband involved in
25 your denoising -- the denoising applies mainly to a main

1 signal which has mostly the signal interest, the speech.

2 And so the denoising involves multiple signals
3 in the subband with that; whereas, the noise estimate is
4 calculated using all the microphone signals. In this
5 case, two of them. If that makes sense or not.

6 Q. I think so. Let me see if I have this
7 correct.

8 The acoustic -- when acoustic signals is
9 recited in the claim, it is your testimony that some of
10 them refer to subband acoustic signals of one singular
11 microphone because that's involved in denoising.

12 So far, do I have that right?

13 A. Yes, because the denoising involves one of the
14 signals, the main signal, which is -- which has
15 primarily the signal of interest. Yes.

16 Q. And it's also your testimony, then, that other
17 instances of acoustic signals recited in the independent
18 claims of the '543 patent refer to all of the acoustic
19 signals from the microphone array that can include
20 multiple microphones?

21 MR. COWELL: Objection to form.

22 THE WITNESS: Yeah. I think, again, the main
23 embodiment, there are two microphones; and, yes, it's --
24 and whenever there is a generation of a noise estimate
25 involved or reference to microphone signals, plural,

1 refers to the microphone array.

2 But when a denoising reference is involved,
3 which, you know, involves subtraction of the noise
4 estimates which were generated from all the microphone
5 signals, then the denoising referred to -- my
6 interpretation of the multiple acoustic signal
7 interpretation of that is the different subbands
8 because, again, there is a single main signal that has
9 been denoised, which has primarily speech or voice in
10 it.

11 BY MS. WANG:

12 Q. So is it your testimony, then, that the
13 independent claims of the '543 patent require multiple
14 subbands?

15 MR. COWELL: Objection to form.

16 THE WITNESS: Well, there is a reference to
17 multiple subbands, and so -- in Claim 1, and so when --
18 so that's -- and that's what dictates, you know, the
19 interpretation of how the acoustic signals, the plural,
20 can be unambiguously interpreted in the context of that
21 claim.

22 Again, you know, in the context of generating
23 a noise estimate when it's referred to, that involves
24 all the microphone array signal -- in this case, both of
25 them, and then going to denoising, it refers to the

1 multiple subbands because there's a single signal --
2 microphone signal that is being denoised.

3 BY MS. WANG:

4 Q. Where does Claim 1 refer to multiple subbands?

5 A. Let's see here.

6 MR. COWELL: Objection to form.

7 THE WITNESS: Yeah. Right here. It's
8 line 21.

9 "Components of the denoising subsystem" --
10 (Court reporter requested clarification.)

11 THE WITNESS: My apologies.

12 Yeah. Line 20, Column 24, "Components of the
13 denoising subsystem automatically selecting at least one
14 denoising method appropriate of data of at least one
15 frequency subband of the acoustic signals."

16 And it goes on.

17 BY MS. WANG:

18 Q. Does Claim 1 require multiple frequency
19 subbands?

20 MR. COWELL: Objection to form.

21 THE WITNESS: It does not necessarily require
22 it, but it is referring to it. And so in order for it
23 to be complete, I think the language has to refer to
24 potentially multiple subbands.

25 And that's -- and that's the way I'm

1 interpreting the meaning of the term -- you know, the
2 plural acoustic signals as you refer to in your
3 questions.

4 BY MS. WANG:

5 Q. Does the '543 patent teach denoising of all
6 the acoustic signals from the microphone array?

7 MR. COWELL: Objection to form.

8 THE WITNESS: That's a good question.

9 And if the methods taught and -- it could be
10 applied to, you know, denoising multiple signals from an
11 array, which would necessarily have more than two
12 elements in there too. But they are not necessarily --
13 they are not emphasized or in the specification or -- or
14 the specific embodiments.

15 BY MS. WANG:

16 Q. So the specific embodiments in the '543 patent
17 do not describe denoising of all the acoustic signals
18 from the microphone array?

19 MR. COWELL: Objection to form.

20 THE WITNESS: They primarily focus on the
21 first microphone signal, which is the main -- denoising
22 the first microphone signal, which has primarily signal.

23 BY MS. WANG:

24 Q. Do any of them describe -- sorry.
25 Strike that.

1 Do any of the embodiments in the '543 patent
2 describe denoising of all the acoustic signals from the
3 microphone array?

4 MR. COWELL: Objection to form.

5 THE WITNESS: I don't -- I don't think so. I
6 think the main discussion of that, the denoising and
7 algorithms, is -- yeah.

8 No. I think the primary focus is on the
9 embodiments of the two-microphone array. And it
10 involved denoising the first microphone signal.

11 BY MS. WANG:

12 Q. Okay. I just want a really clean record, and
13 then we can take a break, if that's okay with you. It's
14 going to be a long question.

15 A. It's going to be a long question?

16 Q. Well, it's -- but you'll just read along with
17 me, and I just want to confirm your testimony on the
18 interpretation of acoustic signals in Claim 1.

19 I just want it kind of all in one place.

20 A. Okay, yeah.

21 Q. If that's okay.

22 A. Actually, I could take a quick bathroom break,
23 if that's okay.

24 Q. Okay. That's fine.

25 A. It doesn't have to be ten minutes.

1 MS. WANG: It's okay. Let's do the break.
2 Let's go off the record. We'll do the break now.

3 (Recess: 10:13 a.m. to 10:26 a.m.)

4 BY MS. WANG:

5 Q. Welcome back from the break, Dr. Sayeed.

6 A. Thank you.

7 Q. Did you speak with anybody during the break?

8 A. No.

9 Q. Did you look at anything during the break?

10 A. I'm staring at Claim 1.

11 Q. Okay. Anything else other than Claim 1?

12 A. No.

13 Q. I just want to make sure my understanding is
14 correct. So I've also been staring at Claim 1. And
15 here's the question.

16 Is it your testimony that the acoustic signals
17 recited at Claim 20 -- I'm sorry. Let me restart.

18 Is it your testimony that the acoustic signals
19 recited at Column 24, lines 25 to 26, and the acoustic
20 signals at Column 24, line 36, of Claim 1 of the '543
21 patent refer to multiple subband signals of the same
22 microphone?

23 MR. COWELL: Objection to form.

24 THE WITNESS: Yes. And, you know, so just to
25 get the -- so I am writing the number that you -- those

1 are the notes I'm taking. So the first one, you said 25
2 and 26 and then 35 and 36?

3 BY MS. WANG:

4 Q. Correct -- or sorry. Just 36.

5 A. Just 36.

6 Q. Yes.

7 A. 25 and 26 and 36.

8 Well, you know, I was looking at it, and now
9 I'm not -- you know, it could be construed both ways.
10 So let me look at those again, and so this may be
11 contradicting what I said earlier, so I apologize for
12 this. I was looking at it.

13 Or at least not necessarily contradicting it,
14 but that, you know, maybe it can be construed both ways.
15 So let me look at 25 and 26 first.

16 So 20 -- 1, 2, 3, 4, 5 -- yes. Okay. So I'm
17 going to read out loud, just for my own sanity, starting
18 from 20.

19 "Components of the denoising subsystem
20 automatically selecting at least one denoising method
21 appropriate to data of at least one frequency subband
22 off the acoustic signals."

23 So that one is definitely microphone array.

24 "Using the control signals and processing the
25 acoustic signals using the selected denoising method to

1 generate the denoise acoustic signals."

2 Now, this could be both, now that I'm reading
3 it again. You know, it could be microphone signals,
4 multiple microphone signals, that we are trying to
5 denoise, or it could be, if it is construed as just
6 two-microphone array, then just the one of them, which
7 are the main signal.

8 And now I'm -- so that -- 25, 26, 27.

9 So on 25 -- I'm sorry. This may be very
10 difficult to -- yeah.

11 "The denoise" -- so I'm now reading at 25
12 again. Having to clean up this again.

13 Yeah. I'm reading it again, and I think that
14 it could be you may not need to make a distinction.

15 Q. So it's your testimony that Claim 1 and 26 of
16 the '543 patent require denoised acoustic signals where
17 those acoustic -- acoustic signals that are denoised
18 refer to all the microphone -- microphones of the
19 microphone array?

20 MR. COWELL: Objection to form.

21 THE WITNESS: The ones that you want to
22 denoise. Not necessarily all of them. Because, you
23 know, not all signals are denoised. Only, you know,
24 certain -- in the specific embodiments, there's only
25 one -- the two microphone embodiments, there is just one

1 signal that has been denoised, the first microphone
2 signal, which contains mainly the speech or voice.

3 And so -- so in 25, 26, that could -- that
4 could refer to denoising all the acoustic signals of
5 interest, and specifically one, or it could also mean,
6 you know, if you're just taking it down to
7 two-microphone array, just the subband off the main
8 signal.

9 BY MS. WANG:

10 Q. Okay. Let me see if I understand this
11 correctly, then.

12 So is it your testimony now that the acoustic
13 signals recited at Column 24, lines 25 to 26, and the
14 acoustic signals recited at Column 24, line 36, can
15 refer to either the acoustic signals of different
16 subbands of the same microphone or to acoustic signals
17 of different microphones of interest that you want to
18 denoise?

19 MR. COWELL: Objection to form.

20 THE WITNESS: You know, and that may be my --
21 you know, sorry. This is -- I think to -- let's just
22 leave it at -- leave the interpretation at, you know,
23 the other microphone array because I don't think it
24 causes any problems.

25 Oops. Sorry. Can you let me just stop it

1 real quick?

2 (Outside audio; unreported.)

3 THE WITNESS: Yeah, I would like to correct my
4 earlier testimony, and I would just say we can interpret
5 them as the microphone signals.

6 BY MS. WANG:

7 Q. Okay. So it's now your testimony that none of
8 the acoustic signals, plural, recited in any of the
9 claims of the '543 patent refer to acoustic signals of
10 different subbands?

11 A. Yes. I --

12 MR. COWELL: Objection to form.

13 THE WITNESS: Yes. I think we can refer to
14 them as any of the microphone signals that need to be,
15 you know, either denoised or -- you know, certainly, you
16 know, I want to clarify that, you know, whenever
17 multiple acoustic signals are being referred to in the
18 context of generating a noise estimate, that's
19 definitely -- noise waveform estimate, that's definitely
20 microphone array signals.

21 And even in the context of denoising, when
22 Claim 1 refers to multiple acoustic signals or the
23 plural, it could refer to the microphone -- or it is
24 referring to microphone array signals, the ones that we
25 want to denoise or maybe interested in denoising.

1 In particular, in the specifics, the -- the
2 embodiments and in the specifications, most of the
3 emphasis is on a two-microphone array, and it would
4 involve just one of them.

5 And in that context, when you just think of
6 one signal to denoise, that's where I was construing it
7 as corresponding to multiple subbands since it involves,
8 you know -- since it's plural. Plural.

9 So as much as it may sound confusing, it's
10 not, I think, if you construe it, interpret it, in the
11 right way.

12 BY MS. WANG:

13 Q. So is it fair to say that it is your opinion
14 that some instances of the acoustic signals recited in
15 Claims 1 and 26 of the '543 patent refer to all
16 microphone signals from the microphone array, and other
17 instances of the acoustic signals recited in Claims 1
18 and 26 of the '543 patent only refer to the microphone
19 signals from the microphone array that are to be
20 denoised?

21 MR. COWELL: Objection to form.

22 THE WITNESS: Yes, but there is a direct way
23 of distinguishing them. Let's also put it in the
24 record.

25 And the ones -- the ones which refer to

1 generating a noise estimate are, you know, definitely
2 all the microphone array signals.

3 And then the ones referring to denoising the
4 signal refer to the subset of microphone array signals
5 that you need to denoise or are interested in denoise,
6 which contain -- which are the signal of microphone
7 which mainly -- or contains strong speech to start with.
8 In this case -- in the specific embodiments, that will
9 be the first microphone of the two-microphone array.

10 So I don't think there's a -- there's a
11 confusion here, as it may seem -- it may seem; but, to
12 me, there's no confusion, and I think I want to make the
13 record to reflect that.

14 I'm sorry. I'm frozen again, so I'm going to
15 try to unfreeze.

16 BY MS. WANG:

17 Q. Is it your testimony today -- now that we've
18 been through this several times now, is it your
19 testimony today that any of the acoustic signals recited
20 in Claims 1 and 26 of the '543 patent can refer to
21 different acoustic signals of different subbands of the
22 same microphone?

23 MR. COWELL: Objection to form.

24 THE WITNESS: The only place -- the only time
25 where -- you know, where I would interpret that way is

1 if I were reading Claim 1 specifically for
2 two-microphone array, and I wanted to make sense of, you
3 know, strictly what those acoustic signals, plural,
4 refer to in the context of denoising.

5 That was my initial interpretation when I
6 looked at that. And that would be the only time.

7 But I think, in the general context of this
8 patent where there could be more than two microphones, I
9 think the best way of interpreting it is that, when it
10 refers to generating a noise estimate, a noise waveform
11 estimate, it is referring to all the microphone signals,
12 whenever the plural is encountered; whereas, when it
13 refers to denoising, a plural response to those
14 microphone signals that we may be interested in
15 denoising.

16 And specifically for the embodiments, that's
17 typically one main microphone signal.

18 BY MS. WANG:

19 Q. What does "associated with" mean?

20 MR. COWELL: Objection to form.

21 THE WITNESS: Associated with?

22 BY MS. WANG:

23 Q. Mm-hmm.

24 A. That's what it means. That's -- corresponds
25 to whatever we are referring to or in association

1 with -- I mean, if you can give me a little more
2 context, I could give you a better answer.

3 Are you referring to anyplace in particular?

4 Q. What does "based on" mean?

5 MR. COWELL: Objection to form.

6 THE WITNESS: You know, that it uses that
7 information, whatever it's based on. Again, something
8 more specific, I could give you a little more.

9 BY MS. WANG:

10 Q. Is there a difference between "associated
11 with" and "based on"?

12 MR. COWELL: Objection to form.

13 THE WITNESS: I -- thinking of just by
14 themselves, that's hard for me to answer that question,
15 "associated with," "based on."

16 You know, "associated with" would be a
17 relationship which goes both ways; whereas, "based on"
18 is going one way that something is based on the other.
19 In a general context.

20 BY MS. WANG:

21 Q. Is it fair to say, then, that "based on" is
22 narrower than "associated with"?

23 MR. COWELL: Objection to form.

24 THE WITNESS: I think that's fair to say.
25 Maybe. I mean, that's so general that I -- yeah.

1 BY MS. WANG:

2 Q. I'm just asking because, in your previous
3 answer, you said "associated with" is a relationship
4 that goes both ways.

5 A. Or could go both ways. Yeah, I'm trying to do
6 my best here --

7 Q. Right.

8 A. -- doing linguistics.

9 Q. And based on -- and also in your prior answer,
10 you had said "based on" is one way because something is
11 based on something else.

12 So I was going off of what you had said. And
13 it sounds like, to me, based on your previous answer,
14 that it's -- it's your opinion, then, that "based on" is
15 narrower than "associated with" because it only goes one
16 way.

17 Do I have that correct?

18 A. Yes. But --

19 MR. COWELL: Objection to form.

20 THE WITNESS: But I would appreciate a little
21 context for this because, you know, I think it's -- it's
22 too general. And I don't know what you are trying to
23 get at or what is the significance to this testimony
24 here.

25

1 BY MS. WANG:

2 Q. In order to calculate X based on Y, does --
3 sorry. Strike that.

4 In order for a system to calculate X based on
5 Y, does the system have to know what Y is?

6 MR. COWELL: Objection to form.

7 THE WITNESS: Would you repeat the question to
8 make sure -- in order for --

9 BY MS. WANG:

10 Q. In order -- yeah. I'll just read it again.

11 In order for a system to calculate X based on
12 Y, does the system have to know Y?

13 A. In order for --

14 MR. COWELL: Objection to form.

15 THE WITNESS: -- something to -- X based --
16 calculate X based on Y, does the system have to know Y?

17 I can't believe this question. You know, this
18 is a -- you know, so I'm going to give you an as --
19 generic answer. You know, I'll tell you this -- sorry.
20 Not generic answer.

21 But that's a -- again, I'm finding it hard to
22 find the relevance because there are -- this comes up in
23 secure communications where functions are calculated
24 without really knowing the depth.

25 So privacy in the context -- this is some word

1 of the art -- state-of-the-art computation to do really
2 anonymous computations. So in that context, maybe. But
3 generally, we do need to -- if we want to apply the
4 function, you do need to know -- or if you want to
5 compute something based on something else, you do need
6 to know what you're manipulating.

7 So I'm really at a complete loss in terms of
8 why we're being so cryptic in terms of these questions.
9 Or what are we getting at?

10 BY MS. WANG:

11 Q. Do you have an understanding of how a
12 microphone works?

13 A. I think so.

14 Q. Can you explain how a microphone works?

15 A. Okay. A microphone works by, you know, the --
16 turning the acoustic -- or at a basic level, turning the
17 acoustic vibration, or the sound signals, into
18 electrical signals. That is receiving input -- you can
19 think of it as the sound signal, the pressure wave,
20 going into electrical signal.

21 Q. What is the difference between acoustic
22 vibration of a sound signal and the corresponding
23 electrical signal that it's turned into?

24 MR. COWELL: Objection to form.

25 THE WITNESS: Again, you know, we could go on

1 the differences until the cows come home, but it's a
2 representation of the pressure signal. So it's
3 turning -- it's just representing that in terms of an
4 electrical signal.

5 It's an -- in some ways, you know, pressure
6 waves could just be described as any -- as a number or
7 whatever or some physical quantity, and it's turning it
8 into an actual measurable electrical signal.

9 BY MS. WANG:

10 Q. Do you have the Andrea reference in front of
11 you?

12 A. Yes, I do.

13 Q. Exhibit 1005, is that what you're looking at?

14 A. Yes.

15 Q. Do you mind turning to Figure 4?

16 Do you have Figure 4 in front of you,
17 Dr. Sayeed?

18 A. Yes.

19 Q. You've seen this figure before?

20 A. Yes, I think so. Yeah, I have.

21 Q. Are there microphones in this figure?

22 MR. COWELL: Objection to form.

23 And if you need to review the reference,
24 Dr. Sayeed, feel free to do so.

25 THE WITNESS: Yeah. I think I see two

1 microphones listed there, but let me just -- Mic 12 and
2 Mic 14, but let me just verify that real quick.

3 Yeah. So I think the Mic 12 and Mic 14 which
4 are listed there, those are the microphones in this
5 schematic.

6 BY MS. WANG:

7 Q. Is one of these microphones being used as a
8 reference microphone?

9 A. Yes, I think the -- what do you mean,
10 "reference microphone"?

11 Q. Reference or noise microphone?

12 A. Yeah. I think that's 14. Mic 14.

13 Q. So looking at Mic 14, do you see the
14 Element 208?

15 A. Yes.

16 Q. What is Element 208?

17 A. That's a resistor, and it's a variable
18 resistor, which I believe they use to calibrate the gain
19 off this microphone.

20 Q. What does it mean to calibrate the gain of a
21 microphone?

22 A. Well, that may be -- maybe I should -- I
23 should just leave it at 14. Forget that I said that.
24 Can I strike that?

25 Q. I'm not sure. I don't -- I don't think so.

1 A. Okay. All right.

2 Q. But I can re-ask the question, and then you

3 can provide another answer.

4 A. Okay. Okay.

5 Q. What is Element 208?

6 A. It's a resistor. It's a variable resistor,

7 you know, so based on the pointer, it can change the

8 value of the resistance that's being used.

9 Q. Did you say "based on the pointer"?

10 A. Yeah. You see the pointer that's -- the arrow

11 that's connecting in the middle of 208? Yeah, that --

12 so it's a variable resistor, so that arrow could be a

13 little bit to the left or a little bit to the right to

14 kind of change the amount of resistance that's actually

15 coming into it. That's, I think, discussed in the --

16 this section of the specification as well.

17 Q. And as the amount of resistance is changed,

18 what -- do you have an understanding of what that does

19 to the signal coming out of the Microphone 14?

20 A. Yes. It just changes the amplitude of that

21 signal, the size or strength of that signal.

22 Q. Can you explain how it changes the amplitude

23 of the signal?

24 A. Well, it's, you know, how much voltage is

25 being dropped across the resistor. So I think you can

1 calculate -- I mean, that's division of -- you know, if
2 I look at this circuit, the total amount of voltage
3 that's across that resistor -- and depending on where
4 the pointer is, it will pick up a certain value between
5 a minimum and a maximum. So there's a voltage dividing
6 network based on that resistor.

7 Q. What causes the pointer to move up and down?

8 A. Well, we adjust it. Somebody will be
9 adjusting it.

10 Q. Is that adjusted through the voltage at 198?

11 MR. COWELL: Objection to form.

12 THE WITNESS: I have to look at -- let me
13 just -- no. Voltage at 198 I think is -- that's -- I
14 have to -- let me just make sure. Let's see if we can
15 read this specifically. I'm referring to the
16 description of Andrea in my declaration.

17 BY MS. WANG:

18 Q. Do you have a certain paragraph you're looking
19 at just so I can keep up with you.

20 A. I'm starting with paragraph 58 and scanning
21 through it.

22 Q. Yes.

23 A. It seems like on Column 15 it's discussing it.
24 Yeah. It's -- so, you know, from 29 -- so Exhibit 1005,
25 Column 15, lines 29 to 38, discuss this. And so I'm

1 going to read from 29.

2 "The limiting resistor 208 is preferably a
3 variable current-limiting resistor which enables the
4 level of the output signal from the second microphone to
5 be matched to within a predetermined value to the level
6 of the output signal of the first Microphone 12. More
7 specifically, the limiting resistor 208 enables the
8 output signal off the second Microphone 14 to be
9 weighted such that, when a signal having a similar level
10 is outputted from the first Microphone 12, the amplitude
11 of the difference there between is minimized."

12 So that's -- yeah. So that's the best
13 interpretation of the calibration that I inadvertently
14 referred to earlier. That's the levels of the output of
15 the two microphones to the same kind of input.

16 Q. So is it fair to say that the variable
17 resistor 208 in Andrea is applying a calibration gain to
18 Microphone 14?

19 A. Yes.

20 MR. COWELL: Objection to form.

21 THE WITNESS: It is like multiplying by a
22 constant. Multiplying the signal of the microphone
23 that's numbered --

24 BY MS. WANG:

25 Q. Why --

1 I'm sorry. Were you done?

2 A. Yeah.

3 Q. Why do calibration?

4 MR. COWELL: Objection to form.

5 THE WITNESS: Well, the simplest answer is --
6 I don't know if you want -- you know, in Andrea, noise
7 cancellation is basically done by subtracting the signal
8 from Mic 14 from the main microphone. And so you want
9 to -- the goal is to minimize or to move the noise as
10 much as possible.

11 So the whole goal of the calibration is so
12 that the noise coming out of the microphone, the
13 reference microphone, is as close in amplitude to the
14 noise corrupting the main microphone so that it can be
15 cancelled.

16 BY MS. WANG:

17 Q. The main microphone here is Microphone 12?

18 A. Yes.

19 Q. Why is the resistor 208 variable?

20 A. So that actually can change that value of the
21 gain, which is applied to Microphone 12. That's --
22 that's how the variable is computed.

23 Q. And why would the value of the gain need to be
24 changed?

25 A. Well, that's what I thought I just explained,

1 so that it's -- so that it's as close as possible so
2 that the noise that you're subtracting is as close as
3 possible to the noise amplitude in the main microphone
4 so that your noise cancellation works as well as
5 possible.

6 Q. So is it fair to say that, in Andrea, the
7 value of the variable resistance 208 is tuned up and
8 down in order to align as closely as possible with the
9 noise present in the main Microphone 12?

10 MR. COWELL: Objection to form.

11 THE WITNESS: Well, you know, I don't think
12 it's automatically tuned or anything. This is more like
13 you fix the position of the microphone and then you kind
14 of fix that value. Doesn't -- if you look at Figure 4
15 that you referred to, there is no -- it's just an
16 element there and -- and its value is, you know -- or
17 given configuration of the mics, its value is set.

18 So it's not like it's an automatic gain
19 control or anything like that as part of the circuit.
20 So it's more manual tuning, if you will. It's not some
21 automatic adjustment or algorithm.

22 BY MS. WANG:

23 Q. Sure.

24 So is it fair to say that, in Andrea, the
25 value of the variable resistance 208 is manually tuned

1 in order to align as closely as possible with the noise
2 present in the main microphone, 12?

3 MR. COWELL: Objection to form.

4 THE WITNESS: I don't know if that's -- you
5 know, that's the goal, the noise. And as I read,
6 it's -- you know, you can't -- you know, you have to
7 remember that both of these microphones will have some
8 signal and noise, even though Andrea kind of assumed
9 that there's mostly noise and can't really separate the
10 two.

11 So the best that the calibration can do is to
12 have the same level of the overall signal that's coming
13 into the microphone. And that's what, you know, is
14 described in the earlier columns 30 -- you know, that I
15 read from Andrea. Column 12 and 15.

16 BY MS. WANG:

17 Q. Is it fair to say that, in Andrea, the value
18 of the variable resistance 208 is set so that the noise
19 aligns as closely as possible with the noise present in
20 the main microphone, 12?

21 MR. COWELL: Objection. Form.

22 THE WITNESS: That's -- I think it's accurate
23 to say that's what we would like to do. But as I stated
24 in 62 -- paragraph 62 of my declaration, you know,
25 "Prior to the subtraction of the signal from the second

1 microphone from the signal in the first microphone to
2 create the denoised signal, Andrea matches the level of
3 the output signal of the second microphone to the level
4 of the output signal of the first microphone.

5 "This is done to reduce the amplitude of the
6 difference between the output level of the microphone to
7 improve noise suppression."

8 So, again, the goal is noise suppression and,
9 as you said, to match as closely as possible the noise
10 levels. But in reality, since both mics would have
11 signals plus noise and you can't really separate the
12 two, the electrical signal, the best you can do is to
13 match the level of what the two microphones are
14 outputting, and that's what the resistors and adjuster
15 can do.

16 BY MS. WANG:

17 Q. Is it fair to say that, in Andrea, the value
18 of the variable resistance, 208, is set so that the
19 level of Microphone 14 aligns as closely as possible
20 with the main microphone, 12?

21 A. Yes, that's correct.

22 Q. So this signal -- going back to just the
23 Figure 4 in Andrea, the signal coming out of
24 Microphone 14, once its level is adjusted using the
25 variable resistor 208, is there any other modification

1 that occurs on the signal before it is received by the
2 op-amp 16?

3 A. Well, that's the main one, I think, other than
4 the -- if you look at 14, the capacitor and other
5 resistor -- and you know, that other resistor is --

6 (Court reporter requested clarification.)

7 THE WITNESS: My apologies.

8 No, it doesn't change in any material fashion.
9 If you look at Figure 4, you know, from the point --
10 from the variable resistor 208, the capacitor and
11 resistor, before it goes into the op-amp -- and the
12 resistor is part of the, you know, voltage --

13 (Court reporter requested clarification.)

14 THE WITNESS: -- the divider network. And the
15 capacitor just blocks DC. So that's the only other
16 change so -- yeah, so nothing material is admitted or
17 goes into the op-amp.

18 BY MS. WANG:

19 Q. Is it fair to say that the amplitude of the
20 microphone signal out of 14 in Andrea changes before and
21 after the variable resistor 208?

22 A. Can you repeat the question?

23 Q. Is it fair to say that the amplitude of the
24 microphone signal out of Mic 14 in Andrea changes before
25 and after the variable resistor 208?

1 MR. COWELL: Objection to form.

2 THE WITNESS: I don't -- I think that the
3 question is a little bit -- you know, I have to pause at
4 what it even means.

5 So the amplitude of the microphone signal by
6 itself is -- so there will be certain amplitude coming
7 out of the microphone. That's not going to change.
8 It's part of the circuit. And so, you know, that
9 pointer is tapping that signal off at a certain point,
10 and that will change, or much of that amplitude you're
11 passing into the op-amp.

12 So microphone's signal -- microphone output is
13 not changing. It's how much of that signal are you
14 feeding into the negative input of the op-amp. That's
15 what change means by adjusting the value of the variable
16 that is listed.

17 BY MS. WANG:

18 Q. Okay. So let me see if I can rephrase.

19 Is it fair to say that the amplitude of the
20 electrical signal on either side of the variable
21 resistor 208 is different?

22 A. Is amplitude on either side different? Yes.
23 That's -- you know, absolutely. There's a voltage drop
24 across the resistor. So if you -- if I interpret your
25 question correctly, if I measure the voltage at the

1 bottom of the resistor or the top of the resistor, they
2 are different, and the difference would be how the
3 voltage is dropped across the resistor. And -- and then
4 the pointer is tapping that voltage somewhere in
5 between.

6 So, yes. You know, that is correct, and
7 it's -- in some ways represent the minimum and maximum
8 values that can be fed into the op-amp.

9 Q. So the amplitude of the signal immediately --
10 well, sorry. Strike that.

11 The amplitude of the electrical signal
12 immediately after the Microphone 14 versus the
13 electrical signal at the pointer, those are two
14 different amplitudes, correct?

15 A. Yes.

16 MR. COWELL: Objection to form.

17 THE WITNESS: Yes. Again, I mean, I don't
18 know what's the relevance of it, and I'm trying to
19 answer a question as best as possible even though, you
20 know, it's kind of hard for me to parse them.

21 MS. WANG: I think we can take one more break,
22 Dr. Sayeed, and then we should be able to wrap this up.

23 THE WITNESS: All right. Thank you.

24 MS. WANG: So let's go off the record.

25 (Recess: 11:12 a.m. to 11:24 a.m.)

1 BY MS. WANG:

2 Q. Welcome back, Dr. Sayeed.

3 A. Thank you.

4 Q. Did you speak with anybody during the break?

5 A. No.

6 Q. Did you look at anything during the break?

7 A. No.

8 Q. What did you do during the break?

9 A. I took a rest.

10 Q. Okay.

11 A. Took a short nap. No, I'm just kidding. Just
12 chilled.

13 Q. Before the break, we were talking about
14 Figure 4 of Andrea.

15 Do you recall?

16 A. Yes.

17 Q. Looking at Figure 4 of Andrea, does the
18 frequency content of the signal output by the microphone
19 change along the path to op-amp 16?

20 MR. COWELL: Objection to form.

21 THE WITNESS: The frequency content of
22 Microphone 14?

23 BY MS. WANG:

24 Q. Does the frequency content of the electrical
25 signal change as it traverses the path to op-amp 16?

1 A. From where? From Microphone 14?

2 Q. Yes. Starting from Microphone 14 and going
3 all the way to the negative terminal of the op-amp 16?

4 A. Yes. Yeah. So I think that's where the
5 capacitor is coming into play. So it's a -- essentially
6 it's a high-pass filter, so it's blocking out any DC.
7 Mainly it's blocking out any direct -- you know, any DC
8 value, and it's only passing non-zero, higher
9 frequencies.

10 So, you know, there will be a little bit. It
11 will emphasize high frequencies and block out lower
12 frequencies. But mainly its aim is to block DC, any
13 direct constant voltage, and then it will remove it. So
14 some frequency content will be changed, but mainly to
15 preserve the non-zero frequencies.

16 Q. So is it fair to say that the signal received
17 at the minus terminal of op-amp 16 has higher frequency
18 content than the signal output by Microphone 14?

19 MR. COWELL: Objection to form.

20 THE WITNESS: No. I think a better -- the
21 highest frequency content is the same. It's more that
22 there may be some content in the lower frequency,
23 especially at DC, the zero frequency at the output of
24 Microphone 14, which is blocked out as it -- after it
25 passes the capacitor.

1 BY MS. WANG:

2 Q. Okay. Let me see if I can get this.

3 Is it fair to say that the signal received at
4 the minus terminal of the op-amp 16 has a higher
5 lowest-frequency content compared to the signal output
6 by Microphone 14?

7 A. Highest low frequency?

8 Yeah. That's -- that is fair to say, I guess.
9 Yeah.

10 Q. And that's because the capacitor --

11 A. Yes.

12 Q. -- along that signal path operates as a
13 high-pass filter to remove slow frequency content from
14 the microphone signal?

15 A. Predominantly the DC. I mean, there's no
16 value here. There is no really standard thing to block
17 any DC values like constant voltage to put a capacitor
18 in the circuit. So the main purpose of this is to block
19 any DC.

20 And so, yes, at the output of the microphone,
21 there will be even, you know, signals going all the way
22 to DC, which is zero frequency; whereas, at the input of
23 the op-amp after it had gone through the capacitor,
24 there will be no DC value.

25 And so the lowest frequency content is

1 higher than the input of the op-amp compared to the
2 output of the microphone.

3 Q. Let's go back to Claim 1 of the '543 patent.

4 A. Okay.

5 Q. Let me know when you have it in front of you.

6 A. I have it in front of me.

7 Q. Turning to Column 24, line 32. Do you see the
8 phrase "a sensor independent from the microphone array"?

9 A. Yes.

10 Q. What's your understanding of "a sensor
11 independent from the microphone array"?

12 A. Well, that's -- my understanding is that is
13 the sensor that's part of the VAD, nonacoustic sensor in
14 '543. So -- so in particular, in Figure 2, for example,
15 the VAD device, if you will -- I'm sorry, Figure 1A, you
16 know, 140 would be the closest to that.

17 Q. Is it your testimony that this sensor
18 independent from the microphone array has to be a
19 nonacoustic sensor?

20 MR. COWELL: Objection to form.

21 THE WITNESS: Well, I think, based on the, you
22 know, specification and the reason, the motivation for
23 it, yes, it would be -- at the very least, it has to be
24 independent from the microphone array, which is being
25 used to -- you know, the signals that we collected which

1 are then being denoised and so on and so forth.

2 (Court reporter requested clarification.)

3 THE WITNESS: Processed and denoised and so on
4 and so forth. So certainly dependent from that and
5 based on the specification and motivation, yes, it will
6 have -- very likely to be nonacoustic.

7 BY MS. WANG:

8 Q. So the sensor independent from the microphone
9 array in the claims of the '543 patent cannot be
10 microphones?

11 A. Actually, I take that back. I take it back.
12 I think the -- my understanding is that the main
13 motivation here is that, you know, it's hard to detect
14 unvoiced speech from the microphone signals, especially
15 when there is noise, background noise. And so we need a
16 sensor which can accurately detect unvoiced speech.

17 And so all the examples of embodiments
18 discussed in the patent are nonacoustic. But that
19 doesn't necessarily preclude, you know, technological
20 developments from focusing on unvoiced speech, and maybe
21 there is an acoustic version too which could do a good
22 job.

23 So I can't preclude it entirely, but the
24 specifications and the specific embodiments are all
25 nonacoustic, as far as I can tell.

1 Q. Are you saying the specific embodiments are
2 not all nonacoustic sensors for detecting unvoiced
3 speech?

4 A. That's the motivation. You know, that --
5 that's what is meant for both voiced and unvoiced. That
6 is what you need to detect, but microphones have a hard
7 time detecting unvoiced speech because of background
8 noise. That's one of the motivations.

9 Q. Would you agree that, in order for a sensor to
10 be independent from the microphone array, that means
11 that the sensor can work with any microphone
12 configuration?

13 MR. COWELL: Objection to form.

14 THE WITNESS: Can you repeat the question
15 again, please?

16 BY MS. WANG:

17 Q. Would you agree that, in order for a sensor to
18 be independent from the microphone array, that means
19 that any sensor can work with any microphone
20 configuration?

21 A. No, can't be any sensor. No, it has to be a
22 sensor which is -- which serves the purpose of a VAD,
23 and it has to be independent of the -- distinct from --
24 independent of the microphone array which are collecting
25 the acoustic signals.

1 Q. So the sensor has to be a VAD sensor that is
2 different from the microphone array?

3 MR. COWELL: Objection to form.

4 THE WITNESS: So you asked me -- so we are
5 deferring to which line again?

6 BY MS. WANG:

7 Q. Sensor independent from the microphone array
8 is in Column 24, lines 32 to 33.

9 A. 32. Oh, sorry.

10 You see the voice -- yeah. Yes, it's part
11 of -- part of the VAD device system independent from
12 microphone array.

13 Q. So your -- it's your testimony that the sensor
14 has to be a VAD sensor that is different from the
15 microphone array?

16 MR. COWELL: Objection to form.

17 THE WITNESS: Well, I'm just reading -- if
18 that's the interpretation, yes. "Wherein the voice
19 detection subsystem is configured to receive the voice
20 activity signals using a sensor independent from the
21 microphone array."

22 It's -- that sensor from the microphone array,
23 as far as I can tell, yes, is part of the VAD system.

24 BY MS. WANG:

25 Q. What is your understanding of "independent

1 from"?

2 MR. COWELL: Objection. Form.

3 THE WITNESS: That it cannot be -- it has to
4 be a signal or a sensor which is -- you know, that's not
5 part of the microphone array. And -- and it's also
6 collecting information which is different and
7 independent; in particular, that it is able to
8 compensate for the limitations of the microphone array,
9 especially in terms of voice activity detection and
10 which in turn refers to the distinction of being
11 voice/nonvoice speech as we have discussed, or I have
12 discussed.

13 BY MS. WANG:

14 Q. Would you agree that, in order for a
15 microphone configuration and a VAD to be independent,
16 that means that any microphone configuration can work
17 with any VAD?

18 MR. COWELL: Objection to form.

19 THE WITNESS: I think that's a very -- you
20 know, I don't -- "any microphone configuration can work
21 with any VAD"...

22 Not necessarily, no. I don't -- I think
23 it's -- that's too broad because, you know, you could
24 have a microphone configuration which is, you know, not
25 paving the signals the way you want. I believe the

1 desire to be -- so, no, that doesn't mean that. It's
2 not that broad.

3 BY MS. WANG:

4 Q. Do you have an understanding of the difference
5 between analog and digital processing?

6 A. I think so.

7 Q. Can you explain that difference?

8 A. How much time do we have?

9 Q. Not much time.

10 A. Okay. Good. No.

11 Analog is -- you know, most natural signals
12 are and all continuous -- that's the best way of
13 describing it, like speech signals. And digital signals
14 are, you know, when you discretize them so that you can
15 store them on a computer, a process on a computer so
16 it's a sample then in time. So you take samples at
17 distinct intervals, for example, every second or
18 millisecond.

19 And then you also quantize or digitize the
20 amplitude because the value could be a real number,
21 which can be any -- you know, even though there's a lot
22 of decimal places. So typically how many bits do you
23 need to represent that number; four, five, six, seven,
24 eight?

25 So digitizing in time and also in amplitude in

1 terms of levels. So those are continuous to discrete
2 levels in time and amplitude, if you will.

3 Q. And subtraction between two signals occur in
4 the analog domain?

5 A. Yes. Absolutely. That's what an op-amp, for
6 example, does.

7 Q. Can subtraction between two signals occur in
8 the digital domain?

9 A. Yes.

10 Q. Is it your opinion that the claims of the '543
11 patent -- sorry. Strike that.

12 Is it your opinion that the independent claims
13 of the '543 patent require calculation in the digital
14 domain?

15 MR. COWELL: Objection to form.

16 THE WITNESS: Can you repeat that question
17 again?

18 BY MS. WANG:

19 Q. Is it your opinion that the independent claims
20 of the '543 patent require calculation in the digital
21 domain?

22 A. That's a good question. I'm trying to think.

23 Well, you know, I think it's kind of a
24 nuanced -- yeah, it's a tricky question. It's not a
25 trick question, but it's a very interesting question.

1 I think, based on the specifications and how
2 it's described, yes, you know, for notations and so on.
3 Yet, the basic principles that are being taught in the
4 patent don't necessarily limit it to --

5 (Court reporter requested clarification.)

6 THE WITNESS: -- a digital implementation.
7 The basic concept or teaching of the patent could
8 potentially admit an analog implementation as well.

9 And, for example, there's something called
10 optical computer. You know, that's completely separate;
11 but, you know, they are very different from digital
12 computer.

13 But I'll leave it at that.

14 BY MS. WANG:

15 Q. So it's your testimony that the independent
16 claims of the '543 patent do not require any calculation
17 to occur in either the analog or digital domains?

18 MR. COWELL: Object to form.

19 THE WITNESS: Well, I think I should -- I
20 think the simplest, most direct interpretation is that
21 it is implemented in the digital domain.

22 So I was just saying that, you know, you
23 could, if you really wanted to -- you know, a POSITA
24 with -- yeah, you could implement it in the analog
25 domain too, but most of the description is applicable to

1 implementation in the digital domain.

2 BY MS. WANG:

3 Q. So your testimony is that the scope of the
4 independent claims of '543 patent are broad enough to
5 encompass calculation occurring in either the analog or
6 digital domain?

7 MR. COWELL: Objection to form.

8 THE WITNESS: Yeah, I think the basic concepts
9 are -- and the teachings would apply in both contexts.

10 MS. WANG: I have no further questions.

11 So I'll pass the witness.

12 MR. COWELL: I have no questions.

13 COURT REPORTER: Counsel, may I get transcript
14 requests on the record, please?

15 MS. WANG: I mean, I'd like expedited. Next
16 day, if possible.

17 COURT REPORTER: And your rough draft today.

18 MS. WANG: Yes.

19 MR. COWELL: I'll take a rough and normal
20 delivery.

21 (Whereupon the proceedings concluded at
22 2:48 p.m.)

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ERRATA SHEET
NAME OF CASE: META PLATFORMS, INC. V. JAWBONE
INNOVATIONS, LLC
DATE OF DEPOSITION: SEPTEMBER 16, 2024
NAME OF WITNESS: DR. AKBAR M. SAYEED, PH.D.

Reason Codes:

- 1: To clarify the record.**
- 2: To conform to the facts.**
- 3: To correct transcription error.**

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DR. AKBAR M. SAYEED, PH.D.	DATED

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DR. AKBAR M. SAYEED, PH.D.	DATED
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DECLARATION UNDER PENALTY OF PERJURY

I, DR. AKBAR M. SAYEED, PH.D., do hereby
certify under penalty of perjury that I have read the
foregoing transcript of my deposition taken on
September 16, 2024; that I have made such corrections as
appear noted on the Deposition Errata Page(s), attached
hereto, signed by me; that my testimony as contained
herein, as corrected, is true and correct.

This Declaration is executed this _____ day
of _____, 20____, at _____,
California.

DR. AKBAR M. SAYEED, PH.D.

STATE OF CALIFORNIA)
) ss.
)

**I, Tamara Houston, RPR, CCRR, CSR No. 7244, a
Certified Shorthand Reporter in the State of California,
duly empowered to administer oaths, do hereby certify:**

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

That said deposition was taken down by me in shorthand at the time and place therein named, and thereafter reduced to typewriting by computer-aided transcription under my direction;

That the dismantling, unsealing, or unbinding of the original transcript will render the reporter's certification null and void.

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

In witness whereof, I have hereunto subscribed my
name.

Dated: 16th of September, 2024.

Gamara L. Houston

TAMARA L. HOUSTON
CSR 7244, RPR, CCRR 140

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