

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

META PLATFORMS, INC.,)
)
 Petitioner,)
)
 vs.)
)
 JAWBONE INNOVATIONS, LLC,)
)
 Patent Owner.)
 _____)

CERTIFIED COPY

No. IPR2023-01084
No. IPR2023-01128
U.S. PATENT NO. 8,321,213
U.S. PATENT NO. 8,326,611

DEPOSITION OF
AKBAR M. SAYEED, Ph.D.
VIA VIDEOCONFERENCE
JULY 17, 2024

Reported by:
LINDSAY JAGICH,
CSR NO. 13889
JOB NO. 24-137973

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Petitioner,	)	
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vs.	)	No. IPR2023-01084
	)	U.S. PATENT NO. 8,321,213
JAWBONE INNOVATIONS, LLC,	)	U.S. PATENT NO. 8,326,611
	)	
Patent Owner.	)	
	)	

DEPOSITION OF AKBAR M. SAYEED, Ph.D.,
a witness herein, taken on behalf of the
Petitioner VIA VIDEOCONFERENCE, at 9:01
a.m. Central Daylight Time on Wednesday,
July 17, 2024, before Lindsay N. Jagich,
CSR No. 13889.

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I N D E X

EXAMINATION BY:

PAGE

MS. WANG

5

EXHIBITS

(None)

1 AKBAR M. SAYEED, Ph.D.,
2 a witness herein, having been sworn, was examined and
3 testified as follows:

4 THE WITNESS: Yes, I do.

5 THE REPORTER: Thank you.

6 THE WITNESS: Thank you.

7 ///

8 -EXAMINATION-

9 BY MS. WANG:

10 Q Good morning, Dr. Sayeed. It's nice to see you
11 again.

12 A Good morning, Grace. Good to see you.

13 Q We didn't read our appearances into the record,
14 but my name is Grace Wang with the firm Paul Hastings,
15 representing Meta, petitioner in these IPR proceedings;
16 and with me today are Associate Ingrid Kao and Summer
17 Associate Alia Basar.

18 Dr. Sayeed, can you please state and spell your
19 full name for the record.

20 A Yes. My first name is Akbar, A-K-B, as in boy,
21 A-R; my middle name is Muhammad, M, as in Mary,
22 U-H-A-M-M-A-D, as in David; and my last name is Sayeed,
23 S, as in Sam, A-Y-E-E-D, as in David.

24 Q Thank you.

25 And where are you sitting today?

1 It looks like the same place as last week.

2 A Yes. I am in my home office in Madison,
3 Wisconsin.

4 Q Thank you.

5 And last week was your first deposition?

6 A Yes.

7 Q Is today your second deposition?

8 A Yes, yes.

9 Q Okay. So you haven't -- you haven't been
10 deposed since last week?

11 A No, thank God.

12 Q Do you have any papers in front of you,
13 Dr. Sayeed?

14 A Yes, I do have -- let me give you -- so I just
15 have the hard copies of the table of contents of my
16 declarations for '213 and '611; and then table of
17 contents for the petitions for '213, '611; and the table
18 of contents for Dr. Kenny's declarations; and then I have
19 hard copies of some of the patents, Avendano and Visser,
20 in particular; and I have hard copies of the first four
21 pages of '213 and '611; and the -- the hard copies of the
22 claims in the two patents, '213 and '611, and that's
23 about it.

24 And then I have, you know, the corresponding
25 documents open in three different PDF windows, Adobe

1 windows, and none of them have any markings or anything.
2 They are clean.

3 Q Okay. So there are no markings or annotations
4 on any of the papers?

5 A No.

6 Q Thank you.

7 And there are no markings or annotations on any
8 of the PDF's that are open on your screen?

9 A Yes, there are no markings there. Yeah. The
10 original is clean.

11 Q And on your computer or device that you're using
12 to do this deposition, are there any other applications
13 or programs open other than the Zoom and the PDF's?

14 A No, I just had a browser open. I just closed
15 it, so nothing else is open.

16 Q Thank you.

17 At any point during the deposition, if you do
18 end up having another program or application open, will
19 you please let us know.

20 A Yes, I will.

21 Q And if you do have another piece of paper that
22 you discover is in front of you, can you please let us
23 know.

24 A Yes, I will.

25 Q Okay. So we've been -- we've just been through

1 this, but I'm still going to go through the ground rules
2 if that's okay.

3 So we have a court reporter transcribing the
4 deposition, so let's try not to talk over each other.

5 Is that okay?

6 A Yes.

7 Q If you do not understand a question that I ask,
8 please do ask, and I will try to clarify the question.

9 Is that okay?

10 A Yes.

11 Q And that way if you do provide an answer to a
12 question that I ask, then we will all know that you
13 understood the question that was asked.

14 Is that okay?

15 A Yes.

16 Q We're going to take breaks about once an hour or
17 so. If -- but if you need a break at any other time,
18 just let us know.

19 Is that okay?

20 A Yes.

21 Q I just ask that if there's a pending question,
22 that you provide an answer to that pending question, and
23 then we can do the break.

24 Is that okay?

25 A Yes.

1 Q Is there anything that would prevent you from
2 testifying completely, truthfully, and accurately today?

3 A No.

4 Q Are you on any medications that would prevent
5 you from providing complete, accurate, truthful testimony
6 today?

7 A No.

8 Q And is there anyone else in the room with you
9 right now?

10 A No.

11 Q So, Dr. Sayeed, you understand that you are here
12 to testify about your opinions in two proceedings?

13 A Yes.

14 Q And the first proceeding is IPR2023-01084
15 regarding U.S. Patent 8,321,213; is that right?

16 A Yes.

17 Q And the second proceeding is IPR2023-01128
18 regarding U.S. Patent 8,326,611?

19 A Yes.

20 Q And today -- you already said this in one of
21 your answers before, but I'll just refer to the patents
22 as "the '213 patent" and "the '611 patent" if that's
23 okay.

24 A Yes. Thank you.

25 Q The declarations you submitted in both

1 proceedings -- would you agree that they're really
2 similar to each other?

3 A Yes, they're substantively similar, yes.

4 Q Would you say that they're substantively
5 identical or the same?

6 A Yeah. It's very similar, yes. Almost.

7 Q Almost identical?

8 A Almost identical, yes.

9 Q So if -- you know, during today's deposition, I
10 might be focused on one patent or in one proceeding, but
11 I will ask -- sorry. Strike that.

12 During the deposition today, some of the
13 questions might be focused on one proceeding or one of
14 the patents, but I -- I'm asking you if you can explain
15 if your answer to that question would be different if
16 it's applied to the other proceeding or the other patent.

17 Is that okay?

18 A Okay. So I would only explain it if the answer
19 would be different. If not, I will -- we can assume that
20 they are the same.

21 Is that okay?

22 Q Yes, yes. That's -- that's what I'm trying
23 to -- that's --

24 A Okay.

25 Q -- that's what I'm trying to say. So --

1 A Okay. Good.

2 Q Yeah. So if you're -- if -- if the question is
3 directed to one proceeding or one patent and you provide
4 an answer without referring to the other proceeding or
5 the other patent, we will assume that the same answer
6 applies to both proceedings and both patents unless you
7 clarify and give an explanation.

8 A Yes, that is okay. That's perfect.

9 Q And earlier you mentioned that you've reviewed
10 or that you have a portion of or all of Dr. Kenny's
11 declarations with you or in front of you?

12 A Yeah. I just have the hard copy of the table of
13 contents. I just -- yeah. That just helps me. But I
14 have the entire declaration and deposition electronically
15 in front of me.

16 Q Okay. Before these proceedings, were you
17 familiar with Dr. Kenny?

18 A I mean, I'm -- not really, I mean, personally or
19 anything, no. I only learned of him through this work.

20 Q Through the work with Jawbone?

21 A Yes.

22 Q Okay. Before being engaged by Jawbone, had you
23 ever heard of a voice activity detector?

24 A I -- you know, I might have heard of it, but not
25 really in the context that I've gotten to know it in the

1 work with Jawbone.

2 Q So is it fair to say that you were less familiar
3 with voice activity detectors before you started working
4 with Jawbone?

5 MR. COWELL: Objection to form.

6 THE WITNESS: Well, the specific version in
7 here, but I'm quite familiar with the general idea of
8 detectors and, you know, voice detection and detection of
9 many kinds of signals. So yes, the specific ones, you
10 know, specifically the -- you know, as discussed in these
11 patents, for example, yeah, I was not familiar with
12 those.

13 BY MS. WANG:

14 Q You said you were quite familiar with voice
15 detection.

16 Is that before you were engaged by Jawbone?

17 A Well, I just said I'm quite familiar with the
18 concept -- you know, engineering, mathematical, physical
19 concept of detection. So, you know, my background is in
20 signal processing technology, so I'm quite familiar with
21 how to detect the presence of signals or signatures and
22 so on; so not necessarily voice detection, per se, but
23 detection of many different kinds of signals.

24 Q Is it fair to say that most of your work --
25 sorry. I'll strike that.

1 Is it fair to say that before being retained by
2 Jawbone, that most of your work had focused on
3 electromagnetic signals?

4 A It's fair to say. Although, you know, I think I
5 would clarify that, you know, the basic, you know -- as I
6 said, my background is in signal processing techniques
7 and concepts and theories and applications, and as -- and
8 particular applications that I worked on are in wireless
9 communications, which involves electromagnetic signals;
10 however, the basic concepts are very similar, identical
11 theoretically, conceptually; and the techniques, whether
12 it's whatever kind of signal, whether they are
13 electromagnetic or they are acoustic signals.

14 And there could be other signals. And I've
15 worked on projects -- for example, I worked on a DARPA
16 project in -- I think it was 2001 through 2004, which
17 part of it we were developing these network of sensors,
18 and these are acoustic sensors for detecting and tracking
19 vehicles moving in a coverage area, so I was familiar
20 with acoustic signal processing as well. Yeah.

21 Q Did those -- for your DARPA project, did the
22 acoustic sensors -- were they targeted for voice activity
23 detection?

24 A No, they were not necessarily. They were
25 targeted for, you know, detecting vehicles and things

1 like that. But again, the idea was to, you know,
2 distinguish or separate signals of interest from
3 background noise, which is generally the case in many
4 signal processing applications, as the case here.

5 Q Are there any differences between
6 electromagnetic signals and acoustic signals?

7 A Yes, there are. You know, one big one is that
8 electromagnetic signals don't need any medium to
9 communicate. They can go in vacuum, whereas acoustic
10 signals require medium, you know, so they are pressure
11 waves.

12 And the other big one is that the speed of sound
13 is much lower than the speed of light, so it's about
14 330 meters per second versus, I think, 300,000 kilometers
15 per second in light.

16 Q So let's take those one at a time.

17 So the fact that electromagnetic signals don't
18 need any medium to communicate but that acoustic signals
19 do require medium to communicate because they're pressure
20 waves -- does that change how the signals are processed?

21 MR. COWELL: Objection to form.

22 THE WITNESS: Well, not -- you know, that's a
23 technical question, and we could be talking about it for
24 a long time.

25 But I think the main thing -- the essential

1 ideas are not different in the sense that, you know,
2 the -- there are characteristics of signals which are,
3 you know, worse in the sense that, whether they are
4 through acoustic waves or electromagnetic waves, they
5 share the same things.

6 For example, 4EA theory is one way which
7 describes, you know, the frequency content of signals,
8 and filtering is based on that. So there are some
9 characteristics which are independent of that.

10 Now, in some cases, you know, we can -- the
11 parameters of the algorithms that we may use to process
12 the signals may use information about the speed of sound
13 versus speed of light. For example, the delays. You
14 know, delays come in -- play an important role in this
15 case as well in some ways, and so the actual calculation
16 of the delay for a particular distance would be different
17 because the speeds are different, and that may change the
18 parameters in the algorithms, but the basic concepts are
19 really the same.

20 I hope that gives you some idea.

21 BY MS. WANG:

22 Q Do the differences between electromagnetic
23 signals and acoustic signals affect the hardware that is
24 used to receive these signals?

25 A Yes, to some extent. I think one of the most

1 important ones, perhaps, is, you know, in digital
2 processing, you know, one of -- you sample the signals in
3 time, and -- and so the sampling rates -- the rate of
4 which you sample the signals can be quite a bit
5 different.

6 For example, you know, in the case of just, you
7 know, human voice, for example, you know, the highest
8 frequencies that we can detect are about 20 kilohertz,
9 most humans, 20,000 cycles per second; so your sampling
10 rates are going to be on the order of, you know, 40, 50,
11 or maybe 100,000 samples per second.

12 With electromagnetic waves, you know, the
13 frequencies -- the highest frequencies can be much
14 larger. So, for example, in cellular communication
15 signals, you know, there could be frequencies in
16 gigahertz or bandwidths which are in megahertz; so now
17 your sampling rates are in millions of samples per
18 second.

19 So I think that's one aspect of hardware where
20 you convert the analog signals into digital format would
21 be different. How they're processed, again, is -- is --
22 the same principles apply for the most part, yeah.

23 Q And is it fair to say that electromagnetic
24 signals are received over antennas?

25 A Yes. And -- yeah. Yes.

1 Q And is it fair to say that acoustic signals are
2 received over microphones?

3 A Yes, although microphones are a form of
4 antennas. But for acoustic signals, yes. But --

5 Q Are there --

6 A Yeah. That might be opening unnecessary can of
7 worms. But, you know, yes.

8 Q We might be getting into it then.

9 Are there differences between antennas and
10 microphones?

11 MR. COWELL: Objection to form.

12 THE WITNESS: Yes. I think it's not really that
13 significant for, you know, the case at hand. But again,
14 that has to do with the -- the nature of the waves, the
15 pressure waves versus the electromagnetic waves. So at a
16 very simple level, in -- in acoustic signals, we are
17 trying to, you know, measure the changes in air pressure.
18 And that's -- for example, a diaphragm in a microphone
19 may do it.

20 Whereas in electromagnetic signals, we are
21 trying to measure the changes in the electromagnetic
22 fields, which is measured through, you know, changes in
23 electrons flowing through an antenna, metallic antenna.

24 So I think both serve the same purpose. They're
25 trying to measure the signals of interest. How, the

1 physical mechanisms, are a little bit different.

2 BY MS. WANG:

3 Q Before being engaged by Jawbone, had you heard
4 of a virtual microphone?

5 A Not -- you know, not the term per se, but I knew
6 what the concept is. Yeah.

7 Q Did your understanding of virtual microphone --
8 strike that.

9 What was your understanding of -- sorry. Strike
10 that.

11 What is your understanding of a virtual
12 microphone?

13 A Well, in the simplest sense, it would be, you
14 know, where you combine the signals of, say -- in this --
15 in the context of these patents, for example, combining
16 the signals of two or more physical microphones to create
17 a new signal and that cellular virtual microphone.

18 So, for example, you know, in the '213 or '611,
19 you know, you -- those V1 and V2 signals are found by
20 combining the two physical microphone signals and the
21 virtual microphone signal.

22 So in essence any -- you know, you process two
23 or more physical signals from physical microphones, and
24 those processed signals are referred to as virtual
25 microphones.

1 Q Earlier, when you were discussing your DARPA
2 project that used acoustic sensors to detect vehicles,
3 what was the frequency range that was used for that
4 detection?

5 A Well, it is -- it -- it was acoustic signals, so
6 it was the same range that you would -- you know, the
7 signal that we can hear, so up to 20,000 hertz.

8 Q So you characterize acoustic signals as up to
9 20,000 hertz?

10 MR. COWELL: Objection to form.

11 THE WITNESS: No, these are the ones that we can
12 hear. So there are something called ultrasound. I'm
13 sure you've heard of it. And that's above the frequency
14 that we can hear.

15 So acoustic signals can exist at higher
16 frequencies. It's just that we cannot hear them with our
17 ears, just like electromagnetic signals exist at many
18 other frequencies. There's only a small window that we
19 can see with our eyes.

20 BY MS. WANG:

21 Q Do you have any teaching or research experience
22 involving beam forming for acoustic signals?

23 A I've done a lot of work in beam forming.
24 Acoustic signals specifically, in that project, we
25 definitely did because, you know, it involved a range

1 of -- excuse me -- sensors to detect signals of interest
2 and their directions.

3 But generally beam forming -- I've been working
4 on beam forming for a long, long time. I dream of beam
5 forming.

6 Q Other than the DARPA project, have you done
7 any -- do you have any teaching or research experience
8 involving beam forming for acoustic signals?

9 A Well, you know, I can't -- I'm sure I've done
10 projects. I wouldn't be surprised if I did projects as
11 part of courses or even as part of the training for
12 research in graduate school and undergrad involving beam
13 forming and the particular projects involved, acoustic
14 signals. I can't quite exactly remember because
15 mathematically they're just so similar that we wouldn't
16 even necessarily distinguish between them.

17 Once you appropriately sample the signals and
18 represent them mathematically, they could be either
19 acoustic or electromagnetic. So even the bulk of it was
20 that -- in electromagnetic, I think I might have worked
21 on some projects and so on. Yeah. And certainly as
22 applications of signal processing techniques, we do
23 discuss, you know, acoustic and electromagnetic signals
24 in our teaching courses and so on.

25 Q Do you have research or teaching experience

1 involving interference for acoustic signals?

2 A Again, not necessarily specifically for acoustic
3 signals. And again, I may have done some projects. You
4 know, certainly in that DARPA project, we did because
5 there are interfering signals there as well.

6 But generally interference and dealing with
7 interfering signals is a big part of signal processing
8 and communication systems that I worked on and is tied in
9 and very much related to the concept of beam forming and
10 filtering and so on as well. So I'm very familiar with
11 that concept even if I've not worked specifically with
12 acoustic signals as much as radio signals or
13 electromagnetic signals.

14 Again, the concepts are very, very similar,
15 almost identical.

16 Q Do you have research or teaching experience
17 involving noise suppression for acoustic signals?

18 A Well, yes. Noise is -- you know, again, not
19 specifically for acoustic signals. Noise suppression is
20 big part of signal processing. All real world signals
21 have some -- are corrupted by noise to some extent,
22 and -- and in many applications, we want to remove or
23 suppress or cancel noise, whether it's acoustic signals
24 or electromagnetic signals.

25 So I worked on that, again, mostly for radio

1 signals, electromagnetic signals. But the mathematics
2 and the concepts that go behind -- and techniques are the
3 same, very similar, whatever the nature of the signals at
4 hand. That's what makes the whole field of signal
5 processing so exciting, that it's applicable to many
6 different kinds of signals and modality.

7 Q Do you have any research or teaching experience
8 involving adaptive filtering for acoustic signals?

9 A Well, very similar answer. I've worked a lot on
10 adaptive filters. Again -- I think for, you know, again,
11 the DARPA project specifically we did work -- applied
12 filters, and some of them were adaptive filters for
13 processing the signals.

14 But generally I've worked a lot on filtering and
15 adaptive filtering techniques for, you know, suppressing
16 noise or interference or extracting desired signals of
17 interest, specifically in electromagnetic regime. But
18 again, the concepts apply generally to any kinds of
19 signals, including acoustic signals.

20 Q So is it fair to say that in this context, the
21 types of processing for electromagnetic signals are
22 applicable to acoustic signals?

23 A Yes, absolutely.

24 Q Can we turn to your declaration.

25 I'm looking at the declaration that you

1 submitted in -- for the '213 proceeding.

2 A Okay.

3 MR. COWELL: Which exhibit number?

4 MS. WANG: Sorry. 2005.

5 MR. COWELL: Thank you.

6 THE WITNESS: Thank you.

7 BY MS. WANG:

8 Q Do you -- do you have that, Dr. Sayeed, in front
9 of you?

10 A Yes, I do.

11 Q I wanted to turn to your claim construction in
12 paragraph 58.

13 A Okay.

14 Q So in this paragraph 58 of your declaration,
15 you're stating your opinion that "the term 'filter' that
16 describes a relationship for speech between the first
17 physical microphone and the second physical microphone
18 refers to a filter that alters a signal based on the
19 nontemporal components of relative responses to speech of
20 the first and second physical microphones."

21 Do you see that?

22 A Yes, I do.

23 Q And this is different from the opinion that you
24 gave in Exhibit -- oh, shoot. I don't have the exhibit.

25 Do you have the exhibit number for the POPR

1 declaration?

2 A The first declaration?

3 Q Might be -- yeah. Might be 2002.

4 MR. COWELL: It's 2002.

5 THE WITNESS: Yeah.

6 BY MS. WANG:

7 Q Okay. Do you have Exhibit 2002 in front of you?

8 A Yes, I do.

9 Q Okay. And paragraph 36 of that exhibit?

10 A Yes.

11 Q You provided -- in that paragraph, you provide a
12 slightly different construction for, quote -- or the
13 different construction as, quote, "a filter that alters
14 the magnitude of a signal based on the relative responses
15 to speech of the first and second physical microphones."

16 Do you see that?

17 A Yes, I do.

18 Q So I wanted to walk through the construction
19 that you're offering now, and I'm going to ask you some
20 questions about how -- you know, just comparing the
21 previous construction and the current construction, if
22 that's okay.

23 A Okay.

24 Q So, first of all, the word "response" here -- do
25 you see that in your current -- in your current

1 construction?

2 A Yes, "the relative responses to speech."

3 Q Yes.

4 A Yeah.

5 Q So what is -- what is a response to speech?

6 A Yeah. So this is a -- so, you know, let's look
7 at the whole thing, "relative responses to speech of the
8 first and second physical microphone."

9 So this is, you know, the responses -- you know,
10 the -- basically the output signals coming out of the
11 first and second physical microphones in response to
12 speech. So that's what the responses refer to is signals
13 actually coming out of the microphones.

14 Q So the -- the -- is it fair to say, then, that
15 the response to speech of the first and second physical
16 microphones are the same as the recordings of the
17 microphones?

18 MR. COWELL: Objection to form.

19 THE WITNESS: Well, depends on what we mean by
20 "recording." But, you know, the -- you know, let's just
21 think of -- yeah. Electrical, you know, microphone will
22 produce an electrical signal, and -- and you may sample
23 it or whatever to store it on a computer, so -- or it's
24 in the analog form. But let's just say in the raw, like,
25 you know, analog form, the electrical signal that the

1 microphone is producing in response to speech -- that's
2 what the response is referring to.

3 BY MS. WANG:

4 Q So is it the same -- strike that.

5 Is the response to speech of the two physical
6 microphones the same as the signal that is generated by
7 the two physical microphones?

8 A Well, it's the -- it's the same because, you
9 know, they -- when the microphones are basically -- they
10 are receiving the speech signal, and so -- and that's the
11 signal that they'll produce in response to it. So I
12 think they are the same, as far as I understand in this
13 context.

14 Q Is the response to speech of the two microphones
15 measured?

16 MR. COWELL: Objection to form.

17 THE WITNESS: Well, you can't really -- yes.
18 Yes, it is -- you know, so let's look back at what it's
19 saying; right?

20 "A filter that alters signal based on the
21 temporal components of relative responses to speech of
22 the first and second physical microphones."

23 So, you know, it's referring to a filter that
24 is -- you know, is there, which is based on these two
25 responses. And so yes, they have to be measured in some

1 form to create the filter. And -- and in -- in '213 and
2 '611, you know, that filter is the beta filter. And, you
3 know, the specification talks about many different ways
4 of forming it, a few different ways.

5 BY MS. WANG:

6 Q How would the response be measured?

7 MR. COWELL: Objection to form.

8 THE WITNESS: Well, how long do you want to sit
9 here?

10 Well, it can be measured in, you know -- they
11 could be measured in many different ways. But in -- most
12 relevant to this case, it will likely be sampled. You
13 know, they are -- so that they are converted into digital
14 signals so that they can be processed.

15 So, you know, you have signals coming out of
16 these microphones, and they'll be sampled with, you know,
17 things like analog-to-digital converters or something;
18 and then those samples would be recorded or stored in a
19 computer, in memory, if you will.

20 You can do -- there are analog computers as well
21 or analog processing techniques which could take the
22 analog signals and store them in some other way and
23 process them, but that's not the case here, for the most
24 part.

25 ///

1 BY MS. WANG:

2 Q You see how the -- the responses are to speech?

3 A Yes.

4 Q So given that these are responses to speech, how
5 does one know that the response of the microphone is to
6 speech and not some other signal?

7 MR. COWELL: Objection to form.

8 THE WITNESS: Well, that's a good question, and
9 I think that's an important one in the sense that's where
10 the VADs come into play to some extent. You know, you
11 need to know when the speech is occurring in some ways so
12 that -- you know, VAD is a voice activity detector -- so
13 that you know that's a speech signal that's coming in,
14 and that's what you're measuring.

15 So some mechanism in that case would be needed
16 to know that it is actually speech that is being produced
17 when we measure those signals.

18 BY MS. WANG:

19 Q So would you agree that a VAD is needed to
20 determine that the response of a physical microphone is
21 to speech and not some other signal?

22 A Well, some, you know, VAD or some way of knowing
23 that, that it was speech occurring. You know -- yeah.

24 Q What's a relative response or relative
25 responses?

1 A Well, relative responses, you know, in specific
2 case, I can refer you to, you know, in -- one -- in one
3 case, it could be the ratio. For example, let me see if
4 I can -- so in my declaration, if you look at 47,
5 paragraph 47 on page 17 -- I can't go lower than two
6 pages.

7 It says "the specification provides two methods
8 to calculate beta: The function of the distance between
9 the microphone and the user's mouth" -- that was one --
10 "and two, adaptively."

11 And if you look at "adaptively," that's a good
12 example of relative because it's taking the ratio of the
13 two microphone signals, 02 and 01, and then it has a
14 calibration filter and a delay in the denominator and a
15 calibration filter in the numerator.

16 But, you know, in terms of the microphone
17 signals, it'll be 02 and 01. You know, it's kind of
18 looking at the ratio between them. That would be one way
19 of looking at what's the relative, so you see what the
20 magnitude of one -- and phase of one signal is relative
21 to the other as a function of frequency.

22 And I think that's also -- I think what I state
23 in 42 is very relevant here as well, and I would like to
24 read that because I think it's -- the specification
25 explains that "one of the mentioned major advances over

1 the prior art is to use the difference in frequency
2 content, not time phase difference, to calculate the
3 relationship for speech between the microphone. And
4 NAVSAD and PSAD systems include an array algorithm for
5 speech detection that uses the difference in frequency
6 content between two microphones to calculate a
7 relationship between the signals of the two microphones.
8 This is in contrast to conventional arrays that attempt
9 to use the time/phase difference of each microphone to
10 remove the noise outside of an area of sensitivity," area
11 of sensitivity in quotes.

12 "The methods described herein provide a
13 significant advantage, as they do not require a specific
14 orientation of the array with respect to the signal."

15 So relative responses as a function of
16 frequency, just to amplify on your question.

17 Q So the relative responses in the construction
18 are -- are over -- over frequency?

19 A Yes, yes. Absolutely.

20 Q In paragraph 47, you pointed us to the two forms
21 of beta. On the left it's the function of the distance
22 between each microphone and the user's mouth, and then
23 the adaptive version on the right.

24 A Uh-huh. Yes.

25 Q Is the form of beta on the left -- is the form

1 of beta on the left indicative of the relative responses
2 to speech of the two microphones?

3 MR. COWELL: Objection to form.

4 THE WITNESS: Partly. I think it's -- it's just
5 the amplitude -- you can think of it as reflective of the
6 relative amplitudes of the signals independent of the
7 frequency, just based on the distance; whereas the
8 adaptive one is kind of giving you a more detailed
9 description of that based on the relative amplitudes and
10 phases as a function of frequency.

11 BY MS. WANG:

12 Q Do you only have multiple relative responses to
13 speech if they are different for different frequencies?

14 MR. COWELL: Objection to form.

15 THE WITNESS: Well, you may call it, but that's
16 maybe more confusing because, you know, if you think of a
17 filter, filter is a description as a function of
18 frequency. The filter is usually described like beta Z
19 as a function of Z, which Z is the description of
20 frequency in the digital domain.

21 So you can -- so here, describing the relative
22 responses as a function of frequencies, you may call them
23 relative multiple ones. But typically it is -- a filter
24 describes that relationship or a frequency of interest.

25 ///

1 BY MS. WANG:

2 Q In paragraph 47, the left beta --

3 A Uh-huh.

4 Q -- that is D1 over D1 plus D or D1 over D2 -- is
5 that a filter that describes a relationship for speech
6 between the first physical microphone and the second
7 physical microphone?

8 MR. COWELL: Objection to form.

9 THE WITNESS: Yes. I said earlier it does, but
10 it's a limited version in the sense that it's just the --
11 the differences in amplitude irrespective of how they are
12 varying over the frequency. That's where the adaptive
13 one -- the second one is more accurate.

14 Excuse me.

15 And I think, you know, the patent emphasizes the
16 importance of using the adaptive one as well, and that's
17 in 52. You know, every -- as stated in paragraph 52, and
18 this is towards -- I'm just going to read the quotes
19 towards the end, starting from one, two, three, four,
20 five, six, seven, eighth line.

21 In quotes, "the accuracy of the adaptation of
22 beta Z of the system is a factor in determining the
23 effectiveness of the VAD. A more accurate adaptation to
24 the actual beta Z of the system leads to a lower energy
25 of the speech response in V2 and a higher ratio R," from

1 '213, column 7, line 8 through 18.

2 BY MS. WANG:

3 Q Does the beta filter that is a D1 over D2 --

4 A Uh-huh.

5 Q -- does that filter alter a signal based on the
6 nontemporal components of relative responses to speech of
7 the two microphones?

8 MR. COWELL: Objection to form.

9 THE WITNESS: Yes, I think this is a -- yes, in
10 the sense that it's not -- it's going beyond just a delay
11 relationship. It's actually talking about an amplitude.

12 So when nontemporal is, you know -- you know,
13 it's -- if he is going to the biggest -- let me just
14 rephrase and go back to what I state in another place.

15 Yeah. In 40 that I say, you know, what -- well,
16 for the revised construction, that, you know, "while that
17 statement remains true," referring to the previous
18 construction, "I provided a revised construction that
19 focuses on the key dispute of Meta and Jawbone, whether a
20 POSITA would understand the filter that describes a
21 relationship for speech between the first microphone and
22 the second physical microphone, herein after the
23 relationship filter, to encompass a delay filter such as
24 the delay filter described in the '213 patent. In my
25 opinion, POSITA would understand that the relationship

1 filter must do more than merely delay a signal."

2 So in that context, yes, it is going beyond
3 the -- you know, it is -- that ratio, D1 over D2, is
4 going beyond the delay in that it's describing the
5 relationship in magnitude, although it's constant over
6 frequency, not as detailed as the second one in the
7 adaptive version.

8 BY MS. WANG:

9 Q The -- sorry. You answered this before.

10 But the relative responses to speech in the
11 construction are over -- with respect to frequency?

12 MR. COWELL: Objection to form.

13 THE WITNESS: Well, you know, non -- again,
14 what -- you know, I just refer to the -- you know, beyond
15 delay. And one way that it's -- you know, the --
16 capturing differences beyond just the -- the delay
17 between the two signals, which is primarily a function of
18 the distance between the speech source and the
19 microphones. So -- and that one way of describing those
20 differences is in the frequency domain in a very --
21 yeah -- very useful way.

22 BY MS. WANG:

23 Q So the delay between the two signals can be
24 captured in the frequency domain?

25 A Yes.

1 MR. COWELL: Objection.

2 THE WITNESS: Sorry. Yes. Yes, it can be.

3 BY MS. WANG:

4 Q And the relative responses to speech are with
5 respect to frequency?

6 MR. COWELL: Object to the form.

7 THE WITNESS: Well, frequency as a general term
8 is -- this is related to 4EA analysis. So that's a very,
9 very powerful tool which basically says that any
10 signal -- you can imagine any signal, and that can be
11 described in terms of frequencies, so -- including
12 delays, which manifest themselves as phase shifts or
13 phases.

14 So yes, you know, I think -- yeah. We can state
15 that. But that's -- that's not really saying much
16 because pretty much anything and everything under the
17 sun, any signal, can be described in terms of
18 frequencies.

19 BY MS. WANG:

20 Q Is temporal the same as phase?

21 MR. COWELL: Objection to form.

22 THE WITNESS: Well, here specifically it's
23 delay. And if you just have delay, strictly speaking,
24 that leads to a phase in the frequency domain. But
25 that's getting technical. But that's -- that's

1 significant here.

2 BY MS. WANG:

3 Q So going back to the current construction, the
4 current construction has nontemporal components of
5 relative responses to speech.

6 A Yes.

7 Q Do you see that?

8 So what is a nontemporal component of relative
9 responses to speech?

10 A Yes. Let me just go back to -- yeah. So again,
11 as I said earlier, the main thing it's -- we are trying
12 to capture here is that it's beyond the differences in
13 just the delay, which would be based on the distances
14 from the speech source to the two microphones, that it's
15 not limited to that. It is going beyond that delay
16 and -- yes. And so -- yeah.

17 Q So what is beyond the delay?

18 A Well, the -- you know, as I -- description of
19 the filter, adaptive version, for example, is a good
20 example of a description of that filter, of the
21 nontemporal components, of the relative responses to
22 speech in the first and second physical microphone, which
23 is, again, in 47, the second one, the adaptive version of
24 the relationship filter beta.

25 Q What about the first one, the fixed version of

1 the filter beta?

2 A Yeah. So that's -- sorry. Didn't mean to
3 interrupt.

4 Q I was -- just to finish my question, is that
5 beyond the delay?

6 MR. COWELL: Objection to form.

7 THE WITNESS: First one is beyond the delay too
8 because it is describing the change in amplitude, which
9 is not just a phase, even if you think in terms -- in the
10 frequency domain.

11 So it is -- it is beyond first level, if you
12 will, and the adaptive version captures it with more
13 detail, more accurately.

14 BY MS. WANG:

15 Q So if the filter describes a change in
16 amplitude, then it is not based on nontemporal
17 components?

18 Sorry. Strike that.

19 If the filter -- it's the opposite, isn't it?
20 Strike that.

21 If the filter describes a change in amplitude,
22 then it is based on nontemporal components?

23 MR. COWELL: Objection to form.

24 THE WITNESS: Can you -- you know, sorry. Can
25 you please repeat the question again? Because I -- you

1 know, I just want to hear it clearly, what --

2 BY MS. WANG:

3 Q Sure.

4 If the filter describes a change in amplitude,
5 then it is based on nontemporal components.

6 Do I have that right?

7 MR. COWELL: Objection to form.

8 THE WITNESS: Well, it is capturing beyond the
9 delay, the first element, first part of it, which is as
10 captured by the ratio D1 over D2. So -- but that's not
11 all that we are trying to capture in the -- in this
12 construction, in this declaration.

13 BY MS. WANG:

14 Q So the ratio D1 over D2 is a nontemporal
15 component?

16 MR. COWELL: Objection to form.

17 THE WITNESS: In the sense that it's different
18 from a delay, you know, capturing just the delay between
19 the two microphones, yes.

20 BY MS. WANG:

21 Q And the delay between the two microphones is
22 based on the distances -- sorry -- the -- what is the
23 delay between the two microphones based on?

24 A Yeah. So I think maybe this is -- I think now I
25 understand what -- partly, or at least -- so delay is

1 based on the distances, and -- but -- but the
2 distances -- you know, the difference of distance
3 introduces a delay as well as a change in the amplitude.
4 And when we just -- the delay is just capturing one part
5 of it, and this ratio of the distance is capturing the
6 change in magnitude of the signals.

7 So, you know, nontemporal would refer to -- you
8 know, one way of thinking about it is it's going beyond
9 that just delay part based on the distance to include the
10 changes in magnitude, relative magnitudes which, in
11 general, vary as a function of frequency.

12 As it is, you know, again -- and, you know, I
13 think in 43 is another -- is -- 43 is a good -- paragraph
14 43 is a good one which explains -- kind of sheds light on
15 this.

16 "A POSITA reading this statement would
17 understand that a key advance and advantage of the patent
18 is to move away from a delay-based method, which the a
19 time phase difference disparaged above. As the patent
20 explains, there are several advantages in moving away
21 from delay based processing." And this is from the
22 patent.

23 "Further, the systems described herein are
24 sensitive to noise of every type and every orientation,
25 unlike conventional arrays that depend on specific noise

1 orientations. Consequently the frequency-based arrays
2 presented herein are unique, as they depend only on the
3 relative orientation of the two microphones themselves
4 with no dependence on the orientation of the noise and
5 signal with respect to the microphone.

6 "This results in a robust signal processing
7 system with respect to the type of noise, microphones,
8 and orientation between the noise signal source and the
9 microphones."

10 From the Patent '213, column 11, lines 30 to 39.

11 Q The left beta in your paragraph 47, the fixed
12 beta, D1 over D2 --

13 A Yes.

14 Q -- is that dependent only on the relative
15 orientation of the two microphones themselves with no
16 dependence on the orientation of noise and signal with
17 respect to the microphones?

18 MR. COWELL: Objection to form.

19 THE WITNESS: That's a good question. No. I
20 mean, that's the -- it depends on both because, you know,
21 D1 and D2, if you look at Figure 1 -- well, Figure 1 is
22 maybe not the best one. But it's a -- it's described in
23 column 5, 52 to 59.

24 So to give you a short answer, they depend on
25 both the relative orientation, and that's why the

1 frequency content as captured by the adaptive filter --
2 the relative differences over the frequency content are
3 more important. That'll allow you to get beyond just a
4 specific dependence on the relative orientations, and
5 that's what was emphasized in the paragraph 43 that I
6 just quoted.

7 BY MS. WANG:

8 Q Is amplitude an example of a nontemporal
9 component?

10 A The differences in amplitudes, yes, in the
11 context of our discussion, yes, beyond just a delay.

12 Q Are there other examples other than amplitude
13 which are nontemporal components?

14 MR. COWELL: Objection to form.

15 THE WITNESS: Amplitude as a function of
16 frequency and phases, for that matter, as a function of
17 frequency. Because you know in -- yeah.

18 BY MS. WANG:

19 Q Are there other examples that are nontemporal
20 components?

21 MR. COWELL: Objection to form.

22 THE WITNESS: Well, it may be -- I -- I think
23 these would be sufficient for now.

24 MR. COWELL: Guys, we've been going about an
25 hour.

1 When you reach a good stopping point, can we
2 take a break?

3 MS. WANG: Yeah. Let me do one more question,
4 and then we can take a break.

5 BY MS. WANG:

6 Q Is it your opinion that any altering of the
7 signal based on a temporal component of relative
8 responses to speech of the two microphones would not meet
9 the claimed filter?

10 MR. COWELL: Objection to form.

11 THE WITNESS: Could you please repeat the
12 question again.

13 BY MS. WANG:

14 Q Sure.

15 A Or rephrase it.

16 Q Is it your opinion that altering the signal
17 based on a temporal component of relative responses to
18 speech of the two microphones would not meet the claimed
19 filter?

20 MR. COWELL: Objection to form.

21 THE WITNESS: Yeah. I think this question could
22 be, you know, interpreted -- and, again, it's, you
23 know -- question and its answer could be misinterpreted.

24 So let me -- again, I'm going to emphasize that
25 the nontemporal/temporal aspects here are related to

1 specifically the delay between them.

2 Now, having said that, a filter by itself, even
3 though we know the beta in 47, the second one, adaptive
4 one, is described in terms of frequency; or generally,
5 you know, a filter is -- can be described in terms of
6 frequency or in the time domain, and -- and, you know,
7 then you can apply the filter in the time domain too.

8 So -- so, you know, in that regard, you know,
9 the filter that we are defining could be applied in the
10 frequency or time domain. It will serve the same
11 function. So the nontemporal in the -- the new, you
12 know, language or claim construction that is posed here
13 is specifically aimed at capturing the differences
14 between the two microphone signals which go beyond the
15 delay. So filters themselves can be applied in frequency
16 and time domains, so it should not be conflated with
17 those aspects. That's what I'm trying to say.

18 Hopefully that clarifies things and doesn't
19 muddle it more.

20 BY MS. WANG:

21 Q Would you like a break?

22 A Absolutely. That would be great. Thank you.

23 Q Let's go off the record.

24 (Recess)

25 ///

1 BY MS. WANG:

2 Q Welcome back, Dr. Sayeed.

3 A Thank you.

4 Q Did you talk with Mr. Cowell during the break?

5 A No.

6 Q So I want to go -- I want to pick up where we
7 left off. I just want to make sure that I understand
8 what -- what we're saying.

9 So is it accurate to say that there are temporal
10 components of the relative responses to speech which
11 are -- which, in the construction, is intended to cover
12 the delay between the two microphones?

13 MR. COWELL: Objection to form.

14 THE WITNESS: I'm going to try to do my best
15 to -- actually I need to -- could you please repeat the
16 question again.

17 BY MS. WANG:

18 Q Sure. Maybe I can rephrase.

19 A Yeah.

20 Q So in the -- sorry.

21 So in the construction, there are relative
22 responses to speech; right?

23 A Yes.

24 Q And in the construction of those relative
25 responses to speech, there are nontemporal components.

1 Do you see that?

2 MR. COWELL: Objection to form.

3 THE WITNESS: Yes, I see that.

4 BY MS. WANG:

5 Q And earlier you testified that the temporal
6 components that are not the nontemporal components were
7 intended to encompass the delay between the two
8 microphones.

9 Do I have that right?

10 MR. COWELL: Objection to form.

11 THE WITNESS: Did I hear you correctly that you
12 said that the nontemporal components were meant to
13 capture the delay?

14 BY MS. WANG:

15 Q I meant the opposite, that the --

16 A Okay.

17 Q -- temporal components that are not the
18 nontemporal components are meant to capture the delay.

19 Do I have that right?

20 MR. COWELL: Objection to form.

21 THE WITNESS: Partly. In the spirit of it is --
22 I'm -- I think.

23 BY MS. WANG:

24 Q What do I have wrong about that? Or sorry.
25 What's missing?

1 A I don't know what's missing. I think it's just
2 the way it's phrased is, you know, making me think.

3 The main, you know -- again, it says a filter --
4 you know, 58 says, "in my opinion, therefore, a POSITA
5 reading the claims in light of the specification would
6 therefore understand that the filter that describes a
7 relationship for speech between the first physical
8 microphone and the second physical microphone refers to a
9 filter that alters a signal based on the nontemporal
10 components of relative responses to speech of the first
11 and second physical microphones."

12 And the main thing as -- is that, you know, it
13 goes beyond just capturing the delay between the two
14 microphone signals. That's the -- that's the main part
15 of the nontemporal aspects that I'm trying to emphasize.

16 And -- and so when we -- you know, so when we
17 talk about components which are not nontemporal, it makes
18 me a little wonder what -- what we are referring to.

19 Q Well, you included the word "nontemporal" in the
20 construction; right?

21 A Yes.

22 Q And you're using "nontemporal" to refer to
23 something beyond a delay; right?

24 A Yes.

25 Q So why isn't it accurate then to say that

1 "temporal" refers to the delay?

2 MR. COWELL: Objection to form.

3 THE WITNESS: Yeah. It's -- you know, I think
4 we could say that in -- in this specific context, yes.
5 Temporal -- the way we are using the term "temporal" is
6 referring to the delay. We could say that.

7 BY MS. WANG:

8 Q Okay. So if "temporal" refers to delay between
9 the two microphones --

10 A Yeah. Then --

11 MR. COWELL: I'm sorry. Is there a question?

12 BY MS. WANG:

13 Q Sorry. Do I have that right, that temporal --
14 the temporal component refers to the delay between the
15 two microphones?

16 MR. COWELL: Objection to form.

17 THE WITNESS: Well, I don't know where we're
18 going with this, but -- yeah. So, you know, maybe
19 I'll -- so in 49, I say "indeed the separate delay, which
20 is defined in terms of distance and the speed of sound,
21 compensates for the temporal difference between the --
22 based on the distance between the microphones, '213
23 patent, column 5, lines 35 to 45, gamma equals D over C.
24 And then 50 -- in paragraph 50 I say "the
25 constant D is the distance between the two microphones,

1 and constant C, the speed of sound in air."

2 So yeah. Temporal difference based on the
3 distance between the microphones, I think that -- in that
4 regard, the temporal, you know -- that's how I would like
5 to refer to temporal components of the temporal
6 difference based on the distance between the microphones.
7 That's what really that construction is referring to.

8 BY MS. WANG:

9 Q So it's -- is it your testimony then that the
10 temporal component of relative responses to speech refers
11 to the gamma equation in paragraph 49 of your
12 declaration?

13 A Yeah, that's specifically --

14 MR. COWELL: Objection to form.

15 THE WITNESS: -- the delay.

16 Specifically, again, I've said it many times
17 now, the delay between the responses of the microphones
18 which is governed by the distance between them relative
19 to the source.

20 BY MS. WANG:

21 Q So if I have the filter that alters the signal
22 based on this delay, which is the temporal component,
23 does that meet the claimed filter?

24 MR. COWELL: Objection to form.

25 THE WITNESS: I'm sorry. Could you repeat the

1 question again.

2 BY MS. WANG:

3 Q If I have a filter that alters the signal based
4 on a delay, which is the temporal component, does that
5 meet the claimed filter?

6 MR. COWELL: Objection to form.

7 THE WITNESS: It cannot just be the delay, no.
8 If it's just -- if the filter is just a delay, then it's
9 not capturing the -- the claim filter is going beyond
10 that.

11 Explicitly, precisely because as I -- as stated
12 in 49, a separate delay is introduced in there to capture
13 the temporal difference based on the distance. So the
14 filter beta that we are referring to goes beyond that.
15 It may have a delay component as well, but it goes beyond
16 it.

17 BY MS. WANG:

18 Q What does it mean for a filter to alter a
19 signal?

20 A Well, 48 is a good description of that,
21 paragraph 48 in my declaration.

22 "In either case, the beta Z compensates for the
23 difference in responses between the two microphones, not
24 just the temporal difference, by increasing or decreasing
25 the magnitude of the filtered signal. For example, as a

1 function of the frequency content, the filter adjusts the
2 signal to account for the relative strengths of the
3 speech signal received over the range of frequencies of
4 interest. The closer microphone is attenuated to the
5 same speech level received at the farther microphone, and
6 this attenuation may change as a function of frequency
7 content."

8 Q So altering the signal is the same as altering
9 the magnitude of the signal?

10 MR. COWELL: Objection to form.

11 THE WITNESS: A filter -- you know, just a
12 basic -- you know, what a filter does is it alters -- it
13 can alter the magnitude and phase of a signal as a
14 function of frequency. That's what a filter does.

15 BY MS. WANG:

16 Q For a filter to alter a signal, is the filter
17 being applied to the signal?

18 MR. COWELL: Objection to form.

19 THE WITNESS: Yes, I think that is correct. You
20 know, there's --

21 BY MS. WANG:

22 Q So in the construction, it no longer says
23 "alters the magnitude of the signal"; it just says
24 "alters a signal."

25 Do I have that right?

1 MR. COWELL: Objection to form.

2 THE WITNESS: "A filter that alters the signal
3 based on the nontemporal components of the relative
4 responses to speech of the first and second physical
5 microphone."

6 Well, I think, you know, it's a -- a filter -- a
7 POSITA would know that a filter generally can alter a
8 magnitude and phase as a function of frequency. That's
9 a -- you know, that's a basic definition of what a filter
10 does. Here this construction is talking about a filter,
11 how it relates to the -- you know, yeah.

12 BY MS. WANG:

13 Q So in the -- sorry. Were you done?

14 A Yes.

15 Q In the current construction, when it says "a
16 filter that alters a signal," if the only alteration is
17 to the phase, can that meet the claimed filter?

18 MR. COWELL: Objection to form.

19 THE WITNESS: Well, that's, again, a technical
20 question. I think generally it would involve both
21 magnitude and phase, and even if it was -- yes, generally
22 it would be magnitude and phase. And -- and a delay has
23 a specific -- you know, you can represent a delay in
24 the -- as a phase as well, but it has a specific
25 response, a linear phase, so it will have to be going

1 beyond that linear phase relationship if -- even if it
2 was just altering the phases.

3 Again, the -- the point here is that this filter
4 is going beyond just capturing delay between the two
5 microphone signals or generally just -- just a delay.

6 BY MS. WANG:

7 Q The linear phase results from the delay being
8 fixed?

9 A Say it again? Could you repeat it?

10 Q Does the linear phase result from the delay
11 being fixed?

12 A Yeah.

13 MR. COWELL: Objection to form.

14 THE WITNESS: Yeah. We're getting into
15 technicalities of 4EA transforms.

16 Yeah. A fixed delay leads to a linear -- you
17 know, if you're representing the frequency domain, it's a
18 linear phase in the frequency domain.

19 BY MS. WANG:

20 Q Okay.

21 A And that phase changes as the delay changes.

22 Q Okay. Is it fair to describe a filter as having
23 coefficients?

24 A Oh, a filter can be described in many different
25 ways. One would be perhaps in terms of coefficients, but

1 even that is not a -- you know, requires more context in
2 terms of what we mean by "coefficients."

3 Q Do you have an understanding of coefficients as
4 they relate to filters?

5 A Are you refer -- I do, but are you referring to
6 anything in specific? Maybe you can point me to that,
7 and I can give you a more concrete answer.

8 Q So if you're looking at -- do you -- if you have
9 the '213 patent --

10 A Yes.

11 Q -- column 6, line 13 to 14 -- wait. Do I have
12 the right cite? Hang on.

13 Yeah. Column 6, line -- the sentence at line 11
14 to 14, do you see where it describes the coefficients of
15 beta with a tilde on top are calculated?

16 A I'm reading it.

17 MR. COWELL: And, Dr. Sayeed, if you need to
18 read more of the specification for context, please feel
19 free.

20 THE WITNESS: Thank you. Yeah. I'm reading it,
21 and I'll respond.

22 Yes, let me --

23 MR. COWELL: What's the pending question?

24 MS. WANG: Well, I was waiting for an answer to
25 my previous question, which was, "Do you have an

1 understanding of coefficients as they relate to filters?"

2 THE WITNESS: Yes, I do have an understanding,
3 and it's -- it's many -- you know, it could be many
4 different forms. And I think a POSITA would know the
5 different ways a filter can be described.

6 And coefficients in particular -- you know, so
7 I'm -- I'm just going to -- I'm trying to see if
8 there's -- I'll just -- if there's anything more specific
9 in the specification that I could point to. But -- yeah.
10 So that's -- you know, I'm just going to try to give a
11 general description of what coefficients could mean.

12 So, you know, as -- in 47, that filter is
13 described, you know -- you know, beta Z, so it could be
14 just Z as a -- you know, a frequency variable, additional
15 frequency variable, and that's a function. So it could
16 be described as just what's called a transfer function as
17 a function of frequencies.

18 And in this case, you know, there aren't
19 parameter -- coefficients, per se; it's just describing
20 the amplitude and phases over the frequency. However,
21 the filter can take on -- so that's the most general
22 form, but there can be specific forms in here.

23 You can describe it in terms of poles and 0s,
24 where those are parameters. Those are the numerators and
25 denominators of the frequency response.

1 Or there's also something called the impulse
2 response of a filter, which is describing the frequency
3 response and the time domain. And -- and so those are
4 sometimes called tabs of the filter. So it could refer
5 to those as well.

6 So a POSITA would know -- you know, depends on
7 what parametric representation of a filter you're using,
8 and -- but the point of, you know, what '213 is
9 basically -- what you referred the -- the place in '213
10 where you referred to is basically -- it's -- it's saying
11 that, you know, a little bit of noise can be tolerated,
12 but it is preferred that only speech is being received
13 while the coefficients of beta are calculated.

14 In other words, you know, whatever the
15 representation of beta that we are using, when we
16 calculate that, it is preferable that it's mostly speech
17 that's coming in. So --

18 BY MS. WANG:

19 Q And how are --

20 A -- hopefully that gives you some answer -- idea.

21 Q Yeah, it does. Thank you.

22 How are the coefficients of beta used to apply
23 to a signal when the filter is applied to a signal?

24 MR. COWELL: Objection to form.

25 THE WITNESS: Well, again, that could be -- a

1 filter can be implemented in many different ways. So --
2 and so, you know, it's -- so, you know, that could be a
3 really long answer, and I don't know if it's really --

4 BY MS. WANG:

5 Q Okay.

6 A -- relevant here. But, you know, I think it
7 could be applied in the frequency domain by just
8 multiplying the 4EA transform of the signal with the
9 frequency response of the filter, or it could be done in
10 the time domain, as a POSITA would understand, by, you
11 know, convolving -- that's a technical term -- of the
12 input signal with the filter impulse response.

13 Or it could be, if it was -- it had poles and
14 0s, there are other implementations, additional
15 implementations which could be used to implement it as
16 well.

17 So there are many different ways a filter could
18 be implemented, for example, on a computer that a POSITA
19 would know. But I don't think we need to necessarily go
20 into the details of that here.

21 Q Is it fair to say that, when multiplying the 4EA
22 transform of the signal with the frequency response of
23 the filter, or when doing the convolution of the impulse
24 response of the filter with the signal and the time
25 domain, that these are both linear combinations of the

1 input signal and the filter?

2 MR. COWELL: Objection to form.

3 THE WITNESS: Can you repeat the last part?
4 Linear combination of the filter and the signal, you
5 said?

6 BY MS. WANG:

7 Q Sure. Maybe I'll rephrase. I'll just -- we'll
8 take it one at a time.

9 Multiplying the 4EA transform of the signal with
10 the frequency response of the filter -- is that a linear
11 process?

12 A Yes, it's a linear process, and -- and you are
13 interpreting the right way. But yes, these are linear
14 systems. Filters are linear systems, and it's a linear
15 process.

16 Q And is the same true when you perform a
17 convolution of the impulse response of the filter with
18 the input signal in the time domain --

19 A Yes.

20 Q -- that that is also -- that's a linear process?

21 A Yes.

22 Q And you said filters are linear -- sorry. I
23 think the transcript is --

24 Filters are linear systems? Is that what you
25 said?

1 A Yes. I mean -- yes.

2 Q Do the claims encompass a linear filter?

3 MR. COWELL: Objection to form.

4 THE WITNESS: I think a filter is a linear -- I
5 mean, the way the filters are being -- the context of the
6 filter is in this patent, yes, they -- these are linear
7 filters or linear systems, yes.

8 BY MS. WANG:

9 Q Going back to the construction, the filter that
10 alters a signal -- do you see that?

11 A Yes.

12 Q Does the -- sorry. Strike that.

13 Can the altering of the signal include
14 compensation of the signal?

15 MR. COWELL: Objection to form.

16 THE WITNESS: What do you mean by
17 "compensation"?

18 BY MS. WANG:

19 Q Do you have an understanding of compensation?

20 A Well, compensation could be many different
21 things. But, you know, I'm just trying to see, you
22 know -- you're the one who is asking the question, so
23 what -- what do you have in mind? Are you referring to
24 any particular place in the document? I can look at that
25 to get context.

1 Q Well, so earlier we were talking about altering
2 of the signal that can be with respect to magnitude or
3 phase --

4 A Yes.

5 Q -- right?

6 And so can the altering of the signal using
7 magnitude or phase in the frequency response -- can that
8 include compensation of one mic to another?

9 MR. COWELL: Objection to form.

10 THE WITNESS: Compensation of one mic to
11 another -- I don't know what that means.

12 Is -- is there a particular place you're
13 referring to that you can -- I can look at so I can
14 answer it more specifically?

15 BY MS. WANG:

16 Q Sitting here today, you don't have an
17 understanding of what it means for compensation of one
18 microphone to another microphone?

19 MR. COWELL: Objection to form.

20 THE WITNESS: It's -- I -- I really -- you know,
21 compensation could be -- I don't know what we are
22 compensating for. Maybe you're referring to calibration
23 that the '213 filter does talk about -- I mean, patent
24 does talk about, calibration filter between the two
25 microphones.

1 Is that what you're referring to?

2 BY MS. WANG:

3 Q I'm just referring to the word "compensation."

4 A Yeah. I think without more context on in what
5 way are we using the term, I can't really offer any more
6 meaning, you know. What would that mean? Especially
7 compensation of one filter into another -- I'm not
8 entirely sure I understand.

9 Q Let's switch gears a little bit. We'll go to --
10 let's go to the figures of the '213 patent.

11 A Okay.

12 Q I'm looking at Figures 2, 3, and 4. Let me know
13 when you're there.

14 A 2, 3, and 4 -- yes, I have it.

15 Q Would you agree that Figures 2 and 3 are the
16 same except that the beta filter in Figure 2 is a fixed
17 filter, and the beta filter in Figure 3 is an adaptive
18 filter?

19 A Yes, that's a fair characterization.

20 Q Does the beta filter remove noise?

21 MR. COWELL: Objection to form.

22 THE WITNESS: Think for a second.

23 Can you repeat the question again?

24 BY MS. WANG:

25 Q Does the beta filter remove noise?

1 MR. COWELL: Objection to form.

2 THE WITNESS: Well, you know, I think in this
3 particular context, if you're looking at '213
4 specifically, one is the microphone --

5 (Interruption by the reporter)

6 THE WITNESS: I was just mumbling, I guess.

7 So here the beta filter is trying to -- you
8 know, again, this is -- beta filter designed based on the
9 speech. So here, this is removing the speech signal
10 primarily that may be corrupting O2 from the --

11 BY MS. WANG:

12 Q Which figure -- sorry --

13 A Figure 3 -- Figure 3 or 2, for that matter.

14 Q So is it fair to say that the beta filter here
15 is designed to remove the speech?

16 MR. COWELL: Objection to form.

17 THE WITNESS: Beta filter could be, you know,
18 affecting noise as well. But, again, you know, the --
19 it's acoustic voice activity detection systems, which is
20 where the ratios are V1 over V2. So, you know, that --
21 when that ratio is large, the speech is detected, and so
22 yes, primarily here beta filter is trying to remove the
23 signal that may be corrupting the second microphone.

24 BY MS. WANG:

25 Q When you say "the second microphone," that's the

1 02 --

2 A The 02 --

3 Q -- microphone?

4 A Yes.

5 Q What about in Figure 4? Is the beta filter here
6 removing the noise that is corrupting the 01, first
7 microphone?

8 MR. COWELL: Objection to form.

9 THE WITNESS: Well, I -- yeah. I -- I think
10 I -- you know, I should be -- beta filter is, again,
11 capturing the relationship between the two microphones
12 with respect to speech, and it is being used so that the
13 AVAD works as well as possible.

14 So -- so let me -- let me see for a second.

15 I'm referring to my declaration here for a
16 second.

17 BY MS. WANG:

18 Q Uh-huh.

19 Is there a specific paragraph that you're --

20 A Yeah. I'm just looking at the description of --
21 in section 6, claimed invention of the '213 patent.

22 So yeah. So I think, you know, in -- again,
23 beta filter is capturing the relationship between the two
24 microphone signals for speech, and the objective here is
25 to -- so that the ratio, you know, in LSN, line -- or

1 paragraph 37, "the voice activity detection is based on
2 computing the ratio of V_1 do V_2 where double bar
3 indicates norm, and again, any size window may be used.
4 If beta, tilde Z, has been accurately calculated, the
5 ratio for speech should be relatively high; for example,
6 greater than approximately 2; and the ratio for noise
7 should be relatively low, less than approximately 1.1."

8 And it's referring to the patent, column 6, 20
9 to 32. "If the ratio is above the threshold, speech is
10 present; otherwise, speech is absent." And it's
11 referring to Figure 5 from the patent.

12 And then it's just saying "many techniques known
13 to those skilled in the art, for example, smoothing,
14 etc., can be used to make R more amenable to use in
15 generating a VAD, and the embodiments herein are not so
16 limited."

17 And again, this is referring to the patent,
18 column 6, 38 to 41.

19 So I'm going to actually go and look at 6 to see
20 if I can refresh my memory to answer your question more
21 accurately.

22 So I'm on column 6 of the patent, 20 to 32.

23 Yeah. So -- yeah. So can you repeat -- I'm
24 sorry. Can you repeat the question again, what you were
25 asking me.

1 Q No worries.

2 So my original question was when we were looking
3 at Figure 4 -- actually I'll take a step back.

4 We were looking at Figures 2 and 3, and you had
5 testified that the adaptive -- sorry -- the fixed or
6 adaptive filter beta was taking part in removing the
7 speech signal that's corrupting the 02 microphone.

8 Do you recall that?

9 A Yes.

10 Q And so that -- then we -- when we were looking
11 at Figure 4, I guess I was wondering, is the same -- and
12 that -- is the same sort of true, where here, the beta
13 filter, because it's in the top branch -- is it then
14 taking part in noise removal from the noise that's
15 corrupting the 01 microphone?

16 A No, I -- in V1, yes -- no, actually -- you know,
17 it's actually a little -- you know, this is really beyond
18 really the scope -- to some extent, the scope of this
19 patent.

20 But beta -- in V1, the role here is to make the
21 noise responses of V1 and V2 as comparable as possible.
22 So, you know, for speech response, V1 and V2 are
23 different. V1 is stronger, and V2 is small, and that's
24 generally how these circuits work.

25 And for noise responses, V1 and V2 are of

1 comparable size so that, you know, when speech is coming,
2 the ratio V1 to V2 is large so you can accurately detect
3 it. That's why the cancelation -- you know, the
4 cancelation of any speech corrupting O2 in Figure 3 is
5 important, whereas when it's noise, the two outputs are
6 comparable, very similar responses, so that the ratio
7 would be close to 1.

8 And that's what's, you know, emphasized in 37,
9 in my declaration as well, where it says "if beta tilde Z
10 has been accurately calculated, the ratio for speech
11 should be relatively high -- for example, greater than
12 approximately 2 -- and the ratio for noise should be
13 relatively low, for example, less than approximately
14 1.1."

15 So hopefully that gives you a better idea of
16 what this filter is doing for V1 and V2.

17 Q Is it your testimony that the beta filter in
18 Figure 4 is designed to ensure that the noise in
19 basically the top branch and the bottom branch are the
20 same?

21 MR. COWELL: Objection to form.

22 THE WITNESS: Yes, we -- partly that is correct
23 or comparable, subject to the design of beta already in
24 V2, where it's suppressing the -- the signal, any signal
25 corrupting O2. And, you know, I can -- yeah.

1 BY MS. WANG:

2 Q The beta shown in Figures 2, 3 -- well, sorry.
3 Strike that.

4 Is it the same beta that's in the bottom branch
5 and in the top branch --

6 A Yes.

7 Q Okay.

8 A I mean in Figure 3 and 4?

9 Q Yes.

10 A Yes, they are the same betas, yes.

11 Q So the same beta that is being used to remove
12 speech in Figure 3 is the same beta that is being used to
13 shape the noise in Figure 4?

14 A In the output of -- the noise in V1 and V2, yes.
15 It's -- yes.

16 Again, I think -- yeah.

17 Q And so it's the same beta in Figures 3 and 4,
18 and is it -- so it's the same beta that's applied to both
19 the 01 microphone signal and the 02 microphone signal?

20 MR. COWELL: Objection to form.

21 THE WITNESS: I think the -- the best way --
22 yes. So 01 -- you know, in Figure 3, the beta is being
23 applied to 01; and Figure 4, beta is being applied to 02,
24 and they are the same betas.

25 And the two circuits, Figure 3 and 4, are for

1 the virtual microphones V2 and V1.

2 BY MS. WANG:

3 Q So even though the beta filter in Figure 4 comes
4 after the alpha filter, the beta filter is still being
5 applied to the O2 signal?

6 A Well, calibrated --

7 (Interruption by the reporter)

8 THE WITNESS: Calibrated, yes. That's the
9 calibration filter alpha.

10 BY MS. WANG:

11 Q Is it fair to say that the alpha filter is
12 applied to the O2 signal?

13 MR. COWELL: Objection to form.

14 THE WITNESS: Well, as is clear from Figure 4.
15 I mean, I'm assuming you're referring to Figure 4; is
16 that correct?

17 BY MS. WANG:

18 Q Yes.

19 A Yeah. So as you can see from Figure 4, O2 is
20 first passed through the calibration filter alpha, and
21 then the beta filter is applied to that, and -- and so --
22 yeah. So it's O2 -- calibrated version of O2 is more
23 accurate because calibration filter is being applied.

24 Q And if we -- now is maybe a good time to turn to
25 the alpha filter, the calibration filter.

1 Would you agree that alpha is the filter that,
2 when applied to the 02 microphone signal, it changes that
3 signal so that it's different before versus after the
4 alpha filter?

5 MR. COWELL: Objection to form.

6 THE WITNESS: Yes. Now I can see compensate,
7 perhaps -- in 32 -- I think the main -- in 32 I explain,
8 you know, in particular the calibration filter in -- on
9 page 11.

10 It says "alpha Z is a calibration filter used to
11 compensate 02's response so that it is the same as 01."

12 And so, you know, basically 02 and 01
13 microphones, these are -- you know, they should have
14 identical responses, but manufacturing aspects can make
15 the response a little bit different. And so this
16 calibration filter is just so that, for the same input
17 signal, the outputs are the same. So that's what the
18 calibration filter does.

19 BY MS. WANG:

20 Q Can you explain what you mean, that the same
21 input -- for the same input signal, the outputs are the
22 same?

23 A Well, you know, what I mean is that, you know,
24 the -- ideally both these microphones should have the
25 same characteristics, that, you know, if you -- if -- if

1 the same signal -- if they were receiving the same
2 signal, for example, a speech signal in particular, then
3 the outputs would be the same, you know, again, from the
4 same distance and orientation or any -- you know, if --
5 if you apply the same input, if you will, to the two
6 microphones, the output would be the same.

7 But in practice, because of variations in
8 manufacturing and so on, they can be a little bit
9 different, and so that's what this calibration filter is
10 used, so that -- to account for any variations in the --
11 you know, manufacturing variations in the two filters.

12 Q So -- and in order to account for those
13 manufacturing variations, the -- is it correct to say
14 that the alpha filter, when applied to any signal -- that
15 it's going to change the signal so that the signal is
16 different before versus after the alpha filter?

17 MR. COWELL: Objection to form.

18 THE WITNESS: Yeah. So it'll be different, but
19 not too much different, as we --

20 MS. WANG: Did he freeze for you guys?

21 THE REPORTER: Yes.

22 MR. COWELL: Yeah.

23 MS. WANG: Oh, he looks unfrozen now.

24 Dr. Sayeed? Oh --

25 THE WITNESS: I was frozen?

1 MS. WANG: You froze for, like, 3 seconds or
2 5 seconds.

3 THE WITNESS: Okay. Glad that I'm unfrozen.
4 That can happen. So --

5 BY MS. WANG:

6 Q Let me repeat the question.

7 In order to account for those manufacturing
8 variations, is it correct to say that the alpha filter,
9 when applied to any signal, is going to change that
10 signal so that it is different before versus after the
11 alpha filter?

12 MR. COWELL: Objection to form.

13 THE WITNESS: Yes. Strictly speaking, it will
14 change. But again, not -- it won't be a significant
15 change, especially compared to what, you know, the beta
16 filter may be doing, for example, because it's -- I --
17 again, ideally 01 and 02, both -- both microphones should
18 have the same response to the same input. And so
19 there'll be some slight variations which the alpha filter
20 is trying to compensate for.

21 So we don't expect the changes introduced by
22 alpha to be too large. If it was too large, then we may
23 want to change the microphone, so then we have two
24 microphones which are really, you know, very different,
25 and that could mess up the system entirely potentially.

1 BY MS. WANG:

2 Q And when the alpha filter is applied to the 02
3 microphone signal in Figure 4, is it compensating for the
4 gain in the 02 microphone?

5 MR. COWELL: Objection to form.

6 THE WITNESS: Well, it could have -- so here in
7 35 -- may be helpful here in my declaration, paragraph
8 35.

9 "Ideally the microphones 01 and 02 are assumed
10 to be calibrated so that their response to a source
11 located the same distance away was identical for both
12 amplitude and phase."

13 That's from the patent, column 28, line 65 to
14 67.

15 "However, this is not always feasible in
16 practice, and the calibration filter alpha Z can be
17 determined using adaptive algorithms, for example, so
18 that in the presence of a speech-only signal (with no or
19 low levels of noise) the microphone signals 01 and 02
20 satisfy the relationship $01 Z = \alpha Z \times 02 Z$."

21 And it's referring to the patent, Exhibit 1001,
22 column 28, line 64, through column 29, line 31.

23 So, again, it could be -- in principle, in
24 general, it could be both amplitude and phase, but again,
25 the variations in both could be relatively small,

1 amplitude possibly even less than phase.

2 MS. WANG: Would you like another break?

3 THE WITNESS: That might be a good idea, yes.

4 Actually I was going to ask for that.

5 MS. WANG: Let's go off the record.

6 (Recess)

7 BY MS. WANG:

8 Q Dr. Sayeed, thank you. I just have a couple
9 more questions.

10 Earlier you stated that the claimed filter can
11 be a linear filter?

12 A Yes.

13 Q Can the claimed filter also be time invariant?

14 MR. COWELL: Objection to form.

15 THE WITNESS: Yes. So that gets a little, you
16 know -- again, it's a little bit of a technical thing,
17 but strictly speaking, the filters that are within the
18 scope of this patent are linear and time invariant.
19 And -- however, they are adaptive as well that they -- we
20 can adapt them over time as well.

21 So how -- so -- so let's not -- so the two
22 should not be confused. Adaptation changes the filters
23 over time; however, whenever we apply a filter, its
24 coefficients or, you know -- it's fixed, and that
25 application of the filter is -- can be understood as a

1 linear time invariant system.

2 I don't know if that makes --

3 BY MS. WANG:

4 Q So --

5 A Yeah.

6 Q -- that's helpful. Thank you.

7 So even though -- in the case that the filters

8 are adaptive, the adaptation can change the filter; but

9 when the filter is applied, it's an LTI or linear time

10 invariant --

11 A Yes.

12 Q -- filter?

13 A Yes, that's correct.

14 Q And -- but it's also the case that the filter

15 can be a fixed filter?

16 A Yes.

17 Q And that fixed -- sorry. Were you --

18 A Yes, that can be -- it can be fixed as well,

19 yes.

20 Q And when the filter is a fixed filter, that

21 fixed filter is an LTI or linear time invariant filter?

22 A Yes.

23 MS. WANG: I have no other questions, so I'll

24 pass the witness.

25 MR. COWELL: I have no questions.

1 THE WITNESS: Okay.

2 MS. WANG: Okay. Then we can conclude.

3 THE REPORTER: Mr. Cowell?

4 MR. COWELL: Yes.

5 THE REPORTER: Would you like a copy?

6 MR. COWELL: I'll take a rough. I don't need a

7 copy of the transcript.

8 THE REPORTER: If you order the rough, you do

9 have to get a copy.

10 MR. COWELL: Okay. Just normal delivery.

11 THE REPORTER: Thank you.

12 Are we ready to go off the record?

13 MS. WANG: Yes.

14 (The proceedings concluded at 11:23 a.m. Central

15 Daylight Time.)

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I, AKBAR M. SAYEED, Ph.D., declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct.

Executed at _____, California,
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Further, that if the foregoing pertains to the original transcript of a deposition in a federal case, before completion of the proceedings, review of the transcript [X] was [] was not requested.

I further certify I am neither financially interested in the action nor a relative or employee of any attorney or any party to this action.

IN WITNESS WHEREOF, I have this date subscribed my name.

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