

META PLATFORMS, INC.,

Petitioner,

vs.

CERTIFIED COPY

JAWBONE INNOVATIONS, LLC,

Patent Owner.

_____/

Case IPR2023-01352 (US Patent No. 7,246,058)

REMOTE CONFERENCING DEPOSITION OF AKBAR SAYEED, Ph.D.

Stenographically reported by NICOLE HATLER

California CSR No. 13730

September 25, 2024

JOB No. 24-142180

 THE SULLIVAN GROUP
OF COURT REPORTERS
SULLIVANCOURTREPORTERS.COM
PHONE 562.888.6488

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

META PLATFORMS, INC.,

Petitioner,

vs.

CERTIFIED COPY

JAWBONE INNOVATIONS, LLC,

Patent Owner.

_____/

Case IPR2023-01352 (US Patent No. 7,246,058)

REMOTE CONFERENCING DEPOSITION OF AKBAR SAYEED, Ph.D.

Stenographically reported by NICOLE HATLER

California CSR No. 13730

September 25, 2024

JOB No. 24-142180

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

I N D E X

PAGE

EXAMINATION BY MS. WANG.....4

EXAMINATION BY MR. OSTLING.....74

(No exhibits marked.)

1 REMOTE CONFERENCING DEPOSITION OF AKBAR SAYEED, Ph.D.

2

3

4 BE IT REMEMBERED, that pursuant to Notice, and on
5 the 25TH day of SEPTEMBER 2024, commencing at the hour of
6 7:09 a.m., in the respective locations via Zoom, before
7 me, NICOLE HATLER, a Certified Shorthand Reporter, State
8 of California, personally appeared AKBAR SAYEED, Ph.D.,
9 produced as a witness in said action, and being by me
10 first duly sworn, was thereupon examined as a witness in
11 said cause.

12

---oOo---

13

APPEARANCES ALL REMOTELY VIA ZOOM

14

For the Petitioner:

15

GRACE I. WANG

16

JEREMY RASHID

INGRID KAO

17

Paul Hastings LLP

200 Park Avenue

18

New York, NY 10166

(212) 318-6833

19

gracewang@paulhastings.com

20

For the Patent Owner and Witness:

21

JACOB OSTLING

Fabricant LLP

22

411 Theodore Fremd Avenue, Suite 206 South

Rye, NY 10580

23

(646) 797-4354

jostling@fabricantllp.com

24

25

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

AKBAR SAYEED, Ph.D.

sworn as a witness

testified as follows:

THE REPORTER: Good morning. My name is Nicole Hatler, California Certified Shorthand Reporter No. 13730. This deposition will be stenographically reported pursuant to CCP 2025.

MS. WANG: Thank you.

EXAMINATION BY MS. WANG:

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

A. Good morning, Ms. Wong. Yes, good to see you, too.

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

A. My first name is Akbar, A-K-B, as in boy, A-R; middle name is Muhammad, M-U-H-A-M-M-A-D, as in David, at the end; and last name is Sayeed, S, as Sam, A-Y-E-E-D, as in David.

MS. WANG: Sorry. Can we go off the record real quick?

(A recess was held from 7:10 a.m. to 7:10 a.m.)

BY MS. WANG:

Q. Dr. Sayeed, have you been deposed since we last spoke at your deposition last week?

1 A. No, I haven't.

2 Q. So today is your fourth deposition?

3 A. Yes.

4 Q. And it looks like you're sitting in your home
5 office in Madison, Wisconsin --

6 A. Yes.

7 Q. -- is that right?

8 A. Correct.

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

10 A. Well, I have hard a copy. I have some hard
11 copies. Basically, the first one I have is, you know,
12 table of contents of my declaration, and also table of
13 contents of the petition. Then I have the -- the patent
14 '058, the hard copy of its claims and its figures. And I
15 also have hard copies of some prior art; particularly
16 Mizel, which is Exhibit 1005. I mean, just the figures,
17 the hard copies of the figures of these patents.
18 Exhibit 1005, Kaneda 1006. And I think that might be it.
19 Yes.

20 Q. And --

21 A. Yeah.

22 Q. When you refer to your declaration and the table
23 of contents of the petition, are those the declaration
24 and the petition in IPR proceeding 2023-01352?

25 A. Yes. That's correct.

1 Q. Other than the papers that you mentioned in your
2 previous answer, do you have any other papers in front of
3 you?

4 A. No, I don't.

5 Q. Are there any indications on those papers?

6 A. No.

7 Q. On the computer device that you're using to do
8 this deposition, are there any applications or programs,
9 other than Zoom, that are open?

10 A. Yes, I do have other than Zoom. I have three
11 PDF applications open. In one, I have my copy of my
12 declaration. And then in the second one, I have the
13 petition and the declaration of Dr. Anderson. And then
14 in the third application, I have copies of the patents,
15 the '058 patent, Exhibit 1001, and then Exhibit 1005,
16 which is the Mizel patent, and then Exhibit 1006 Kaneda
17 patent, and Exhibit 1007, which is the Freden patent, and
18 then Exhibit 1008, which is the Sico patent, and that's
19 it.

20 Q. Are there any annotations on any of the PDFs
21 that you have open?

22 A. No.

23 Q. Other than PDF and Zoom, do you have any other
24 applications or programs open?

25 A. No.

1 Q. Okay. So if at any point during this
2 deposition, if you do have another program or application
3 open, or if you happen to have another piece of paper in
4 front of you, just please let us know.

5 A. Okay.

6 Q. And you understand that these rules apply not
7 just during the questioning and answering part of the
8 deposition, but also during the breaks?

9 A. Yes.

10 Q. So given that we have a court reporter
11 transcribing us today, let's try not to talk over each
12 other. Is that okay?

13 A. Yes.

14 Q. If you don't understand a question, please ask,
15 and I will try to clarify the question. Is that okay?

16 A. Okay.

17 Q. And that way, if you answer the question, then
18 we will all know that you understood that question; is
19 that fair?

20 A. Yes.

21 Q. Okay. If you need a break at any time, just let
22 me know.

23 A. Okay.

24 Q. But during the break, please don't refer to any
25 materials or use the Internet.

1 A. Okay.

2 Q. Just -- if there is a pending question, we just
3 ask that you provide the answer to that question and then
4 we can do the break. Is that okay?

5 A. Yes. That's okay.

6 Q. Is there anything that would prevent you from
7 testifying completely, truthfully, and accurately today?

8 A. No.

9 Q. Are you on any medications that would prevent
10 you from providing complete, accurate, and truthful
11 testimony today?

12 A. No.

13 Q. And is there anyone else in the room with you
14 right now?

15 A. No.

16 Q. So you understand that you're here to testify
17 about your opinions in the proceeding IPR 2023-01352
18 regarding U.S. Patent 7246058?

19 A. Yes. That's correct.

20 Q. And we'll refer to that patent as the '058
21 patent. Is that okay with you?

22 A. Yes.

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

24 A. Yes.

25 Q. How much time did you spend?

1 A. Probably about 13 hours -- 10, 15 hours.

2 Q. And what did you do to prepare?

3 A. Well, we --

4 MR. OSTLING: And, Dr. Sayeed, I'm just going to
5 caution not to reveal communications with Jawbone's
6 attorneys in answering that question.

7 THE WITNESS: Thanks, Jacob.

8 Yeah. Basically, reviewed the material relevant
9 to this case and the petition and the patents and my
10 declaration, and, yeah. And had discussions -- some
11 discussion with, you know, the Jawbone's attorneys,
12 particular Mr. Ostling.

13 BY MS. WANG:

14 Q. Did you speak with anyone else while preparing
15 for the deposition?

16 A. No.

17 Q. What is voicing?

18 MR. OSTLING: Objection. Form.

19 THE WITNESS: What is voicing? It's -- could
20 you -- that seems a little broad. Could you, you know,
21 refine or give the context?

22 BY MS. WANG:

23 Q. Do you have an understanding of the word
24 voicing?

25 A. Yes. But depending on the context, it can mean

1 somewhat different things.

2 Q. In the context of the '085 patent, what is
3 voicing?

4 A. Well, one context is, you know, a voicing
5 sensor, for example, which, according to '058 patent --
6 let me just go to where I specifically talk about it.
7 Can I talk or state, in paragraph 37, a POSITA reading
8 the '058 patent, in combination of its prosecution
9 history, would understand the term voicing sensor to mean
10 a sensor that is able to detect human tissue motion,
11 associated speech as unaffected by environmental noise.
12 So that's in the context of voicing sensor, for example.

13 Q. Is a voicing sensor the same as a speech sensor?

14 MR. OSTLING: Objection to form.

15 THE WITNESS: Well, I think, again, it's a
16 question of what it -- you know, it's -- could be related
17 to speech, but I think it's more about what it is sensing
18 or detecting and more, you know, the human tissue motion.

19 (Reporter clarification.)

20 THE WITNESS: Yes. Human tissue motion. As
21 opposed to a microphone that just senses or detects the
22 sound waves, which are produced during speech.

23 BY MS. WANG:

24 Q. Are you drawing a distinction between a sensor
25 and a microphone?

1 A. Specifically, a voicing sensor as I have -- in
2 the context of this patent and a microphone.

3 Q. So a voicing sensor, in the context of this
4 patent, is different from a microphone?

5 A. Well, specifically, you know, as I -- you know,
6 in the construction, as I articulated in my declaration,
7 a microphone is also a sensor. Sensor can be, you know,
8 many, many sensors. You know, not all sensors are
9 microphones, but a microphone is also a particular kind
10 of sensor.

11 Q. The question was about a voicing sensor, not
12 sensor in general. So I'll ask it again.

13 A. Okay.

14 Q. Is a voicing sensor, in the context of the '058
15 patent, different from a microphone?

16 MR. OSTLING: Objection to form.

17 THE WITNESS: Yes, yeah. I'll just refer to,
18 you know, for example, the language in Claim 1. "At
19 least one voicing sensor that receives physiological
20 information associated with human voicing activity." So,
21 yes. That is specifically referring to a sensor that's
22 different than a microphone.

23 BY MS. WANG:

24 Q. So the voicing sensor in Claim 1 and 2 of the
25 '058 patent have to be different from a microphone, is

1 that your testimony?

2 MR. OSTLING: Objection to form.

3 THE WITNESS: I think that it's fair to say
4 because it is making a distinction between a voicing
5 sensor, and it refers to microphones later in the claim.

6 BY MS. WANG:

7 Q. Do all voicing sensors have to be able to detect
8 human tissue motion associated with speech?

9 A. You know, within the context of this '058
10 patent, especially the -- what's being claimed, that's --
11 a voicing sensor means, as I stated in paragraph 37,
12 sensor that is able to detect human tissue motion
13 associated with speech and unaffected by environmental
14 noise. So, yes, within the -- the context of this patent
15 that's the -- yeah.

16 Q. Is the voicing sensor the same as the voice
17 activity detector?

18 MR. OSTLING: Objection to form.

19 THE WITNESS: It's not the same voice activity
20 detector, and voicing sensor are -- sometimes they could
21 be the same, but they're not the same thing.

22 BY MS. WANG:

23 Q. How are they different?

24 A. Well, a sensor is a device, and a detector may
25 have some additional processing may be, for example,

1 associated with it.

2 Q. Any other difference other than the device
3 versus processing?

4 MR. OSTLING: Objection to form.

5 THE WITNESS: I think I would -- yeah. There
6 could be others, too, but that's adding. The main thing
7 is that they are not the same thing. You know, some --
8 yeah. A voice activity detector would include a voicing
9 sensor or may include, but it doesn't have to be exactly
10 the same.

11 BY MS. WANG:

12 Q. What's an example of a voice activity detector
13 that does not include a voicing sensor?

14 MR. OSTLING: Objection to form. Objection;
15 relevance.

16 THE WITNESS: Yeah. I didn't say that it does
17 not include. I said that they aren't the same thing. So
18 a voice activity detector would have a voicing sensor,
19 but it may have some additional processing on top of it,
20 for example, off the signals coming from the voicing
21 sensor.

22 BY MS. WANG:

23 Q. So --

24 A. So yeah.

25 Q. Sorry. Were you done?

1 A. Yes.

2 Q. So is it your testimony that a voice activity
3 detector must include a voicing sensor?

4 MR. OSTLING: Objection. Misstates the
5 testimony.

6 THE WITNESS: Could you please repeat the
7 question?

8 BY MS. WANG:

9 Q. Is it your testimony that a voice activity
10 detector must include a voicing sensor?

11 MR. OSTLING: Objection. Same objection.

12 THE WITNESS: Well, no. Not strictly speaking.
13 That is not correct. In some cases so there are two --
14 for example, in this '058 patent, you know, there are two
15 different systems, and in some cases PSAD and NAVSAD, but
16 in some cases a VAD, or voice activity detector, may be
17 based on, you know, derived from microphone signals, too.

18 And so, that would be based on different device
19 or sensor than a voicing sensor the way it's interpreted
20 in this patent or what that means in context of this
21 patent, as I state in paragraph 37. Again, a voicing
22 sensor, to me, is a sensor that is able to detect human
23 tissue motion associated with speech that is unaffected
24 by environmental noise. So, yeah. So there are -- there
25 can be embodiments or voice activity detectors which

1 use -- which are based on, you know -- includes a
2 microphone, as well, but that's different than what -- so
3 that would be different than. In that case, the sensor
4 would not be the voicing sensor as implied here.

5 BY MS. WANG:

6 Q. So a voice activity detector that uses
7 microphones as opposed to some other type of sensor is
8 not covered by the claims of the '058 patent?

9 A. I think the claims don't explicitly directly
10 refer to a voice activity detector, so -- so I wouldn't
11 necessarily say that.

12 Q. Well, it's -- that's the point is that the
13 claims don't refer to a voice activity detector. So if
14 there were a system that had a voice activity detector
15 using microphones, that would not be covered by the
16 claims of the '058 patent; is that correct?

17 A. Well, I am going to try to do the best to -- to
18 my ability. I think, again -- I think that's maybe fair
19 to say, you know, that the specifications, certainly in
20 terms of the two systems discussed, consider both kind of
21 voice activity detectors, but the claims are specifically
22 referring to one of them which involves nonacoustic
23 sensors. So it is differentiating between the two.

24 Q. Earlier, you referred to the patent as
25 describing an acoustic microphone as a voice detector.

1 What portion of the '058 patent were you referring to?

2 MR. OSTLING: Objection to form.

3 THE WITNESS: Could you repeat the question
4 again? I'm sorry.

5 BY MS. WANG:

6 Q. Earlier when you were referring to the patent as
7 describing embodiments that use an acoustic microphone as
8 detecting voice, what portion of the '058 patent were you
9 referring to?

10 MR. OSTLING: Objection to form.

11 THE WITNESS: All I know is I was mainly
12 referring to the two systems which are in the -- so I was
13 referring to the PSAD system which explicitly does not
14 have a voicing sensor. So let me just -- so let me see
15 what's stated in -- yes. But basically, I was referring
16 to figure 2 in the patent which is an associated
17 discussion with is the PSAD system that's, for example,
18 on column two and lines 41. Starting at line 41 it talks
19 about figure 2.

20 BY MS. WANG:

21 Q. Is it fair to say that voicing can include
22 screaming and yelling but does not necessarily include
23 speech?

24 MR. OSTLING: Objection to form.

25 THE WITNESS: Could you please repeat the

1 question?

2 BY MS. WANG:

3 Q. Is it fair to say that voicing can include
4 screaming and yelling, but that does not necessarily
5 include speech?

6 MR. OSTLING: Objection to form.

7 THE WITNESS: I don't think so. If I
8 understand, I mean, yeah. Screaming and yelling and
9 versus speech, could you provide a context? Maybe what
10 context in this question. I don't know. I'm not sure
11 what the -- what --

12 BY MS. WANG:

13 Q. Is all voicing the same as speech?

14 A. Well, I -- no. I don't think so. Or I don't --
15 yeah. It's not. And again, in the context of this
16 patent, voicing is or voicing sensor that's the closest
17 connection to this patent. I can see is about sensor that
18 detects physiological information or, you know, a sensor
19 that is able to detect human tissue motion associated
20 with speech and is unaffected by environmental noise, and
21 it's directly detecting physiological information related
22 to generation of voice speech, in particular, as referred
23 to in Claim 1, as well, and then when the vocal cords are
24 vibrating, in particular. So -- so it's not all speech
25 that -- yeah. And I don't know the distinction with

1 screaming necessarily, but it's not all speech.

2 Q. What is the difference between voicing and
3 speech?

4 MR. OSTLING: Objection to form.

5 THE WITNESS: Well, it's -- you know, in Claim
6 1, for example, it's distinguishing between detecting
7 voice, you know -- voice and unvoiced speech, and the
8 main difference there is whether the vocal cords are
9 vibrating or not. So that's one distinction here in
10 terms of how speech is generated. Yeah. And I'll leave
11 it at that.

12 BY MS. WANG:

13 Q. Can you describe what is unvoiced speech?

14 MR. OSTLING: Objection to form.

15 THE WITNESS: Well, let me -- I'll just review
16 in my own declaration. Well, the main difference, you
17 know, between -- as I said earlier, voice speech involves
18 vibration of vocal cords where as unvoiced speech does
19 not involve vocal cords vibrations. That's one basic
20 difference.

21 BY MS. WANG:

22 Q. Is it possible for the vocal folds -- sorry.
23 Strike that.

24 Is it possible for the vocal cords to vibrate
25 without the person speaking or -- sorry. Strike that.

1 Is it possible for the vocal cords to vibrate
2 without the person producing speech?

3 MR. OSTLING: Objection to form.

4 THE WITNESS: Well, I'm -- could you -- can you
5 repeat the question again? Or -- yeah.

6 Q. Is it --

7 A. Go ahead.

8 Q. Is it possible for the -- a person's vocal cords
9 to vibrate without the person producing speech?

10 MR. OSTLING: Objection to form.

11 THE WITNESS: Well, I guess, you know, I think
12 you could be -- a person could be generating some sound
13 which is not necessarily speech, per se, which involve
14 vocal cords vibrating, or vocal cords could be vibrating
15 because of, in response to, some external stimulus,
16 potentially if it was something strong pressure waves hit
17 the person, but -- so I guess it is possible that they
18 could be vibrating without being involved in speech
19 production, per se.

20 BY MS. WANG:

21 Q. What is human tissue motion?

22 A. Well, the correct meaning would be when human
23 tissue moves.

24 Q. Is vibration a type of human tissue motion?

25 A. If it's the vibration of human tissue, yes,

1 because vibration involves movement.

2 Q. Is vibration of vocal cords a type of human
3 tissue motion?

4 A. Yes.

5 Q. What other types of human tissue motion exist
6 other than vibration of vocal cords?

7 MR. OSTLING: Objection to form.

8 THE WITNESS: You know, that's a very broad
9 question. It could be, you know, obviously, many, many
10 things, but I think, you know, movement of tongue, maybe,
11 I don't know, or jaw.

12 BY MS. WANG:

13 Q. Movement of tongue or jaw could be human tissue
14 motion associated with speech?

15 A. Yes. But not necessarily in the context of
16 voice speech or voicing sensor. Because I think, you
17 know, the position of the jaw or tongue can affect how
18 speech is produced, or, you know, how some of the sounds
19 are modulated. So, yes, but not in the context of --
20 yeah. The necessarily limited -- not in the context of a
21 voicing sensor, per se, that is referred to in this
22 patent and also in my declaration.

23 Q. A sensor that detects vibration of the vocal
24 cords, is that a voicing sensor in the context of the
25 '058 patent?

1 MR. OSTLING: Objection to form.

2 THE WITNESS: I -- can you, please, repeat the
3 question again, just so that I understand it accurately?

4 BY MS. WANG:

5 Q. Yes. Yes. A sensor that detects the vibration
6 of vocal cords, is that a voicing sensor in the context
7 of the '058 patent?

8 MR. OSTLING: Same objection.

9 THE WITNESS: So what -- so the voicing sensor,
10 again, is the way it's articulated in this patent, and
11 also, in my declaration, is one that is directly
12 detecting human tissue motion associated with speech,
13 which is, you know, vibration of vocal cord, as well. So
14 -- and another place where -- an example would be, you
15 know, the -- an electromagnetic sensor, which is in 39,
16 and an important thing there that it's unaffected by
17 noise, so POSITA would understand that the voicing sensor
18 must be unaffected by environmental noise. Every
19 embodiment disclosed in the '058 patent in doing those
20 using GEM sensors, auto sound devices, acoustic throat
21 microphones, and air flow detectors utilizes a
22 nonacoustic sensor, which would be unaffected by
23 environmental acoustic noise. And it goes on to, you
24 know, describe the gem sensor as a, you know, based on
25 electromagnetic waves.

1 So a distinction here in which it's directly
2 detecting the physical motion, which is unaffected by
3 noise as opposed to, you know, some where -- which are,
4 of course, generated by motion -- motion of vocal cords
5 but are sensed through the acoustic signals generated,
6 and they are prone to being corrupted by noise.

7 BY MS. WANG:

8 Q. In your previous answer, when you referred to
9 environmental noise, is that environmental acoustic
10 noise?

11 A. Yes. And -- and primarily in the context or
12 distinction between, you know, nonacoustic versus
13 acoustic sensor, yes, that will be environmental acoustic
14 noise.

15 Q. What is noise?

16 MR. OSTLING: Objection to form.

17 THE WITNESS: Yeah. That's a very broad
18 question. I think in the context of -- of this patent,
19 it would be, you know, any other background sound that is
20 coming in which interferes with the -- with the speech or
21 target speech of interest, you know, whether it could be
22 a horn blaring in the background, for example, or some
23 other acoustic signal that are not of interest.

24 BY MS. WANG:

25 Q. Does environmental mean background?

1 MR. OSTLING: Objection to form.

2 THE WITNESS: It could. You know, it's a --
3 basically, whatever is the environment in which the
4 system is operating or where -- yeah.

5 BY MS. WANG:

6 Q. Do you have an understanding of how to determine
7 whether a sensor is unaffected by something?

8 MR. OSTLING: Objection to form.

9 THE WITNESS: Well, I mean, I'm going to refer
10 to, again, you know, in the -- you know, in the context
11 of how I stated in said paragraph 37 and elaborate on it,
12 but unaffected by environmental noise -- let me -- so,
13 for example, in 41 -- paragraph 41, I state, "Moreover,
14 being unaffected by environmental noise is key to the
15 invention and required for good performance."

16 And this is stated in columns 4, lines 44 to 46.
17 I'm citing knowing that external noise is not a problem
18 when using a nonacoustic sensor, and then I stated, "A
19 POSITA to understand this to be a requirement of all
20 voicing sensors as claimed in the '058 patent.
21 Particularly, given the distinction drawn between voicing
22 sensors, which receive psychological information and
23 microphones, which receive acoustic signals in the
24 claims.

25 So, you know, again, in this context, what a

1 voicing sensor is doing, for example, is directly
2 detecting the motion of the human tissue, for example,
3 vocal cords moving to generate sound, and -- and it's not
4 affected by any other sound. So it's going to the
5 source, if you will. Whereas, microphones are just
6 sensing -- the acoustic microphones are just sensing the
7 sound waves generated by that vocal cord movement, but
8 they are also sensing other noise coming to them from the
9 background or the environment.

10 BY MS. WANG:

11 Q. Can there be nonacoustic noise?

12 MR. OSTLING: Objection to form; relevance.

13 THE WITNESS: Of course there can be nonacoustic
14 noise. Again, that's a very broad question. But here,
15 the relevant part is the acoustic noise, which would be
16 impacting the performance of signals picked up by
17 acoustic microphones.

18 BY MS. WANG:

19 Q. So is it your opinion that, as long as the
20 voicing sensor is nonacoustic, then it is unaffected by
21 environmental noise?

22 A. Well, in -- you know, not -- in this -- can you
23 -- can you restate the question again, please.

24 Q. Is it your opinion that, as long as the voicing
25 sensor is nonacoustic, then it is unaffected by

1 environmental noise?

2 A. Again, this is a very broad question. And I
3 think I -- you know, let me -- I think the -- the
4 difference here is in the context of this patent, the
5 difference is that, you know, acoustic noise,
6 environmental noise is the issue which would be
7 corrupting the signals of acoustic microphones. And a
8 nonacoustic sensor, for example, one based on, you
9 know -- through electromagnetic waves, would be avoiding
10 that noise, but that doesn't, necessarily, mean that a
11 nonacoustic sensor, per se, is immune to any
12 environmental noise because, for example, someone could
13 be generating signals at exactly the same frequency as an
14 electromagnetic sensor, voicing sensing and sending in
15 the direction of that sensor to create noise. But that's
16 a farfetched situation.

17 So it doesn't always mean the way you implied,
18 so hopefully, my answer clarified the question. So --

19 Q. I'm not --

20 MR. OSTLING: Just when you get to the end of
21 this line, can we just get a restroom break?

22 MS. WANG: Yeah. Let me just do one quick
23 question, following up on this.

24 MR. OSTLING: Sure.

25 BY MS. WANG:

1 Q. I'm not trying to be purposely obtuse or
2 difficult with the question. I'm just trying to get an
3 understanding of what's your opinion as to what the
4 voicing sensor of the '058 claim is.

5 So is it your testimony that a nonacoustic
6 sensor is unaffected by acoustic noise?

7 A. A nonacoustic sensor is unaffected by acoustic
8 noise. Well, if the nonacoustic sensor is -- you know,
9 let me just -- yeah. So in 40 -- in paragraph 40, I say
10 state, you know, "'058 patent also explicitly defines a
11 voicing sensor as a nonacoustic sensor. A nonacoustic
12 sensor or after just the sensor." It also refers to the
13 voicing sensor as a nonacoustic sensor, discussing
14 voicing activity detected or nonacoustic sensors. And
15 so, to -- yes. A nonacoustic sensor, because it is
16 sensing nonacoustic signals, would, by definition, be
17 immune to acoustic noise because that's not the modality
18 that it's detecting or sensing.

19 MS. WANG: Thank you. Let's take a quick break.

20 MR. OSTLING: How's 10 minutes?

21 MS. WANG: Yeah. That sounds good.

22 THE WITNESS: Thank you.

23 MR. OSTLING: Okay.

24 MS. WANG: Thank you.

25 (A recess was held from 7:59 a.m. to 8:09 a.m.)

1 BY MS. WANG:

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

3 A. Thank you.

4 Q. During the break, did you speak with anybody?

5 A. No.

6 Q. During the break, did you look at any web
7 browser?

8 A. No.

9 Q. Did you look at any notes?

10 A. I was just here looking at my own declaration.

11 Q. The un-annotated declaration?

12 A. Un-annotated declaration. Yes.

13 Q. Before the break, you gave an answer about
14 nonacoustic sensor being unaffected by acoustic knows.

15 Do you remember that?

16 A. Yes.

17 Q. In your answer, you stated a nonacoustic sensor,
18 because it is something nonacoustic signals would -- by
19 definition, would be immune to acoustic noise because
20 that's not the modality that its detecting or sensing?

21 A. Yes. Yes.

22 Q. In this answer, when you refer to immune to, is
23 that the same as unaffected by?

24 A. Yes. Unaffected by. Yes. That would mean --
25 yeah.

1 Q. So is it your testimony that a nonacoustic
2 sensor is unaffected by environmental acoustic noise?

3 A. Yes. Again, as I said, because, by definition,
4 a nonacoustic sensor is sensing in a modality, which is
5 different than the acoustic signals. So it would not be
6 affected by that. It's -- yeah.

7 Q. Have you --

8 A. Just like an electromagnetic sensor, for
9 example, is not going to be affected by acoustic signals.
10 So, yeah.

11 Q. Sorry. I keep interrupting.

12 A. Yeah. Yeah. Sorry. Sorry. Because there are
13 two different modalities, electromagnetic signals and,
14 you know, acoustic signals. So, yeah. Those are very
15 different sensors. So each one of them would be not
16 affected by the other modality. I was just giving an
17 example of that.

18 Q. So if I'm understanding you correctly, is it
19 fair to say that a sensor in one modality is unaffected
20 by noise in a different modality?

21 A. Yes.

22 MR. OSTLING: Objection to form.

23 THE WITNESS: Again, I -- it's -- you know --
24 you know, I don't want to give a very broad answer, but,
25 yes. You know, if it's -- the only -- you know, every

1 sensor detects or senses signals in a particular
2 modality. And so, a noise -- in that also has to be the
3 same physical modality. So if it doesn't sense it, it's
4 not going to be affected by it.

5 So, again, a specific example would be an
6 electromagnetic sensor is not going to be affected by no
7 matter what kind of sound you send in its direction
8 because that's not what it the sensing or can. They are
9 different modalities.

10 BY MS. WANG:

11 Q. And there's other types of noise other than
12 acoustic noise, right?

13 MR. OSTLING: Objection. Scope.

14 THE WITNESS: Yes. Absolutely. Noise is -- is
15 very broad scope for noise.

16 BY MS. WANG:

17 Q. So is it fair to say that a sensor in one
18 modality is affected by noise in that modality?

19 MR. OSTLING: Objection. Scope.

20 THE WITNESS: Yes. If we -- yeah. At least the
21 way I'm thinking about the modality, yes. The physical
22 modality, which the sensor is operating, yes. Again,
23 concrete example, in general things, an electromagnetic
24 sensor, for example, senses only electromagnetic signals.
25 And so, it will only be affected by electromagnetic

1 signals. And, similarly, you know, a microphone -- an
2 acoustic microphone would be sensing sound waves. And
3 so, it's not going to be impacted by electromagnetic
4 signals as noise, only by noise in the form of sound
5 waves.

6 BY MS. WANG:

7 Q. Is it fair, then, to say that a nonacoustic
8 sensor is affected by nonacoustic noise that comes from
9 the environment?

10 MR. OSTLING. Objection. Relevance.

11 THE WITNESS: It could be if there was noise in
12 that modality in the environment. Again, in this
13 context, the noise is, you know, in the acoustic realm.
14 So sounds -- other extraneous sounds would be the noise
15 and a -- a nonacoustic sensor is unaffected by that.

16 BY MS. WANG:

17 Q. Are you reading environment in the '058 patent
18 to mean acoustic?

19 A. Well, I'm reading environment to, you know --
20 environment is environment. I don't think I'm reading it
21 that way. I think the noise-impacting microphone,
22 acoustic microphones would be acoustic noise. That's
23 what I'm reading it as.

24 Q. What is environment?

25 MR. OSTLING: Objection. Asked and answered.

1 THE WITNESS: Yes. I think -- I think I already
2 answered it earlier. It's the environment in which the
3 system is operating with a microphones and a nonacoustic
4 sensors are collecting the signals where the invention is
5 operating. Yeah -- could. Yeah.

6 BY MS. WANG:

7 Q. And that environment includes nonacoustic
8 modality?

9 A. That's a --

10 Q. Sorry.

11 A. You know. Please, you know, I don't know what
12 that question means, Ms. Wang.

13 Q. Well, you --

14 A. So --

15 Q. Oh, sorry.

16 In your previous answer, you said the
17 environment in which the system is operating with
18 microphones and the nonacoustic sensors are collecting
19 the signals where the invention is operating. So my
20 question to you was to confirm that the environment
21 includes a nonacoustic modality.

22 MR. OSTLING: Objection to form. It misstates
23 the testimony.

24 THE WITNESS: Well, I think, you know -- I don't
25 know what I -- you know -- it's like a -- environment is,

1 as I said, where the system is operating. Of course, in
2 their environment, there could be all sorts of signals.
3 For example, there could be a cellphone sitting there,
4 and it's emanating electromagnetic waves. So to that
5 extent, there could be nonacoustic signals in the
6 environment, as well, which may be completely irrelevant
7 to the operation of the system because they could be at
8 different frequencies. They could be, you know, yeah.
9 So, you know, for -- for someone, yeah. We are washed
10 with signals of many, many kinds in some ways. So it's a
11 very broad question. And, yes, the environment could
12 have signals of different modalities, but here, the focus
13 is on acoustic noise because we're dealing with
14 microphones which are picking up sounds and speech.

15 BY MS. WANG:

16 Q. So in the claim construction for voicing sensor,
17 you provided your opinion that a voicing sensor is a
18 sensor that is able to detect human tissue motion
19 associated with speech that is unaffected by
20 environmental noise.

21 The environment noise in that construction, is
22 it acoustic noise?

23 MR. OSTLING: Objection to form.

24 THE WITNESS: I think that's fair to say it's --
25 in 38, for example, I say the construction -- this

1 construction comes directly from the specification --
2 paragraph 38 -- sorry. This construction comes directly
3 from the specification which explains that alternative
4 embodiments, however, may use any sensor that is able to
5 detect human tissue motion associated with speech and is
6 unaffected by environmental acoustic noise, '058 patent
7 at column 3, line 61 to 63.

8 BY MS. WANG:

9 Q. Is it fair to say that the construction came
10 from this language in the specification?

11 MR. OSTLING: Objection to form.

12 THE WITNESS: Could you repeat the question,
13 please?

14 BY MS. WANG:

15 Q. Is it fair to say that the claim construction
16 for voicing sensor came from this language in the
17 specification?

18 MR. OSTLING: Same objection.

19 THE WITNESS: Well, not just this as I, you
20 know -- I describe in the, you know -- paragraph 37
21 to 46, the -- the rationale for this claim construction.
22 So it's not just that specific one.

23 BY MS. WANG:

24 Q. Is it your testimony that the environment in
25 which the invention is operating includes both acoustic

1 and nonacoustic modalities?

2 MR. OSTLING: Objection. Relevance.

3 THE WITNESS: I think environment and talking
4 about modalities is, kind of, like apples and oranges, to
5 some extent. What I -- you know, and I think what I --
6 so the best -- you know, in terms of what I stated, you
7 know. There could be signals in different modalities in
8 the environment that the patent is referring to, but
9 again, the -- the main source of noise which is of
10 concern is the acoustic noise, the modality. So, yes,
11 that's the best answer I can provide there.

12 BY MS. WANG:

13 Q. Going back to the construction, do you recall
14 the language, Detect human tissue motion associated with
15 speech?

16 A. That's right in paragraph 37, for example.
17 Yeah.

18 Q. How is human tissue motion associated with
19 speech?

20 A. Well, one example is, that you've discussed
21 already, vocal cords vibrating and voice speech to
22 generating, yeah, sound waves.

23 Q. Is there another example of human tissue motion
24 associated with speech other than vocal cords vibrating?

25 A. Well, I think -- because also question we've

1 discussed that, you know, there can be other movement,
2 for example, you know, a tongue or a jaw that could
3 modulate the speech production, as well, but, here, the
4 voicing sensor is specifically aimed at, you know, the
5 human tissue motion, generation of speech and in some
6 ways -- well, this speech. Vocal cords for example is.

7 Q. Can human tissue motion be associated with voice
8 but not speech?

9 MR. OSTLING: Objection. Asked and answered.

10 THE WITNESS: Well, I think it's as in, you
11 know, Claim 1, it's a system for detecting voice and
12 unvoiced speech and acoustic signals having varying
13 levels of background noise. So here, the difference in
14 distinction is between voice and unvoiced speech. That's
15 relevant here, and we've talk about it: Vocal cords
16 vibrating or not vibrating.

17 BY MS. WANG:

18 Q. What is the meaning acoustic?

19 A. Relating to sound where --

20 Q. That's -- sorry. Did you finish?

21 A. Yeah, I think so.

22 Q. What's an acoustic signal?

23 A. Acoustic signal, the way I would interpret it,
24 is a sound -- sound wave, you know, that a microphone may
25 sense or detect.

1 Q. How does a microphone sense or detect an
2 acoustic signal?

3 A. Well, directly senses the vibrations, you
4 know -- the sound waves are changes in air pressure, and
5 a microphone directly senses those vibrations or changes
6 in air pressure, for example, with the diaphragm and
7 converts them into an electrical signal.

8 Q. Are all microphones acoustic microphones?

9 A. Well, the -- I think the typical meaning of
10 microphones already qualifies as acoustic microphones
11 except for throat microphone, as I talk in -- or state in
12 paragraph 43, has a very specific meaning. And I would
13 like to state that throat microphone, also known as a
14 larynx phone, is a well-known term of art for a type of
15 skin surface microphone originally developed for military
16 aircraft pilots operating in extremely high noise
17 environments in which a vibration receiving diaphragm is
18 in contact with a user's throat or the larynx from which
19 it receives vibrations directly, and then later at the
20 end is the key difference here. It's -- it's as is
21 stated, throat microphones are designed to pick up, or in
22 parentheses, transduce the vibrations of the vocal
23 apparatus at the throat instead of the vibrations of air
24 molecules at the mouth, and it's referring to -- I'm
25 referring to Exhibit 2009 at page 8, I believe, and that

1 exhibit is a publication from U.S. Army Aeromedical
2 Research Laboratory.

3 Q. Are you drawing a distinction between an
4 acoustic microphone and a throat microphone?

5 A. Yes. I'm drawing a distinction between, you
6 know, the colloquial meaning of a microphone which is --
7 which measures acoustic signals, as opposed to a throat
8 microphone, which is, you know, at least in one
9 embodiment, an acoustic microphone but reconfigured so
10 that the diaphragm is directly measuring the vibrations
11 through skin contact as opposed to detecting sound waves,
12 changes in air pressure.

13 Q. How does an acoustic microphone directly measure
14 the vibrations through skin contact?

15 MR. OSTLING: Objection to form.

16 THE WITNESS: Well, that's what I just stated.
17 For example, it's a -- and I'll state it again from 43.
18 A throat microphone is a well-known term of art for a
19 type of skin surface microphone in which a vibration
20 receiving diaphragm and -- that's a typo there -- is in
21 contact with the user's throat or the larynx from which
22 it receives the vibrations directly. So it's literally
23 in physical contact. The diaphragm of a microphone which
24 can detect sound waves, as well, is directly in touch
25 with skin. And so, it's directly measuring the

1 vibrations through the skin and, hence, not affected by
2 acoustic noise.

3 MR. OSTLING: And I'd just like to note for the
4 record here to check the spelling of diagram versus
5 diaphragm in that answer.

6 THE WITNESS: Thank you.

7 BY MS. WANG:

8 Q. Sound travels through -- sorry. Strike that.

9 An acoustic signal travels over air and is
10 sensed, changes in pressure levels; is that correct?

11 A. Yes. That's -- yeah. Sounds are changes in air
12 pressure or air molecules; vibrating, if you will, and --
13 and typical microphone, it's diaphragm, senses those
14 changes in pressure. It literally moves.

15 Q. And an acoustic signal can also travel through a
16 solid?

17 A. Yes. I -- yes, I think. Yes.

18 Q. Does it cause the molecules in the solid to
19 vibrate?

20 A. Well, let me think for a second. It has --
21 both vibrations are, yeah, being transferred through the
22 compilation of the solids. So it will be the molecules,
23 and then, yeah -- yes. It's a material wave, so yeah.
24 Molecules of the material or the medium of which the way
25 it is traveling or moving.

1 Q. In order to detect vibration of the skin, does a
2 sensor have to touch the skin?

3 MR. OSTLING: Objection to form.

4 THE WITNESS: I think it's -- this is a subtle
5 question, and I think, you know, the difference, again,
6 is -- so in order to detect the vibrations, the source of
7 the vibrations or the vibration of the vocal cord in this
8 case as closely as possible without being affect by
9 acoustic noise, it is necessary to touch the skin.
10 Because then you're going as close to the source, if you
11 will, as possible and not affected by other noise through
12 air pressure, in particular, that may affect the
13 diaphragm.

14 So, again, as stated in bold at the end of
15 paragraph 43 is the critical distinction. Throat
16 microphones are designed to pick up or, in parentheses,
17 transduce the vibrations of the vocal apparatus at the
18 throat instead of the vibrations of air molecules at the
19 mouth. Or -- or even, you know, the -- the throat
20 microphones, for example, in my example which is, you
21 know, referred to as that, but it's just a normal
22 acoustic microphone pointed at the throat. And -- and
23 so, it's -- it's measuring signals through air, and
24 hence, is acceptable to noise -- acoustic noise.

25 BY MS. WANG:

1 Q. So in your previous answer, you stated that, in
2 order to detect the vibrations, the source of the
3 vibrations or the vibration of the vocal cord, in this
4 case, as closely as possible without being affected by
5 acoustic noise, it is necessary to touch the skin. In
6 that answer, is it also necessary to touch the vocal --
7 vocal cord?

8 A. Well, it can't, obviously. You can't touch the
9 vocal cords directly in the context of a microphone the
10 way it's described there, like, a skin surface
11 microphone. So no, it's not necessary to touch the vocal
12 cords or -- yeah. Or is not implied either.

13 Q. Do you have an understanding of how the
14 vibration that originates from the vocal cord travels
15 through, for lack of a better word, to the skin on the
16 throat?

17 A. Well, I mean, some, you know, I just think of
18 physically. You know, it's vocal cords moving, and it's
19 the -- you know, vibrations are being transmitted through
20 the human tissue between the cords and the larynx and the
21 skin. So that's what's happening there. But the key
22 difference, again, here is that, if you're measuring
23 those vibrations at the skin and not through the air,
24 because even that skin vibrating at the throat will
25 produce some changes in sound pressure which can be

1 detected, but they will be affected by environmental
2 noise or acoustic noise in that gap, if you will, between
3 the skin and where the microphone -- some normal acoustic
4 microphone may be sensing those signals.

5 Q. In order to detect vibration of the skin, does a
6 microphone have to touch the skin?

7 A. Can you --

8 MR. OSTLING: Objection to form.

9 THE WITNESS: Yeah. Can you repeat the
10 question, please?

11 BY MS. WANG:

12 Q. In order to detect vibration of the skin, does
13 the microphone have to touch the skin?

14 A. Well, not necessarily. Because, you know,
15 indirectly, you are -- again, I think we are -- it's the
16 same question being asked, and I want to try to answer it
17 again. You know, you can get the indirect -- indirectly,
18 you can detect the vibrations of the skin, if you will,
19 or the throat, in this case, through a microphone pointed
20 at it. But the difference is that it's not the same as
21 directly measuring them at the skin because you're
22 opening yourself to being affected by noise when you
23 introduce that gap, acoustic noise, which may come
24 through that air gap.

25 So indirectly, you can, but then you are being

1 affected by noise. So, again, this is -- I, kind of,
2 state it a little more in 44, a POSITA would further not
3 understand though '058 patents -- well, reference to a
4 throat microphone and acoustic, to suggest it must be
5 susceptible to environmental acoustic noise, as opposed
6 to claiming a throat microphone conventionally used to
7 detect the acoustic waves through skin, which is
8 implemented to detect human tissue motion within the
9 scope of the claim. A POSITA would recognize that the
10 primary purpose of the throat microphone is to avoid
11 environmental acoustic noise.

12 A POSITA, with the benefit of the '058 patent
13 specification, would further recognize that human tissue
14 motion corresponding with voicing activity, distinct from
15 acoustic signals, could be sensed by the diaphragm of the
16 acoustic throat microphone in the same manner as with a
17 GEMS sensor.

18 Q. So for an acoustic sensor that's sensing sound
19 produced by the vocal cords but is not touching the vocal
20 cords, is it your testimony that that acoustic sensor is
21 not unaffected by environmental noise?

22 MR. OSTLING: Objection to form.

23 THE WITNESS: Yes. Not unaffected means
24 affected, right? So can you repeat your question again,
25 please?

1 BY MS. WANG:

2 Q. For an acoustic sensor that's sensing sound
3 produced by the vocal cords but is not touching the vocal
4 cords, is it your testimony that that acoustic sensor is
5 not unaffected by environmental noise?

6 MR. OSTLING: Same objection.

7 THE WITNESS: Yes. Well, I -- it is affected.
8 So I'm going to say acoustic sensor normal -- you know,
9 not a throat microphone or anything like that, an
10 acoustic sensor, which is sensing sound waves generated
11 by vocal cords, yes, it is going to be affected by noise.
12 And -- and, yeah. It's almost impossible for it to be
13 directly in contact with vocal cords, as well. That
14 would be rather uncomfortable.

15 BY MS. WANG:

16 Q. Yeah. The GEM sensor in the '058 patent, does
17 it touch the skin or any other part of the user?

18 A. No. The way it's described -- so -- so, for
19 example, in paragraph 39, I talk about later, you know,
20 maybe through -- as the '058 patent explains, the GEM
21 sensor or the GEM sends out weak electromagnetic waves,
22 less than 1 milliwatt that reflect off of whatever is
23 around the sensor. The reflected waves are mixed with
24 the original transmitted waves, and the results are
25 analyzed for changes in position of the targets. And

1 this is at, you know, columns 364 to 413 in the patents.

2 So, no, it's not directly touching. It's,
3 basically, sending electromagnetic waves, just like a
4 radar, for example, you know, you sent electromagnetic
5 waves, and you listen for reflections from the target, in
6 this case, human tissue or vocal cord, and then you
7 compare the transmitted wave or receive waves, the
8 transmitted waves, to measure or detect motion.

9 Q. Do you have an understanding of the one divided
10 by R relationship in terms of sound amplitude where R is
11 the distance from the sound source to the microphone?

12 A. Yes, I do.

13 MR. OSTLING: Objection to form; foundation.

14 BY MS. WANG:

15 Q. Does that one divided by R relationship mean
16 that, the further a sound source is from a microphone,
17 the smaller the amplitude?

18 MR. OSTLING: Same objection.

19 THE WITNESS: Yes. Generally, that's what it
20 means. Yes.

21 BY MS. WANG:

22 Q. Just to resolve this objection, I'm just going
23 to point you to the '058 patent. Sorry.

24 Dr. Sayeed, I'm going to point you to the '058
25 patent, page 7, line 41 to 51. Are you there?

1 A. Yes.

2 Q. Do you see this portion of the '058 patent is
3 describing the one over R relationship we're describing?

4 A. Well, that's after 41 to 51, correct?

5 Q. 41 to 50 -- this paragraph, column 7, line 41 to
6 51 is discussing --

7 A. Oh, yeah. No. I see that. Yes. Sorry. I
8 missed that. Yes.

9 Q. Okay. So when a person is producing speech, the
10 sound emanating or -- sorry. Strike that.

11 For a person producing speech, is it fair to say
12 that the source of that speech is coming from the
13 person's mouth?

14 A. Can you repeat the first part of the question?
15 Sorry. Source of the speech is coming from a person's
16 mouth, what was before that?

17 Q. Yeah. Just a person producing speech, is it
18 fair to say that the source of that speech is coming from
19 the person's mouth?

20 A. Yeah. For the sound wave.

21 Q. Okay.

22 A. Yes. The sound wave produced by the person that
23 would be -- you know, the source is the mouth.

24 Q. So in a two microphone system or a system that
25 has at least two microphones where one microphone is

1 located closer to the mouth and the other microphone is
2 located further from the mouth, then it's the microphone
3 that's located closer to the mouth that has a higher
4 amplitude for the speech; is that right?

5 MR. OSTLING: Objection to form.

6 THE WITNESS: Yeah. I think, generally, the
7 closer microphone would have a stronger signal. Yes.
8 Everything else, the same.

9 BY MS. WANG:

10 Q. And if there is a situation where the microphone
11 that is further from the person's mouth has a higher
12 amplitude or the same amplitude as the microphone that is
13 closer to the mouth, would that be unusual if the person
14 was producing speech?

15 MR. OSTLING: Objection to form.

16 THE WITNESS: Yeah. I think, you know, so
17 it's -- again, it's a very broad question in the sense
18 that you -- if -- in a very strict sense, if the source
19 was fixed at the mouth and I had two microphones, one was
20 farther away by a fair amount of distance, you know, a
21 measurable distance compared to the first one, and then
22 after the same, yes, that would be unusual. You know,
23 but there's a lot of assumptions in there that, you know,
24 the microphones are identical and they're calibrated so
25 that, you know, there's no differences in how much --

1 how -- what the electrical signal, for example, related
2 to the the pressure changes or the strength of the
3 acoustic wave. But, you know, the position is mostly --
4 it's not just the mouth. You know, I think some of these
5 vibrations are also being indirectly produced by the nose
6 or the throat, and that -- for example, with the Mizel
7 patent, you know, we have these different microphones
8 pointed differently, you know, on either the mouth or the
9 side of the mouth or the throat or the nose. So, you
10 know, those microphones could be picking up some
11 different signals and -- which could be within the
12 context of your original question in this case, in that
13 that may not be unusual with respect to distance from the
14 mouth because that second microphone, which is farther
15 away, may be close to the nose.

16 So it's -- yeah. So, you know, one where our
17 relationship applies with -- with the right context and
18 knowing exactly where the source is and their distances
19 and amongst other things.

20 BY MS. WANG:

21 Q. What does physiological mean?

22 A. Direct interpretation would be a relationship
23 to -- related to physiology, and -- yeah. I'll leave it
24 at that.

25 Q. What does physiology mean?

1 A. I think in the context of this patent may be
2 more relevant, you know, physiological information, as
3 stated in paragraph 47, a POSITA reading the '058 patent,
4 in combination with its prosecution history, would
5 understand the term physiological information to mean
6 human tissue motion. So here, you know, physiology is
7 human tissue, and physiological information, in
8 particular, is related to human tissue motion
9 information.

10 Q. Is there anything that's physiological that is
11 not human tissue motion?

12 MR. OSTLING: Objection. Scope.

13 THE WITNESS: I mean, obviously, yes. I mean,
14 physiology is much bigger than human tissue motion. But
15 here, I'm going to -- I'm answering in the context of
16 '058 patent in a particular meaning of the term
17 physiological information, by the way, if we are offering
18 construction.

19 BY MS. WANG:

20 Q. So outside the context of the '058 patent,
21 physiological is much bigger or much broader than human
22 tissue motion, but -- so it's just in the context of this
23 patent where physiological has this specific meaning of
24 human tissue motion?

25 MR. OSTLING: Objection. Misstates the

1 testimony.

2 THE WITNESS: Well, I think -- physiological had
3 had obviously a much broader meaning --

4 (Reporter clarification.)

5 THE WITNESS: But, again, we have to put it in
6 the context of, you know, that's the patent we are
7 discussing. So that's why I'm answering to let you know
8 that's -- specifically what it relates to; otherwise, I
9 don't know -- you know, it's too broad a scope.

10 BY MS. WANG:

11 Q. Okay. So in the context of the '058 patent, is
12 it your testimony that human tissue has to move in order
13 for it to be physiological?

14 A. No. It's about specifically physiological
15 information to -- to mean human tissue motion
16 information.

17 Q. So is it your testimony that the information has
18 to involve movement of human tissue, not human tissue
19 being stationary, in order for the information to qualify
20 as physiological information?

21 MR. OSTLING: Objection to form.

22 THE WITNESS: I think this is specifically
23 related to, you know -- you know, the claim language, as
24 well, in the patent. So, for example, in Claim 1, you
25 know, it says, "At least one voicing sensor that receives

1 physiological information associated with human voicing
2 activity." So whenever there is activity, there is some
3 motion, and the activity is where the human tissue motion
4 is occurring. So that's what is the context in which
5 physiological information is interpreted here. And I
6 think I've had too much coffee. So I'm getting ready for
7 a break.

8 MS. WANG: Now is a good time. Let's take a
9 10-minute break.

10 THE WITNESS: Okay. Thank you.

11 MS. WANG: Thanks.

12 (A recess was held from 8:59 a.m. to 9:10 a.m.)

13 BY MS. WANG:

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

15 A. Thank you.

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

17 A. No.

18 Q. Look at anything on Google during the break?

19 A. No.

20 Q. Before the break, we were talking about the
21 physiological information.

22 Do you remember?

23 A. Yes.

24 Q. Can an acoustic signal produced by a person
25 speaking contain physiological information?

1 MR. OSTLING: Objection to form.

2 THE WITNESS: Well, I think, you know, in --
3 in -- at a very basic level, you can argue that, yes, it
4 does, you know, that it's -- it's -- because that's
5 what's -- you know, some physiological -- you know, some
6 human tissue motion is what's creating that sound. But,
7 again, the -- the difference is, you know, that we get to
8 the source of, you know, physiological information, which
9 producing the sound, rather than measuring it indirectly,
10 you know, like detecting the sound pressure through a
11 microphone, for example, because that is going to be
12 affected by noise.

13 So, yes. Both of them have information about
14 the physiological contained or are related or
15 physiological information, but one is more affected by
16 noise than the other.

17 BY MS. WANG:

18 Q. What is correlation?

19 MR. OSTLING: Objection to form.

20 THE WITNESS: I think here -- again, correlation
21 is a very broad term here. The relevant term is
22 cross-correlation, which has a very specific meaning as I
23 state in 51, for example, cross-correlation data. A
24 POSITA reading the '058 patent would understand
25 cross-correlation data to mean data generated by

1 multiplying and adding the result of a windowed set of
2 samples from one time from one sources while a windowed
3 set of samples from another source where the two sets of
4 samples may be shifted in time relative to each other,
5 and then, you know, in -- it goes on to describe it in
6 more detail and including specific mathematical
7 expressions in 53 -- paragraph 53, for example.

8 BY MS. WANG:

9 Q. What's the distinction between correlation and
10 cross-correlation?

11 A. Well, I -- yeah. Yeah. I think the -- I think,
12 again, the cross-correlation has a very specific meaning,
13 and the corresponding version of correlation would be
14 autocorrelation. So the difference between, you know,
15 their -- you know, and I'm, perhaps, introducing another
16 term here which is not relevant.

17 So again, it involves multiplying two signals
18 and adding, you know, two sequence of those signals over
19 a window and then adding the results, and every one could
20 be shifted with respect to another, and in
21 autocorrelation you take the same signal rather than two
22 different signals and compute the same function as, for
23 example, in, you know -- described in paragraph 53
24 cross-correlation and defined as $R_{xy}(\tau)$, and then
25 there's a summation of products of X event and Y event

1 minus tau. So that's cross-correlation and
2 autocorrelation, and X and Y would be the same.

3 Now correlation, by itself, you know, is a
4 broader term, which is -- you know, in some ways reflects
5 similarities between signals, but a cross-correlation is
6 the -- really the relevant term that's -- or the term
7 that is relevant here.

8 Q. So correlation is broader than cross-correlation
9 and autocorrelation?

10 MR. OSTLING: Objection to form.

11 THE WITNESS: Well, think for a second. I
12 think -- you know, I also use in correlation specifically
13 in paragraph 76. And, yeah, I just want clarify that,
14 you know, there -- it's in the context of imbalance and
15 comparisons and -- and I say, you know, the plain meaning
16 of cross-correlation requires multiplication, not merely
17 a comparament or difference operation, at most,
18 imbalances are correlation but not a cross-correlation
19 are required, and there also -- I mean, comparison. And
20 so, in some ways, you know, correlation can -- you know,
21 as a word, can have a much broader meaning. Whereas,
22 cross-correlation has a very specific meaning and a
23 well-defined meaning in the art as, you know, discussed
24 in the paragraphs involving the construction of that term
25 in paragraphs 51 through 60 of my declaration.

1 BY MS. WANG:

2 Q. It's your opinion that cross-correlation
3 measures the similarities of two sequences?

4 MR. OSTLING: Objection to form.

5 THE WITNESS: Well, I think it has aimed at
6 measuring the similarities between two different signals
7 including, you know, the function of time shifts between
8 them. So, yeah, it's, kind of, like a matching pattern,
9 if you will.

10 BY MS. WANG:

11 Q. Is correlation also a measurer of similarity
12 between two different signals?

13 A. Correlation, by itself, is too broad a term, and
14 yet, it may represent a similarity of some form, but
15 cross-correlation has a very specific meaning in the art,
16 and that's the important thing: How to actually compute
17 it and for two different signals as, again, stated in,
18 you know, paragraphs 51 through 60 in my declaration.
19 And again, cross-correlation data, to me -- I'm going to
20 state from 51 again, cross-correlation data to mean data
21 generated by multiplying and adding the result of a
22 window set of samples at one time from one source by a
23 windowed set of samples from another source where the two
24 sets of samples may be shifted in time relative to
25 each other.

1 In this way, the cross-correlation function can
2 mirror the similarity of the two sequences if the
3 sequences are timed or offsetted.

4 Q. So the question didn't have cross-correlation in
5 it. The question was only about correlation, and I'm
6 just trying to understand how you're distinguishing
7 correlation from cross-correlation. So I'm going to
8 repeat the question.

9 Can correlation be a measure of similarities
10 between two different signals?

11 A. Well, I understood your question, but I don't
12 know what correlation would mean there. If I were to
13 interpret it as autocorrelation or cross-correlation,
14 then there is a specific meaning to it, and -- and that's
15 what's relevant here. Correlation, I don't know, by
16 itself, what it means other than just some generic
17 representation of similarity.

18 Q. Okay. So, sitting here today, it's testimony
19 that you don't know what correlation means other than the
20 generic representation of similarities?

21 A. Yes. Just that that term, by itself, unless I
22 interpret it, it gets more concrete and I -- it's a
23 well-defined -- and I have termed the cross-correlation
24 or other-correlation function that I mentioned earlier.

25 Q. Do you have an understanding of what it means

1 when two signals are correlated?

2 A. Yes. And it's -- again, it has -- you know,
3 there's a -- just an English language interpretation of
4 what is -- what it means in the art or, you know, in
5 signal crossing, for example, or communication and so on,
6 technical aspects. And again, there -- also, it can
7 have -- it can be even mathematically interpreted in
8 different ways which are related. So -- but all of them
9 are tied in, and many of them are stated in the -- you
10 know, in my declaration, as well.

11 For example, I'll give you -- in 54, which
12 refers to paragraph 54, which refers to Exhibit 1009, the
13 cross-correlation function XCORR, you know, eventually
14 goes to true cross-correlation sequence. Which if the --
15 you know, there's an expectation operator involving two
16 sequences, X_N and Y_N plus N . And there -- they're
17 referencing -- their reference to stationary processes,
18 and this is on some averages and -- but a POSITA would
19 understand that there's a relationship between this
20 definition of cross-correlation function and the one
21 stated in 53, as well, which is specifically based on
22 sequences in time. So yeah.

23 Q. Can you determine, from the cross-correlation
24 equations that are shown in paragraphs 53, 54 of your
25 declaration, whether the signals X and Y are correlated

1 with one another?

2 MR. OSTLING: Objection. Relevance.

3 THE WITNESS: I can determine their similarity.
4 For example, you know -- well, typical way in which this
5 may be used is you look at the correlation functions, for
6 example, defined in 53 as a function of the different
7 timelines and look for a peak, and where the peak
8 occurred is where -- that's a timeline when the
9 similarity is the highest.

10 So -- and let me see. For example, you know,
11 this is -- yeah. And this is also, kind of, elaborate on
12 59 -- paragraph 59, indeed, the '058 patent explained
13 that its use of cross-correlation XCORR requires the
14 ability to shift the samples in time, and it refers to
15 the patent column 5, lines 11 through 14, quotes, X- --
16 the XCORR is only calculated to 15 delays which
17 correspond to just under two-millisecond at 8,000 Hertz,
18 end of quote.

19 So then it goes on to describe a modulation for
20 it, too, that -- it's the difference of -- between the
21 account for difference and the propagation speed of sound
22 versus the electromagnetic signals.

23 BY MS. WANG:

24 Q. Is it fair to say, then, that when the
25 cross-correlation function exhibits a peak, that is where

1 the input signals are the most correlated?

2 MR. OSTLING: Objection to form.

3 THE WITNESS: That's -- I'm going to use the
4 term similar. That's the -- where they are more similar
5 where the value of the cross-correlation function is the
6 largest or highest.

7 BY MS. WANG:

8 Q. Is there a distinction between correlated and
9 had similar that you are referring to in your answer?

10 A. Yeah. Again, I think I've distinguished
11 between, you know, I think -- yeah. Even the way --
12 they'll use the term correlate in my declaration is in
13 terms of similarity, and I think, again, going back to my
14 earlier response, I'm referring to interpreting or
15 interpreting the meaning in terms of similarity because
16 cross-correlation function or XCORR has a very specific
17 meaning in the art; whereas, correlation is broader, and
18 it doesn't have that specific connotation.

19 Q. So I understand your position that XCORR
20 cross-correlation has that very specific meaning. My
21 only question is what's the difference -- or is there a
22 difference between correlation and similarity.

23 MR. OSTLING: Objection. Asked and answered.

24 THE WITNESS: Well, I think I've tried to
25 explain it that to make it as clear as possible so that

1 we don't get confused, that there is cross-correlation
2 and autocorrelation as extension, you know, they have a
3 function. They have a very specific meaning. Whereas,
4 correlation, by itself, is a bit too broad. So I
5 wouldn't -- so in order to avoid confusion, I'm going to
6 refer to similarity or how similar they are so that we
7 don't get confused.

8 BY MS. WANG:

9 Q. But, in your mind, those are the same,
10 correlation and similarity?

11 MR. OSTLING: Objection. Misstates the
12 testimony.

13 THE WITNESS: No. I think correlation is, you
14 know -- this is a very specific term here that weighed --
15 is -- which comes into play in context of this patent,
16 and -- and correlation is too broad in that regard, too.
17 And so, I'm trying to avoid that.

18 BY MS. WANG:

19 Q. Do you recall your testimony earlier today where
20 you said -- where -- where you agreed -- I asked the
21 question, Sitting here today, is it your testimony that
22 you don't know what correlation means other than a
23 generic representation of similarities, and you said yes
24 to that answer or to that --

25 A. Yes.

1 Q. -- question.

2 A. Yes. Yes.

3 Q. Are you changing -- are you changing your
4 testimony now?

5 A. No. No.

6 Q. Okay.

7 A. I'm still saying yes to that rather than --
8 that's why I'm referring to similarities. Because, to
9 me, correlation is a generic reference -- a very broad
10 reference to similarity.

11 MR. OSTLING: And I'm going to step in here.
12 Counsel, you've asked him the same question like six
13 times. He's answer it.

14 MS. WANG: I have not.

15 MR. OSTLING: He's pointed you to his report.

16 MS. WANG: Look.

17 MR. OSTLING: This is getting --

18 MS. WANG: Counsel, this is --

19 MR. OSTLING: -- over the line of argumentative.

20 MS. WANG: This is not argumentative. It's kind
21 of ridiculous, your objections. We have his declaration.
22 I'm allowed to ask him questions about his opinions
23 formed in making his declaration.

24 MR. OSTLING: And he's given those to you.

25 MS. WANG: And I'm clarifying them.

1 MR. OSTLING: No. You're repeating the same
2 question --

3 MS. WANG: I'm not, at all, repeating the
4 question.

5 MR. OSTLING: -- over and over again, until you
6 create some issue between his answers to your repeated
7 questions.

8 MS. WANG: I'm allowed to ask him questions
9 about his opinions.

10 MR. OSTLING: Yes. You're not allowed to badger
11 him, which is what this is going into.

12 MS. WANG: I'm absolutely not badgering him.

13 THE WITNESS: Go Badgers. Sorry. I have to say
14 that.

15 BY MS. WANG:

16 Q. So Dr. Sayeed, do you have an understanding of
17 analog signals versus digital signals?

18 A. Yes, I do.

19 MR. OSTLING: Objection. Scope.

20 BY MS. WANG:

21 Q. What's the distinction?

22 A. Well, again, it's a very broad scope. Analog
23 signals are continuous in nature in a very simple way.
24 For example, you know, sound waves, for example, they
25 are -- you know, you can measure them in principal or

1 they exist all time; whereas, digital signals would be
2 sampled in time at discrete instances. And on top of it,
3 you also have a digitalization or -- digitalization and
4 amplitude, where the amplitude can be also arbitrary
5 values, so you represent with a certain number of bits.
6 So the simplest distinction would be, you know,
7 continuous versus discrete or digitized representation.

8 Q. Can you calculate the cross-correlation between
9 two analog signals?

10 A. Well, again, that's a broad question. But, you
11 know, in principle or in many cases -- well -- so, yeah.
12 I think that's -- again, that's a very broad question.
13 You know, there are ways in which you can actually
14 calculate the correlation. You can define correlation
15 even for analog signals and even compute with some
16 devices. And I'm not going to go into the details of
17 that. But in most cases, the way we calculate even
18 for -- correlation for analog signal is first digitizing
19 them and then processing them on a digital computer or
20 device, and there is a relationship between them that
21 should -- even digital correlation gives you information
22 about the analog correlation.

23 Q. So the way that one would calculate the
24 cross-correlation between two analog signals would be to
25 typically digitize the analyze signals first and then do

1 the cross-correlation on the digital signals?

2 MR. RABB: Objection to form.

3 THE WITNESS: That's fair to say. I think, you
4 know, in the -- in this context of this patent, too. But
5 there are ways in which correlations can be computed in
6 analog fashion, too, but it's not relevant here.

7 BY MS. WANG:

8 Q. And cross-correlations can also be --

9 A. Yes.

10 Q. -- computed in analog?

11 A. Yes. Yes. Cross-correlations. Yes.

12 Q. These equations in paragraph 53 to 54 of your
13 declaration, are these the only way to perform a
14 cross-correlation?

15 MR. OSTLING: Objection. Relevance.

16 THE WITNESS: Well, I think it's not the only
17 way that these -- these relationships capture the
18 essential idea. I think there are different -- there can
19 be different variations on these definitions. You know,
20 sometimes there are some normalization factors that may
21 be involved, but I think these equations capture the
22 essential idea between a cross-correlation function or a
23 cross-correlation.

24 BY MS. WANG:

25 Q. Are these equations the only way to generate

1 cross-correlation data?

2 A. No. Again, same thing, there could be some
3 minor modifications on these in terms of some
4 normalization constants. But the essential aspect of
5 cross-correlation data is captured by these equations,
6 which is, you know, taking two signals, a windowed
7 versions of two signals and potentially one shifted in
8 time multiplying them and adding as these gradings show.

9 Q. The cross-correlation -- sorry. Strike that.

10 Is it your opinion that the cross-correlation
11 data is generated is shown in the equations on paragraph
12 53, 54 to your declaration?

13 A. Cross-correlation data generated where -- can
14 you be a little bit more specific which --

15 Q. Yeah. Sorry. I'm referring to, like, the Claim
16 1 and Claim 2 language of the '058 patent that states,
17 "Generating cross-correlation data." So my question
18 is --

19 A. Yeah.

20 Q. -- is that cross-correlation data that's
21 generated shown in these equations?

22 A. Well, again, it could be -- it could be
23 implemented. A POSITA would understand that it could be
24 implemented with the slight variations that are known in
25 the art, as well. For example, some cases it could be

1 normalized by, you know, multiplying the front by the
2 side of the window, reciprocal of the size of the window.
3 So with that caveat, yes. This would be, essentially,
4 what's being calculated or minor variant, as would be
5 known to a POSITA.

6 Q. So in these equations, I see an infinite sum of
7 X of N times Y of N minus L?

8 A. Yes.

9 Q. Is the cross-correlation data referring to --
10 okay. Sorry. Strike that.

11 So what I see in this equation is a summation of
12 a bunch of products; is that fair?

13 A. Yes.

14 Q. Is the cross-correlation data referring to the
15 individual products before summation?

16 A. No. It's -- it's referring to a sum. And, you
17 know, you point out another good point that, you know,
18 it's infinite sum. And in practice, you know, you'll be
19 computing an infinite sum. So it would be over some
20 certain window, finite window. So you will be
21 multiplying and adding over some finite window of
22 samples, which is also referred to in the patent, as
23 well.

24 Q. So is it your opinion that the cross-correlation
25 data that needs to be generated in the claim, it requires

1 the result of that multiply and sum calculation?

2 A. Yes. Or some window, yes.

3 MR. OSTLING: For the record, can we get a typo
4 check on "or" versus "over"?

5 BY MS. WANG:

6 Q. Does the cross-correlation data refer to
7 anything else other than the results of the multiplied
8 sum calculation?

9 A. Well, that's the interpretation here in this
10 patent.

11 Q. So the interpretation is that the
12 cross-correlation data in the patent has to be the result
13 of the multiplied sum calculation of the equation shown
14 in paragraph 53, 54, accounting for some normalization
15 that is not shown in the equations but may occur?

16 A. Yes.

17 Q. You mentioned time lags. So my understanding,
18 correct me if I'm wrong, of cross-correlation data is
19 that we, kind of, like -- sorry. Strike that.

20 My understanding of cross-correlation is that
21 you have one scaler value, which is the result of the
22 multiplied sum calculation, and then you -- I -- I think
23 what you're saying is that you can then shift one of your
24 input signals by one sample in time, re-run the
25 multiplied sum operation, and then you get another scaler

1 value, and that's another data point in your
2 cross-correlation data.

3 Do I have that right?

4 A. Yes, that is right.

5 MR. OSTLING: Objection to form.

6 BY MS. WANG:

7 Q. So does one scaler value count as
8 cross-correlation data, or do you need more than one
9 scaler value, in terms of a scaler value being the result
10 of the multiplied sum?

11 A. Yes. So this -- yeah. So, again, this is, you
12 know, a implementation detail that a -- a POSITA would be
13 aware of. And, again, this -- I'll go back to 59, which
14 again says, you know, the '058 patent explains that its
15 use of course -- cross-correlation requires the ability
16 to shift samples in time. And -- and so, you would -- so
17 going back to your question, you would be looking at --
18 you know, you may not know exactly what the time delay or
19 the differences between them, so you will count a bunch
20 of those scalers or a certain window. And then possibly
21 look for a peak, and that would define the correlation.

22 So these are the different ways of, you know,
23 implementing or using this cross-correlation data that
24 would be known to POSITA. And it may go on, as you
25 correctly inferred, that, you know, calculating this sum

1 of the products for multiple delays or timelines, if you
2 will.

3 Q. It may involve multiple timelines or it has to
4 involve multiple timelines or just one?

5 A. It depends. If you knew exactly what the time
6 difference you expect, then you may just calculate that.
7 But in practice, there's always some uncertainty, so you
8 would calculate it over a certain window of values, a
9 range of values, if you will. It's all a question of how
10 much a priori information you have available. And,
11 again, this would be -- a POSITA would under -- know
12 about these nuances or how we actually apply the
13 cross-correlation function in -- in '058 implementation
14 of '058 claims, for example.

15 MR. OSTLING: And just for the record, can we
16 get a typo check on "priority" versus "a priori"?

17 BY MS. WANG:

18 Q. So --

19 MR. OSTLING: And as a priori, A P-R-I-O-R-I.

20 (Reporter clarification.)

21 Q. BY MS. WANG: So, Dr. Sayeed, you mentioned a
22 priori. Having a priori information about whether --
23 about which time lag to expect based on, you know, the
24 known time delays of the system.

25 Do you recall that testimony?

1 A. Yes.

2 Q. Are you saying that whether the
3 cross-correlation data in the claims requires one scaler
4 value or more than one scaler value is based on whether
5 the POSITA knows a priori which time lag to expect?

6 A. No. I'm not -- that's not what I implied at
7 all. I think I was responding to your question that, you
8 know, once value is needed or multiple values, and what I
9 was saying was that if you -- if you knew and that's
10 beyond this particular application. But, you know, if
11 you knew exactly what the delay was in order to calculate
12 a cross-correlation, you would just use that particular
13 lag to just test a similarity which could be ignored in
14 some situations. But, in general, you don't know, and
15 that would certainly be the case in application of '058.
16 And in this case, you would calculate the
17 cross-correlation data for multiple lag values and
18 potentially look for the peak and compare that largest
19 value for example. And again, there are other -- yeah.
20 And a POSITA would be familiar with that as is, yeah --
21 how the cross-correlation function or data is used.

22 Q. So please correct me if I have this wrong, but
23 then is it your testimony that, in the context of the
24 '058 patent, because you don't know what time lag to
25 expect, you would generally want to calculate the

1 cross-correlation data for multiple time shifts of the
2 input signal?

3 A. Yes. For example, I'll refer you to and then we
4 will discuss -- on column 5, and in particular from
5 lines 26 to 38, and there it says, However, an embodiment
6 uses a 15-sample correlation as acoustic waves shape very
7 significantly depending on the sound produced and the
8 wider correlation width is needed to ensure detection.
9 So that's the correlation width, if you will, is talking
10 about and how many lines you compute.

11 Q. So given that there are multiple values in the
12 cross-correlation data, because you're calculating it for
13 multiple time shifts, is it -- is the cross-correlation
14 data now a signal?

15 MR. OSTLING: Objection to form.

16 THE WITNESS: Well, you could call it a signal,
17 if you will. It's data. And you know, with -- labels
18 can be misleading, too. So I won't necessarily call it a
19 signal. I would just say we are computing the
20 cross-correlation function, if you will, for computing
21 the data for multiple possible time lags, because we
22 don't know exactly which one is physically the correct
23 one, and that particular calculation or time and so --
24 and then looking at, for example, the largest value
25 within that width -- correlation width or the number of

1 data samples you calculated.

2 BY MS. WANG:

3 Q. What does it mean to be similar?

4 A. I think, again, it can be very broad meaning,
5 but in this specific context, similar would be when you
6 are correlation -- cross-correlation function -- two
7 signals would be similar in the cross-correlation
8 function between or value between them is high or large.

9 Q. Does similar have the same meaning as same?

10 A. No. It's not the same. I was thinking about
11 the question, does it have the same meaning as same.

12 No, it doesn't. It's similar. Because, you
13 know, there's always noise. Also, you know, in this
14 particular context, there's a cross-correlation being
15 computed between the physiological data and the acoustic
16 data. So at best, they can be similar. Can't be same.

17 Q. What does it mean to be different?

18 MR. OSTLING: Objection. Asked and answered.

19 THE WITNESS: Not similar. Certainly not same.
20 Yeah.

21 BY MS. WANG:

22 Q. Two signals can be different from one another
23 and still be similar due to noise?

24 MR. OSTLING: Objection to form.

25 THE WITNESS: Can you please restate the

1 question?

2 BY MS. WANG:

3 Q. Can two -- strike that.

4 Can two signals be different from each other but
5 still be similar to each other?

6 A. Yeah. I don't know what -- what to answer,
7 really, your question or how you interpret similar and
8 different and, you know, in -- in, you know, yeah.
9 It's -- yeah. Because of -- yeah. I think there's
10 tolerances. There's values. There's thresholds that are
11 used for distinguishing whether they're similar or
12 different for that reason and because of noise. So
13 personally, if -- if similar was interpreted as same,
14 then, obviously, nothing -- you know, if there's noise,
15 nothing would be similar. So it really -- you can -- and
16 from an engineering or signal processing perspective, you
17 can only answer that within certain threshold or bounds
18 and -- yeah. And that's what, you know, using threshold
19 is, you know, for comparing value that is used for that
20 reason, for example.

21 Q. Earlier, we talked about converting an analog
22 signal to a digital signal.

23 Do you recall that?

24 A. Yes.

25 Q. Would that be done with an analog to digital

1 converter?

2 A. Typically, yes. That's one way.

3 Q. Were analog to digital converters known before
4 2001?

5 MR. OSTLING: Objection. Relevant.

6 THE WITNESS: Definitely none -- but more than
7 yes.

8 BY MS. WANG:

9 Q. Sorry. Can you -- the record just isn't that
10 clear. Were analog to digital converters known before
11 2001?

12 A. Yes.

13 MR. OSTLING: Same objection.

14 BY MS. WANG:

15 Q. Would you like a break, Dr. Sayeed?

16 A. That'd be great.

17 Q. Let's do another ten minutes?

18 A. Thank you.

19 MR. OSTLING: Sure.

20 MS. WANG: Thank you.

21 (A recess was held from 9:57 p.m. to 10:09 p.m.)

22 MS. WANG: I have no further questions. So I'll
23 pass the witness. Thank you so much, Dr. Sayeed, for
24 your time today.

25 THE WITNESS: Thank you, Grace. I appreciate

1 it.

2 MR. OSTLING: Just give me one moment.

3 EXAMINATION BY MR. OSTLING:

4 Q. Good morning, Dr. Sayeed. I have a brief
5 redirect.

6 A. Okay.

7 Q. Sir, do you recall Meta's counsel asking you
8 about sound waves traveling through solids?

9 A. Yes.

10 Q. And do you recall Meta's counsel asking you
11 about acoustic microphones?

12 A. Yes.

13 Q. Can conventional acoustic microphones detect
14 sound waves traveling through a solid?

15 MS. WANG: Objection. Form.

16 THE WITNESS: No.

17 BY MR. OSTLING:

18 Q. That's different -- well, strike that.

19 Then is that different from how a throat
20 microphone works?

21 MS. WANG: Objection to form.

22 THE WITNESS: Yes. I -- you know, yeah. I
23 wasn't sure about that question in the first place
24 because it is different from how a throat -- throat
25 microphone works because, you know, a throat microphone,

1 the diaphragm is directly in contact with the skin.
2 Some mics can't -- yeah. So how the sound waves
3 traveling through a solid are detected are completely
4 different ball game and, you know, in some cases and
5 maybe this is answering too much. Some cases, at one
6 end, the solid may vibrate and may produce a sound which
7 a microphone can detect or maybe other ways, but it's
8 very different from a throat microphone.

9 BY MR. OSTLING:

10 Q. So the vibration that the throat microphone is
11 picking up is not a sound wave; is that right?

12 A. Yes. It's not a sound wave. No. Absolutely
13 right.

14 MR. OSTLING: Nothing further.

15 THE REPORTER: Okay. And does both counsel need
16 the rough draft and the expedite?

17 MS. WANG: Yeah. We'll take a next day. Yeah.
18 We'll -- we want an expedited final and rough today,
19 please.

20 MR. OSTLING: We'll take a rough, but standard
21 turnaround for the final is fine.

22 (Whereupon proceedings concluded at 10:13 a.m.)
23
24
25

- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 0
- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 0
- 1
- 2
- 3
- 4
- 5

[illegible]

AKBAR SAYEED, Ph.D., Date

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

REPORTER'S CERTIFICATE

I, NICOLE HATLER, a Shorthand Reporter, State of California, do hereby certify:

That AKBAR SAYEED, Ph.D., in the foregoing deposition named, was present and by me sworn as a witness in the above-entitled action at the time and place therein specified;

That said deposition was taken before me at said time and place, and was taken down in shorthand by me, a Certified Shorthand Reporter of the State of California, and was thereafter transcribed into typewriting, and that the foregoing transcript constitutes a full, true and correct report of said deposition and of the proceedings that took place;

IN WITNESS WHEREOF, I have hereunder subscribed my hand this 25th day of September 2024.



NICOLE HATLER, CSR NO. 13730
State of California

-	10:13 75:22	37 10:7 12:11 14:21 23:11 33:20 34:16	6
---ooo--- 3:12	11 57:15	38 32:25 33:2 70:5	60 53:25 54:18
0	13 9:1	39 21:15 43:19	61 33:7
058 5:14 6:15 8:20 10:5,8 11:14,25 12:9 14:14 15:8,16 16:1,8 20:25 21:7,19 23:20 26:4,10 30:17 33:6 42:3,12 43:16,20 44:23,24 45:2 48:3,16,20 49:11 51:24 57:12 64:16 67:14 68:13,14 69:15,24	13730 4:6	4	63 33:7
085 10:2	14 57:15	4 23:16	646 797-4354 3:22
1	15 9:1 57:16	40 26:9	7
1 11:18,24 17:23 18:6 35:11 43:22 49:24 64:16	15-sample 70:6	41 16:18 23:13 44:25 45:4, 5	7 44:25 45:5
10 9:1 26:20	2 11:24 16:16,19 64:16	413 44:1	7246058 8:18
10-minute 50:9	200 3:17	43 36:12 37:17 39:15	76 53:13
1001 6:15	2001 73:4,11	44 23:16 42:2	7:09 3:6
1005 5:16,18 6:15	2009 36:25	46 23:16 33:21	7:10 4:22
1006 5:18 6:16	2023-01352 5:24 8:17	47 48:3	7:59 26:25
1007 6:17	2024 3:5	5	8
1008 6:18	2025 4:7	5 57:15 70:4	8 36:25
1009 56:12	206 3:21	50 45:5	8,000 57:17
10166 3:17	212 318-6833 3:18	51 44:25 45:4,6 51:23 53:25 54:18,20	8:09 26:25
10580 3:22	25TH 3:5	53 52:7,23 56:21,24 57:6 63:12 64:12 66:14	8:59 50:12
10:09 73:21	26 70:5	54 56:11,12,24 63:12 64:12 66:14	9
	3 33:7	59 57:12 67:13	9:10 50:12
	364 44:1		9:57 73:21
			A
			A-K-B

4:16	12:25 13:19	7:7 9:6 48:15 49:7 75:5	59:2
A-R	Aeromedical	answers	Avenue
4:16	37:1	61:6	3:17,21
A-Y-E-E-D	affect	apparatus	averages
4:18	20:17 39:8,12	36:23 39:17	56:18
a.m.	affected	APPEARANCES	avoid
3:6 4:22 26:25 50:12	24:4 28:6,9,16 29:4,6,	3:13	42:10 59:5,17
75:22	18,25 30:8 38:1 39:11	appeared	avoiding
ability	40:4 41:1,22 42:1,24	3:8	25:9
15:18 57:14 67:15	43:7,11 51:12,15	apples	aware
absolutely	agreed	34:4	67:13
29:14 61:12 75:12	59:20	application	
acceptable	ahead	6:14 7:2 69:10,15	B
39:24	19:7	applications	back
account	aimed	6:8,11,24	27:2 34:13 50:14 58:13
57:21	35:4 54:5	applies	67:13,17
accounting	air	47:17	background
66:14	21:21 36:4,6,23 37:12	apply	22:19,22,25 24:9 35:13
accurate	38:9,11,12 39:12,18,23	7:6 68:12	badger
8:10	40:23 41:24	arbitrary	61:10
accurately	aircraft	62:4	badgering
8:7 21:3	36:16	argue	61:12
acoustic	Akbar	51:3	Badgers
15:25 16:7 21:20,23	3:1,8 4:1,16	argumentative	61:13
22:5,9,13,23 23:23	allowed	60:19,20	ball
24:6,15,17 25:5,7 26:6,	60:22 61:8,10	Army	75:4
7,17 27:14,19 28:2,5,9,	alternative	37:1	based
14 29:12 30:2,13,18,22	33:3	art	14:17,18 15:1 21:24
32:13,22 33:6,25 34:10	amount	5:15 36:14 37:18 53:23	25:8 56:21 68:23 69:4
35:12,18,22,23 36:2,8,	46:20	54:15 56:4 58:17 64:25	basic
10 37:4,7,9,13 38:2,9,	amplitude	articulated	18:19 51:3
15 39:9,22,24 40:5	44:10,17 46:4,12 62:4	11:6 21:10	basically
41:2,3,23 42:4,5,7,11,	analog	aspect	5:11 9:8 16:15 23:3
15,16,18,20 43:2,4,8,10	61:17,22 62:9,15,18,22,	64:4	44:3
47:3 50:24 70:6 71:15	24 63:6,10 72:21,25	aspects	benefit
74:11,13	73:3,10	56:6	42:12
action	analyze	assumptions	bigger
3:9	62:25	46:23	48:14,21
activity	analyzed	attorneys	bit
11:20 12:17,19 13:8,12,	43:25	9:6,11	59:4 64:14
18 14:2,9,16,25 15:6,	Anderson	auto	bits
10,13,14,21 26:14	6:13	21:20	62:5
42:14 50:2,3	annotations	autocorrelation	blaring
adding	6:20	52:14,21 53:2,9 55:13	22:22
13:6 52:1,18,19 54:21	answering		
64:8 65:21			
additional			

bold 39:14 bounds 72:17 boy 4:16 break 7:21,24 8:4 25:21 26:19 27:2,4,6,13 50:7,9,14, 16,18,20 73:15 breaks 7:8 broad 9:20 20:8 22:17 24:14 25:2 28:24 29:15 32:11 46:17 49:9 51:21 54:13 59:4,16 60:9 61:22 62:10,12 71:4 broader 48:21 49:3 53:4,8,21 58:17 browser 27:7 bunch 65:12 67:19 C calculate 62:8,14,17,23 68:6,8 69:11,16,25 calculated 57:16 65:4 71:1 calculating 67:25 70:12 calculation 66:1,8,13,22 70:23 calibrated 46:24 California 3:8 4:5 call 70:16,18 capture 63:17,21 captured 64:5	case 9:9 15:3 39:8 40:4 41:19 44:6 47:12 69:15, 16 cases 14:13,15,16 62:11,17 64:25 75:4,5 caution 9:5 caveat 65:3 CCP 4:7 cellphone 32:3 Certified 3:7 4:5 changing 60:3 check 38:4 66:4 68:16 citing 23:17 claim 11:18,24 12:5 17:23 18:5 26:4 32:16 33:15, 21 35:11 42:9 49:23,24 64:15,16 65:25 claimed 12:10 23:20 claiming 42:6 claims 5:14 15:8,9,13,16,21 23:24 68:14 69:3 clarification 10:19 49:4 68:20 clarified 25:18 clarify 7:15 53:13 clarifying 60:25 clear 58:25 73:10	close 39:10 47:15 closely 39:8 40:4 closer 46:1,3,7,13 closest 17:16 coffee 50:6 collecting 31:4,18 colloquial 37:6 column 16:18 33:7 45:5 57:15 70:4 columns 23:16 44:1 combination 10:8 48:4 commencing 3:5 communication 56:5 communications 9:5 comparament 53:17 compare 44:7 69:18 compared 46:21 comparing 72:19 comparison 53:19 comparisons 53:15 compilation 38:22 complete 8:10 completely	8:7 32:6 75:3 compute 52:22 54:16 62:15 70:10 computed 63:5,10 71:15 computer 6:7 62:19 computing 65:19 70:19,20 concern 34:10 concluded 75:22 concrete 29:23 55:22 CONFERENCING 3:1 confirm 31:20 confused 59:1,7 confusion 59:5 connection 17:17 connotation 58:18 constants 64:4 construction 11:6 32:16,21,25 33:1, 2,9,15,21 34:13 48:18 53:24 contact 36:18 37:11,14,21,23 43:13 75:1 contained 51:14 contents 5:12,13,23 context 9:21,25 10:2,4,12 11:2, 3,14 12:9,14 14:20 17:9,10,15 20:15,19,20,
---	--	--	---

24 21:6 22:11,18 23:10, 25 25:4 30:13 40:9 47:12,17 48:1,15,20,22 49:6,11 50:4 53:14 59:15 63:4 69:23 71:5, 14 continuous 61:23 62:7 conventional 74:13 conventionally 42:6 converter 73:1 converters 73:3,10 converting 72:21 converts 36:7 copies 5:11,15,17 6:14 copy 5:10,14 6:11 cord 21:13 24:7 39:7 40:3,7, 14 44:6 cords 17:23 18:8,18,19,24 19:1,8,14 20:2,6,24 21:6 22:4 24:3 34:21,24 35:6,15 40:9,12,18,20 42:19,20 43:3,4,11,13 correct 5:8,25 8:19 14:13 15:16 19:22 38:10 45:4 66:18 69:22 70:22 correctly 28:18 67:25 correlate 58:12 correlated 56:1,25 58:1,8 correlation 51:18,20 52:9,13 53:3, 8,12,18,20 54:11,13 55:5,7,9,12,15,19 57:5	58:17,22 59:4,10,13,16, 22 60:9 62:14,18,21,22 67:21 70:6,8,9,25 71:6 correlations 63:5 correspond 57:17 corrupted 22:6 corrupting 25:7 counsel 60:12,18 74:7,10 75:15 count 67:7,19 court 7:10 covered 15:8,15 create 25:15 61:6 creating 51:6 critical 39:15 cross-correlation 51:22,23,25 52:10,12, 24 53:1,5,8,16,18,22 54:2,15,19,20 55:1,4,7, 13,23 56:13,14,20,23 57:13,25 58:5,16,20 59:1 62:8,24 63:1,14, 22,23 64:1,5,9,10,13, 17,20 65:9,14,24 66:6, 12,18,20 67:2,8,15,23 68:13 69:3,12,17,21 70:1,12,13,20 71:6,7,14 cross-correlations 63:8,11 crossing 56:5 D data 51:23,25 54:19,20 64:1, 5,11,13,17,20 65:9,14, 25 66:6,12,18 67:1,2,8,	23 69:3,17,21 70:1,12, 14,17,21 71:1,15,16 David 4:17,19 day 3:5 75:17 dealing 32:13 declaration 5:12,22,23 6:12,13 9:10 11:6 18:16 20:22 21:11 27:10,11,12 53:25 54:18 56:10,25 58:12 60:21,23 63:13 64:12 define 62:14 67:21 defined 52:24 57:6 defines 26:10 definition 26:16 27:19 28:3 56:20 definitions 63:19 delay 67:18 69:11 delays 57:16 68:1,24 depending 9:25 70:7 depends 68:5 deposed 4:24 deposition 3:1 4:6,25 5:2 6:8 7:2,8 8:23 9:15 derived 14:17 describe 18:13 21:24 33:20 52:5 57:19 describing 15:25 16:7 45:3 designed	36:21 39:16 detail 52:6 67:12 details 62:16 detect 10:10 12:7,12 14:22 17:19 32:18 33:5 34:14 35:25 36:1 37:24 39:1,6 40:2 41:5,12,18 42:7,8 44:8 74:13 75:7 detected 26:14 41:1 75:3 detector 12:17,20,24 13:8,12,18 14:3,10,16 15:6,10,13, 14,25 detecting 10:18 16:8 17:21 18:6 21:12 22:2 24:2 26:18 27:20 35:11 37:11 51:10 detection 70:8 detectors 14:25 15:21 21:21 detects 10:21 17:18 20:23 21:5 29:1 determine 23:6 56:23 57:3 developed 36:15 device 6:7 12:24 13:2 14:18 62:20 devices 21:20 62:16 diagram 38:4 diaphragm 36:6,17 37:10,20,23 38:5,13 39:13 42:15 75:1 difference 13:2 18:2,8,16,20 25:4, 5 35:13 36:20 39:5
--	---	---	--

40:22 41:20 51:7 52:14 53:17 57:20,21 58:21, 22 68:6 differences 46:25 67:19 differentiating 15:23 differently 47:8 difficult 26:2 digital 61:17 62:1,19,21 63:1 72:22,25 73:3,10 digitalization 62:3 digitize 62:25 digitized 62:7 digitizing 62:18 Direct 47:22 direction 25:15 29:7 directly 15:9 17:21 21:11 22:1 24:1 33:1,2 36:3,5,19 37:10,13,22,24,25 40:9 41:21 43:13 44:2 75:1 disclosed 21:19 discrete 62:2,7 discuss 70:4 discussed 15:20 34:20 35:1 53:23 discussing 26:13 45:6 49:7 discussion 9:11 16:17 discussions 9:10	distance 44:11 46:20,21 47:13 distances 47:18 distinct 42:14 distinction 10:24 12:4 17:25 18:9 22:1,12 23:21 35:14 37:3,5 39:15 52:9 58:8 61:21 62:6 distinguished 58:10 distinguishing 18:6 55:6 72:11 divided 44:9,15 draft 75:16 drawing 10:24 37:3,5 drawn 23:21 due 71:23 duly 3:10 E earlier 15:24 16:6 18:17 31:2 55:24 58:14 59:19 72:21 elaborate 23:11 57:11 electrical 36:7 47:1 electromagnetic 21:15,25 25:9,14 28:8, 13 29:6,23,24,25 30:3 32:4 43:21 44:3,4 57:22 emanating 32:4 45:10 embodiment 21:19 37:9 70:5	embodiments 14:25 16:7 33:4 end 4:18 25:20 36:20 39:14 57:18 75:6 engineering 72:16 English 56:3 ensure 70:8 environment 23:3 24:9 30:9,12,17, 19,20,24 31:2,7,17,20, 25 32:2,6,11,21 33:24 34:3,8 environmental 10:11 12:13 14:24 17:20 21:18,23 22:9,13, 25 23:12,14 24:21 25:1, 6,12 28:2 32:20 33:6 41:1 42:5,11,21 43:5 environments 36:17 equation 65:11 66:13 equations 56:24 63:12,21,25 64:5, 11,21 65:6 66:15 essential 63:18,22 64:4 essentially 65:3 event 52:25 eventually 56:13 EXAMINATION 4:9 74:3 examined 3:10 exhibit 5:16,18 6:15,16,17,18 36:25 37:1 56:12 exhibits 57:25	exist 20:5 62:1 expect 68:6,23 69:5,25 expectation 56:15 expedite 75:16 expedited 75:18 explain 58:25 explained 57:12 explains 33:3 43:20 67:14 explicitly 15:9 16:13 26:10 expressions 52:7 extension 59:2 extent 32:5 34:5 external 19:15 23:17 extraneous 30:14 extremely 36:16 F Fabricant 3:21 factors 63:20 fair 7:19 12:3 15:18 16:21 17:3 28:19 29:17 30:7 32:24 33:9,15 45:11,18 46:20 57:24 63:3 65:12 familiar 69:20 farfetched 25:16
---	--	---	--

farther 46:20 47:14	frequencies 32:8	9:21 28:24 56:11 74:2	hit 19:16
fashion 63:6	frequency 25:13	giving 28:16	home 5:4
figure 16:16,19	front 5:9 6:2 7:4 65:1	good 4:4,10,12 23:15 26:21 50:8 65:17 74:4	horn 22:22
figures 5:14,16,17	full 4:14	Google 50:18	hour 3:5
final 75:18,21	function 52:22 54:7 55:1,24 56:13,20 57:6,25 58:5, 16 59:3 63:22 68:13 69:21 70:20 71:6,8	Grace 3:15 73:25	hours 9:1
fine 75:21	functions 57:5	gracewang@ paulhastings.com 3:18	How's 26:20
finish 35:20		gradings 64:8	human 10:10,18,20 11:20 12:8, 12 14:22 17:19 19:21, 22,24,25 20:2,5,13 21:12 24:2 32:18 33:5 34:14,18,23 35:5,7 40:20 42:8,13 44:6 48:6,7,8,11,14,21,24 49:12,15,18 50:1,3 51:6
finite 65:20,21	G	great 73:16	
fixed 46:19	game 75:4	guess 19:11,17	I
flow 21:21	gap 41:2,23,24		idea 63:18,22
focus 32:12	gave 27:13	happen 7:3	identical 46:24
folds 18:22	gem 21:20,24 43:16,20,21	happening 40:21	imbalance 53:14
form 9:18 10:14 11:16 12:2, 18 13:4,14 16:2,10,24 17:6 18:4,14 19:3,10 20:7 21:1 22:16 23:1,8 24:12 28:22 30:4 31:22 32:23 33:11 37:15 39:3 41:8 42:22 44:13 46:5, 15 49:21 51:1,19 53:10 54:4,14 58:2 63:2 67:5 70:15 71:24 74:15,21	GEMS 42:17	hard 5:10,14,15,17	imbalances 53:18
formed 60:23	general 11:12 29:23 69:14	Hastings 3:16	immune 25:11 26:17 27:19,22
foundation 44:13	generally 44:19 46:6 69:25	Hatler 3:7 4:5	impacted 30:3
fourth 5:2	generate 24:3 63:25	held 4:22 26:25 50:12 73:21	impacting 24:16
Freden 6:17	generated 18:10 22:4,5 24:7 43:10 51:25 54:21 64:11,13, 21 65:25	Hertz 57:17	implementation 67:12 68:13
Fremd 3:21	generating 19:12 25:13 34:22 64:17	high 36:16 71:8	implemented 42:8 64:23,24
	generation 17:22 35:5	higher 46:3,11	implementing 67:23
	generic 55:16,20 59:23 60:9	highest 57:9 58:6	implied 15:4 25:17 40:12 69:6
	give	history 10:9 48:4	

important 21:16 54:16 impossible 43:12 include 13:8,9,13,17 14:3,10 16:21,22 17:3,5 includes 15:1 31:7,21 33:25 including 52:6 54:7 indications 6:5 indirect 41:17 indirectly 41:15,17,25 47:5 51:9 individual 65:15 inferred 67:25 infinite 65:6,18,19 information 11:20 17:18,21 23:22 48:2,5,7,9,17 49:15,16, 17,19,20 50:1,5,21,25 51:8,13,15 62:21 68:10, 22 INGRID 3:16 input 58:1 66:24 70:2 instances 62:2 interest 22:21,23 interferes 22:20 Internet 7:25 interpret 35:23 55:13,22 72:7 interpretation 47:22 56:3 66:9,11	interpreted 14:19 50:5 56:7 72:13 interpreting 58:14,15 interrupting 28:11 introduce 41:23 introducing 52:15 invention 23:15 31:4,19 33:25 involve 18:19 19:13 49:18 68:3, 4 involved 19:18 63:21 involves 15:22 18:17 20:1 52:17 involving 53:24 56:15 IPR 5:24 8:17 irrelevant 32:6 issue 25:6 61:6 J Jacob 3:20 9:7 jaw 20:11,13,17 35:2 Jawbone's 9:5,11 JEREMY 3:15 jostling@fabricantllp.com 3:23 K Kaneda 5:18 6:16	KAO 3:16 key 23:14 36:20 40:21 kind 11:9 15:20 29:7 34:4 42:1 54:8 57:11 60:20 66:19 kinds 32:10 knew 68:5 69:9,11 knowing 23:17 47:18 L labels 70:17 Laboratory 37:2 lack 40:15 lag 68:23 69:5,13,17,24 lags 66:17 70:21 language 11:18 33:10,16 34:14 49:23 56:3 64:16 large 71:8 largest 58:6 69:18 70:24 larynx 36:14,18 37:21 40:20 leave 18:10 47:23 level 51:3 levels 35:13 38:10 limited 20:20 lines 16:18 23:16 57:15 70:5, 10	listen 44:5 literally 37:22 38:14 LLP 3:16,21 located 46:1,2,3 locations 3:6 long 24:19,24 lot 46:23 M M-U-H-A-M-M-A-D 4:17 Madison 5:5 main 13:6 18:8,16 34:9 make 58:25 making 12:4 60:23 manner 42:16 matching 54:8 material 9:8 38:23,24 materials 7:25 mathematical 52:6 mathematically 56:7 matter 29:7 meaning 19:22 35:18 36:9,12 37:6 48:16,23 49:3
---	---	--	--

51:22 52:12 53:15,21, 22,23 54:15 55:14 58:15,17,20 59:3 71:4, 9,11	4:17	morning 4:4,10,11,12 74:4	needed 69:8 70:8
means 12:11 14:20 31:12 42:23 44:20 55:16,19, 25 56:4 59:22	military 36:15	motion 10:10,18,20 12:8,12 14:23 17:19 19:21,24 20:3,5,14 21:12 22:2,4 24:2 32:18 33:5 34:14, 18,23 35:5,7 42:8,14 44:8 48:6,8,11,14,22,24 49:15 50:3 51:6	nice 4:10
measurable 46:21	milliwatt 43:22	mouth 36:24 39:19 45:13,16, 19,23 46:1,2,3,11,13,19 47:4,8,9,14	Nicole 3:7 4:4
measure 37:13 44:8 55:9 61:25	mind 59:9	move 49:12	noise 10:11 12:14 14:24 17:20 21:17,18,23 22:3, 6,9,10,14,15 23:12,14, 17 24:8,11,14,15,21 25:1,5,6,10,12,15 26:6, 8,17 27:19 28:2,20 29:2,11,12,14,15,18 30:4,8,11,13,14,22 32:13,20,21,22 33:6 34:9,10 35:13 36:16 38:2 39:9,11,24 40:5 41:2,22,23 42:1,5,11,21 43:5,11 51:12,16 71:13, 23 72:12,14
measurer 54:11	minor 64:3 65:4	movement 20:1,10,13 24:7 35:1 49:18	noise-impacting 30:21
measures 37:7 54:3	minus 53:1 65:7	moves 19:23 38:14	nonacoustic 15:22 21:22 22:12 23:18 24:11,13,20,25 25:8,11 26:5,7,8,11,13, 14,15,16 27:14,17,18 28:1,4 30:7,8,15 31:3,7, 18,21 32:5 34:1
measuring 37:10,25 39:23 40:22 41:21 51:9 54:6	minutes 26:20 73:17	moving 24:3 38:25 40:18	normal 39:21 41:3 43:8
medications 8:9	mirror 55:2	Muhammad 4:17	normalization 63:20 64:4 66:14
medium 38:24	misleading 70:18	multiple 68:1,3,4 69:8,17 70:1, 11,13,21	normalized 65:1
mentioned 6:1 55:24 66:17 68:21	missed 45:8	multiplication 53:16	nose 47:5,9,15
Meta's 74:7,10	misstates 14:4 31:22 48:25 59:11	multiplied 66:7,13,22,25 67:10	note 38:3
microphone 10:21,25 11:2,4,7,9,15, 22,25 14:17 15:2,25 16:7 30:1,2,21 35:24 36:1,5,11,13,15 37:4,6, 8,9,13,18,19,23 38:13 39:22 40:9,11 41:3,4,6, 13,19 42:4,6,10,16 43:9 44:11,16 45:24,25 46:1, 2,7,10,12 47:14 51:11 74:20,25 75:7,8,10	mixed 43:23	multiply 66:1	notes 27:9
microphones 11:9 12:5 15:7,15 21:21 23:23 24:5,6,17 25:7 30:22 31:3,18 32:14 36:8,10,21 39:16,20 45:25 46:19,24 47:7,10 74:11,13	Mizel 5:16 6:16 47:6	multiplying 52:1,17 54:21 64:8 65:1,21	Notice 3:4
mics 75:2	modalities 28:13 29:9 32:12 34:1, 4,7	N	nuances 68:12
middle	modality 26:17 27:20 28:4,16,19, 20 29:2,3,18,21,22 30:12 31:8,21 34:10	nature 61:23	number 62:5 70:25
	modifications 64:3	NAVSAD 14:15	
	modulate 35:3	necessarily 15:11 16:22 17:4 18:1 19:13 20:15,20 25:10 41:14 70:18	
	modulated 20:19		
	modulation 57:19		
	molecules 36:24 38:12,18,22,24 39:18		
	moment 74:2		

NY 3:17,22	opinion 24:19,24 26:3 32:17 54:2 64:10 65:24	73:21	peak 57:7,25 67:21 69:18
O	opinions 8:17 60:22 61:9	paper 7:3	pending 8:2
objection 9:18 10:14 11:16 12:2, 18 13:4,14 14:4,11 16:2,10,24 17:6 18:4,14 19:3,10 20:7 21:1,8 22:16 23:1,8 24:12 28:22 29:13,19 30:10, 25 31:22 32:23 33:11, 18 34:2 35:9 37:15 39:3 41:8 42:22 43:6 44:13, 18,22 46:5,15 48:12,25 49:21 51:1,19 53:10 54:4 57:2 58:2,23 59:11 61:19 63:2,15 67:5 70:15 71:18,24 73:5,13 74:15,21	opposed 10:21 15:7 22:3 37:7,11 42:5	papers 5:9 6:1,2,5	perform 63:13
objections 60:21	oranges 34:4	paragraph 10:7 12:11 14:21 23:11, 13 26:9 33:2,20 34:16 36:12 39:15 43:19 45:5 48:3 52:7,23 53:13 56:12 57:12 63:12 64:11 66:14	performance 23:15 24:16
obtuse 26:1	order 39:1,6 40:2 41:5,12 49:12,19 59:5 69:11	paragraphs 53:24,25 54:18 56:24	person 18:25 19:2,9,12,17 45:9,11,17,22 46:13 50:24
occur 66:15	original 43:24 47:12	parentheses 36:22 39:16	person's 19:8 45:13,15,19 46:11
occurred 57:8	originally 36:15	Park 3:17	personally 3:8 72:13
occurring 50:4	originates 40:14	part 7:7 24:15 43:17 45:14	perspective 72:16
offering 48:17	Ostling 3:20 9:4,12,18 10:14 11:16 12:2,18 13:4,14 14:4,11 16:2,10,24 17:6 18:4,14 19:3,10 20:7 21:1,8 22:16 23:1,8 24:12 25:20,24 26:20, 23 28:22 29:13,19 30:10,25 31:22 32:23 33:11,18 34:2 35:9 37:15 38:3 39:3 41:8 42:22 43:6 44:13,18 46:5,15 48:12,25 49:21 51:1,19 53:10 54:4 57:2 58:2,23 59:11 60:11,15, 17,19,24 61:1,5,10,19 63:15 66:3 67:5 68:15, 19 70:15 71:18,24 73:5, 13,19 74:2,3,17 75:9, 14,20	pass 73:23	petition 5:13,23,24 6:13 9:9
office 5:5	other-correlation 55:24	patent 3:19 5:13 6:15,16,17,18 8:18,20,21 10:2,5,8 11:2,4,15,25 12:10,14 14:14,20,21 15:8,16,24 16:1,6,8,16 17:16,17 20:22,25 21:7,10,19 22:18 23:20 25:4 26:10 30:17 33:6 34:8 42:12 43:16,20 44:23,25 45:2 47:7 48:1,3,16,20,23 49:6,11,24 51:24 57:12, 15 59:15 63:4 64:16 65:22 66:10,12 67:14 69:24	Petitioner 3:14
offsetted 55:3	Owner 3:19	patents 5:17 6:14 9:9 42:3 44:1	Ph.d. 3:1,8 4:1
open 6:9,11,21,24 7:3	P	pattern 54:8	phone 36:14
opening 41:22	P-R-I-O-R-I 68:19	Paul 3:16	physical 22:2 29:3,21 37:23
operating 23:4 29:22 31:3,5,17,19 32:1 33:25 36:16	p.m.	PDF 6:11,23	physically 40:18 70:22
operation 32:7 53:17 66:25		PDFS 6:20	physiological 11:19 17:18,21 47:21 48:2,5,7,10,17,21,23 49:2,13,14,20 50:1,5, 21,25 51:5,8,14,15 71:15
operator 56:15			physiology 47:23,25 48:6,14
			pick 36:21 39:16
			picked 24:16
			picking 32:14 47:10 75:11
			piece

7:3	principal 61:25	provide 8:3 17:9 34:11	57:18
pilots 36:16	principle 62:11	provided 32:17	quotes 57:15
place 21:14 74:23	prior 5:15	providing 8:10	
plain 53:15	priori 68:10,16,19,22 69:5	PSAD 14:15 16:13,17	R
play 59:15	priority 68:16	psychological 23:22	RABB 63:2
point 7:1 15:12 44:23,24 65:17 67:1	problem 23:17	publication 37:1	radar 44:4
pointed 39:22 41:19 47:8 60:15	proceeding 5:24 8:17	purpose 42:10	range 68:9
portion 16:1,8 45:2	proceedings 75:22	purposely 26:1	RASHID 3:15
POSITA 10:7 21:17 23:19 42:2, 9,12 48:3 51:24 56:18 64:23 65:5 67:12,24 68:11 69:5,20	processes 56:17	pursuant 3:4 4:7	rationale 33:21
position 20:17 43:25 47:3 58:19	processing 12:25 13:3,19 62:19 72:16	put 49:5	re-run 66:24
possibly 67:20	produce 40:25 75:6		reading 10:7 30:17,19,20,23 48:3 51:24
potentially 19:16 64:7 69:18	produced 3:9 10:22 20:18 42:19 43:3 45:22 47:5 50:24 70:7	Q	ready 50:6
practice 65:18 68:7	producing 19:2,9 45:9,11,17 46:14 51:9	qualifies 36:10	real 4:20
prepare 8:23 9:2	production 19:19 35:3	qualify 49:19	realm 30:13
preparing 9:14	products 52:25 65:12,15 68:1	question 7:14,15,17,18 8:2,3 9:6 10:16 11:11 14:7 16:3 17:1,10 19:5 20:9 21:3 22:18 24:14,23 25:2,18, 23 26:2 31:12,20 32:11 33:12 34:25 39:5 41:10, 16 42:24 45:14 46:17 47:12 55:4,5,8,11 58:21 59:21 60:1,12 61:2,4 62:10,12 64:17 67:17 68:9 69:7 71:11 72:1,7 74:23	reason 72:12,20
pressure 19:16 36:4,6 37:12 38:10,12,14 39:12 40:25 47:2 51:10	program 7:2	questioning 7:7	recall 34:13 59:19 68:25 72:23 74:7,10
prevent 8:6,9	programs 6:8,24	questions 60:22 61:7,8 73:22	receive 23:22,23 44:7
previous 6:2 22:8 31:16 40:1	prone 22:6	quick 4:21 25:22 26:19	receives 11:19 36:19 37:22 49:25
primarily 22:11	propagation 57:21	quote	receiving 36:17 37:20
primary 42:10	prosecution 10:8 48:4		recess 4:22 26:25 50:12 73:21
			reciprocal 65:2
			recognize 42:9,13

reconfigured 37:9	56:19 62:20	67:15 69:3	sample 66:24
record 4:15,20 38:4 66:3 68:15 73:9	relationships 63:17	Research 37:2	sampled 62:2
redirect 74:5	relative 52:4 54:24	resolve 44:22	samples 52:2,3,4 54:22,23,24 57:14 65:22 67:16 71:1
refer 5:22 7:24 8:20 11:17 15:10,13 23:9 27:22 59:6 66:6 70:3	relevance 13:15 24:12 30:10 34:2 57:2 63:15	respect 47:13 52:20	Sayeed 3:1,8 4:1,10,18,24 9:4 27:2 44:24 50:14 61:16 68:21 73:15,23 74:4
reference 42:3 56:17 60:9,10	relevant 9:8 24:15 35:15 48:2 51:21 52:16 53:6,7 55:15 63:6 73:5	respective 3:6	scaler 66:21,25 67:7,9 69:3,4
referencing 56:17	remember 27:15 50:22	responding 69:7	scalars 67:20
referred 15:24 17:22 20:21 22:8 39:21 65:22	REMEMBERED 3:4	response 19:15 58:14	scope 29:13,15,19 42:9 48:12 49:9 61:19,22
referring 11:21 15:22 16:1,6,9, 12,13,15 34:8 36:24,25 58:9,14 60:8 64:15 65:9,14,16	REMOTE 3:1	restate 24:23 71:25	screaming 16:22 17:4,8 18:1
refers 12:5 26:12 56:12 57:14	REMOTELY 3:13	restroom 25:21	send 29:7
refine 9:21	repeat 14:6 16:3,25 19:5 21:2 33:12 41:9 42:24 45:14 55:8	result 52:1 54:21 66:1,12,21 67:9	sending 25:14 44:3
reflect 43:22	repeated 61:6	results 43:24 52:19 66:7	sends 43:21
reflected 43:23	repeating 61:1,3	reveal 9:5	sense 29:3 35:25 36:1 46:17, 18
reflections 44:5	report 60:15	review 18:15	sensed 22:5 38:10 42:15
reflects 53:4	reported 4:6	reviewed 9:8	senses 10:21 29:1,24 36:3,5 38:13
regard 59:16	reporter 3:7 4:4,5 7:10 10:19 49:4 68:20 75:15	ridiculous 60:21	sensing 10:17 24:6,8 25:14 26:16,18 27:20 28:4 29:8 30:2 41:4 42:18 43:2,10
related 10:16 17:21 47:1,23 48:8 49:23 51:14 56:8	represent 54:14 62:5	room 8:13	sensor 10:5,9,10,12,13,24 11:1,3,7,10,11,12,14, 19,21,24 12:5,11,12,16, 20,24 13:9,13,18,21 14:3,10,19,22 15:3,4,7 16:14 17:16,17,18 20:16,21,23,24 21:5,6,
relates 49:8	representation 55:17,20 59:23 62:7	rough 75:16,18,20	
Relating 35:19	required 23:15 53:19	rules 7:6	
relationship 44:10,15 45:3 47:17,22	requirement 23:19	Rxy 52:24	
	requires 53:16 57:13 65:25	Rye 3:22	
		Sam 4:18	
		S	

9,15,17,22,24 22:13 23:7,18 24:1,20,25 25:8,11,14,15 26:4,6,7, 8,11,12,13,15 27:14,17 28:2,4,8,19 29:1,6,17, 22,24 30:8,15 32:16,17, 18 33:4,16 35:4 39:2 42:17,18,20 43:2,4,8, 10,16,21,23 49:25 sensors 11:8 12:7 15:23 21:20 23:20,22 26:14 28:15 31:4,18 SEPTEMBER 3:5 sequence 52:18 56:14 sequences 54:3 55:2,3 56:16,22 set 52:1,3 54:22,23 sets 52:3 54:24 shape 70:6 shift 57:14 66:23 67:16 shifted 52:4,20 54:24 64:7 shifts 54:7 70:1,13 Shorthand 3:7 4:5 show 64:8 shown 56:24 64:11,21 66:13, 15 Sico 6:18 side 47:9 65:2 signal 22:23 35:22,23 36:2,7 38:9,15 46:7 47:1 50:24 52:21 56:5 62:18 70:2, 14,16,19 72:16,22	signals 13:20 14:17 22:5 23:23 24:16 25:7,13 26:16 27:18 28:5,9,13,14 29:1,24 30:1,4 31:4,19 32:2,5,10,12 34:7 35:12 37:7 39:23 41:4 42:15 47:11 52:17,18,22 53:5 54:6,12,17 55:10 56:1, 25 57:22 58:1 61:17,23 62:1,9,15,24,25 63:1 64:6,7 66:24 71:7,22 72:4 significantly 70:7 similar 58:4,9 59:6 71:3,5,7,9, 12,16,19,23 72:5,7,11, 13,15 similarities 53:5 54:3,6 55:9,20 59:23 60:8 similarity 54:11,14 55:2,17 57:3,9 58:13,15,22 59:6,10 60:10 69:13 similarly 30:1 simple 61:23 simplest 62:6 Sir 74:7 sitting 5:4 32:3 55:18 59:21 situation 25:16 46:10 situations 69:14 size 65:2 skin 36:15 37:11,14,19,25 38:1 39:1,2,9 40:5,10, 15,21,23,24 41:3,5,6, 12,13,18,21 42:7 43:17 75:1	slight 64:24 smaller 44:17 solid 38:16,18 74:14 75:3,6 solids 38:22 74:8 sorts 32:2 sound 10:22 19:12 21:20 22:19 24:3,4,7 29:7 30:2,4 34:22 35:19,24 36:4 37:11,24 38:8 40:25 42:18 43:2,10 44:10,11,16 45:10,20, 22 51:6,9,10 57:21 61:24 70:7 74:8,14 75:2,6,11,12 sounds 20:18 26:21 30:14 32:14 38:11 source 24:5 34:9 39:6,10 40:2 44:11,16 45:12,15,18, 23 46:18 47:18 51:8 52:3 54:22,23 sources 52:2 South 3:21 speak 9:14 27:4 50:16 speaking 14:12 18:25 50:25 specific 29:5 33:22 36:12 48:23 51:22 52:6,12 53:22 54:15 55:14 58:16,18, 20 59:3,14 64:14 71:5 specifically 10:6 11:1,5,21 15:21 35:4 49:8,14,22 53:12 56:21 specification 33:1,3,10,17 42:13	specifications 15:19 speech 10:11,13,17,22 12:8,13 14:23 16:23 17:5,9,13, 20,22,24 18:1,3,7,10, 13,17,18 19:2,9,13,18 20:14,16,18 21:12 22:20,21 32:14,19 33:5 34:15,19,21,24 35:3,5, 6,8,12,14 45:9,11,12, 15,17,18 46:4,14 speed 57:21 spell 4:14 spelling 38:4 spend 8:25 spoke 4:25 standard 75:20 Starting 16:18 state 3:7 4:14 10:7 14:21 23:13 26:10 36:11,13 37:17 42:2 51:23 54:20 stated 12:11 16:15 23:11,16, 18 27:17 34:6 36:21 37:16 39:14 40:1 48:3 54:17 56:9,21 states 64:16 stationary 49:19 56:17 stenographically 4:6 step 60:11 stimulus 19:15 strength 47:2
---	---	--	---

strict 46:18	72:21	things 10:1 20:10 29:23 47:19	tongue 20:10,13,17 35:2
strictly 14:12	talking 34:3 50:20 70:9	thinking 29:21 71:10	top 13:19 62:2
strike 18:23,25 38:8 45:10 64:9 65:10 66:19 72:3 74:18	talks 16:18	threshold 72:17,18	touch 37:24 39:2,9 40:5,6,8, 11 41:6,13 43:17
strong 19:16	target 22:21 44:5	thresholds 72:10	touching 42:19 43:3 44:2
stronger 46:7	targets 43:25	throat 21:20 36:11,13,18,21, 23 37:4,7,18,21 39:15, 18,19,22 40:16,24 41:19 42:4,6,10,16 43:9 47:6,9 74:19,24,25 75:8,10	transcribing 7:11
subtle 39:4	tau 52:24 53:1	tied 56:9	transduce 36:22 39:17
suggest 42:4	technical 56:6	time 7:21 8:25 50:8 52:2,4 54:7,22,24 56:22 57:14 62:1,2 64:8 66:17,24 67:16,18 68:5,23,24 69:5,24 70:1,13,21,23 73:24	transferred 38:21
Suite 3:21	ten 73:17	timeline 57:8	transmitted 40:19 43:24 44:7,8
sum 65:6,16,18,19 66:1,8, 13,22,25 67:10,25	term 10:9 36:14 37:18 48:5, 16 51:21 52:16 53:4,6, 24 54:13 55:21 58:4,12 59:14	timelined 55:3	travel 38:15
summation 52:25 65:11,15	termed 55:23	timelines 57:7 68:1,3,4	traveling 38:25 74:8,14 75:3
surface 36:15 37:19 40:10	terms 15:20 18:10 34:6 44:10 58:13,15 64:3 67:9	times 60:13 65:7	travels 38:8,9 40:14
susceptible 42:5	test 69:13	tissue 10:10,18,20 12:8,12 14:23 17:19 19:21,23, 24,25 20:3,5,13 21:12 24:2 32:18 33:5 34:14, 18,23 35:5,7 40:20 42:8,13 44:6 48:6,7,8, 11,14,22,24 49:12,15, 18 50:3 51:6	true 56:14
sworn 3:10 4:2	testified 4:3	today 5:2 7:11 8:7,11 55:18 59:19,21 73:24 75:18	truthful 8:10
system 15:14 16:13,17 23:4 31:3,17 32:1,7 35:11 45:24 68:24	testify 8:16	today's 8:23	truthfully 8:7
systems 14:15 15:20 16:12	testifying 8:7	tolerances 72:10	turnaround 75:21
T			
table 5:12,22	testimony 8:11 12:1 14:2,5,9 26:5 28:1 31:23 33:24 42:20 43:4 49:1,12,17 55:18 59:12,19,21 60:4 68:25 69:23		two-millisecond 57:17
taking 64:6	That'd 73:16		type 15:7 19:24 20:2 36:14 37:19
talk 7:11 10:6,7 35:15 36:11 43:19	Theodore 3:21		types 20:5 29:11
talked	thing 12:21 13:6,7,17 21:16 54:16 64:2		typical 36:9 38:13 57:4
			typically 62:25 73:2
			typo 37:20 66:3 68:16

U U.S. 8:18 37:1 un-annotated 27:11,12 unaffected 10:11 12:13 14:23 17:20 21:16,18,22 22:2 23:7,12,14 24:20,25 26:6,7 27:14,23,24 28:2,19 30:15 32:19 33:6 42:21,23 43:5 uncertainty 68:7 uncomfortable 43:14 understand 7:6,14 8:16 10:9 17:8 21:3,17 23:19 42:3 48:5 51:24 55:6 56:19 58:19 64:23 understanding 9:23 23:6 26:3 28:18 40:13 44:9 55:25 61:16 66:17,20 understood 7:18 55:11 unusual 46:13,22 47:13 unvoiced 18:7,13,18 35:12,14 user 43:17 user's 36:18 37:21 utilizes 21:21	variant 65:4 variations 63:19 64:24 varying 35:12 version 52:13 versions 64:7 versus 13:3 17:9 22:12 38:4 57:22 61:17 62:7 66:4 68:16 vibrate 18:24 19:1,9 38:19 75:6 vibrating 17:24 18:9 19:14,18 34:21,24 35:16 38:12 40:24 vibration 18:18 19:24,25 20:1,2, 6,23 21:5,13 36:17 37:19 39:1,7 40:3,14 41:5,12 75:10 vibrations 18:19 36:3,5,19,22,23 37:10,14,22 38:1,21 39:6,7,17,18 40:2,3,19, 23 41:18 47:5 vocal 17:23 18:8,18,19,22,24 19:1,8,14 20:2,6,23 21:6,13 22:4 24:3,7 34:21,24 35:6,15 36:22 39:7,17 40:3,6,7,9,11, 14,18 42:19 43:3,11,13 44:6 voice 12:16,19 13:8,12,18 14:2,9,16,25 15:6,10, 13,14,21,25 16:8 17:22 18:7,17 20:16 34:21 35:7,11,14 voicing 9:17,19,24 10:3,4,9,12, 13 11:1,3,11,14,19,20, 24 12:4,7,11,16,20 13:8,13,18,20 14:3,10,	19,21 15:4 16:14,21 17:3,13,16 18:2 20:16, 21,24 21:6,9,17 23:20, 21 24:1,20,24 25:14 26:4,11,13,14 32:16,17 33:16 35:4 42:14 49:25 50:1 W Wang 3:15 4:8,9,20,23 9:13, 22 10:23 11:23 12:6,22 13:11,22 14:8 15:5 16:5,20 17:2,12 18:12, 21 19:20 20:12 21:4 22:7,24 23:5 24:10,18 25:22,25 26:19,21,24 27:1 29:10,16 30:6,16 31:6,12 32:15 33:8,14, 23 34:12 35:17 38:7 39:25 41:11 43:1,15 44:14,21 46:9 47:20 48:19 49:10 50:8,11,13 51:17 52:8 54:1,10 57:23 58:7 59:8,18 60:14,16,18,20,25 61:3, 8,12,15,20 63:7,24 66:5 67:6 68:17 71:2,21 72:2 73:8,14,20,22 74:15,21 75:17 washed 32:9 wave 35:24 38:23 44:7 45:20, 22 47:3 75:11,12 waves 10:22 19:16 21:25 24:7 25:9 30:2,5 32:4 34:22 36:4 37:11,24 42:7 43:10,21,23,24 44:3,5, 7,8 61:24 70:6 74:8,14 75:2 ways 32:10 35:6 53:4,20 56:8 62:13 63:5 67:22 75:7 weak 43:21 web 27:6 week	4:25 weighed 59:14 well-defined 53:23 55:23 well-known 36:14 37:18 wider 70:8 width 70:8,9,25 window 52:19 54:22 65:2,20,21 66:2 67:20 68:8 windowed 52:1,2 54:23 64:6 Wisconsin 5:5 Wong 4:12 word 9:23 40:15 53:21 works 74:20,25 wrong 66:18 69:22 X X- 57:15 XCORR 56:13 57:13,16 58:16, 19 XN 56:16 Y yelling 16:22 17:4,8 YN 56:16 York 3:17
---	--	--	---

Z

Zoom

3:6,13 6:9,10,23