

DEPOSITION OF  
DURAND BEGAULT, PH.D  
META PLATFORMS, INC. V. EIGHT KHZ  
TAKEN ON  
JULY 3, 2024



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| <div>1 UNITED STATES PATENT AND TRADEMARK OFFICE</div> <div>2 BEFORE THE PATENT TRIAL AND APPEAL BOARD</div> <div>3 ---o0o---</div> <div>4 META PLATFORMS, INC.,</div> <div>5 Petitioner,</div> <div>6 V.</div> <div>7 EIGHT KHZ, LLC,</div> <div>8 Patent Owner</div> <div>9 IPR2023-01003</div> <div>10 US Patent No. 9,226,090</div> <div>11</div> <div>12</div> <div>13 VIDEOTAPED REMOTE CONFERENCING DEPOSITION OF</div> <div>14 DURAND BEGAULT, Ph.D</div> <div>15</div> <div>16</div> <div>17 Stenographically reported by NICOLE HATLER</div> <div>18 California CSR No. 13730</div> <div>19 July 3, 2024</div> <div>20</div> <div>21</div> <div>22</div> <div>23</div> <div>24</div> <div>25 JOB No. 24-139100</div>                                                                                                                            | <div>Page 3</div> <div>1 VIDEOTAPED REMOTE CONFERENCING DEPOSITION OF</div> <div>2 DURAND BEGAULT, Ph.D</div> <div>3</div> <div>4 BE IT REMEMBERED, that pursuant to Notice, and on</div> <div>5 the 3rd day of July 2024, commencing at the hour of 8:40</div> <div>6 a.m., in the respective locations via Zoom, before me,</div> <div>7 NICOLE HATLER, a Certified Shorthand Reporter, State of</div> <div>8 California, personally appeared DURAND BEGAULT, Ph.D,</div> <div>9 produced as a witness in said action, and being by me</div> <div>10 first duly sworn, was thereupon examined as a witness in</div> <div>11 said cause.</div> <div>12 ---o0o---</div> <div>13 APPEARANCES ALL REMOTELY VIA ZOOM</div> <div>14 For the Petitioner:</div> <div>15 LISA NGUYEN</div> <div>16 Paul Hastings LLP</div> <div>17 1117 S. California Avenue</div> <div>18 Palo Alto, CA 94304</div> <div>19 (650) 320-1800</div> <div>20 lisanguyen@paulhastings.com</div> <div>21</div> <div>22 For the Patent Owner:</div> <div>23 JAYME PARTRIDGE</div> <div>24 PATRICK DUNN</div> <div>25 Spencer Fane LLP</div> <div>3040 Post Oak Boulevard, Suite 1400</div> <div>Houston, TX 77056-6560</div> <div>(713) 212-2713</div> <div>jpartridge@spencerfane.com; pdunn@spencerfane.com</div> <div>Also present:</div> <div>Andy Nation, videographer</div> <div>Emma Kim</div>                                            |
| <div>Page 2</div> <div>1 I N D E X</div> <div>2 PAGE</div> <div>3 EXAMINATION BY MS. NGUYEN.....5</div> <div>4 EXAMINATION BY MS. PARTRIDGE.....60</div> <div>5</div> <div>6</div> <div>7</div> <div>8 E X H I B I T S</div> <div>9 PAGE</div> <div>10 PETITIONER'S</div> <div>11 Exhibit 1001 Patent No. 9,226,090.....29</div> <div>12 Exhibit 1036 3D Sound for Virtual Reality and.....25</div> <div>13 Multimedia</div> <div>14 Exhibit 1047 Headphone Localization of Speech.....8</div> <div>15 Stimuli</div> <div>16 Exhibit 1048 Headphone Localization of Speech.....9</div> <div>17 Exhibit 1049 Improved HRTF-Based Pseudostereophony...11</div> <div>18 Exhibit 1050 Inter-Laboratory Round Robin HRTF.....15</div> <div>19 Measurement Comparison</div> <div>20</div> <div>21</div> <div>22</div> <div>23</div> <div>24</div> <div>25</div> | <div>Page 4</div> <div>1 DURAND BEGAULT, Ph.D</div> <div>2 sworn as a witness</div> <div>3 testified as follows:</div> <div>4 THE VIDEOGRAPHER: Good morning. We are</div> <div>5 now on the record. Today's date is July 3rd, 2024,</div> <div>6 and the time 8:41 a.m. Pacific Coast Time. This is</div> <div>7 the video deposition of Dr. Durand Begault being</div> <div>8 taken in the matter of Meta Platforms, Inc., versus</div> <div>9 Eight KHZ, LLC. This case is pending in the US</div> <div>10 Patent and Trademark Office before the Patent Trial</div> <div>11 and Appeal Board with an IPR No. Of 202301003, US</div> <div>12 Patent No. 9226090.</div> <div>13 And this deposition is being taken via</div> <div>14 remote connection today on the part of both the</div> <div>15 videographer and the court reporter. The</div> <div>16 videographer is Andy Nation of the Sullivan Group</div> <div>17 of Court Reporters.</div> <div>18 And would counsel please identify</div> <div>19 yourselves and state whom you represent, beginning</div> <div>20 with our questioning attorney today?</div> <div>21 MS. NGUYEN: This is Lisa Nguyen of Paul</div> <div>22 Hastings for Petitioner Meta Platforms. With me</div> <div>23 today is summer associate Emma Kim.</div> <div>24 MS. PARTRIDGE: Jayme Partridge, and I</div> <div>25 have with me Patrick Dunn on behalf of Eight KHZ.</div> |

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| <p style="text-align: right;">Page 5</p> <p>1 Welcome, Ms. Kim. It will be wonderful to<br/>2 see -- I love seeing young summer associate -- or<br/>3 not young -- I'm not supposed to say young anymore,<br/>4 but trust me, compared to me, young. So it's great<br/>5 to see you.<br/>6 THE VIDEOGRAPHER: Thank you, Counsel.<br/>7 Our court reporter today is Nicole Hatler,<br/>8 and she may now swear in the doctor.<br/>9 THE REPORTER: Good morning. My name is<br/>10 Nicole Hatler, California Certified Shorthand<br/>11 Reporter No. 13730. This deposition will be<br/>12 stenographically reported pursuant to CCP 2025.<br/>13 MS. NGUYEN: Thank you.<br/>14 EXAMINATION BY MS. NGUYEN:<br/>15 Q. Sir, can you please spell your name for the<br/>16 record?<br/>17 A. Yes. It's Durand, D-U-R-A-N-D, Rene,<br/>18 R-E-N-E, with a final accent on the -- I'm sorry --<br/>19 with an accent mark on the final E, Begault,<br/>20 B-E-G-A-U-L-T.<br/>21 Q. And where are you sitting today?<br/>22 A. I'm sitting at my desk at my home.<br/>23 Q. And have you been deposed before?<br/>24 A. Yes.<br/>25 Q. About, approximately, how many times have</p>    | <p style="text-align: right;">Page 7</p> <p>1 A. Fine.<br/>2 Q. So Doctor, this case involves something<br/>3 called head-related transfer functions.<br/>4 Are you familiar with that term?<br/>5 A. Yes.<br/>6 Q. And you -- have you heard it referred to as<br/>7 HRTF?<br/>8 A. Yes.<br/>9 Q. What is an HRTF?<br/>10 A. An HRTF stands for head-related transfer<br/>11 function, and it refers to the spectral and<br/>12 temporal processing -- or not processing, really,<br/>13 but effects of the outer ear and the head on an<br/>14 incoming sound.<br/>15 Q. Are there different ways to describe HRTF,<br/>16 depending on context?<br/>17 A. No. Fundamentally, there is --<br/>18 scientifically, we need to refer to the spectral<br/>19 changes and the interaural time delay differences<br/>20 that occur with an HRTF.<br/>21 Q. And interaural, what does interaural mean?<br/>22 A. Oh, that refers to two ears or the<br/>23 difference between two ears. So in that case,<br/>24 we're talking about a binaural HRTF.<br/>25 Q. I'm dropping a document into the chat</p> |
| <p style="text-align: right;">Page 6</p> <p>1 you been deposed before?<br/>2 A. Combining courtroom testimony and<br/>3 depositions, I think 99 times. This might be<br/>4 number 100 or it might be 99. I haven't counted in<br/>5 a while.<br/>6 Q. And have you been deposed remotely before?<br/>7 A. Yes.<br/>8 Q. Do you have anything -- any papers in front<br/>9 of you right now?<br/>10 A. Only a plain unaltered copy of my<br/>11 declaration, and that's all.<br/>12 Q. And on your computer or a device that<br/>13 you're using to do this deposition, are there any<br/>14 applications or any other programs open?<br/>15 A. No.<br/>16 Q. At any point in time during this deposition<br/>17 if you do have another program open or application<br/>18 open or if you do have another piece of paper open,<br/>19 can you, please, let me know?<br/>20 A. I will certainly do that.<br/>21 Q. And given that you have been deposed so<br/>22 many times before, I won't go through all the<br/>23 formal instructions, but do feel free to let me<br/>24 know if you need a break. I only ask that you<br/>25 answer a question, if it's pending, first.</p> | <p style="text-align: right;">Page 8</p> <p>1 that's been marked as Exhibit 1047.<br/>2 (Exhibit 1047 was marked for identification.)<br/>3 BY MS. NGUYEN:<br/>4 Q. Can you, please, open it?<br/>5 A. Sure. Let me figure this out.<br/>6 Okay. Exhibit 1047. Okay. So it allows<br/>7 me to download it. Do you want me to download it<br/>8 and it will open as a separate document?<br/>9 Q. Yes, please.<br/>10 A. Okay.<br/>11 MS. PARTRIDGE: Okay. One second. You<br/>12 put it in the chat, and I just need to go to the<br/>13 chat to get that?<br/>14 Is that what you're saying?<br/>15 MS. NGUYEN: That's right.<br/>16 MS. PARTRIDGE: Sorry. Every one of<br/>17 these, to me, is different, but it may just be I<br/>18 forget in between.<br/>19 Okay. Yep. Keep going.<br/>20 THE WITNESS: Okay. I think I've<br/>21 downloaded it. Let me find it.<br/>22 Okay. Yes. I'm looking at the paper,<br/>23 uh-huh.<br/>24 BY MS. NGUYEN:<br/>25 Q. And you're familiar with Exhibit 1047?</p>                                                                                         |

| Page 9                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Page 11                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
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| <p>1 A. It's been a long time. I think this dates<br/>2 from 1991, but yes.<br/>3 Q. In the first paragraph, which appears to be<br/>4 the abstract, do you see that it says, Head-related<br/>5 transfer functions, HRTFs, the direction-dependent<br/>6 spectral changes caused primarily by the outer<br/>7 ears?<br/>8 A. I do.<br/>9 Q. Would you say that's consistent with the<br/>10 description of HRTF that you previously provided?<br/>11 A. Yes.<br/>12 Q. I'm dropping another document into the<br/>13 chat, Exhibit 1048. Can you please download and<br/>14 open?<br/>15 (Exhibit 1048 was marked for identification.)<br/>16 MS. PARTRIDGE: And Ms. Nguyen, just so I<br/>17 know, the Exhibit 1048 is exhibits that were in the<br/>18 IPR?<br/>19 MS. NGUYEN: They are, actually, newly<br/>20 marked. So I -- in order to avoid confusion, I<br/>21 typically mark it with exhibit numbers that are<br/>22 going to be new.<br/>23 MS. PARTRIDGE: Oh, I see what you're<br/>24 saying. It's just -- it had, kind of, a high<br/>25 exhibit number, so I'm trying to figure out what's</p> | <p>1 that it says, Head-related transfer function, HRTF,<br/>2 the listener-specific direction-dependent acoustic<br/>3 effects of those on an incoming signal?<br/>4 A. I see that.<br/>5 Q. Would you agree that this is also<br/>6 consistent with your description of HRTF?<br/>7 MS. PARTRIDGE: Objection -- objection.<br/>8 Outside scope.<br/>9 THE WITNESS: It's -- yeah. It's<br/>10 consistent.<br/>11 BY MS. NGUYEN:<br/>12 Q. I'm dropping another exhibit into the chat,<br/>13 Exhibit 1049. Please download and let me know when<br/>14 you have it open.<br/>15 (Exhibit 1049 was marked for identification.)<br/>16 MS. PARTRIDGE: And we'll also object to<br/>17 this exhibit as outside the scope.<br/>18 THE WITNESS: I have it open.<br/>19 BY MS. NGUYEN:<br/>20 Q. Underneath the introduction section --<br/>21 strike that.<br/>22 Sir, are you familiar with Exhibit 1049?<br/>23 A. I, kind of, forgot about it. I'm trying to<br/>24 remember -- did I author this? I probably did.<br/>25 Yeah. It's been -- it's been a while since</p>                    |
| Page 10                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Page 12                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <p>1 going on.<br/>2 Are these documents that were used in the<br/>3 IPR proceeding?<br/>4 MS. NGUYEN: They have not been yet.<br/>5 MS. PARTRIDGE: Okay. I just want to make<br/>6 sure because I'm going to object as outside the<br/>7 record for these -- both Exhibits 1048 and 1047.<br/>8 So I just want to make sure. I thought -- I<br/>9 thought they were from the record itself. So I'm<br/>10 going to object as new evidence and outside the<br/>11 scope of Dr. Begault's deposition and declaration.<br/>12 But you can answer, Dr. Begault.<br/>13 THE WITNESS: I forgot what the question<br/>14 was.<br/>15 MS. PARTRIDGE: Sorry.<br/>16 BY MS. NGUYEN:<br/>17 Q. No worries. I just asked if you have it<br/>18 open.<br/>19 A. I do.<br/>20 Q. And is Exhibit 1048 familiar to you?<br/>21 A. Yes.<br/>22 Q. And it's a paper that you authored?<br/>23 A. 30 years ago, I think. 31 years ago.<br/>24 Q. On the first page of Exhibit 1048, in the<br/>25 second column, near -- on the very end, do you see</p>                                                                         | <p>1 I've seen this one. Yes. It's a description of a<br/>2 patent.<br/>3 Q. And do you see in the second paragraph of<br/>4 the sentence that starts, In the time domain?<br/>5 A. I think I do. Where are you exactly?<br/>6 Q. It says, "In the time domain, an HRTF is an<br/>7 impulse response as a function of direction of<br/>8 incidence, that is convolved with the incident<br/>9 acoustic signal."<br/>10 Do you see that?<br/>11 A. No. Is that second paragraph?<br/>12 Q. Apologies.<br/>13 A. Oh, wait. I think I do see it.<br/>14 Q. Yeah. Second paragraph, I would say midway<br/>15 through the paragraph.<br/>16 A. Yeah, yeah.<br/>17 MS. PARTRIDGE: Okay. Dr. Begault, please<br/>18 slow down. Because I need to make some objections<br/>19 because these are outside the record. Okay? So<br/>20 slow down on your answers. Okay?<br/>21 THE WITNESS: Okay.<br/>22 BY MS. NGUYEN:<br/>23 Q. I'll go ahead and read it again. It's --<br/>24 about midway through the second paragraph, it says,<br/>25 "In the time domain, an HRTF is an impulse response</p> |

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| <p style="text-align: right;">Page 13</p> <p>1 as a function of direction of incidence; that is</p> <p>2 convolved with the incident acoustic signal."</p> <p>3 Do you see that?</p> <p>4 A. I do.</p> <p>5 MS. PARTRIDGE: Object as outside the</p> <p>6 scope; and outside the record.</p> <p>7 BY MS. NGUYEN:</p> <p>8 Q. Would you agree that that sentence is an</p> <p>9 accurate description of an HRTF in the time domain?</p> <p>10 MS. PARTRIDGE: Objection. Outside scope;</p> <p>11 and outside the record on this IPR.</p> <p>12 THE WITNESS: Yes. It's descriptive. It</p> <p>13 might be -- not include 100 percent of everything I</p> <p>14 might be able to say about it, but it is consistent</p> <p>15 with what I said earlier.</p> <p>16 BY MS. NGUYEN:</p> <p>17 Q. And when you say it's -- not necessarily</p> <p>18 includes 100 percent of what you might be able to</p> <p>19 say about it, what is it missing?</p> <p>20 MS. PARTRIDGE: Objection. Outside scope.</p> <p>21 Objection. Outside record of the IPR.</p> <p>22 THE WITNESS: Let me think about it here.</p> <p>23 Well, it's fundamentally true, what's said</p> <p>24 there. It just -- I could have used -- I could</p> <p>25 have used more detail, for instance.</p> | <p style="text-align: right;">Page 15</p> <p>1 MS. PARTRIDGE: Objection. Form.</p> <p>2 Objection. Scope. And objection. Outside the IPR</p> <p>3 record.</p> <p>4 THE WITNESS: Well, it's talking just</p> <p>5 about the frequency domain there. It's also</p> <p>6 talking about a processing, right. So that</p> <p>7 multiplies. That last part of the sentence is more</p> <p>8 descriptive of a process, but it's accurate.</p> <p>9 BY MS. NGUYEN:</p> <p>10 Q. And I'm dropping into the chat an exhibit</p> <p>11 marked Exhibit 1050. Can you, please, download and</p> <p>12 let me know when you have it open.</p> <p>13 (Exhibit 1050 was marked for identification.)</p> <p>14 MS. PARTRIDGE: And I'll object to this</p> <p>15 exhibit as outside the record and outside the</p> <p>16 scope.</p> <p>17 THE WITNESS: Okay. I see it.</p> <p>18 BY MS. NGUYEN:</p> <p>19 Q. Do you recognize Exhibit 1050?</p> <p>20 A. I do.</p> <p>21 Q. And it's a paper that you previously wrote?</p> <p>22 MS. PARTRIDGE: Objection. Form.</p> <p>23 Objection. Outside the record and scope.</p> <p>24 THE WITNESS: It's a -- I coauthored it.</p> <p>25 //</p> |
| <p style="text-align: right;">Page 14</p> <p>1 But it -- fundamentally, it's correct.</p> <p>2 BY MS. NGUYEN:</p> <p>3 Q. And what additional detail might you have</p> <p>4 added to that?</p> <p>5 MS. PARTRIDGE: Objection. Form.</p> <p>6 Objection. Outside the scope. Objection. Outside</p> <p>7 the IPR record.</p> <p>8 THE WITNESS: Oh, I could have added</p> <p>9 something about acoustics and wavelengths.</p> <p>10 BY MS. NGUYEN:</p> <p>11 Q. Anything else?</p> <p>12 A. Not off the top of my head.</p> <p>13 Q. In the sentence after that, it says, "In</p> <p>14 the frequency domain, the HRTF is a magnitude and</p> <p>15 phase response as a function of frequency of sound</p> <p>16 and direction of incidence; that multiplies the</p> <p>17 frequency domain, complex amplitude representation</p> <p>18 of the instant -- incident acoustic signal."</p> <p>19 Do you see that?</p> <p>20 A. I do.</p> <p>21 MS. PARTRIDGE: Objection. Form.</p> <p>22 Objection. Outside the scope and record.</p> <p>23 BY MS. NGUYEN:</p> <p>24 Q. And would you agree that this sentence is</p> <p>25 an accurate description of HRTF?</p>                                                                                                      | <p style="text-align: right;">Page 16</p> <p>1 BY MS. NGUYEN:</p> <p>2 Q. And under the heading, Introduction, do you</p> <p>3 see the second sentence that says, "HRTFs are</p> <p>4 frequency domain transforms of time domain</p> <p>5 head-related impulse responses"?</p> <p>6 MS. PARTRIDGE: Objection. Outside the</p> <p>7 scope and record.</p> <p>8 THE WITNESS: Yes, I do.</p> <p>9 BY MS. NGUYEN:</p> <p>10 Q. Would you agree that that is an accurate</p> <p>11 description of HRTS?</p> <p>12 MS. PARTRIDGE: Objection. Form.</p> <p>13 Objection. Outside scope and outside the IPR</p> <p>14 record.</p> <p>15 THE WITNESS: The sentence is accurate.</p> <p>16 BY MS. NGUYEN:</p> <p>17 Q. Would you, generally, agree with me that</p> <p>18 HRTFs can be described in different ways?</p> <p>19 MS. PARTRIDGE: Objection. Form.</p> <p>20 THE WITNESS: Well, sure. They could be</p> <p>21 described correctly or incorrectly or more</p> <p>22 completely or less completely. I'm not sure what</p> <p>23 you mean.</p> <p>24 BY MS. NGUYEN:</p> <p>25 Q. Is there one definition for HRTF?</p>                                                  |

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| <p style="text-align: right;">Page 17</p> <p>1 A. I provided a pretty concise definition as a<br/>2 part of this litigation, I believe, where there was<br/>3 a document that was providing definitions, and I<br/>4 think HRTF was in there. I thought that was a good<br/>5 definition.<br/>6 Q. Have you heard the term interaural time<br/>7 difference?<br/>8 A. Yes, I have.<br/>9 Q. What is interaural time difference?<br/>10 A. Well, it is, generally speaking, time<br/>11 differences in the time of arrival of frequencies<br/>12 between the two ears for an incident sound source.<br/>13 Q. Would a fair description be -- of<br/>14 interaural time difference be dependent on the<br/>15 speed of sound and the difference in distance the<br/>16 sound travels to reach both ears?<br/>17 MS. PARTRIDGE: Objection. Form.<br/>18 Objection. Ambiguous.<br/>19 THE WITNESS: Those are two relevant<br/>20 physical factors.<br/>21 BY MS. NGUYEN:<br/>22 Q. So would that be a yes, it's there to<br/>23 describe interaural time difference that way?<br/>24 MS. PARTRIDGE: Objection. Form.<br/>25 Objection. Ambiguous.</p>                                  | <p style="text-align: right;">Page 19</p> <p>1 THE WITNESS: That's an odd definition<br/>2 that you just gave.<br/>3 BY MS. NGUYEN:<br/>4 Q. And what makes it odd?<br/>5 A. Well, one, is talking about the speed of<br/>6 sound. Certainly that's, you know, relevant to<br/>7 this, but typically speaking, when we're discussing<br/>8 interaural time delay, we're talking about how it<br/>9 changes as a function of angle of incidents to a<br/>10 head. And so, the speed of sound is typically<br/>11 fixed in those situations or insignificant. It's<br/>12 just there. It's a physical property, right.<br/>13 So I would be surprised if I saw, in<br/>14 writing, something that talked in great detail<br/>15 about the effect of the speed of sound without<br/>16 talking about things like the frequency dependents<br/>17 of ITD, for instance. So there -- again, as I<br/>18 answered you earlier, there's different levels of<br/>19 detail that you can have, and the level of detail<br/>20 that you just gave, the speed of sound, the<br/>21 difference between two ears, seems very high level<br/>22 and seems incomplete.<br/>23 Q. Would you say that a proper definition of<br/>24 interaural time difference requires some reference<br/>25 to frequency?</p> |
| <p style="text-align: right;">Page 18</p> <p>1 THE WITNESS: No. I wouldn't call it<br/>2 fair. It seems to be somewhat incomplete.<br/>3 BY MS. NGUYEN:<br/>4 Q. What would you say is missing?<br/>5 A. I think all of these definitions that are<br/>6 brought up in the first paragraph of some of these<br/>7 papers are a little more detailed.<br/>8 As you can see in my declaration, there's<br/>9 far more detail given about the effects of<br/>10 interaural time delay as a function of frequency<br/>11 and phase delay. So it really depends on how<br/>12 detailed you want to go into the descriptor.<br/>13 Q. And so, would your criticism of the<br/>14 definition I just provided for interaural time<br/>15 difference be that it's missing some requirements?<br/>16 MS. PARTRIDGE: Objection. Form.<br/>17 Objection. Mischaracterizes testimony.<br/>18 THE WITNESS: You're going to have to read<br/>19 me back what your definition of ITD was.<br/>20 BY MS. NGUYEN:<br/>21 Q. Sure.<br/>22 Dependent on the speed of sound, any<br/>23 difference in distance that sound travels to reach<br/>24 both ears.<br/>25 MS. PARTRIDGE: Objection. Form.</p> | <p style="text-align: right;">Page 20</p> <p>1 A. Yes.<br/>2 Q. Have you heard the term interaural level<br/>3 difference?<br/>4 A. Yes.<br/>5 Q. And what is interaural level difference?<br/>6 A. Well, that can refer to a number of things.<br/>7 But quite -- in its simplest mode, it just talks<br/>8 about the -- when we say level, we're talking about<br/>9 sound pressure level, and we're talking about the<br/>10 difference of sound pressure level at the two ears.<br/>11 Q. Would it be fair to say that interaural<br/>12 level difference represents a difference in sound<br/>13 pressure levels at each ear?<br/>14 MS. PARTRIDGE: Objection. Form.<br/>15 THE WITNESS: Well, it's not typically<br/>16 referred to just in that way. Again, it's the<br/>17 level of detail that you're offering there. So<br/>18 give me your definition again.<br/>19 BY MS. NGUYEN:<br/>20 Q. Sure. Interaural level difference<br/>21 represents a difference in a sound pressure -- I'm<br/>22 sorry. Let me start over.<br/>23 Interaural level difference represents a<br/>24 difference in sound pressure levels at each ear.<br/>25 A. Well, that's true in it's --</p>                                                                                                        |

| Page 21                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Page 23                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
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| <p>1 MS. PARTRIDGE: Form.<br/>2 THE WITNESS: Sorry.<br/>3 MS. PARTRIDGE: Objection. Form.<br/>4 THE WITNESS: I'm sorry.<br/>5 That's true in itself, yes. But again, it<br/>6 doesn't go into the level of detail that one might<br/>7 provide.<br/>8 BY MS. NGUYEN:<br/>9 Q. And what level of detail do you believe is<br/>10 missing from that description?<br/>11 MS. PARTRIDGE: Objection. Form.<br/>12 THE WITNESS: Frequency difference. Also,<br/>13 for both the definitions of ITD and ILD that you're<br/>14 giving, causation.<br/>15 BY MS. NGUYEN:<br/>16 Q. Anything else?<br/>17 A. Oh, I'm sure there's probably more, but<br/>18 that's what I've got so far.<br/>19 Q. So in your opinion, a proper definition of<br/>20 ILD and ITD would reference frequency difference<br/>21 and causation?<br/>22 MS. PARTRIDGE: Objection.<br/>23 Mischaracterizes testimony. Objection. Form.<br/>24 THE WITNESS: So again, definitions could<br/>25 be very general, or they could be very detailed.</p> | <p>1 MS. PARTRIDGE: Objection. Form. Let<br/>2 me -- wait. Talk for a second. Objection. Form.<br/>3 THE WITNESS: I couldn't hear you.<br/>4 BY MS. NGUYEN:<br/>5 Q. No worries.<br/>6 So would an ITD, by itself, be an HRTF?<br/>7 A. No.<br/>8 MS. PARTRIDGE: Without more.<br/>9 THE WITNESS: Again, by itself, I think,<br/>10 requires some clarification, though.<br/>11 BY MS. NGUYEN:<br/>12 Q. If I -- if I have a difference in sound<br/>13 pressure levels at each ear, you would not<br/>14 characterize that as an HRTF, correct?<br/>15 MS. PARTRIDGE: Objection.<br/>16 THE WITNESS: That's correct.<br/>17 MS. PARTRIDGE: Form.<br/>18 THE WITNESS: That's correct.<br/>19 BY MS. NGUYEN:<br/>20 Q. Is an ILD, by itself, an HRTF?<br/>21 A. Is an ILD, by itself, an HRTF?<br/>22 Q. Correct.<br/>23 A. No.<br/>24 Q. Have you heard the term, "Infinite impulse<br/>25 response"?</p> |
| Page 22                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Page 24                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <p>1 And the level of detail sometimes is improved, if<br/>2 you will, if we start to look at the causation for<br/>3 interaural level differences or interaural time<br/>4 differences.<br/>5 BY MS. NGUYEN:<br/>6 Q. And apologies. I think I said ILD, and you<br/>7 understand that means interaural level difference,<br/>8 correct?<br/>9 A. That's my understanding of its meaning.<br/>10 Q. And I also referred to ITD which you<br/>11 understand that to mean interaural time difference?<br/>12 A. Yes.<br/>13 Q. Does an HRTF include ILD?<br/>14 A. Yes.<br/>15 Q. Does an HRTF include an ITD?<br/>16 A. Yes.<br/>17 Q. Is ITD without more an HRTF?<br/>18 MS. PARTRIDGE: Objection. Form.<br/>19 THE WITNESS: Wait. Ask your question<br/>20 again.<br/>21 BY MS. NGUYEN:<br/>22 Q. Sure.<br/>23 Is an ITD without more an HRTF?<br/>24 A. An ITD without what?<br/>25 Q. I'm -- I'm --</p>                                                                                                        | <p>1 A. Yes.<br/>2 Q. What is an infinite impulse response?<br/>3 A. I know that term from the domain of signal<br/>4 processing. So it refers to a feedback system.<br/>5 Q. Have you heard of an infinite impulse<br/>6 response filter?<br/>7 A. Same answer.<br/>8 Q. Have you heard of a finite impulse<br/>9 response?<br/>10 A. Yes.<br/>11 Q. And what is a finite impulse response?<br/>12 A. Typically, a feed-forward operation as in a<br/>13 filter.<br/>14 Q. Is an -- I'm sorry. Strike that.<br/>15 Is an infinite impulse response filter an<br/>16 HRTF?<br/>17 MS. PARTRIDGE: Objection. Form.<br/>18 THE WITNESS: Not by itself.<br/>19 BY MS. NGUYEN:<br/>20 Q. Is a finite response filter an HRTF?<br/>21 MS. PARTRIDGE: Objection. Form.<br/>22 THE WITNESS: Same answer.<br/>23 BY MS. NGUYEN:<br/>24 Q. Have you heard the term spatialization?<br/>25 A. Yes.</p>              |

| Page 25                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Page 27                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
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| <p>1 Q. What is spatialization?</p> <p>2 A. Ambiguous.</p> <p>3 Q. You mentioned before that you had heard the</p> <p>4 term spatialization before. In what context have</p> <p>5 you heard that term?</p> <p>6 A. Many, many, many commercial products used</p> <p>7 as a -- kind of a -- I forget the right term for</p> <p>8 it, but you know, just as a generic descriptor. It</p> <p>9 could mean a lot of things.</p> <p>10 Q. Have you heard the term -- I'm sorry.</p> <p>11 Strike that.</p> <p>12 Have you heard of a system called</p> <p>13 Convolvotron?</p> <p>14 A. Yes.</p> <p>15 Q. Have you heard the term spatialization in</p> <p>16 the context of Convolvotron before?</p> <p>17 A. I don't remember. Convolvotron is a very</p> <p>18 old device.</p> <p>19 MS. NGUYEN: I'm dropping into the chat a</p> <p>20 document marked Exhibit 1036.</p> <p>21 And Counsel, this is already in the</p> <p>22 record.</p> <p>23 (Exhibit 1036 was marked for identification.)</p> <p>24 MS. PARTRIDGE: Okay. Thank you.</p> <p>25 THE WITNESS: I'm not seeing it.</p> | <p>1 about midway through, it starts, "The</p> <p>2 Convolvotron's spatialization functions."</p> <p>3 Do you see that?</p> <p>4 A. I do.</p> <p>5 Q. It says, "The Convolvotron's spatialization</p> <p>6 functions can be run either through supplied</p> <p>7 software via routine -- sorry. I need better</p> <p>8 glasses -- via routines that can be called within a</p> <p>9 seed language program by including special</p> <p>10 library."</p> <p>11 Do you know what you're referring to here</p> <p>12 when you say, "Convolvotron spatialization</p> <p>13 functions"?</p> <p>14 A. Yeah. I'm using spatialization as a verb</p> <p>15 there, basically, to say that -- is that a verb,</p> <p>16 actually? I don't know my grammar. Excuse me. I</p> <p>17 have a very bad cold, by the way. So if I cough,</p> <p>18 forgive me, everybody.</p> <p>19 Okay. Spatialization, here, is just,</p> <p>20 basically, talking about the function of a</p> <p>21 Convolvotron in a general way saying that it takes</p> <p>22 sound and puts it into different spatial positions.</p> <p>23 Q. When you say that you can put it into</p> <p>24 different spatial positions, does that have to be</p> <p>25 through HRTFs?</p> |
| Page 26                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Page 28                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <p>1 Oh, there it is.</p> <p>2 BY MS. NGUYEN:</p> <p>3 Q. It's large. It's taking a while.</p> <p>4 A. That's all right. Okay. Yes.</p> <p>5 Q. Are you familiar with Exhibit 1036?</p> <p>6 A. Yes.</p> <p>7 Q. And what is Exhibit 1036?</p> <p>8 A. It's a reprint of a book that I authored in</p> <p>9 1994.</p> <p>10 Q. And what is this book about?</p> <p>11 A. I'm sorry. What is the book about?</p> <p>12 Q. Correct.</p> <p>13 A. Oh, you can look at the title. It's about</p> <p>14 3D sound for virtual reality and multimedia.</p> <p>15 Q. Can you go to page 175 of Exhibit 1036?</p> <p>16 A. Is that the PDF page?</p> <p>17 Q. The PDF page, not the book's page.</p> <p>18 A. All right. Okay. 175, you say?</p> <p>19 Q. Correct.</p> <p>20 A. Okay. All right. Yes. I think I'm on</p> <p>21 page 175. Yes, I am.</p> <p>22 Q. Do you see where it says, Crystal River</p> <p>23 Engineering?</p> <p>24 A. I do.</p> <p>25 Q. So in that paragraph, right below that,</p>                                                                                  | <p>1 A. Where do you -- where are you looking at?</p> <p>2 Q. Just generally, can -- can spatialization</p> <p>3 be implemented through other methods besides HRTFs?</p> <p>4 MS. PARTRIDGE: Objection. Form.</p> <p>5 THE WITNESS: I testified earlier that</p> <p>6 spatialization is a very ambiguous term. It's used</p> <p>7 in a lot of different ways. Now the reader of this</p> <p>8 book knows what I'm talking about because it's</p> <p>9 talking about a very specific kind of process. But</p> <p>10 you can find all kinds of ways to interpret that</p> <p>11 word spatialization. So I'm not sure how to answer</p> <p>12 your question, exactly.</p> <p>13 BY MS. NGUYEN:</p> <p>14 Q. Well, previously, you mentioned that, in</p> <p>15 this context, it means taking a sound and putting</p> <p>16 it in a particular location in space.</p> <p>17 Can you do that using methods outside of</p> <p>18 HRTFs?</p> <p>19 MS. PARTRIDGE: Objection.</p> <p>20 Mischaracterizes testimony. Form.</p> <p>21 THE WITNESS: Well, you can take a</p> <p>22 stereo -- pair of stereo loud speakers and alter</p> <p>23 the position of the sound between the two loud</p> <p>24 speakers.</p> <p>25 //</p>              |

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| <p style="text-align: right;">Page 29</p> <p>1 BY MS. NGUYEN:<br/>2 Q. What if you wanted to change a sound so<br/>3 that it appears to originate from a specific<br/>4 location?<br/>5 A. I --<br/>6 MS. PARTRIDGE: Objection. Form.<br/>7 THE WITNESS: Again, depends on what<br/>8 you're talking about. I just gave you an example<br/>9 of stereo loud speakers. I can make it come from a<br/>10 specific position more to the left, I can make it<br/>11 sound more to the right.<br/>12 BY MS. NGUYEN:<br/>13 Q. I'm dropping into the chat Exhibit 1001<br/>14 which was previously marked in this IPR proceeding.<br/>15 (Exhibit 1001 was marked for identification.)<br/>16 BY MS. NGUYEN:<br/>17 Q. Let me know when you have it open.<br/>18 A. Okay. 1001. This is the '090 patent.<br/>19 Q. Right. And let's go to column 9, line 54.<br/>20 A. Going to blow it up a little bit. Give me<br/>21 a second. Okay. Column 9, line 54.<br/>22 A. Yes.<br/>23 Q. Do you see that says, "As the first<br/>24 individual moves with respect to the sound<br/>25 localization point, one or more aspects of the</p> | <p style="text-align: right;">Page 31</p> <p>1 one who brought up the question about<br/>2 spatialization. I don't see that word here.<br/>3 Q. Would it be inaccurate to describe the<br/>4 alteration of the sound to follow -- to localize at<br/>5 the sound localization point to be spatialization?<br/>6 MS. PARTRIDGE: Objection. Form.<br/>7 Objection. Mischaracterizes testimony.<br/>8 THE WITNESS: So would it be accurate to<br/>9 take the -- let's see.<br/>10 BY MS. NGUYEN:<br/>11 Q. Would it be inaccurate.<br/>12 A. Oh, to -- finish your sentence.<br/>13 Q. Sure.<br/>14 Would it be inaccurate to describe the<br/>15 alterations made to the sound to localize it at the<br/>16 sound localization point to be spatialization?<br/>17 MS. PARTRIDGE: Objection. Form.<br/>18 THE WITNESS: If one were speaking very<br/>19 generally and wanted to use that word, you could<br/>20 say that this is a type of spatialization, if<br/>21 you're using it, sort of, in this generic way that<br/>22 we're taking a sound and making it spatial.<br/>23 BY MS. NGUYEN:<br/>24 Q. And do you see the sentence that says, "One<br/>25 or more -- I'm sorry. The -- that first sentence</p> |
| <p style="text-align: right;">Page 30</p> <p>1 sound are altered to compensate for the movements<br/>2 such that the sound the first individual hears<br/>3 continues to be localized at the sound localization<br/>4 point."<br/>5 Do you see that?<br/>6 A. I do.<br/>7 Q. And then the next sentence says, "For<br/>8 example, one or more of an HRTF, an interaural<br/>9 level difference, and/or an interaural time<br/>10 difference are altered."<br/>11 Do you see that?<br/>12 A. I do.<br/>13 Q. And would you describe what -- the<br/>14 alterations being made on the sound to be<br/>15 spatialization?<br/>16 MS. PARTRIDGE: Objection. Form.<br/>17 THE WITNESS: I don't see the word<br/>18 spatialization here. And again, I testified<br/>19 earlier that spatialization is a very ambiguous<br/>20 term.<br/>21 BY MS. NGUYEN:<br/>22 Q. So you wouldn't describe it that way?<br/>23 A. I don't know. I mean, if I was -- wanted<br/>24 to describe something in a very abstract way or an<br/>25 unspecific way, but I think you're -- you're the</p>                                                  | <p style="text-align: right;">Page 32</p> <p>1 again that we've read, "As the first individual<br/>2 moves with respect to the sound localization point,<br/>3 one or more aspects of the sound are altered," does<br/>4 that require an HRTF?<br/>5 A. It just says one or more aspects of the<br/>6 sounds are altered.<br/>7 Q. So it does not necessarily describe<br/>8 altering an HRTF; is that correct?<br/>9 MS. PARTRIDGE: Objection.<br/>10 Mischaracterizes testimony.<br/>11 THE WITNESS: The sentence you're pointing<br/>12 out there, "One or more aspects of the sounds are<br/>13 altered," doesn't say HRTF.<br/>14 BY MS. NGUYEN:<br/>15 Q. Could you -- could this describe altering<br/>16 sound intensity?<br/>17 MS. PARTRIDGE: Objection. Form.<br/>18 THE WITNESS: I don't see the word sound<br/>19 intensity there. Sound intensity has a specific<br/>20 meaning.<br/>21 BY MS. NGUYEN:<br/>22 Q. So you would not include that in the one or<br/>23 more aspects of the sound that could be altered?<br/>24 MS. PARTRIDGE: Objection. Form;<br/>25 mischaracterizes testimony.</p>                                                                                                |

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| <p style="text-align: right;">Page 33</p> <p>1 THE WITNESS: The acoustics' sound<br/>2 intensity refers to particle velocity, which is not<br/>3 being evaluated here or mentioned here.<br/>4 BY MS. NGUYEN:<br/>5 Q. Would I say that one or more aspects of the<br/>6 sound that can be altered would include sound<br/>7 balance?<br/>8 MS. PARTRIDGE: Objection. Form.<br/>9 THE WITNESS: What do you mean by "sound<br/>10 balance"?<br/>11 BY MS. NGUYEN:<br/>12 Q. Have you heard the term "balance" before --<br/>13 "sound balance"?<br/>14 A. Yeah. Sure. I mean, you might -- for<br/>15 instance, if you were mixing the sound of a rock<br/>16 and roll band, you might change the balance between<br/>17 the guitarist and the base player.<br/>18 Q. Is it your understanding that you could<br/>19 change the sound balance in order to compensate for<br/>20 the movements of a sound so that it's localized at<br/>21 a sound localization point?<br/>22 MS. PARTRIDGE: Objection. Form.<br/>23 THE WITNESS: Well, again, it has to do<br/>24 with what you're defining as sound balance. You<br/>25 know, I just gave you an example of changing some</p> | <p style="text-align: right;">Page 35</p> <p>1 THE WITNESS: That's not accurate, what<br/>2 you just said. Because what I just said was you<br/>3 can change the location of a stereo sound -- you<br/>4 know, sound in a stereo field by changing between<br/>5 the left and right speaker.<br/>6 BY MS. NGUYEN:<br/>7 Q. Right. And I'm just trying to understand<br/>8 whether or not I can change the sound balance in<br/>9 order to localize sound at a particular point in<br/>10 space.<br/>11 MS. PARTRIDGE: Objection. Form.<br/>12 THE WITNESS: Well, again, you're not<br/>13 giving me a very specific definition of balance.<br/>14 Do you want to -- I mean, if you give me something<br/>15 specific, then I can give you some examples.<br/>16 BY MS. NGUYEN:<br/>17 Q. Have you heard of the term balance in the<br/>18 context of localizing sound at a particular point<br/>19 in space?<br/>20 A. I just gave you examples of moving a sound<br/>21 back and forth in a stereo field from loud<br/>22 speakers.<br/>23 Q. And so, you would describe that as<br/>24 localizing a sound in a particular point in space?<br/>25 MS. PARTRIDGE: Objection. Form.</p>                                                                     |
| <p style="text-align: right;">Page 34</p> <p>1 factors of a base player and a guitarist. There's<br/>2 a lot of ways you could do that.<br/>3 BY MS. NGUYEN:<br/>4 Q. Would you say that the one or more aspects<br/>5 of the sound that could be altered excludes<br/>6 balance?<br/>7 A. I'm having difficulty answering your<br/>8 question because balance is a very unspecific word.<br/>9 I don't know what you mean by it.<br/>10 Q. Have you ever heard sound balance being<br/>11 altered in order to localize a sound at a<br/>12 particular point in space?<br/>13 MS. PARTRIDGE: Objection. Form.<br/>14 Sorry. Objection. Form.<br/>15 THE WITNESS: So I have a balance knob in<br/>16 my car stereo, and I can turn the sound from the<br/>17 left sound of the car speaker to the right sound of<br/>18 the car speaker for a stereo. I've heard of it<br/>19 that way, balance nob's.<br/>20 BY MS. NGUYEN:<br/>21 Q. So you've never heard of altering the sound<br/>22 balance in order to localize sound at a particular<br/>23 point in space?<br/>24 MS. PARTRIDGE: Objection. Form.<br/>25 Objection. Mischaracterizes testimony.</p>                   | <p style="text-align: right;">Page 36</p> <p>1 THE WITNESS: If you move the balance<br/>2 between two stereo loud speakers, you take the<br/>3 balance knob, then you are moving the virtual<br/>4 stereo image back and forth in between the loud<br/>5 speakers on a single plain, yeah. I should say a<br/>6 single line. Let's use the word line, not plain.<br/>7 BY MS. NGUYEN:<br/>8 Q. Let's set the Exhibit 1001 aside for a<br/>9 little bit.<br/>10 Have you heard the term binaural sound?<br/>11 A. Yes. It's in my declaration.<br/>12 Q. What is binaural sound?<br/>13 A. Well, let's go to the declaration and see<br/>14 how I defined it there so I'm -- we're consistent.<br/>15 All right. So binaural sound, in terms of<br/>16 my declaration, is talking about two ways of<br/>17 creating spatial positions. One is binaural<br/>18 recording, the other one is binaural synthesis.<br/>19 Q. What is a binaural recording?<br/>20 A. Binaural recording has its history with<br/>21 dummy head recordings. It's basically a microphone<br/>22 located near the ears of a head.<br/>23 Q. What is binaural synthesis?<br/>24 A. Binaural synthesis is using HRTF processing<br/>25 to be able to move a sound to an arbitrary</p> |

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1 location.  
2 Q. Does binaural synthesis always require  
3 HRTF?  
4 MS. PARTRIDGE: Objection. Form.  
5 THE WITNESS: Yes. I would say it does.  
6 It requires an HRTF --  
7 BY MS. NGUYEN:  
8 Q. Why does that always require HRTF?  
9 MS. PARTRIDGE: Objection. Form.  
10 THE WITNESS: The word binaural infers the  
11 outer ear and the head.  
12 BY MS. NGUYEN:  
13 Q. Did you do binaural synthesis with ILD?  
14 MS. PARTRIDGE: Objection. Form.  
15 Just didn't understand the question. I'm  
16 sorry.  
17 THE WITNESS: Yeah. Could you repeat  
18 that?  
19 BY MS. NGUYEN:  
20 Q. Sure.  
21 Did you perform binaural synthesis with ILD  
22 by itself?  
23 MS. PARTRIDGE: Objection. Form.  
24 THE WITNESS: Well, typically, there would  
25 be some sort of HRTF present, but then that would

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1 be ILD. But I'm not sure -- I'd have to know more  
2 about, specifically, what you're referring to as  
3 far as ILD.  
4 BY MS. NGUYEN:  
5 Q. We talked about ILD previously and how an  
6 ILD, by itself, is not necessarily an HRTF; is that  
7 right?  
8 MS. PARTRIDGE: Objection. Form.  
9 THE WITNESS: Right. We typically include  
10 an HRTF.  
11 BY MS. NGUYEN:  
12 Q. Right.  
13 And I'm trying to understand whether or not  
14 binaural synthesis can be performed with just ILD.  
15 MS. PARTRIDGE: Objection. Form.  
16 THE WITNESS: I would include the HRTF  
17 somewhere in the process.  
18 BY MS. NGUYEN:  
19 Q. To be more accurate; is that right?  
20 A. I'm sorry?  
21 Q. It would be more accurate?  
22 MS. PARTRIDGE: Objection. Form.  
23 THE WITNESS: What do you mean by  
24 accurate?  
25 //

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1 BY MS. NGUYEN:  
2 Q. To create a more accurate virtual  
3 positioning of the sound.  
4 MS. PARTRIDGE: Objection. Form.  
5 THE WITNESS: Maybe, maybe not. Depends  
6 on the context.  
7 BY MS. NGUYEN:  
8 Q. So you said you would include HRTF. Why  
9 would you always include HRTF?  
10 MS. PARTRIDGE: Objection.  
11 Mischaracterizes testimony.  
12 THE WITNESS: What I was saying is that --  
13 wait. I'm -- I'm getting a little lost here. Can  
14 we go back?  
15 BY MS. NGUYEN:  
16 Q. I --  
17 A. Can you repeat your question for me?  
18 Q. Sure.  
19 So we're talking about binaural synthesis.  
20 A. Right.  
21 Q. And you gave a definition of binaural  
22 synthesis that includes HRTF, and I'm trying to  
23 understand whether or not you can have binaural  
24 synthesis with just ILD, alone.  
25 A. With just ILD alone? No.

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1 Q. Could you have binaural synthesis with just  
2 ITD, alone?  
3 MS. PARTRIDGE: Objection. Form.  
4 THE WITNESS: Usually there's HRTF present  
5 somehow in the processing.  
6 BY MS. NGUYEN:  
7 Q. So is it your opinion you can't have  
8 binaural synthesis with ITD, alone?  
9 MS. PARTRIDGE: Objection. Form.  
10 Objection. Scope.  
11 THE WITNESS: Well, you can capture,  
12 technically speaking, the interaural time  
13 differences as they change for somebody moving  
14 their head, and it would correspond to the binaural  
15 aspect of the time delay difference. And if the  
16 frequencies that we were concerned with were  
17 weighted in the area where ITD mattered more than  
18 ILD, then, sure, you could do it.  
19 BY MS. NGUYEN:  
20 Q. Is there a reason why you can have binaural  
21 synthesis with just ITD, alone, but not ILD, alone?  
22 MS. PARTRIDGE: Objection. Outside the  
23 scope.  
24 THE WITNESS: ITD tends to be a more  
25 effective cue at frequencies which most sounds,

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| <p style="text-align: right;">Page 41</p> <p>1 including speech, is concentrated.<br/>2 BY MS. NGUYEN:<br/>3 Q. And you consider speech a type of sound,<br/>4 correct?<br/>5 A. Yes. Speech is considered a type of sound.<br/>6 Q. Would it be accurate to say a binaural<br/>7 recording consists of two channels of audio?<br/>8 MS. PARTRIDGE: Objection. Form.<br/>9 THE WITNESS: Two or more. I mean, if we<br/>10 have multiple binaural recordings combined, then<br/>11 there might be more than two. But typically, for<br/>12 one head and one -- you know, one receiver, I<br/>13 should say, there's typically two channels. Yes.<br/>14 BY MS. NGUYEN:<br/>15 Q. Do you --<br/>16 A. I want to make sure I understood your last<br/>17 question.<br/>18 Would you repeat your last question?<br/>19 Because I want to make sure I answered it<br/>20 accurately.<br/>21 MS. NGUYEN: Sure. Actually, if the court<br/>22 reporter could please repeat the last question.<br/>23 (Whereupon the previous question was read.)<br/>24 MS. PARTRIDGE: Objection. Form.<br/>25 THE WITNESS: I believe my answer was</p> | <p style="text-align: right;">Page 43</p> <p>1 BY MS. NGUYEN:<br/>2 Q. And are you referring to any particular<br/>3 paragraph in your declaration?<br/>4 A. Regarding what?<br/>5 Q. What you just mentioned.<br/>6 A. I was referring to something about your<br/>7 question prior to the last question, but I don't<br/>8 remember the last question.<br/>9 In other words, your last question --<br/>10 why -- why don't you read me your second-to-last<br/>11 question, and I will tell you where I'm looking at<br/>12 in my declaration, if you'd like.<br/>13 Q. Sure. Sure.<br/>14 I asked you if you were aware of any<br/>15 systems that used both binaural recording and<br/>16 binaural synthesis, and you said, yes, you referred<br/>17 to one in your declaration.<br/>18 MS. PARTRIDGE: Objection. Outside scope<br/>19 as to binaural synthesis.<br/>20 THE WITNESS: Correct. Paragraph 26.<br/>21 BY MS. NGUYEN:<br/>22 Q. Would it be fair to say that binaural<br/>23 synthesis transforms a sound source with no<br/>24 positional information to a virtual sound source<br/>25 with respect to head of a listener?</p> |
| <p style="text-align: right;">Page 42</p> <p>1 accurate.<br/>2 Binaural recording consist of at least two<br/>3 channels of audio. And if we're talking about a<br/>4 situation where there might be multiple binaural<br/>5 recordings involved, then we would have -- you<br/>6 know, we could multiply two times the number of<br/>7 sources.<br/>8 BY MS. NGUYEN:<br/>9 Q. Have you ever seen a system that uses both<br/>10 binaural recordings and binaural synthesis?<br/>11 MS. PARTRIDGE: Objection. Outside the<br/>12 scope.<br/>13 THE WITNESS: Yes. That's referred to in<br/>14 my declaration.<br/>15 BY MS. NGUYEN:<br/>16 Q. If you have a binaural recording, why would<br/>17 you need binaural synthesis?<br/>18 MS. PARTRIDGE: Objection. Outside scope<br/>19 as to binaural synthesis.<br/>20 THE WITNESS: Well, as I describe in my<br/>21 declaration, if you use the binaural recording, the<br/>22 positions are fixed. You can't arbitrarily<br/>23 manipulate them. So you need to use binaural<br/>24 synthesis to synthesize the sound independently.<br/>25 //</p>                               | <p style="text-align: right;">Page 44</p> <p>1 MS. PARTRIDGE: Objection. Outside scope.<br/>2 THE WITNESS: I believe that might be<br/>3 fair.<br/>4 BY MS. NGUYEN:<br/>5 Q. Would another way to describe binaural<br/>6 synthesis be convolving a mono sound with HRIRs<br/>7 to generate a synthetic --<br/>8 (Reporter clarification.)<br/>9 MS. NGUYEN: Sure.<br/>10 BY MS. NGUYEN:<br/>11 Q. Would another way to describe binaural<br/>12 synthesis be convolving a mono sound with HRIRs to<br/>13 generate a synthetic binaural signal that includes<br/>14 directional information of the sound source?<br/>15 MS. PARTRIDGE: Objection. Form.<br/>16 Objection. Outside scope.<br/>17 THE WITNESS: Yes.<br/>18 BY MS. NGUYEN:<br/>19 Q. Can you perform binaural synthesis on a<br/>20 binaural recording?<br/>21 MS. PARTRIDGE: Objection. Outside scope.<br/>22 THE WITNESS: You can, but with the<br/>23 problem that -- of course, that you need to,<br/>24 basically, either take one channel of that<br/>25 recording or fold the two channels together because</p>                                                            |

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|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p style="text-align: right;">Page 45</p> <p>1 you're going to lose the -- whatever spatial<br/>2 aspects were captured in that binaural recording.<br/>3 BY MS. NGUYEN:<br/>4 Q. You said fold the two channels. What do<br/>5 you mean by that?<br/>6 A. I said what?<br/>7 Q. Fold -- I think you said fold the two<br/>8 channels, but was that inaccurate?<br/>9 A. Yes.<br/>10 Q. Oh, you said -- so sorry. I'm reading off<br/>11 the realtime.<br/>12 So my understanding was that you said you<br/>13 could either take one channel of the recording<br/>14 or --<br/>15 A. Fold. Mix. Fix the two other channels.<br/>16 But you need a single input.<br/>17 THE REPORTER: So was it fold, like<br/>18 F-O-L-D?<br/>19 THE WITNESS: Yes. Frank as in Frank, O<br/>20 as in Oscar, L as in Larry, D as in dog.<br/>21 BY MS. NGUYEN:<br/>22 Q. And I'm just trying to understand what you<br/>23 mean by fold the two channels.<br/>24 A. Mix.<br/>25 Q. Mix.</p>                                                                                            | <p style="text-align: right;">Page 47</p> <p>1 here.<br/>2 Well, the convolvotron, essentially, is<br/>3 called the convolvotron because it performs<br/>4 convolution on input signals with head-related<br/>5 transfer functions.<br/>6 Q. And when it's performing those head-related<br/>7 transfer functions, with what goal in mind?<br/>8 Is it trying to place a sound at a<br/>9 particular location?<br/>10 MS. PARTRIDGE: Objection. Form.<br/>11 THE WITNESS: Yes. I mean, that's one way<br/>12 of describing it, yes. It's designed to -- it was<br/>13 designed to allow a user of the device to place<br/>14 sounds at virtual locations.<br/>15 BY MS. NGUYEN:<br/>16 Q. Was the convolvotron ever used for<br/>17 telephone calls?<br/>18 A. Not that I recall. No. There was a lot of<br/>19 latency in the system is what I recall, but that's<br/>20 neither here nor there. What really matters is<br/>21 that the answer to your question is no.<br/>22 Q. Are you aware of any other systems that<br/>23 were used for creating a virtual conference call<br/>24 where it maybe simulate a face-to-face<br/>25 conversation?</p>            |
| <p style="text-align: right;">Page 46</p> <p>1 And how would you mix the two channels?<br/>2 A. Well, by combining the two signals either<br/>3 using a digital signal processor -- that would<br/>4 be -- typically the way to do it.<br/>5 MS. PARTRIDGE: So Ms. Nguyen, when you<br/>6 get to a good stopping place, can we take a break,<br/>7 please?<br/>8 MS. NGUYEN: Sure. Why don't we go ahead<br/>9 and take a break now.<br/>10 MS. PARTRIDGE: Okay. Thank you.<br/>11 THE VIDEOGRAPHER: Okay. I'll read us off<br/>12 the record for that break. We're going off the<br/>13 record at 11 -- I'm sorry -- 9:33 a.m. Off the<br/>14 record.<br/>15 (A recess was held from 9:33 a.m. to .)<br/>16 THE VIDEOGRAPHER: Okay. We are back on<br/>17 the record, and the time now, 9:56 a.m.<br/>18 BY MS. NGUYEN:<br/>19 Q. Welcome back, Dr. Begault.<br/>20 A. Thank you.<br/>21 Q. Earlier, we were talking about the<br/>22 convolvotron.<br/>23 Can you describe what the convolvotron<br/>24 does?<br/>25 A. Okay. You're taking me back a long time</p> | <p style="text-align: right;">Page 48</p> <p>1 MS. PARTRIDGE: Objection. Scope.<br/>2 Objection. Outside the scope of this IPR record.<br/>3 THE WITNESS: Not I can -- I'm not really<br/>4 thinking of anything off the top of my head.<br/>5 BY MS. NGUYEN:<br/>6 Q. Have you heard of the term "cross-talk<br/>7 cancellation"?<br/>8 A. Yes.<br/>9 Q. What is cross-talk cancellation?<br/>10 A. Cross-talk cancellation is a technology<br/>11 that was developed, I think, in the '60s to be able<br/>12 to simulate over loud speakers a virtual position,<br/>13 and I think that might -- I'm trying to recall if<br/>14 it actually included some sort of the simulation of<br/>15 HRTFs or not.<br/>16 But the idea was that, by introducing an<br/>17 out-of-face signal in one channel of the opposite<br/>18 channel, that you could, essentially, try to<br/>19 attempt to create a headphone-like experiment -- or<br/>20 experience. You try to simulate a headphone-like<br/>21 experience over loud speakers, and it only worked<br/>22 only so well.<br/>23 Mostly, yes, it was not a very successful<br/>24 technology.<br/>25 Q. Why not?</p> |

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1 A. Well, one reason is that if you are trying  
2 to simulate headphone sound over loud speakers, you  
3 have to be very -- well, you have to predict  
4 exactly where the listener is going to be relative  
5 to the loud speakers, and the listener can't really  
6 move their head. So it depends on -- you know, for  
7 the cancellation part of it, it really depends on,  
8 like, very fixed parameters, so to speak.  
9 Q. Let's go to Exhibit 1001, the '090 patent.  
10 A. I'm there.  
11 Q. What is your understanding of the inventive  
12 concept of the '090 patent?  
13 A. I'm sorry. What's my understanding of  
14 what?  
15 Q. Inventive concept.  
16 A. Inventive concept?  
17 Q. Yeah. What makes it inventive?  
18 A. What the claims say.  
19 Q. Let's look at Claim 1 of the '090 patent.  
20 Let me know when you're there.  
21 A. Yeah. I'm searching for it.  
22 Okay. Here it is. Yes.  
23 Q. Would you agree with me that capturing  
24 binaural sound was known by 2014?  
25 MS. PARTRIDGE: Objection. Form.

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1 THE WITNESS: So you're just speaking  
2 generally then?  
3 BY MS. NGUYEN:  
4 Q. Generally, yeah.  
5 A. Yeah. So you directed me to this claim,  
6 but now you're just making a general question about  
7 was binaural sound known to be captured -- wait.  
8 I've missed your question.  
9 Q. Sure. We talked previously about binaural  
10 recordings; is that right?  
11 A. Yes, we did.  
12 Q. Is it your understanding that capturing  
13 binaural sound is the same thing as capturing a  
14 binaural recording?  
15 MS. PARTRIDGE: Objection. Form.  
16 THE WITNESS: No. We talked about that  
17 earlier, was binaural synthesis. So there's  
18 binaural recording -- there are two aspects of  
19 binaural sound, as described in my declaration.  
20 BY MS. NGUYEN:  
21 Q. So what's the difference between capturing  
22 binaural sound and capturing a binaural recording?  
23 A. Well, binaural sound is a general term. A  
24 binaural recording, I guess, could be considered,  
25 within the structure of my declaration, a subset,

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1 if you will, of there's capturing binaural --  
2 there's -- there's binaural sound, right, and then  
3 there's a binaural recording, which we are saying  
4 is a subset of that. Binaural sound could also be  
5 binaural synthesis.  
6 Q. So what is your understanding of the term  
7 by -- capturing binaural sound?  
8 A. Well, it would mean capturing sound with  
9 two microphones located near the ears of a listener  
10 or a dummy head.  
11 Q. Would you agree with me that capturing  
12 binaural sound was known by 2014?  
13 MS. PARTRIDGE: Objection. Form.  
14 THE WITNESS: In the way that we're  
15 speaking about it, yes, by -- by 2014, binaural  
16 sound was being captured using dummy heads.  
17 BY MS. NGUYEN:  
18 Q. Was it known, by 2014, to capture binaural  
19 sound using microphones at the earphones of the --  
20 of the speaker?  
21 MS. PARTRIDGE: Objection. Form.  
22 THE WITNESS: That, I'm not sure about. I  
23 would imagine that maybe such a system existed.  
24 I'm not sure.  
25 BY MS. NGUYEN:

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1 Q. Would you agree that designating a sound  
2 localization point in empty space that is away from  
3 and approximate to the listening person was known  
4 by 2014?  
5 MS. PARTRIDGE: Objection. Form.  
6 THE WITNESS: Yeah. That would be  
7 something that was known, is to designate, based on  
8 localization point, away and from and approximate  
9 to a listening person in itself.  
10 BY MS. NGUYEN:  
11 Q. Would you agree that, by 2014, it was known  
12 to simulate an origin of binaural sound at an empty  
13 space that the listening person hears during a  
14 telephone call?  
15 MS. PARTRIDGE: Objection. Form.  
16 THE WITNESS: I don't know about telephone  
17 call, specifically.  
18 BY MS. NGUYEN:  
19 Q. Would you agree that, by 2014, adjusting  
20 binaural sound captured at a earphone of a talking  
21 person was known?  
22 MS. PARTRIDGE: Objection. Form.  
23 THE WITNESS: Are you referring to the  
24 context of the claims?  
25 BY MS. NGUYEN:

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| <p style="text-align: right;">Page 53</p> <p>1 Q. Yes.</p> <p>2 A. Are we talking about the full -- the full</p> <p>3 claim here, or we're talking about a telephone</p> <p>4 call? I'm not aware of any system that had to do</p> <p>5 with a telephone call where adjusting, you know, et</p> <p>6 cetera, as you were quoting from the subsection of</p> <p>7 Claim 1.</p> <p>8 Q. Would you agree that, in general, it was</p> <p>9 known by 2004 to adjust binaural sound so that it</p> <p>10 originates at an empty space that is away and</p> <p>11 proximate to a listening person?</p> <p>12 MS. PARTRIDGE: Objection. Form.</p> <p>13 Objection. Legal conclusions.</p> <p>14 THE WITNESS: It was known to adjust a</p> <p>15 sound localization point, virtual acoustic</p> <p>16 location, relative to a person -- to a listener.</p> <p>17 BY MS. NGUYEN:</p> <p>18 Q. Do you believe the innovative concept of</p> <p>19 the '090 patent is to be able to to place a sound</p> <p>20 localization point in an empty space during a</p> <p>21 telephone call?</p> <p>22 MS. PARTRIDGE: Objection. Form.</p> <p>23 THE WITNESS: I think that's one of the</p> <p>24 novel aspects of Claim 1.</p> <p>25 BY MS. NGUYEN:</p> | <p style="text-align: right;">Page 55</p> <p>1 Q. Do you see that the passage says "John and</p> <p>2 Paul" -- this is the second sentence -- "John and</p> <p>3 Paul both wear electronic earpieces that record and</p> <p>4 provide binaural sound"?</p> <p>5 A. I'm sorry. Yes. Uh-huh.</p> <p>6 Q. In this context, is "record" referring to</p> <p>7 the microphone picking up the live conversation?</p> <p>8 A. I believe what it's referring to is picking</p> <p>9 up the voice of one person in the communication</p> <p>10 channel. So not both people, but one person.</p> <p>11 Q. And in recording, is it conveying that</p> <p>12 sound in real time to the second person?</p> <p>13 MS. PARTRIDGE: Objection. Form.</p> <p>14 Objection. Legal conclusion.</p> <p>15 THE WITNESS: In the context of this, it</p> <p>16 clearly is talking about a real-time interaction</p> <p>17 and not talking about "record" in a sense that</p> <p>18 sometimes the word "record" is used, to talk about</p> <p>19 a pre-stored sound.</p> <p>20 Excuse me.</p> <p>21 BY MS. NGUYEN:</p> <p>22 Q. Do you need to get some water?</p> <p>23 A. No. I've got some here. I'm good. A cold</p> <p>24 is a bear. Sorry. Okay. Continue.</p> <p>25 Q. Let's go back to Claim 1.</p> |
| <p style="text-align: right;">Page 54</p> <p>1 Q. Let's go to column 8 of '090 patent, at</p> <p>2 line 7.</p> <p>3 A. Okay. I'm in column 8.</p> <p>4 Q. Do you see where it says "consider a third</p> <p>5 scenario"?</p> <p>6 A. I do.</p> <p>7 Q. "Consider a third scenario in which Paul</p> <p>8 travels in another country and initiates a call</p> <p>9 with John. John and Paul both wear electronic ear</p> <p>10 pieces that record and provide binaural sound.</p> <p>11 When the call initiates, the voice of Paul is</p> <p>12 localized to its empty chair in John's apartment,</p> <p>13 while John sits in his chair.</p> <p>14 "John and Paul have the same conversation</p> <p>15 as in the first scenario, and John performs the</p> <p>16 same actions. During the conversation, John stands</p> <p>17 from his chair, walks to the refrigerator, opens a</p> <p>18 can of soda, and returns to his chair."</p> <p>19 Is -- does Claim 1 capture this third</p> <p>20 scenario?</p> <p>21 MS. PARTRIDGE: Objection. Form.</p> <p>22 Objection. Legal conclusion.</p> <p>23 THE WITNESS: It seems to be talking about</p> <p>24 a telephone call.</p> <p>25 BY MS. NGUYEN:</p>                                    | <p style="text-align: right;">Page 56</p> <p>1 A. Okay.</p> <p>2 Q. Is it your understanding that Claim 1</p> <p>3 requires HRTFs?</p> <p>4 A. Yes.</p> <p>5 Q. And what language in the claim requires</p> <p>6 HRTFs?</p> <p>7 A. Binaural sound.</p> <p>8 Q. Does Claim 1 require binaural synthesis?</p> <p>9 A. It could, but -- since binaural sound</p> <p>10 includes binaural synthesis.</p> <p>11 Q. Let's look at Claim 8.</p> <p>12 A. Okay. I am there.</p> <p>13 Q. Is it your opinion that Claim 8 requires</p> <p>14 HRTFs?</p> <p>15 MS. PARTRIDGE: Objection. Calls for</p> <p>16 legal conclusion.</p> <p>17 THE WITNESS: Let me read it.</p> <p>18 Yes. It would need to include HRTFs.</p> <p>19 BY MS. NGUYEN:</p> <p>20 Q. And what language in the claim requires</p> <p>21 HRTFs?</p> <p>22 A. "Away from and proximate to." So that</p> <p>23 infers the fact that the sound has to be</p> <p>24 externalized.</p> <p>25 Q. Does Claim 8 require binaural synthesis?</p>                                                                                                                                                                                                                                                                                 |

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| <p style="text-align: right;">Page 57</p> <p>1 A. It may.</p> <p>2 Q. And what language in the claim would</p> <p>3 require binaural synthesis?</p> <p>4 MS. PARTRIDGE: Objection.</p> <p>5 Mischaracterizes testimony. Objection. Form.</p> <p>6 THE WITNESS: The language regarding</p> <p>7 moving and changing the location of head</p> <p>8 orientation with respect to the sound localization</p> <p>9 point and maintaining the origin of the voice the</p> <p>10 second individual at the sound localization point.</p> <p>11 BY MS. NGUYEN:</p> <p>12 Q. Let's go to Claim 15.</p> <p>13 A. I'm there.</p> <p>14 Q. Does Claim 15 require HRTFs?</p> <p>15 A. I'm reading it. It captures a binaural</p> <p>16 voice of the second person, and it refers to</p> <p>17 positioning the binaural voice of the person to a</p> <p>18 sound localization point. So that would require</p> <p>19 HRTFs.</p> <p>20 Q. And does Claim 15 require binaural</p> <p>21 synthesis?</p> <p>22 A. That would be required in order to update</p> <p>23 the position of the sound. Also, for the --</p> <p>24 Q. And --</p> <p>25 A. I'm sorry. Just to finish the -- the</p> | <p style="text-align: right;">Page 59</p> <p>1 Q. Have you -- you've reviewed</p> <p>2 Dr. Kyriakakis's declaration in this proceeding?</p> <p>3 A. I have, and I commented on it extensively</p> <p>4 in my declaration.</p> <p>5 Q. Before this proceeding, were you familiar</p> <p>6 with Dr. Kyriakakis?</p> <p>7 A. Yes.</p> <p>8 Q. And how were you familiar with him?</p> <p>9 A. I believe through the audio engineering</p> <p>10 society, we may have met many years ago. I may</p> <p>11 have even done a lecture -- I don't recall,</p> <p>12 though -- for one of his classes, but I could be</p> <p>13 completely wrong about that.</p> <p>14 But I've known about him and his work, and</p> <p>15 I know that he's been at USC for quite a while.</p> <p>16 That's about the extent of it. We haven't spoken</p> <p>17 in many years.</p> <p>18 BY MS. NGUYEN: Why don't we take a break,</p> <p>19 and I think we can actually wrap this up.</p> <p>20 THE WITNESS: Okay.</p> <p>21 MS. PARTRIDGE: Okay.</p> <p>22 THE VIDEOGRAPHER: All right. I'll read</p> <p>23 us off the record for that break now. Going off,</p> <p>24 10:18 a.m.</p> <p>25 (A recess was held from 10:18 a.m. to 10:39 a.m.)</p> |
| <p style="text-align: right;">Page 58</p> <p>1 answer.</p> <p>2 Also, that is away from the proximate to</p> <p>3 the first person, so it requires externalized head.</p> <p>4 Q. And when you say "update," what are you</p> <p>5 referring to?</p> <p>6 A. When I say what?</p> <p>7 Q. Before you said binaural synthesis is</p> <p>8 required in order to update the position of the</p> <p>9 sound.</p> <p>10 A. Yes.</p> <p>11 Q. Which language are you specifically</p> <p>12 referring to in Claim 15?</p> <p>13 A. Paragraph beginning a processor that</p> <p>14 executes --</p> <p>15 (Reporter clarification.)</p> <p>16 THE WITNESS: "A processor that executes</p> <p>17 the instructions to adjust the binaural voice of</p> <p>18 the second person during the electronic phone call</p> <p>19 in order to position a sound localization point of</p> <p>20 a binaural voice to a location that is away from</p> <p>21 and proximate to the first person."</p> <p>22 BY MS. NGUYEN:</p> <p>23 Q. Okay. We can go ahead and put Exhibit 1001</p> <p>24 aside.</p> <p>25 A. Okay.</p>                                                                    | <p style="text-align: right;">Page 60</p> <p>1 THE VIDEOGRAPHER: We are back on the</p> <p>2 record now. The time, 10:39 a.m.</p> <p>3 BY MS. NGUYEN:</p> <p>4 Q. Dr. Begault, are you on any medications</p> <p>5 that would have prevented you from providing</p> <p>6 truthful testimony today?</p> <p>7 A. No.</p> <p>8 Q. Are there any other reasons why you might</p> <p>9 be prevented from providing truthful or accurate</p> <p>10 testimony today?</p> <p>11 A. No.</p> <p>12 MS. NGUYEN: So with that, I have no</p> <p>13 further questions and can pass you to your counsel</p> <p>14 for any redirect.</p> <p>15 MS. PARTRIDGE: Okay. And we're going to</p> <p>16 take just about a ten-minute break, and we'll be</p> <p>17 back. Okay?</p> <p>18 THE WITNESS: Ten minutes? Okay.</p> <p>19 MS. PARTRIDGE: Okay.</p> <p>20 THE VIDEOGRAPHER: I'll read us off for</p> <p>21 that break. Going off now, 10:40 a.m.</p> <p>22 (A recess was held from 10:40 a.m. to 11:15 a.m.)</p> <p>23 THE VIDEOGRAPHER: Okay. We're back on</p> <p>24 the record now. Time, 11:15 a.m.</p> <p>25 EXAMINATION BY MS. PARTRIDGE:</p>                                                                                       |

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1 Q. Hello, Dr. Begault. I guess, for you, it's  
2 still morning, right?  
3 A. Correct.  
4 Q. Okay. And did we talk during the break or  
5 during any of the breaks, at all, during this  
6 deposition?  
7 A. No, we did not.  
8 Q. So I want to direct you back to a couple of  
9 issues that you and Ms. -- Ms. Nguyen discussed  
10 earlier. Okay?  
11 A. Sure.  
12 Q. And can we first pull up Exhibit 1001,  
13 which I believe is the '090 patent?  
14 A. I have it up.  
15 Q. Okay.  
16 MS. PARTRIDGE: Ms. Nguyen?  
17 MS. NGUYEN: I have it. Thank you.  
18 MS. PARTRIDGE: Ms. Nguyen --  
19 BY MS. PARTRIDGE:  
20 Q. And, Dr. Begault, I want to direct you to  
21 Claim 8 of the '090 patent.  
22 A. Yes.  
23 Q. Are you there?  
24 A. I'm there.  
25 Q. Okay. And I'm going to direct you to

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1 limitation B of the '090 patent.  
2 Are you there?  
3 A. So would that be the sentence that begins  
4 "designate for the first individual"?  
5 Q. Yes. And can you read that paragraph,  
6 please, into the record?  
7 A. Sure.  
8 "Designate, for the first individual, a  
9 sound localization point that simulates a location  
10 in empty space from where an origin of a voice of a  
11 second individual occurs with the first individual  
12 through the electronic earphone, such that the  
13 sound localization point in empty space is located  
14 away from and approximate to the first individual."  
15 Q. Thank you.  
16 And I'm going to direct your attention  
17 specifically to "the location away from and  
18 proximate to."  
19 Do you see that?  
20 A. I do.  
21 Q. And correct me if I'm wrong, but I believe  
22 you testified earlier that "away from and proximate  
23 to" means that the sound must be externalized,  
24 correct?  
25 A. That is correct.

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1 MS. NGUYEN: Objection. Mischaracterizes  
2 the testimony; leading.  
3 BY MS. PARTRIDGE:  
4 Q. And can you go -- go --  
5 MS. PARTRIDGE: I apologize, Ms. Nguyen.  
6 Does someone know the number for  
7 Dr. Begault's declaration, the exhibit number?  
8 MS. NGUYEN: Yes, I have it. It's 2011.  
9 BY MS. PARTRIDGE:  
10 Q. Okay. And can we pull up Exhibit 2011,  
11 Dr. Begault, which is your declaration in this IPR?  
12 A. Yes.  
13 Q. And let me direct your attention to  
14 paragraph 79B on page 55.  
15 A. I'm there.  
16 Q. Okay. And do you see -- will you read the  
17 first sentence of 79B?  
18 A. "The phrase 'away from and approximate to'  
19 in limitation 8B indicates a mode of binaural sound  
20 that would require externalization of the sound  
21 image."  
22 Q. So that's exactly what your declaration  
23 says in 79B, that away from and proximate to  
24 requires externalization of the sound, correct?  
25 A. That is correct.

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1 Q. Okay. And can I also direct your attention  
2 to -- just a second -- well, okay, so -- I'm sorry.  
3 So let me move forward.  
4 So paragraph 79B states, in your  
5 declaration, that approximate -- "away from and  
6 approximate to" means sound must be externalized,  
7 correct?  
8 A. Yes.  
9 Q. And you also testified earlier that a sound  
10 is externalized that requires HRTF processing,  
11 correct?  
12 A. Yes.  
13 MS. NGUYEN: Objection. Mischaracterizes  
14 the testimony; leading.  
15 THE WITNESS: That's correct.  
16 BY MS. PARTRIDGE:  
17 Q. You agree, Dr. Begault, that if sound is  
18 externalized, that requires HRTF processing,  
19 correct?  
20 MS. NGUYEN: Objection. Leading.  
21 THE WITNESS: Yes, it does.  
22 BY MS. PARTRIDGE:  
23 Q. So Claim 8, necessarily, covers external --  
24 necessarily requires that the sound is  
25 externalized, which requires HRTF processing,

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p style="text-align: right;">Page 65</p> <p>1 correct?</p> <p>2 A. Yes. That and six degrees of freedom</p> <p>3 tracking of the listener.</p> <p>4 Q. Right. And so, Claim 8, necessarily,</p> <p>5 covers binaural synthesis, correct?</p> <p>6 A. Yes, it does.</p> <p>7 MS. NGUYEN: Leading.</p> <p>8 BY MS. NGUYEN:</p> <p>9 Q. And let's move to paragraph 34 of your</p> <p>10 declaration, which is, again, Exhibit 2011.</p> <p>11 A. I'm there.</p> <p>12 Q. And the -- the heading for this section is</p> <p>13 "HRTFs must include interaural time differences,"</p> <p>14 correct?</p> <p>15 A. That's correct.</p> <p>16 Q. Okay. And let me direct your attention to</p> <p>17 the last sentence of paragraph 34.</p> <p>18 Are you there?</p> <p>19 A. Yes, I'm there, to the last sentence.</p> <p>20 Q. Okay. Can you read that to -- in the</p> <p>21 record, please?</p> <p>22 A. "This is the plain and the ordinary meaning</p> <p>23 of the term to a POSITA. The transformations</p> <p>24 responsible for modifying the spectrum and time of</p> <p>25 arrival of sound in each of a listener's ears for a</p> | <p style="text-align: right;">Page 67</p> <p>1 from HRTF, that would be incorrect?</p> <p>2 A. As the title of the section says, you have</p> <p>3 to have interaural time differences in order to</p> <p>4 have an HRTF -- or part of an HRTF.</p> <p>5 Q. So HRTF, necessarily, requires interaural</p> <p>6 time difference, correct?</p> <p>7 MS. NGUYEN: Objection.</p> <p>8 THE WITNESS: Yes.</p> <p>9 BY MS. PARTRIDGE:</p> <p>10 Q. And you can't externalize without an</p> <p>11 interaural time difference, correct?</p> <p>12 MS. NGUYEN: Objection. Leading.</p> <p>13 THE WITNESS: You would need to have that.</p> <p>14 BY MS. PARTRIDGE:</p> <p>15 Q. Okay. Okay. Can you go back to</p> <p>16 Exhibit 1001, which is the '090 patent, please?</p> <p>17 A. Okay. Give me a moment. I am there.</p> <p>18 Q. And can you confirm for me that Claims 1,</p> <p>19 Claims 8, and Claims 15 all have the requirement of</p> <p>20 away from and proximate to in those claims?</p> <p>21 A. Sure. Give me a second.</p> <p>22 It's true of Claim 1. Yes, Claim 8. Claim</p> <p>23 15, yes. It appears in all three.</p> <p>24 Q. And again, as you testified previously,</p> <p>25 away from and proximate to, in the claims, means</p> |
| <p style="text-align: right;">Page 66</p> <p>1 given sense of a position relative to the</p> <p>2 listener."</p> <p>3 Q. And this is, necessarily, the definition of</p> <p>4 HRTFs to a person of ordinary skill in the art,</p> <p>5 correct?</p> <p>6 MS. NGUYEN: Objection. Leading.</p> <p>7 THE WITNESS: Yes.</p> <p>8 BY MS. PARTRIDGE:</p> <p>9 Q. And if you omitted ITD interaural time</p> <p>10 differences from the definition of HRTF, that would</p> <p>11 not be the definition of HRTF, correct?</p> <p>12 A. Correct. An HRTF --</p> <p>13 THE WITNESS: I'm sorry. I didn't mean to</p> <p>14 talk over you. Was there an objection?</p> <p>15 MS. NGUYEN: Yes. Nicole, did -- sorry.</p> <p>16 Did the court reporter get that?</p> <p>17 Objection. Vague.</p> <p>18 THE WITNESS: Okay. Please restate your</p> <p>19 question.</p> <p>20 BY MS. PARTRIDGE:</p> <p>21 Q. So if you admit --</p> <p>22 MS. PARTRIDGE: That's a good objection,</p> <p>23 by the way.</p> <p>24 BY MS. PARTRIDGE:</p> <p>25 Q. So if you admit interaural time difference</p>                                                           | <p style="text-align: right;">Page 68</p> <p>1 the sound must be externalized, correct?</p> <p>2 MS. NGUYEN: Objection. Leading.</p> <p>3 THE WITNESS: Correct. If the sound</p> <p>4 wasn't externalized, it couldn't be away from and</p> <p>5 proximate to.</p> <p>6 BY MS. PARTRIDGE:</p> <p>7 Q. And can you have sound externalization</p> <p>8 without HRTFs -- I'm sorry. Strike that.</p> <p>9 And you cannot have sound externalization</p> <p>10 without HRTF processing, correct?</p> <p>11 MS. NGUYEN: Objection. Leading.</p> <p>12 THE WITNESS: That's right. That's an</p> <p>13 important aspect of sound externalization, is the</p> <p>14 HRTF. Yes.</p> <p>15 BY MS. PARTRIDGE:</p> <p>16 Q. And you cannot accomplish sound</p> <p>17 externalization with stereo processing, correct?</p> <p>18 A. Correct. Stereo processing over</p> <p>19 headphones, all the sounds would sound on inside of</p> <p>20 the head. And over loud speakers, all you would be</p> <p>21 doing is moving the sound along the line and the</p> <p>22 two loud speakers.</p> <p>23 Q. So you cannot accomplish sound</p> <p>24 externalization with stereo processing or stereo</p> <p>25 speakers, correct?</p>                                  |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
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| <div>Page 69</div> <div>1 A. Well, just to be accurate, if you use loud<br/>2 speakers, then the sound is going to be external at<br/>3 one point because the loud speakers are external<br/>4 from the human. So the sound will be externalized<br/>5 somewhere in between the two loud speakers, but<br/>6 otherwise, over headphones, you need to have HRTFs<br/>7 to be able to externalize the sound on the side of<br/>8 your head.<br/>9 Q. Right. So this claim does not cover any<br/>10 kind of sound with stereo sound or stereo speakers,<br/>11 correct?<br/>12 A. Which claim?<br/>13 Q. The Claims 1, 8 and 15, under the<br/>14 limitation away from and proximate to?<br/>15 A. Those are not concerned with stereo phonic<br/>16 reproduction.<br/>17 MS. PARTRIDGE: Okay. Let me take a<br/>18 break, and then we'll see if I'm finished. Okay.<br/>19 THE WITNESS: Okay.<br/>20 THE VIDEOGRAPHER: All right. I'll read<br/>21 us off the record for that break. Going off the<br/>22 record, 11:27.<br/>23 (A recess was held from 11:27 a.m. to 11:33 a.m.)<br/>24 THE VIDEOGRAPHER: And we're back on the<br/>25 record now. Time, 11:33 a.m.</div> | <div>Page 71</div> <div>1 THE REPORTER: Ms. Nguyen, you want a<br/>2 rough draft with a final by Monday?<br/>3 MS. NGUYEN: Final Tuesday will be fine,<br/>4 too, if you want to enjoy the 4th.<br/>5 THE REPORTER: Ms. Partridge, did you want<br/>6 rough draft and final by Tuesday, as well?<br/>7 (Whereupon proceedings concluded at 11:34 a.m.)<br/>8<br/>9<br/>10<br/>11<br/>12<br/>13<br/>14<br/>15<br/>16<br/>17<br/>18<br/>19<br/>20<br/>21<br/>22<br/>23<br/>24<br/>25</div>                                                                                                  |
| <div>Page 70</div> <div>1 BY MS. PARTRIDGE:<br/>2 Q. Okay. Did we talk during the break,<br/>3 Dr. Begault?<br/>4 A. No, we did not.<br/>5 Q. And I just want to ask, hopefully, one more<br/>6 question, just to make sure the last testimony was<br/>7 clear.<br/>8 So to be clear, you cannot accomplish sound<br/>9 externalization using stereo processing, correct?<br/>10 A. Over headphones, that's absolutely true.<br/>11 MS. PARTRIDGE: Okay. I have no further<br/>12 questions at this time.<br/>13 MS. NGUYEN: No further questions from me.<br/>14 Thank you so much, Dr. Begault. Have a wonderful<br/>15 4th of July.<br/>16 THE WITNESS: Yes, you too.<br/>17 MS. PARTRIDGE: Wow, this is a treat,<br/>18 getting out --<br/>19 THE VIDEOGRAPHER: Just making sure all<br/>20 agree -- sorry about that. I just want to make<br/>21 sure I get us off the record for the day. We're<br/>22 all good?<br/>23 MS. PARTRIDGE: I'm sorry. I just talk.<br/>24 THE VIDEOGRAPHER: That's okay. Okay.<br/>25 I'll read us off the record. Going off, 11:34 a.m.</div>                                                                                          | <div>Page 72</div> <div>1 SIGNATURE OF DEPONENT<br/>2<br/>3 I, the undersigned, DURAND BEGAULT, Ph.D, do<br/>4 hereby certify that I have read the foregoing<br/>5 deposition and find it to be a true and accurate<br/>6 transcription of my testimony, with the following<br/>7 corrections, if any:<br/>8<br/>9 PAGE LINE CHANGE/REASON<br/>10 _____<br/>11 _____<br/>12 _____<br/>13 _____<br/>14 _____<br/>15 _____<br/>16 _____<br/>17 _____<br/>18 _____<br/>19 _____<br/>20 _____<br/>21 _____<br/>22 _____<br/>23 _____<br/>24 _____<br/>25<br/>DURAND BEGAULT, Ph.D, Date</div> |

REPORTER'S CERTIFICATE

I, NICOLE HATLER, a Shorthand Reporter,  
State of California, do hereby certify:  
That DURAND BEGAULT, 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 8th day of July 2024.



NICOLE HATLER, CSR NO. 13730  
State of California

|                                                                                  |                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
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| <b>Exhibits</b>                                                                  | <b>11:15</b> 60:22,24<br><b>11:27</b> 69:22,23<br><b>11:33</b> 69:23,25<br><b>11:34</b> 70:25<br><b>13730</b> 5:11<br><b>15</b> 57:12,14,20 58:12 67:19, 23 69:13<br><b>175</b> 26:15,18,21<br><b>1991</b> 9:2<br><b>1994</b> 26:9 | <b>7</b><br><b>7</b> 54:2<br><b>79B</b> 63:14,17,23 64:4                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>adjust</b> 53:9,14 58:17<br><b>adjusting</b> 52:19 53:5<br><b>admit</b> 66:21,25<br><b>agree</b> 11:5 13:8 14:24 16:10,17 49:23 51:11 52:1, 11,19 53:8 64:17 70:20<br><b>ahead</b> 12:23 46:8 58:23<br><b>alter</b> 28:22<br><b>alteration</b> 31:4<br><b>alterations</b> 30:14 31:15<br><b>altered</b> 30:1,10 32:3,6,13, 23 33:6 34:5,11<br><b>altering</b> 32:8,15 34:21<br><b>ambiguous</b> 17:18,25 25:2 28:6 30:19<br><b>amplitude</b> 14:17<br><b>and/or</b> 30:9<br><b>Andy</b> 4:16<br><b>angle</b> 19:9<br><b>answering</b> 34:7<br><b>answers</b> 12:20<br><b>anymore</b> 5:3<br><b>apartment</b> 54:12<br><b>apologies</b> 12:12 22:6<br><b>apologize</b> 63:5<br><b>Appeal</b> 4:11<br><b>appears</b> 9:3 29:3 67:23<br><b>application</b> 6:17<br><b>applications</b> 6:14<br><b>approximate</b> 52:3,8 62:14 63:18 64:5,6<br><b>approximately</b> 5:25<br><b>arbitrarily</b> 42:22<br><b>arbitrary</b> 36:25<br><b>area</b> 40:17<br><b>arrival</b> 17:11 65:25<br><b>art</b> 66:4<br><b>aspect</b> 40:15 68:13 |
| <b>Begault Ph.<br/>D Exhibit 1001</b> 2:11 29:13, 15 36:8 49:9 58:23 61:12 67:16 |                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Begault Ph.<br/>D Exhibit 1036</b> 2:12 25:20, 23 26:5,7,15                   |                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Begault Ph.<br/>D Exhibit 1047</b> 2:13 8:1,2, 6,25                           |                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Begault Ph.<br/>D Exhibit 1048</b> 2:15 9:13, 15,17 10:20,24                  |                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Begault Ph.<br/>D Exhibit 1049</b> 2:16 11:13, 15,22                          |                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Begault Ph.<br/>D Exhibit 1050</b> 2:17 15:11, 13,19                          |                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>0</b>                                                                         | <b>2</b><br><b>2004</b> 53:9<br><b>2011</b> 63:8,10 65:10<br><b>2014</b> 49:24 51:12,15,18 52:4,11,19<br><b>202301003</b> 4:11<br><b>2024</b> 4:5<br><b>2025</b> 5:12<br><b>26</b> 43:20                                           | <b>8</b><br><b>8</b> 54:1,3 56:11,13,25 61:21 64:23 65:4 67:19,22 69:13<br><b>8:41</b> 4:6<br><b>8B</b> 63:19                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>090</b> 29:18 49:9,12,19 53:19 54:1 61:13,21 62:1 67:16                       | <b>3</b><br><b>30</b> 10:23<br><b>31</b> 10:23<br><b>34</b> 65:9,17<br><b>3D</b> 26:14<br><b>3rd</b> 4:5                                                                                                                           | <b>9</b><br><b>9</b> 29:19,21<br><b>9226090</b> 4:12<br><b>99</b> 6:3,4<br><b>9:33</b> 46:13,15<br><b>9:56</b> 46:17                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>1</b>                                                                         | <b>4</b><br><b>4th</b> 70:15                                                                                                                                                                                                       | <b>A</b><br><b>a.m.</b> 4:6 46:13,15,17 59:24, 25 60:2,21,22,24 69:23,25 70:25<br><b>absolutely</b> 70:10<br><b>abstract</b> 9:4 30:24<br><b>accent</b> 5:18,19<br><b>accomplish</b> 68:16,23 70:8<br><b>accurate</b> 13:9 14:25 15:8 16:10,15 31:8 35:1 38:19, 21,24 39:2 41:6 42:1 60:9 69:1<br><b>accurately</b> 41:20<br><b>acoustic</b> 11:2 12:9 13:2 14:18 53:15<br><b>acoustics</b> 14:9<br><b>acoustics'</b> 33:1<br><b>actions</b> 54:16<br><b>added</b> 14:4,8<br><b>additional</b> 14:3 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>1</b> 49:19 53:7,24 54:19 55:25 56:2,8 67:18,22 69:13                         | <b>5</b><br><b>54</b> 29:19,21<br><b>55</b> 63:14                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>100</b> 6:4 13:13,18                                                          | <b>6</b><br><b>60s</b> 48:11                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>1001</b> 29:13,15,18 36:8 49:9 58:23 61:12 67:16                              |                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>1036</b> 25:20,23 26:5,7,15                                                   |                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>1047</b> 8:1,2,6,25 10:7                                                      |                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>1048</b> 9:13,15,17 10:7,20,24                                                |                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>1049</b> 11:13,15,22                                                          |                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>1050</b> 15:11,13,19                                                          |                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>10:18</b> 59:24,25                                                            |                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>10:39</b> 59:25 60:2                                                          |                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>10:40</b> 60:21,22                                                            |                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>11</b> 46:13                                                                  |                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

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|--------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>aspects</b> 29:25 32:3,5,12,23 33:5 34:4 45:2 50:18 53:24 | 19,22,23,24 51:1,2,3,4,5,7, 12,15,18 52:12,20 53:9 54:10 55:4 56:7,8,9,10,25 57:3,15,17,20 58:7,17,20 63:19 65:5 | <b>changing</b> 33:25 35:4 57:7                                                                                        | <b>conclusions</b> 53:13                                                                                                                                                |
| <b>associate</b> 4:23 5:2                                    |                                                                                                                  | <b>channel</b> 44:24 45:13 48:17, 18 55:10                                                                             | <b>conference</b> 47:23                                                                                                                                                 |
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