

Filed on behalf of: Meta Platforms, Inc.

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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

META PLATFORMS, INC.
Petitioner,

v.

EIGHT KHZ, LLC
Patent Owner.

Case No. IPR2023-01003
U.S. Patent No. 9,226,090

PETITIONER'S REPLY TO PATENT OWNER'S RESPONSE

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1001	U.S. Patent No. 9,226,090 (“’090 Patent”)
1002	Prosecution History of U.S. Patent No. 9,226,090 (“’090 FH”)
1003	Declaration of Dr. Kyriakakis (“Kyriakakis”)
1004	<i>Curriculum Vitae</i> of Dr. Kyriakakis
1005	U.S. Patent No. 8,406,439 to Bedingfield et al. (“Bedingfield”)
1006	U.S. Patent No. 9,131,305 to Li et al. (“Li”)
1007	U.S. Patent No. 8,818,000 to Andrea (“Andrea”)
1008	U.S. Patent Pub. No. 2003/0059070 to Ballas (“Ballas”)
1009	U.S. Patent No. 7,606,375 to Bailey et al. (“Bailey”)
1010	RESERVED
1011	RESERVED
1012	RESERVED
1013	U.S. Patent App. Pub. 2014/0064526 to Otto, et al. (“Otto”)
1014	RESERVED
1015	Rumsey, Francis “Whose head is it anyway? Optimizing binaural audio.” J. Audio Eng. Soc., Vol. 59, No. 9, 2011 (“Rumsey”)
1016	RESERVED
1017	U.S. Patent App. Pub. 2008/0273708 to Sandgren, et al. (“Sandgren”)

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1018	RESERVED
1019	RESERVED
1020	Scheinerman, Matt "Exploring Augmented Reality." Haverford College Computer Science (2009) ("Scheinerman")
1021	Comeau, Charles et al. "Headsight TV System." Electronics, 1961, pp. 86-90 ("Comeau")
1022	Sutherland, Ivan "The Ultimate Display." Proceedings of IFIP Congress, pp. 506-508 (1965) ("Sutherland1965")
1023	Sutherland, Ivan "A head-mounted three dimensional display." Fall Joint Computer Conference, pp. 757-764 (1968) ("Sutherland1968")
1024	Moller, Henrik, et al. "Head-Related Transfer Functions of Human Subjects." J. Audio Eng. Soc., Vol. 43, No. 5, 1995, pp. 300-321 ("Moller")
1025	Akeroyd, Michael. "The psychoacoustics of binaural hearing." International Journal of Audiology, 45:sup1, 25-33 (2006) ("Akeroyd")
1026	Middlebrooks, John, et al. "Sound Localization by Human Listeners." Annual Review of Psychology, 1991. 42:135-39 ("Middlebrooks")
1027	<i>Eight KHZ, LLC v. Meta Platforms, Inc. et al.</i> , 6:22-cv-575-ADA-DTG (W.D. Tex.), Plaintiff's Claim Construction Reply Brief (ECF 92) ("8KHZ Claim Construction Brief")
1028	RESERVED
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1031	Cheng, Corey, et al. "Moving Sound Source Synthesis for Binaural Electroacoustic Music Using Interpolated Head-Related Transfer Functions (HRTFs)." ("Cheng")
1032	May 22, 2023 Deposition Transcript of Durand Begault, Ph.D. from <i>Eight KHZ, LLC v. Meta Platforms, Inc. et al.</i> , 6:22-cv-575-ADA-DTG (W.D. Tex.)
1033	U.S. Patent No. 257,453 to Ader("Ader")
1034	Olson, Harry. "Sound Reproducing Systems - Monaural, Binaural, Monophonic, and Stereophonic." Audio, 1958 ("Olson")
1035	Kyriakakis, Chris. "Fundamental and Technological Limitations of Immersive Audio Systems." Proceedings of the IEEE, Vol. 86, No. 5, 1998 ("Kyriakakis 1998")
1036	Begault, Durand. "3-D Sound for Virtual Reality and Multimedia." 2000 ("Begault")
1037	Vertesi, Janet. "Seamful Space: Heterogeneous Infrastructures in Interaction." Science, Technology, & Human Values 2014, Vol. 39:2, 264-284 ("Vertesi")
1038	Torrejon, Alfonso, et al. "Improving Communication and Presence in Online Telepresence Systems." Workshop Proceedings of the 9th International Conference on Intelligent Environments, 2013 ("Torrejon")
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1047	D. Begault, et al., <i>Headphone Localization of Speech Stimuli</i> , Proceedings of the Human Factors Society 35 th Annual Meeting, 82-86 (1991)
1048	Durand R. Begault, et al., <i>Headphone Localization of Speech</i> , Human Factors, 35(2), 361-776 (1993)
1049	<i>Improved HRTF-Based Pseudostereophony, Monaural are filtered digitally to obtain pseudosterophonic output signals</i> (April 2000)
1050	Areti Andreopoulou, et al., <i>Inter-Laboratory Round Robin HRTF Measure Comparison</i> , 9(5) 895-906 (2015)
1051	Deposition Transcript of Durand Begault, Ph.D. (July 3, 2024)
1052	U.S Patent No. 4,136,260 to Asahi ("Asahi")
1053	B.B. Bauer, <i>Stereophonic Earphones and Binaural Loudspeakers</i> , Journal of the Audio Engineering Society, 2 (9) 148-151 (April 1961)
1054	Fabio Kaiser, <i>Transaural Audio – The reproduction of binaural signals over loudspeakers</i> , 1-34 (March 2011)
1055	Declaration of Chris Kyriakakis in Support of Petitioner's Reply ("Kyriakakis Reply")

I. INTRODUCTION

The Petition established that the challenged claims are unpatentable. In a transparent attempt to avoid the prior art, PO injects numerous limitations into the claim language, directly contrary to the intrinsic evidence and in conflict with PO's concession that "no express constructions of the claims are necessary" as "the plain and ordinary meaning of [each] term should be adopted." POR 3-4.

Notably, PO asserts that localizing sound at a point that is "away from and proximate to" the listener requires adjusting HRTFs and 6 degrees of freedom (6DOF) tracking. But the term "away from and proximate to" does not require such. As to HRTFs, the specification expressly identifies numerous other ways to localize sound at a point that is "away from and proximate to" the listener, including adjusting "calculations for and changes to ITDs, ILDs,...attenuation, reverberations, and other aspects of sound." Ex. 1001, 35:49-55. As to 6DOF tracking, the specification never even references 6DOF, and discloses multiple embodiments that do not require any tracking at all.

At bottom, the challenged claims are directed to no more than using known sound localization techniques during a call. Indeed, PO's expert Dr. Begault admitted as much. Ex. 1051, 51:6-53:24. And that is exactly what the asserted combinations teach.

II. CLAIM CONSTRUCTION

A. “away from and proximate to” (all claims)

Petitioner's Interpretation	PO's Interpretation
plain and ordinary meaning of “a distance from” (Pet. 15-16)	externalization of sound through HRTFs and 6DOF tracking of the listener relative to the SLP that represents the talker (Begault Decl. ¶79 (cl. 8); <i>see also</i> ¶¶64-65 (cl. 1), ¶85 (cl. 15); POR 43) ¹

The Petition established that both Bedingfield and Li combinations teach adjusting sound during a conference call to localize a voice “away from and proximate to” the listener (such as at a conference table). Pet. 19-22, 36, 58-60, 70.

To evade these disclosures, PO injects HRTFs and 6DOF tracking into the term.² PO argues that externalization and binaural synthesis require both. POR 43.

¹ Dr. Begault states “away from and proximate to” requires HRTFs and 6DOF tracking for claim 8. EX2011, ¶79. He later confirmed that this analysis applies to claims 1 and 15. EX1051, 64:23-65:3.67:17-68:14; *see also* EX2011, ¶83.

² It is unclear why PO and Dr. Begault inject 6DOF tracking. Although they argue that “externalization...cannot be accomplished without tracking the change in head location and orientation of the listener (*i.e.*, 6 degrees of freedom head-tracking)”

But they do not. Kyriakakis Reply, ¶30. Indeed, the patent expressly identifies other methods.³

1. The claim language precludes limiting the term to HRTFs and 6DOF tracking.

The claim language makes clear that “away from and proximate to” is not limited to HRTFs and 6DOF tracking.

First, the independent claims include no language limiting the term to any specific method, let alone HRTFs and 6DOF tracking. Kyriakakis Reply, ¶¶6-8. Claims 1 and 15 recite “adjusting...the binaural sound...so the binaural sound originates...from a sound localization point that is away from and proximate to the listening person.” EX2001, 42:45-49. That is, the claims encompass any adjustment

(POR, 43), they never argue that the prior art fails to disclose this limitation. *See generally* POR. To the extent PO attempts to argue such on sur-reply, the argument is waived.

³ The POR and Dr. Begault's declaration are confusing and disorganized, attempting to inject “localization cues used in binaural synthesis (HRTFs, 6DOF tracking)” (EX2011, ¶15) into claim language randomly. *See, e.g.*, EX2011, ¶¶59, 67, 86. But HRTFs and 6DOF tracking are not required by any language in the independent claims. Kyriakakis Reply, ¶¶25-28.

to the binaural sound to localize at a point “away from and proximate to” the listener. Moreover, claim 8 is not even limited to adjusting the binaural sound, as it merely recites “execute the electronic call such that the origin of the voice...appears...to originate from...the sound localization point [that is away from and proximate to the listener.]” Notably, claim 8 separately requires something other than HRTFs and 6DOF tracking, reciting in limitation 8[d] “alter[ing] an interaural time difference [ITD]” when the head orientation of the first listener moves. *Id.*, 43:57-61. As Dr. Begault confirmed, ITD is not an HRTF. EX1051, 23:6-7, 23:20-23. Thus, the claim language plainly establishes that the term is not restricted to HRTF and 6DOF tracking.

Second, the dependent claims confirm that the term must encompass methods other than HRTFs. It is a basic tenet that dependent claims cannot be broader than the claim from which they depend. *Littlefuse, Inc. v. Mersen USA EP Corp.*, 29 F.4th 1376, 1380 (Fed. Cir. 2022). Here, the independent claims must be broad enough to cover at least ITD and interaural level difference (“ILD”) because the dependent claims recite adjustments to the binaural sound can include adjustments to ITD or ILD. *See, e.g.*, EX1001, claims 2, 5, 17. Thus, PO's interpretation must be rejected because it fails to cover “explicitly claimed embodiments” in the dependent claims. *Baxalta Inc. v. Genentech, Inc.*, 972 F.3d 1341, 1346 (Fed. Cir. 2020).

Third, claim differentiation and antecedent bases further establish the term is not limited to HRTFs. Kyriakakis Reply, ¶¶9-10. Claim 17, which depends from claim 15, recites “change...*a* head-related transfer function (HRTF) in order to position the sound localization point of the binaural voice to the location that is away from and proximate to the first person.” If HRTFs were already required, claim 17 would not need to recite it. Also, claim 17 recites “*a*” (not “said”), introducing HRTF for the first time.

Thus, not only do the claims fail to recite any language restricting the term to HRTFs and 6DOF tracking, but they include language precluding such restrictions.

2. The specification discloses methods other than HRTFs and 6DOF tracking.

A POSITA would not have understood the '090 Patent to provide a special definition of “away from and proximate to” which restricts the term to HRTFs and 6DOF tracking. Kyriakakis Reply, ¶5. Far from clearly and unambiguously disclaiming other methods, the specification includes multiple embodiments that expressly embrace other methods.

The specification repeatedly discusses localizing sound at a point “away from and proximate to” the listener through adjustment of any of a number of aspects of sound. *See, e.g.*, EX1001, 3:59-67 (describing altering a sound location using ITD, ILD, spectral reflections, phase delays, group delays, and a ratio of the direct to

reverberated signal), 35:49-55 (describing adjustments to localize participants around a conference table using “calculations for and changes to ITDs, ILDs, HRTFs, attenuation, reverberations, and *other aspects of sound* discussed herein.”) (emphasis added).

Importantly, the specification merely identifies HRTFs as an exemplary method of localizing sound, not the only method. In one passage, the specification explains “one or more aspects of sound are altered...*For example*, one or more of a HRTF, an interaural level difference, and/or an interaural time difference are altered.” EX1001, 9:54-60; *see also* 4:20-29, 6:56-63. The specification does not disparage other methods to localize sound, nor does it ever state that HRTFs must be used.

As to 6DOF tracking, the term “6DOF” or any variation does not appear in the patent at all. Even for tracking generally, the specification states that this is merely an option, not required—“designation of a sound localization point *can be* based on tracking.” EX1001, 14:30-31 (emphasis added). Indeed, there are multiple embodiments disclosed in the specification that do not require any tracking. For example, tracking is not required to localize a voice to an empty chair at a conference table (EX1001, 35:49-55) or in a kitchen (EX1001, 5:32-36). Kyriakakis Reply, ¶¶17-20.

3. Injection of HRTFs and 6DOF tracking is contrary to Dr. Begault's own statements.

PO and Dr. Begault repeatedly allege that because “away from and proximate to” means externalization, the term necessarily requires HRTFs and 6DOF tracking. Not only is this contrary to the intrinsic evidence, it is also contrary to Dr. Begault's own statements and other extrinsic evidence.

At deposition, Dr. Begault confirmed that externalization can be accomplished through other methods. Despite direct leading questions from PO's counsel to confirm that “you cannot accomplish sound externalization with stereo processing,” Dr. Begault could not agree.⁴ EX1051, 68:23-69:8. Instead, he admits, “if you use loud speakers, then the sound is going to be external at one point because the loud speakers are external from the human.” *Id.*; *see also* 69:1-8, 70:8-10.⁵

⁴ While binaural sound is provided over headphones, stereophonic sound is intended for playback over loudspeakers, and either can accomplish sound externalization. Kyriakakis, ¶¶43-46 (reproducing Fig. 4 of EX1034, depicting sound externalization using loudspeakers).

⁵ Dr. Begault qualifies this admission by stating that externalization through loudspeakers does not require HRTFs, but externalization through headphones does. But claim 15 does not require headphones, and multiple references

Further, Dr. Begault has previously explained “reverberation—is key for the effective simulation of distance and the perception of an environmental context.” Ex. 1036 at 79. This is consistent with the patent’s embodiment for localizing sound “away and proximate to” the listener by adjusting reverberation. *See, e.g.*, EX1001, 10:46-50.

Dr. Begault also testified, consistent with the '090 Patent, that binaural synthesis “transforms a sound source with no position information to a virtual sound source with respect to a head of a listener.” EX1051, 43:22-44:3. Strikingly, Dr. Begault never explains why binaural synthesis needs to be achieved through HRTFs and 6DOF tracking, particularly when the '090 Patent expressly identifies adjustments of other aspects of sound to create a virtual sound source. *See generally* EX2011.

Notably, externalization without HRTF and 6DOF tracking is not just recognized by the '090 Patent, but was also known in the industry. Kyriakakis Reply, ¶¶31-38. For example, U.S. Patent No. 4,136,260 described an “out-of-head localized sound reproduction system for headphone[s]” that utilized a dip filter. EX1052, Title, Abstract. Similarly, a 1961 paper by Bauer (cited by Dr. Begault in

document known methods of externalization through headphones without HRTFs.

See, e.g., EX1052, EX1053; Kyriakakis Reply, ¶35.

his book, EX1026, 69) describes externalization over headphones involving just filters and delays. EX1053.

Dr. Begault appears to suggest that PO's true issue is that implementing the term using other methods "only *crudely approximate* the cues evoked by sources that are physically placed at the auditory event positions." EX2011, ¶16 (quotations omitted and emphasis added). But crude or not (and as the '090 Patent expressly states), ITD, ILD, and adjustments to other aspects of sound still localize that sound to a point that is "away from and proximate to" the listener. And PO and Dr. Begault's injection of HRTFs and 6DOF tracking to provide a perfectly ideal SLP is improper and contrary to the disclosures of the '090 Patent.

B. "capturing...binaural sound" (claims 1-7)

Petitioner's Interpretation	PO's Interpretation
plain and ordinary meaning (Pet. 15-16)	capturing each and every sound wave at the talker's system binaurally (POR 1)

The Petition established that both Bedingfield and Li as modified by Andrea render obvious "capturing...binaural sound." Pet. 19-22, 58-60. Specifically, Andrea discloses audio receiving means on earbuds worn by a user at left and right ears that captures two "distinct audio signal[s]" because of "the spatial discrepancy between each of the audio receiving means." EX1007, 14:52-61.

To counter, PO argues that “capturing...binaural sound” requires “capturing each and every sound wave at the talker’s system” binaurally. POR 1. PO’s interpretation is not only counter to the intrinsic evidence and law, but also futile. Like the ’090 Patent, Andrea discloses that the sound picked up by each earbud includes background noise that is transmitted to the processor, which has the option of filtering or reducing the noise. *See infra* Section IV.A.

1. “capturing...binaural sound” has its plain meaning

The claim language confirms that the term has its plain meaning, which means capturing binaural sound, not *all* binaural sound. Notably, the claim requires adjusting “*the* binaural sound captured...so the binaural sound originates...from *the* sound localization point.” EX1001, 42:45-49 (emphasis added). For example, if a listener has a telephone call with his mother, his mother’s captured voice will be adjusted so that it “appears to originate from the empty kitchen chair such that the listener localizes her voice to this location.” EX1001, 5:40-42.

Critically, the claim language as recited requires “*the* binaural sound captured” to originate from “*the* sound localization point.” Thus, the claim language does not make sense under PO’s interpretation, which would require all binaural sounds to be captured and then adjusted to originate from the *same* sound localization point. For example, if the binaural sounds of the mother’s voice and a bird at different locations were captured, under PO’s interpretation, the claim would

require both to be localized at the same point—“capturing each and every sound wave at the talker's system, adjusting the same, and then providing the adjusted sound to the listener.” POR 1. But these two sources of binaural sound do not share the same sound localization point.

The specification confirms that capturing binaural sound (not all binaural sound) is sufficient to meet the limitation. For example, the specification explains “the first person 2110 holds an HPED 2105 that captures, records, and transmits sound (such as *a* voice of the first person).” EX1001, 33:7-8. Further, the specification explains that when multiple sounds are captured, they can have different sound localization points. EX1001, 5:67-6:2 (“The binaural recordings of the three sounds (i.e., footsteps, voice, and opening door) can be stored to preserve their original sound localization points. As such, a listener of the recording would hear the footsteps at the first coordinate, the voice at the second coordinate, and the opening door at the third coordinate.”).

2. PO's interpretation is incorrect.

PO's arguments that all binaural sound must be captured are unavailing. PO argues that Petitioner “effectively equat[es]” “sound” with “voice.” POR 39. Incorrect. As Dr. Begault confirmed, “speech [i.e., voice] is a type of sound.” EX1051, 41:3-5. Thus, a voice is “sound,” as is a door opening, footsteps, or a bird chirping. Importantly, each of these sounds by themselves would meet the “sound”

limitation of claim 1, but not the “voice” limitation of claims 8 and 15. Accordingly, interpreting “sound” by its plain meaning to cover a sound (including a voice) does not mean that Petitioner equates “sound” with “voice.”

PO also argues that to “cancel or minimize the environment sounds in the talker’s room...contradicts Claim 1’s goal, which is to capture the talker’s voice and all other sounds present in the talker’s room environment (e.g., chirping bird).” POR 51. This is factually wrong. The ’090 Patent discloses embodiments that cancel or minimize the environment sounds. *See, e.g.*, EX1001, 25:39-41 (“Ambient noise and attenuation due to environmental conditions can be filtered.”), 39:65-40:3 (“The vocal sound captured from the third microphone is used to enhance the sound captured by the fourth microphone, to isolate and cancel non-vocal components of sound, and to improve the clarity of a vocal part of the signal that is ultimately provided to the listener.”).

III. DR. KYRIAKAKIS’S OPINIONS ARE WELL-SUPPORTED

With little (if any) arguments of substance, PO resorts to ad hominem attacks against Dr. Kyriakakis, alleging that his opinions are conclusory or self-contradictory. But these allegations are mischaracterizations and demonstrably false.

For example, PO argues that “[t]he Board should give no weight to Dr. Kyriakakis’s declaration to the extent it addresses the HRTFs topic due to failure to

disclose the definition he uses for his conclusions.” POR 11. Yet Dr. Kyriakakis clearly stated that he applied the plain meaning to any term not identified in the claim construction section of his declaration, like HRTFs. Kyriakakis, ¶32. PO makes much of the fact that Dr. Kyriakakis stated during deposition that he applied PO's construction. POR 9. But PO's construction is the ordinary meaning. EX1027, 21.

PO also argues that Dr. Kyriakakis “conceded” that the plain meaning was different from the definition he used. POR 10-11. Again, not so. Dr. Kyriakakis merely stated what the acronym HRTFs stands for. EX2016, 90:16-91:6 (cited by POR 11). Further, as Dr. Begault himself admitted, different words can be used to describe HRTFs. EX1051, 9:3-17:5. Different words do not mean the descriptions are inconsistent. Indeed, Dr. Begault himself has described HRTFs differently in multiple papers, and stated during his deposition that the different descriptions of HRTFs are each “accurate.” EX1047, EX1048, EX1049, EX1050, EX1051, 13:8-15, 14:24-15:8, 16:10-15.

Importantly, the Board is required to construe “only those terms...that are in controversy, and only to the extent necessary to resolve the controversy.” *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999). PO fails to identify any specific controversy on the scope of “HRTFs.” Rather, PO merely attempts to place a shadow on Dr. Kyriakakis's opinions.

At bottom, Dr. Kyriakakis is a known expert in the audio engineering community. EX1051, 59:5-17. Each of Dr. Kyriakakis's opinions should be given the appropriate weight based on his analysis in full context and supporting evidence.

IV. GROUND 1: BEDINGFIELD-ANDREA RENDERS OBVIOUS CLAIMS 1 AND 15

A. Bedingfield-Andrea discloses “capturing...binaural sound” even under PO’s erroneous interpretation.

The Petition established that Bedingfield-Andrea discloses “capturing... binaural sound” under its plain meaning. Pet. 19-22; *see also* EX1007, 14:55-61. But the combination also discloses the limitation even if it requires capturing each and every sound wave at the talker's system, as PO contends. Kyriakakis Reply, ¶¶39-41.

Andrea provides “an audio receiving means on each earbud” that captures each and every sound at the talker's system, including “unwanted sound perceived by the user.” EX1007, 14:55-61, 15:34-37. Andrea explains “the sound picked up by the audio receiving means on the earbuds may be converted to audio signals that are transmitted to an external device comprising a processor.” EX1007, 16:21-24. Using beamforming algorithms, the processor then “may execute executable instructions causing it to generate an audio signal that substantially fails to reflect noise generated from an area outside of the beam width.” EX1007, 16:24-28.

Thus, Andrea's teaching reflects the '090 Patent optional embodiment where all binaural sounds are captured so that "[a]mbient noise and attenuation due to environmental conditions can be filtered." EX1001, 25:39-41.

B. Bedingfield-Andrea discloses "adjusting...the captured binaural sound."

PO argues that Bedingfield-Andrea does not disclose the adjusting limitation because "adding a second microphone to Bedingfield merely enables listening to the captured binaural voice." POR 52.⁶ PO misunderstands the Petition.

The Petition established that Bedingfield-Andrea does not simply reproduce the captured binaural sound; rather, the Bedingfield-Andrea system captures binaural sound, adjusts that sound, then provides it to the listener. As Dr. Kyriakakis explained, a POSITA would have modified the Bedingfield system by adding both "an additional microphone to Bedingfield's *electronic earphone* and **a software module to process** the *binaural sound* as taught by Andrea." Kyriakakis, ¶125; Pet.

⁶ To the extent that PO suggests that a system cannot use both binaural recording and binaural synthesis (*e.g.*, POR 36), PO is incorrect. As Dr. Begault testified, a system can include both. EX1051, 42:9-14. For example, a binaural recording can be adjusted so that the sound appears to originate from a different direction. EX2016, 143:12-144:8.

22. (emphasis added). As Dr. Kyriakakis emphasized, the benefit of Andrea's "'dual-channel earbud embodiment' is that it 'allows for the application of audio enhancement techniques, such as active noise reduction, which 'refers to a technique for reducing unwanted sound.'" Kyriakakis, ¶123; Pet. 22.

After the captured binaural sound has been processed, "Bedingfield's multi-channel processing device 118 (part of the *computer system*) receives the audio signals (*sound*) and 'process[es] the signals' (*adjust[s] the sound*) to 'creat[e] a sound field 122' so that 'the listener 102 [] hear[s] the speaking participant in the sound field 122.'" Kyriakakis, ¶138 Pet. 26. Dr. Kyriakakis notes "[t]his processing is *adjusting* the binaural sound, because it involves transforming the sound so that it appears to originate from a specific location [different from the original location as captured]." *Id.*

Accordingly, the captured binaural sound is adjusted before it is provided to the listener. PO's argument otherwise is plain misreading.

C. Bedingfield discloses "providing...the binaural sound."

PO argues that Bedingfield "does not teach, suggest, or disclose binaural sound." POR 53. Incorrect. As PO represented in district court: "The word [binaural] has two parts: 'bi' meaning 'two,' and 'aural' meaning 'of or relating to the ear or to the sense of hearing.'" EX1027, 18. And Bedingfield plainly teaches providing two different sounds to each ear.

Bedingfield explains that its multi-channel audio system sends different sounds to the listener's left and right ears to simulate virtual positions of the participants in the sound field. For example, in a sound field that includes four participants in a circular configuration, a "listener may hear a second speaker, located at the 3 o'clock position relative to the listener, in stereo sound with an increased volume level in the right audio channel and a decreased volume level in the left audio channel, as compared to the right and left volume levels received from the first speaker." EX1005, 3:62-4:12, Figs. 14, 15, 19a.

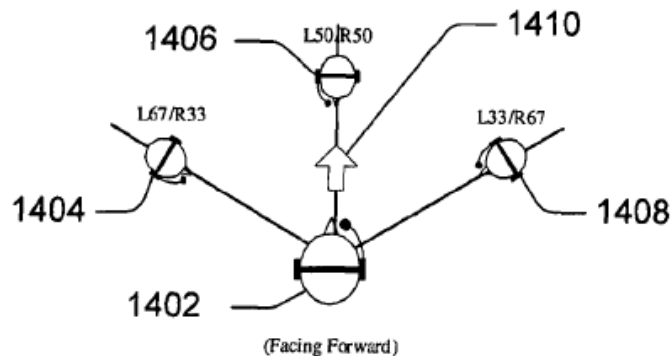


Fig. 14

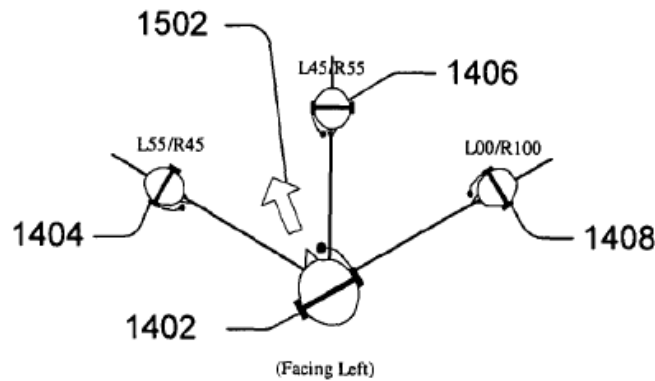


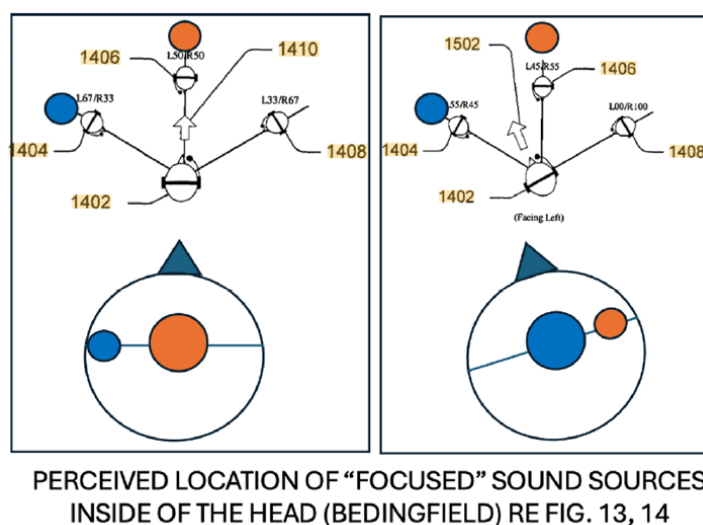
Fig. 15

Indeed, Bedingfield recognizes “the human hearing mechanism (including the ears, nerves and brain processing, subsequently referred to as ‘the ear’) detects placement of a speaker (or source of sound)...by detecting [differences]...perceived by the listener’s two ears.” EX1005, 3:35-39. Bedingfield expressly teaches methods of adjusting differences in the left and right channels to localize the sound source at different points of origin. Kyriakakis Reply, ¶¶43-51; EX1005, 8:49-51; 9:50-57. Notably, Bedingfield’s teaching of volume differences to localize sound is reflected in the ’090 Patent. EX1001, 12:27-30.

Thus, Bedingfield-Andrea discloses “binaural sound,” and specifically “providing...the binaural sound to the listening person...such that the origin of the binaural sound for the listening person occurs at the sound localization point.”

D. Bedingfield discloses SLPs “away from and proximate to” the listener that simulate “the origin of the binaural sound.”

Relying on Dr. Begault, PO argues that “the resulting spatial perspective for the listener [in Bedingfield] will be...*from the inside their head.*” POR 53 (emphasis added). This argument fails. First, Dr. Begault's characterization is directly contrary to the express teachings of Bedingfield. In the very passage that Dr. Begault relies on, Bedingfield teaches “in FIG. 15, the participant 1408 that is now speaking will sound as if the speaker were *located behind* the listener 1402.” EX1005, 14:30-43 (cited by EX2011, ¶82). A POSITA reading Bedingfield would have understood that perceiving the speaker behind the listener is externalized and not inside the head. Kyriakakis Reply, ¶¶48-49. Indeed, to make his argument, Dr. Begault *modified* the figures of Bedingfield to allege that the sound sources are inside the head of the listener rather than externalized.



PO-Modified EX1005, Figs. 14 and 15 (EX2011, ¶82)

Second, PO contradicts itself, admitting that Bedingfield (and specifically Figures 19a-c) does “allow[] the listener to perceive the stereo sound as externalized” but alleges this is based on the “imagination of the listener.” POR 57. PO's sole support for this argument is Dr. Begault's say-so. Dr. Begault cites no objective evidence supporting his assertion that Bedingfield's adjustments to volume, echo, delay, balance, attenuation, and other aspects of sound “externalize a sound based solely on *imagination* as opposed to a manipulation of auditory cues.” EX2011, ¶17.

Third, Bedingfield identifies auditory cues for adjustment that include (and render obvious) those disclosed in the '090 Patent. For example, both discuss volume and attenuation adjustments. EX1001, 12:27-30; EX1005, 3:35-61, 5:35-41. And as discussed below, both disclose ITD. *See* Section VI.B.

V. GROUNDS 2 AND 3: THE BEDINGFIELD-ANDREA COMBINATIONS RENDER CLAIM 18-19 OBVIOUS

PO's challenge to Grounds 2 and 3 rely entirely on its challenge to Ground 1. As discussed in Section IV, these challenges fail.

VI. GROUNDS 4: BEDINGFIELD-BALLAS RENDERS CLAIM 8 OBVIOUS

Again, PO attempts to evade the prior art by injecting limitations that have no basis in the claim.

A. PO's improper injection of "binaural" into claim 8 does not evade Bedingfield-Ballas.

PO complains that "Petitioner fails to recognize Claim 8 is directed at binaural synthesis" and uses "two prior art references that have nothing to do with binaural sound or binaural synthesis." POR 58-59. This argument fails.

First and foremost, the term "binaural" is found nowhere in claim 8. And regardless of whether Bedingfield or Ballas disclose binaural sound or synthesis, both references teach each limitation of the claim. For example, Bedingfield teaches a system that "further enhance[s] the listener's experience [by providing a] communication system [that] may assign each participant a virtual position within a virtual sound field." EX1005, 3:29-32. Notably, "[e]ach participant is heard by the listener in multi-channel audio based on the participant's virtual location in the sound field." EX1005, 3:32-34; *see also* Pet. 22-25, 50-52. Similarly, Ballas teaches "producing virtual sound sources that are externally perceived and positioned at any orientation in azimuth and elevation from a listener." EX1008, Abstract; *see also* Pet. 42-43. Thus, the limitations of claim 8 are plainly met without the injection of a "binaural" limitation. *See also* Section IV.C-D.

Second, even if binaural sound is required, Bedingfield-Ballas discloses this limitation. As discussed in Section IV.C, Bedingfield discloses providing binaural sound. Similarly, Ballas teaches providing binaural sound to the listener.

Kyriakakis Reply, ¶¶51-57. Although the “speakers 110 are attached close to the temple of a user’s head,” Ballas teaches that the “spatialized audio signals are amplified” and the “amplified signals are binaural in nature (i.e., left channels signals are supplied to the left ear and right channel signals are supplied to the right ear[.]” EX1008, ¶25. Indeed, Ballas expressly states “the audio signals generated by the speakers is binaural so that the audio signals from right and left speakers are delivered to right and left ears of the user, respectively.” EX1008, claim 2.

PO argues that Dr. Kyriakakis “is inconsistent regarding Ballas” because Dr. Kyriakakis opined in IPR2023-01005 that Ballas discloses binaural sound and stated at deposition that “Ballas discloses transaural sound.” POR 34. But there is nothing inconsistent about Dr. Kyriakakis’s testimony. Transaural sound is binaural sound processed and delivered through speakers instead of headphones. EX1054, 1; Kyriakakis Reply, ¶52. Thus, Ballas discloses and renders obvious binaural sound.

B. Bedingfield teaches ITD.

The '090 Patent explains ITD is merely the “difference in arrival times between the ears.” EX1001, 3:59-67; FIGS. 13A-D. This difference is highlighted when comparing the difference in arrival times between the ears when a sound source is in front of the listener (FIG. 13A-13B) as opposed to the left of the listener (FIGS. 13C-13D)

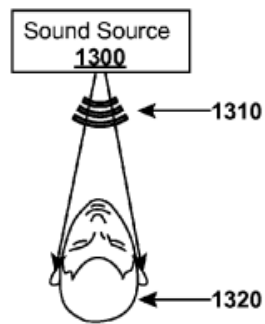


Figure 13A

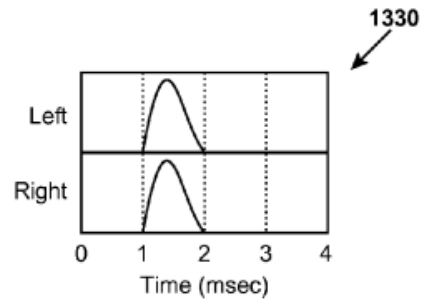


Figure 13B

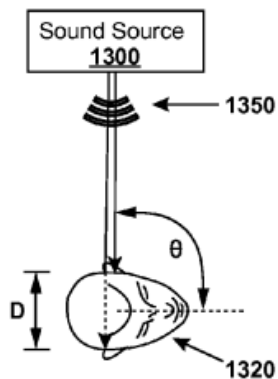


Figure 13C

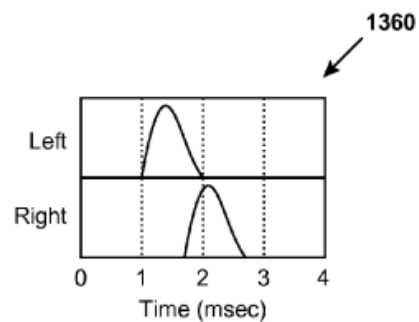


Figure 13D

As the Petition established, Bedingfield describes applying “changes to delay” to enhance the “impression that a sound source has moved” relative to the listener. Pet., 29; EX1005, 3:56-61. Bedingfield further uses “various audio techniques” including “delay” to place the different participants in different “configurations within the sound field.” EX1005, 5:35-41. As Dr. Kyriakakis explained, a POSITA

would have understood “delay” to mean a time delay, which would have been understood to mean ITD. Kyriakakis, ¶147; Pet. 29. Indeed, the '090 Patent also referred to ITD as “interaural time *delay*.” EX1001, 27:57.

PO urges the Board to ignore these disclosures. As to the first disclosure, PO argues that Bedingfield is only discussing placement behind the listener, and “ITD is not useful for such impressions, because ITD is the same for the front and rear position.” POR 18. But this is directly contradicted by PO's admission that the passage “relates to the human ear ‘detect[ing] placement of a speaker’” generally. *Id.* (citing EX1005, 3:35-61). PO also argues that “a PHOSITA would not understand delay, as used by Bedingfield, to teach ITD, when an echo can produce the very sound effect.” POR 19. Setting aside that this is entirely attorney argument (Dr. Begault is not cited nor is any other support), it is nonsensical. Bedingfield expressly identifies various audio techniques that allows “the placement of a sound source [to be] determined,” whether echo or ITD. EX1005, 3:44-45. Notably, PO does not explain what “delay” in this context means if it does not refer to ITD. *See generally* POR 18-19. Rather, PO seems to suggest that a POSITA would simply give “delay” no meaning in this context.

As to the second disclosure, PO argues “‘delay’ here merely means a technique for simulating a room with participants for a listener, thereby creating a ‘perception’ that the listener is among the participants, whereas ITD is typically used

to adjust binaural sound as a function of [the] listener's head orientation." POR 19. This argument is also nonsensical. First, PO once again fails to explain what "delay" means in this context if it does not mean "time delay." Second, the disclosure in Bedingfield mirrors the disclosure in the '090 Patent. The '090 Patent teaches adjusting ITD so that "the first individual can localize the voice of the second individual in a similar manner as if the second individual were proximate to and talking with the first individual (such as both individuals being in a same room together)." EX1001, 9:24-29. There is no meaningful distinction between the disclosures.

C. Ballas does not teach away from the combination.

PO suggests that Ballas teaches away from the combination because it teaches the use of speakers as opposed to headphones. POR 59. But Ballas's speakers do not teach away from the combination. A POSITA designing a spatialized headphone system would have looked at known methods used in spatialized speaker systems, and vice versa. Kyriakakis Reply, ¶¶51-57. Indeed, both the '090 Patent and Dr. Begault discuss localization methods for both, and use of known methods, such as crosstalk cancellation, to adjust filters for headphones to speakers. EX1001, 8:44-50EX1036, 26, 184-87; *see also* EX2016, 256:5-257:2 (Dr. Kyriakakis discussing cross-talk cancellation); EX2026, 4.

Thus, Ballas's use of speakers would not have deterred a POSITA from modifying Bedingfield with Ballas's HRTF filter teachings.

VII. GROUNDS 5-8: THE LI COMBINATIONS RENDER THE CHALLENGED CLAIM OBVIOUS

A. Li discloses an electronic/telephone call

PO argues that “Li does not teach an electronic/telephone call involving a live voice exchange.” POR 61; *see also* POR 21-30. But Li discloses: “[T]he configurable 3D sound system 900 provides a method of communication among multiple people [located remotely from one another], for example, in a conference call, by placing different speaking users at different spots to mimic a real conference room environment.” EX1006, 21:60-22:5; *see also* Pet. 58-59.

PO counters that Li's disclosure of a conference call embodiment is insufficient to teach an electronic/telephone call because Li is limited to recording sound in advance. Incorrect. Li expressly contrasts a person's voice (i.e., from a live exchange) as compared to a pre-recording: “As used herein, the term ‘sound sources’ refers to...a person's voice, pre-recorded multiple sound tracks, pre-recorded stereo sound tracks.” EX1006, 4:48-64; *see also* Pet. 60; Kyriakakis ¶245. Notably, Li explains: “The sound sources may also comprise sources from where sound originates and *can be transmitted*.” EX1006, 4:64-67 (emphasis added). Thus, Li discloses transmitting the sound, not storing the sound.

PO further counters that “Li consistently uses ‘recorded’ or ‘recordings’ to describe recorded sound playing back at a later time—not in real-time.” POR 26. But as both the '090 Patent and Dr. Begault confirm, the plain meaning of “record” covers both live and non-live sounds.⁷ The '090 Patent repeatedly uses the term “record” in the context of telephone calls. For example, the specification describes in one embodiment:

[A] listener sits at his kitchen table and has an *electronic telephone call* with his mother...These electronic devices *record* binaural sound of the speaker and provide binaural sound to the listener.

EX1001, 5:32-36; *see also* 8:8-11 (“John and Paul both wear electronic earpieces that *record* and provide binaural sound. When the *call* initiates, the voice of Paul is localized to his empty chair in John’s apartment.”); 33:42-45 (“The WED 2115 *records* and *transmits* this sound at the head of the second person 2120.”) (emphasis added). Indeed, as Dr. Begault confirmed: “In the context of [the '090 Patent], [‘record’] clearly is talking about a real-time interaction and not talking about

⁷ PO asserts that “Dr. Kyriakakis self-contradicted when he conceded several of Li’s statements containing the word ‘recorded’ do not imply ‘live’ sound.” POR 24. But “recorded” can include live and non-live sound. EX1051, 55:6-19

‘record’ in a sense that sometimes the word ‘record’ is used, to talk about pre-stored sound.” EX1051, 55:6-19; *see also* EX2016, 282:9-22.

PO further relies on IPR2023-1004 to allege Petitioner is precluded from arguing that Li discloses a live exchange. But the Board's finding in IPR2023-1004 pertained to a different limitation. *See* EX2017, 17-24; EX2021, 18-32. Moreover, the Board did not have Dr. Begault's admission that “record” can include live sound.

At bottom, Li teaches the same disclosure reflected in the '090 Patent—recording sound during a call.

B. The Li combinations teach each and every limitation of the challenged claims.

To discuss as a whole and in context the entire system resulting from the combination of Li and Andrea, the Petition established how Li-Andrea would have designated an SLP “away from and proximate to” the listener, adjusted the captured binaural sound, and provided that binaural sound to the listener in its discussion of limitation 1[b]. Pet. 60-63. The Petition then references back to limitation 1[b] for 1[c] and 1[d]. Pet. 63-66. This use of certain cross-references is appropriate, particularly in view of how limitations 1[b], 1[c], and 1[d] relate, and PO's complaints about same does not change the fact that the Petition explained in detail how each limitation, and each claim as a whole, was disclosed and rendered obvious by the Li combinations.

PO alleges that Petitioner “fails to address portions of limitations 1[c] and 1[d] that are worded differently than limitation 1[b]” (POR 61), but PO never identifies any portions that were not addressed (because the Petition addresses all the claim terms).

VIII. CONCLUSION

The Board should find all challenged claims unpatentable.

By: / Lisa K. Nguyen /
Lisa K. Nguyen (Reg. No. 58,018)
PAUL HASTINGS LLP
1117 S. California Avenue
Palo Alto, CA 94304
Telephone: 650-320-1800
lisanguyen@paulhastings.com

Counsel for Petitioner
Meta Platforms, Inc.

CERTIFICATE OF COMPLIANCE WITH 37 C.F.R. § 42.24

I hereby certify that this Reply complies with the word count limitation of 37 C.F.R. § 42.24(c)(1) because the Reply contains a total of 5,579 words, which is the sum calculated by Microsoft Word's word-count feature. This total excludes the cover page, signature block, and the parts of the Reply exempted by 37 C.F.R. § 42.24(c).

By: /Lisa K. Nguyen/
Lisa K. Nguyen (Reg. No. 58,018)
PAUL HASTINGS LLP
1117 S. California Avenue
Palo Alto, CA 94304
Telephone: 650-320-1800
lisanguyen@paulhastings.com

*Counsel for Petitioner
Meta Platforms, Inc.*

CERTIFICATE OF SERVICE

The undersigned certifies that a true and correct copy of **PETITIONER'S REPLY TO PATENT OWNER'S RESPONSE** was served via electronic email on Patent Owner's counsel of record listed below, pursuant to its Mandatory Notices, on July 16, 2023:

Kevin S. Tuttle (Reg. No. 52,307)
Kyle L. Elliott (Reg. No. 39,485)
Homayoon Rafatijo
Spencer Fane LLP
1000 Walnut Street, Suite 1400
Kansas City, MO 64106
ktuttle@spencerfane.com
kelliott@spencerfane.com
hrafatijo@spencerfane.com

Brian G. Strand (Reg. No. 62,442)
Erick S. Robinson (Reg. No. 51,354)
Patrick M. Dunn (Reg. No. 70,474)
Spencer Fane LLP
3040 Post Oak Boulevard, Suite 1300
Houston, TX 77056
bstrand@spencerfane.com
erobinson@spencerfane.com
pdunn@spencerfane.com

By: /Lisa K. Nguyen/
Lisa K. Nguyen (Reg. No. 58,018)
PAUL HASTINGS LLP
1117 S. California Avenue
Palo Alto, CA 94304
Telephone: 650-320-1800

*Counsel for Petitioner
Meta Platforms, Inc.*