

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

META PLATFORMS, INC.,
Petitioner,

v.

EIGHT KHZ, LLC,
Patent Owner.

IPR2023-01005
Patent 9,674,628 B1

Before JUSTIN T. ARBES, LYNNE H. BROWNE, and
SCOTT RAEVSKY, *Administrative Patent Judges*.

ARBES, *Administrative Patent Judge*.

DECISION
Granting Institution of *Inter Partes* Review
35 U.S.C. § 314

I. INTRODUCTION

A. Background and Summary

Petitioner Meta Platforms, Inc. filed a Petition (Paper 1, “Pet.”) requesting *inter partes* review of claims 9–14 and 16–20 of U.S. Patent No. 9,674,628 B1 (Ex. 1001, “the ’628 patent”) pursuant to 35 U.S.C. § 311(a). Patent Owner Eight kHz, LLC filed a Preliminary Response (Paper 6, “Prelim. Resp.”) pursuant to 35 U.S.C. § 313. Pursuant to our

authorization (Ex. 1045), Petitioner filed a Reply (Paper 7, “Reply”) and Patent Owner filed a Sur-Reply (Paper 8, “Sur-Reply”).

Pursuant to 35 U.S.C. § 314(a), the Director may not authorize an *inter partes* review unless the information in the petition and preliminary response “shows that there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition.” *See* 37 C.F.R. § 42.4(a) (“The Board institutes the trial on behalf of the Director.”). For the reasons that follow, we institute an *inter partes* review as to claims 9–14 and 16–20 of the ’628 patent on all grounds of unpatentability asserted in the Petition.

B. Related Matters

The parties indicate that the ’628 patent is the subject of *Eight kHz, LLC v. Meta Platforms, Inc.*, No. 6:22-cv-00575 (W.D. Tex.) (“the district court case”). *See* Pet. 2–3; Paper 4, 2. Petitioner filed petitions challenging patents related to the ’628 patent in Cases IPR2023-01003 and IPR2023-01004, and petitions challenging unrelated patents asserted in the district court case in Cases IPR2023-01019, IPR2023-01020, IPR2023-01021, IPR2023-01022, IPR2023-01023, and IPR2023-01024.

C. The ’628 Patent

The ’628 patent states that electronic devices, such as telephones, “typically provide monophonic or stereophonic sound,” which has “good speech intelligibility” but “is not comparable in quality to sound that the listeners would hear if they were communicating face-to-face with each other.” Ex. 1001, col. 1, ll. 8–16. The ’628 patent discloses an improved “computer system in which two electronic devices communicate with each

other during a telephone call between two people” and “[t]he computer system positions a voice of one person at a sound localization point that is proximate to the other person.” *Id.* at col. 2, ll. 44–48.

In order to determine a location of sound, humans process and compare monaural cues from each ear. This comparison reveals difference cues or binaural cues that enable sound localization. These cues include interaural time differences (ITDs), interaural level differences (ILDs), and head-related transfer functions (HRTFs). Cues thus result from changes to the sound wave from an interaction with the human anatomy. Humans process these changes as impulse responses or head-related impulse responses (HRIRs). Once the HRIRs for an individual are known, the associated or transformed HRTFs can be calculated. The HRIRs and transformed HRTFs enable sound to be convolved such that a location of the sound or sound localization point can be changed. A listener hears the convolved sound as if it had originated from the sound localization point.

Id. at col. 2, l. 55–col. 3, l. 2.

The ’628 patent describes, with reference to Figure 1, a method of “provid[ing] sound that is localized at a sound localization point.” *Id.* at col. 3, ll. 3–4. Step 100 is to “capture sound that will be provided to a listener,” where the “sound can be provided in real-time to a listener, processed and delayed, or stored in memory.” *Id.* at col. 3, ll. 5–11. Step 110 is to “designate a sound localization point at a location in empty space that is away from and proximate to a location of the listener such that the sound localization point simulates an origin of the sound that the listener hears.” *Id.* at col. 3, ll. 35–38. The sound localization point (SLP) can be a three-dimensional or two-dimensional position. *Id.* at col. 3, ll. 48–57. Step 120 is to “adjust the sound so the sound originates from the sound localization point at the location in empty space that is away from and proximate to the location of the listener.” *Id.* at col. 4, ll. 20–23. For

example, the sound can be “processed to alter, add, or generate head-related transfer functions (HRTFs), interaural time differences, and/or interaural level differences to correspond to a fixed or variable distance from the listener, a coordinate location or a GPS location of the sound localization point.” *Id.* at col. 4, ll. 28–33. Lastly, step 130 is to “provide the sound to the listener such that the listener localizes the origin of the sound at the sound localization point in empty space.” *Id.* at col. 4, ll. 34–36. The SLP can be “an empty space” or an occupied space where a physical or virtual object or character exists. *Id.* at col. 4, ll. 37–64.

Similarly, the ’628 patent describes, with reference to Figure 9, a method of “adust[ing] HRTFs of an individual during an electronic call.” *Id.* at col. 21, ll. 34–35. Step 900 is to “execute an electronic call between a first individual and a second individual such that an origin of a voice of the second individual appears to the first individual to originate from a sound localization point that simulates a location in empty space of the second individual.” *Id.* at col. 21, ll. 36–40. Step 910 is to “monitor, during the electronic call, movements of a head location and/or head orientation of the first individual in response to the first individual localizing sounds,” for example, using an electronic device that determines “when the [first individual’s] head turns left or right, turns up or down, or rotates back and forth.” *Id.* at col. 21, ll. 51–59. Lastly, step 920 is to “adjust, during the electronic call, stored [HRTFs] of the first individual to more accurately simulate real HRTFs of the first individual in response to the movements of the head location and/or head orientation of the first individual.” *Id.* at col. 22, ll. 3–7. The HRTFs can be adjusted in real time. *Id.* at col. 22, ll. 12–14.

Figure 17 of the '628 patent is reproduced below.

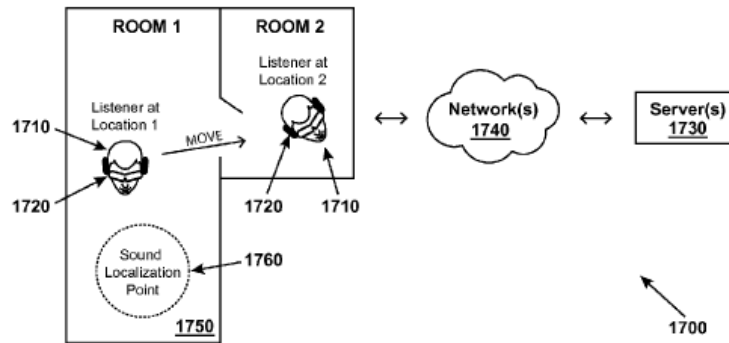


Figure 17

Figure 17 depicts listener 1710 wearing wearable electronic device (WED) 1720 that plays sound, displays corresponding images, and tracks the location and head orientation of the listener. *Id.* at col. 30, ll. 44–47, 55–60, col. 31, ll. 13–19. Sound from WED 1720 initially localizes at SLP 1760 in empty space of room 1. *Id.* at col. 30, ll. 47–52. When the listener moves, SLP 1760 “remains fixed at the location in room 1” and the sound “automatically adjusts to compensate for changes to the head orientation and the location of the listener as the listener moves about rooms 1 and 2.” *Id.* at col. 30, l. 52–col. 31, l. 10. “For example, amplitude and localization cues (e.g., ITD and ILD) change in real-time as the listener 1710 moves from room 1 to room 2.” *Id.* at col. 31, ll. 10–12.

Figure 18 of the '628 patent is reproduced below.

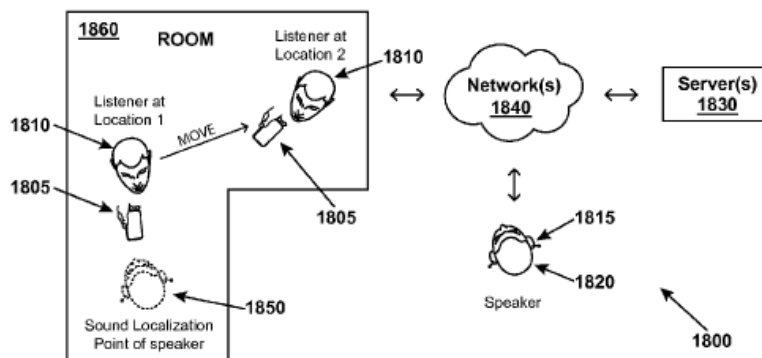


Figure 18

Figure 18 depicts a similar arrangement involving listener 1810 conducting an electronic call with handheld portable electronic device (HPED) 1805 that captures and emits binaural sound and tracks the location and head orientation of the listener. *Id.* at col. 31, ll. 36–48. SLP 1850 “has a size, a shape, and an orientation of a head that emulates a size, a shape, and an orientation of a head of the speaker 1820” such that “[w]hen the speaker 1820 moves his head (such as changing location, yaw, pitch, or roll), then a head of the sound localization point 1850 simultaneously changes to emulate or copy this movement” and “[a] direction or source of the sound from the sound localization point emulates sound from the mouth of the speaker 1820.” *Id.* at col. 31, ll. 49–57. Likewise,

[w]hen the listener 1810 moves his head with respect to the sound localization point 1850 (such as changing location, yaw, pitch, or roll), then adjustments are simultaneously made to the sound of the voice of the speaker to compensate for these movements. These adjustments change the sound so the sound that the listener hears emulates the sound that the listener would hear if the speaker were physically present at the sound localization point 1850. For instance, the listener 1810 continues to hear the voice of the speaker 1820 at the sound localization point as the listener moves from location 1 in the room 1860 to location 2 in the room 1860.

Id. at col. 31, l. 65–col. 32, l. 9.

Finally, the '628 patent discloses an embodiment in which a user speaks with others on a conference call and the system localizes the voice of each user at different SLPs around a table (e.g., at empty spaces or chairs at the table). *Id.* at col. 35, l. 40–col. 36, l. 28, Fig. 23. “Adjustments are made to the sound for each of the[] users since they are located at different locations around the table with respect to the sound localization points” (e.g., adjustments “based on movements to head orientation and location for

each user”). *Id.* at col. 36, ll. 34–47. The ’628 patent also discloses an example in which a user is speaking to four others that “are not people but computer programs with interactive audio input/output interfaces.” *Id.* at col. 36, ll. 48–52. The user “can hear each of his programs running in a different spot on his large desk” and “can move the SLPs of a window/process using, for example, a voice command, a mouse, a head or other body gesture, or other method.” *Id.* at col. 36, l. 63–col. 37, l. 2.

D. Illustrative Claim

Challenged claims 9 and 16 of the ’628 patent are independent. Claims 10–14 depend from claim 9 and claims 17–20 depend from claim 16. Claim 9 recites (with letter designations used in the Petition to refer to the various limitations):

9. [pre] A method executed by one or more electronic devices in an electronic system that improves an experience of a calling party and a called party talking to each other during a telephone call, the method comprising:

[a] processing, during the telephone call and with a processor, a voice of the calling party with head related transfer functions (HRTFs) so the voice of the calling party localizes to the called party as binaural sound at a sound localization point (SLP) that is one meter to two meters away from the called party;

[b] displaying, during the telephone call and to the called party with a wearable electronic device worn on a head of the called party, an image that represents the calling party that is seen by the called party as being at the SLP that is one meter to two meters away from the called party;

[c] tracking, during the telephone call and with the wearable electronic device, head movements of the called party with respect to the image that represents the calling party and that is seen by the called party as being at the SLP; and

[d] changing, during the telephone call and in response to the head movements of the called party, the HRTFs processing the voice of the calling party so the voice of the calling party continues to localize to the SLP that is seen by the called party as being the image that represents the calling party that is one meter to two meters away from the called party while the head of the called party moves with respect to the image that represents the calling party.

E. Evidence

Petitioner relies on the following prior art:

U.S. Patent Application Publication No. 2003/0059070 A1, published Mar. 27, 2003 (Ex. 1008, “Ballas”);

International Patent Application Publication No. WO 2005/032209 A2, published Apr. 7, 2005 (Ex. 1012, “Schröder”);

International Patent Application Publication No. WO 2013/049248 A2, published Apr. 4, 2013 (Ex. 1011, “Haddick”);

Mark Billingham *et al.*, “A Wearable Spatial Conferencing Space,” Digest of Papers, Second International Symposium on Wearable Computers (1998) (Ex. 1010, “Billingham”); and

Zhiying Zhou *et al.*, “An Experimental Study on the Role of Software Synthesized 3D Sound in Augmented Reality Environments,” 16 Interacting with Computers 989 (2004) (Ex. 1018, “Zhou”).

F. Prior Art and Asserted Grounds

Petitioner asserts that claims 9–14 and 16–20 of the ’628 patent are unpatentable on the following grounds:

Claim(s) Challenged	35 U.S.C. §	References/Basis
9–14, 16–20	103	Billinghurst, Schröder
9–14, 16–20	103	Billinghurst, Schröder, Zhou, Haddick
9–14, 16–20	103	Billinghurst, Ballas
9–14, 16–20	103	Billinghurst, Ballas, Zhou, Haddick

II. ANALYSIS

A. Discretionary Denial Under 35 U.S.C. § 314(a)

Institution of *inter partes* review is discretionary. *See Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1367 (Fed. Cir. 2016) (“[T]he PTO is permitted, but never compelled, to institute an [*inter partes* review (IPR)] proceeding.”); 35 U.S.C. § 314(a) (“The Director *may not* authorize an *inter partes* review to be instituted unless the Director determines that the information presented in the petition filed under section 311 and any response filed under section 313 shows that there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition.” (emphasis added)). Patent Owner argues that we should exercise our discretion to deny the Petition in view of the district court case. *See* Prelim. Resp. 43–52; Sur-Reply 1–5. Petitioner disagrees. *See* Pet. 77; Reply 1–4.

The Board has held that the advanced state of a parallel district court action is a factor that may weigh in favor of denying a petition under

§ 314(a). *See NHK Spring Co. v. Intri-Plex Techs., Inc.*, IPR2018-00752, Paper 8 at 20 (PTAB Sept. 12, 2018) (precedential); Patent Trial and Appeal Board Consolidated Trial Practice Guide (Nov. 2019), 58 & n.2, *available at* <https://www.uspto.gov/TrialPracticeGuideConsolidated>. We consider the following factors to assess “whether efficiency, fairness, and the merits support the exercise of authority to deny institution in view of an earlier trial date in the parallel proceeding”:

1. whether the court granted a stay or evidence exists that one may be granted if a proceeding is instituted;
2. proximity of the court’s trial date to the Board’s projected statutory deadline for a final written decision;
3. investment in the parallel proceeding by the court and the parties;
4. overlap between issues raised in the petition and in the parallel proceeding;
5. whether the petitioner and the defendant in the parallel proceeding are the same party; and
6. other circumstances that impact the Board’s exercise of discretion, including the merits.

Apple Inc. v. Fintiv, Inc., IPR2020-00019, Paper 11 at 5–6 (PTAB Mar. 20, 2020) (precedential). We also consider “several clarifications” made by the Director of the United States Patent and Trademark Office (“USPTO”). *See* USPTO Memorandum, Interim Procedure for Discretionary Denials in AIA Post-Grant Proceedings with Parallel District Court Litigation, 2 (June 21, 2022) (“Director’s Memo”), *available at* https://www.uspto.gov/sites/default/files/documents/interim_proc_discretionary_denials_aia_parallel_district_court_litigation_memo_20220621_.pdf.

The Director’s Memo provides that “[c]onsistent with [*Sotera Wireless, Inc. v. Masimo Corp.*, IPR2020-01019, Paper 12 (PTAB Dec. 1,

2020) (precedential as to § II.A) (*Sotera*)], the PTAB will not discretionarily deny institution in view of parallel district court litigation where a petitioner presents a stipulation not to pursue in a parallel proceeding the same grounds or any grounds that could have reasonably been raised before the PTAB.” Director’s Memo 3. With our authorization, Petitioner filed a stipulation which stipulates that

[i]f the PTAB institutes the pending IPR in IPR2023-01005 challenging the patentability of claims 9–14 and 16–20 of the ’628 patent, then [Petitioner, Meta Platforms Technologies, LLC, and Twisted Pixel Games, LLC] will not pursue as to the challenged claims any ground raised or that could have been reasonably raised in the IPR in the above-captioned district court litigation (No. 6:22-cv-00575-ADA).

Reply 1 (quoting Ex. 1046, 4); *see also* Ex. 2013, 2 (Petitioner’s final invalidity contentions, dated October 18, 2023, indicating that Patent Owner is asserting only claims 9, 12, and 16 of the ’628 patent in the district court case); Ex. 2007 (Order Granting Joint Motion to Amend Scheduling Order in the district court case indicating that the deadlines to serve final infringement contentions and to amend pleadings, including to “add[] . . . patent claims,” have expired).

Patent Owner concedes that Petitioner filed a “*Sotera*-like stipulation” but argues that it is insufficient because it “leaves the door open to a duplication of efforts and the possibility of conflicting decisions.”

Sur-Reply 1–2 (citing Ex. 1046, 4 (“This stipulation is not intended . . . to limit [Petitioner’s] ability to assert . . . invalidity under 35 U.S.C. §§ 102 and 103 not available in IPR and under 35 U.S.C. §§ 101 and 112[], regardless of whether IPRs are instituted.”)). Namely, Patent Owner argues that Petitioner’s stipulation carves out the “right to assert overlapping system art in the district court,” such that institution here would not address the risk

of “inconsistent outcomes between the PTAB and the district court.” *Id.* at 2–5.

We disagree with Patent Owner, as Petitioner’s stipulation comports with the “could have reasonably been raised” language of the Director’s Memo. *Compare* Reply 1 (stipulation not to pursue in the district court case “any ground raised or that could have been reasonably raised in” this proceeding), *with* Director’s Memo 3 (“stipulation not to pursue in a parallel proceeding the same grounds or any grounds that could have reasonably been raised before the PTAB”). Patent Owner’s argument essentially attacks the reasoning of *Sotera* itself and the Director’s Memo, which we are bound to follow. Accordingly, Patent Owner’s argument is unavailing.

Patent Owner also urges us not to accept a “late” stipulation. Sur-Reply 5. We disagree that Petitioner’s stipulation is late. It is within our discretion to permit Petitioner to file a stipulation prior to institution. *See NXP USA, Inc. v. Impinj, Inc.*, IPR2021-01556, Paper 13 at 4 (PTAB Sept. 7, 2022) (precedential).

For the above reasons, we decline to exercise our discretion to deny institution under § 314(a).

B. Legal Standards

A claim is unpatentable for obviousness if “the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains.” 35 U.S.C. § 103; *see KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including “the scope and

content of the prior art”; “differences between the prior art and the claims at issue”; and “the level of ordinary skill in the pertinent art.” *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). Additionally, secondary considerations, such as “commercial success, long felt but unsolved needs, failure of others, etc., might be utilized to give light to the circumstances surrounding the origin of the subject matter sought to be patented. As indicia of obviousness or nonobviousness, these inquiries may have relevancy.” *Id.* When conducting an obviousness analysis, we consider a prior art reference “not only for what it expressly teaches, but also for what it fairly suggests.” *Bradium Techs. LLC v. Iancu*, 923 F.3d 1032, 1049 (Fed. Cir. 2019).

A patent claim “is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art.” *KSR*, 550 U.S. at 418. An obviousness determination requires finding “both ‘that a skilled artisan would have been motivated to combine the teachings of the prior art references to achieve the claimed invention, and that the skilled artisan would have had a reasonable expectation of success in doing so.’” *Intelligent Bio-Sys., Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1367–68 (Fed. Cir. 2016); *see KSR*, 550 U.S. at 418 (for an obviousness analysis, “it can be important to identify a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does”).

“Although the *KSR* test is flexible, the Board ‘must still be careful not to allow hindsight reconstruction of references . . . without any explanation as to *how* or *why* the references would be combined to produce the claimed invention.’” *TriVascular, Inc. v. Samuels*, 812 F.3d 1056, 1066 (Fed. Cir. 2016). Further, an assertion of obviousness “cannot be sustained by mere

conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.” *KSR*, 550 U.S. at 418 (quoting *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006)); accord *In re NuVasive, Inc.*, 842 F.3d 1376, 1383 (Fed. Cir. 2016) (stating that “conclusory statements” amount to an “insufficient articulation[] of motivation to combine”; “instead, the finding must be supported by a ‘reasoned explanation’”); *In re Magnum Oil Tools Int’l, Ltd.*, 829 F.3d 1364, 1380 (Fed. Cir. 2016) (“To satisfy its burden of proving obviousness, a petitioner cannot employ mere conclusory statements. The petitioner must instead articulate specific reasoning, based on evidence of record, to support the legal conclusion of obviousness.”).

C. Level of Ordinary Skill in the Art

Petitioner argues that at the time of the ’628 patent (June 2014), a person of ordinary skill in the art would have had “at least a bachelor’s degree in computer science or engineering with a focus on audio signal processing and sound localization, with at least two years of relevant experience,” where “[a]dditional experience could substitute for less education, and additional education could likewise substitute for less experience.” Pet. 19 (citing Ex. 1003 ¶¶ 32–34). Patent Owner applies Petitioner’s definition of the level of ordinary skill in the art for purposes of its Preliminary Response. Prelim. Resp. 5. Based on the record presented, including our review of the ’628 patent and the types of problems and solutions described in the ’628 patent and cited prior art, we agree with Petitioner’s proposed definition of the level of ordinary skill in the art and apply it for purposes of this Decision, except that we remove the term

“at least” to eliminate vagueness as to the amount of education and practical experience.

D. Claim Interpretation

We interpret each challenged claim

using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. 282(b), including construing the claim in accordance with the ordinary and customary meaning of such claim as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent.

37 C.F.R. § 42.100(b). Petitioner does not propose express interpretations of any claim terms and states that “[t]he prior art relied on in this Petition discloses the subject matter of the challenged claims under any reasonable construction, including their plain meaning.” Pet. 19. Petitioner also notes that Patent Owner argued in the district court case that the term “non-transitory computer readable storage medium” in the preamble of claim 16 is not a means-plus-function limitation under 35 U.S.C. § 112(f). *Id.* (citing Ex. 1027, 24–38). Petitioner states that it adopts Patent Owner’s district court construction “[s]olely for this IPR.” *Id.* at 19–20. Patent Owner likewise does not propose express interpretations of any claim terms, but disputes Petitioner’s statement regarding “any reasonable construction,” arguing that it “harkens back to the broadest reasonable interpretation standard” previously used by the Board. Prelim. Resp. 5–6. We do not understand Petitioner to have applied that standard, however, given that Petitioner never used the term “broadest.” *See* Pet. 19. We apply the claim interpretation standard set forth in 37 C.F.R. § 42.100(b) and conclude that no express interpretation of any claim term is necessary to determine

whether to institute an *inter partes* review in this proceeding. *See Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (“Because we need only construe terms ‘that are in controversy, and *only to the extent necessary* to resolve the controversy,’ we need not construe [a particular claim limitation] where the construction is not ‘material to the . . . dispute.’” (citation omitted) (emphasis added)).

E. Obviousness Ground Based on Billinghamhurst and Schröder (Claims 9–14 and 16–20)

Petitioner contends that claims 9–14 and 16–20 are unpatentable over Billinghamhurst and Schröder under 35 U.S.C. § 103, citing the testimony of Chris Kyriakakis, Ph.D., as support. Pet. 20–64 (citing Ex. 1003). Patent Owner responds, citing the testimony of Durand R. Begault, Ph.D., as support. Prelim. Resp. 9–32 (citing Ex. 2001). We are persuaded that Petitioner has established a reasonable likelihood of prevailing on its asserted ground as to independent claims 9 and 16.

1. Billinghamhurst

Billinghamhurst is an article titled “A Wearable Spatial Conferencing Space.” Ex. 1010, 2.¹ Billinghamhurst discloses a “wearable augmented reality communication space with audio enabled avatars of . . . remote collaborators surrounding [a] user,” where “[t]he user can use natural head motions to attend to the remote collaborators, can communicate freely while being

¹ When referencing pages of Billinghamhurst, we refer to the page numbers added by Petitioner in the bottom-right corner of the reference. We note that certain citations to Billinghamhurst in the Petition appear to be incorrect by one page (likely due to the inclusion of the cover page labeled as page 1).

aware of other side conversations and can move through the communication space.” *Id.* Billinghurst discloses presenting information in a number of ways using “wearable computers [having] see-through or see-around monoscopic head mounted displays with stereo headphones,” including the following:

Body-stabilized - information is fixed relative to the user[']s body position and varies as the user changes viewpoint orientation, but not as they change position. This requires the user[']s viewpoint orientation to be tracked.

World-stabilized - information is fixed to real world locations and varies as the user changes viewpoint orientation and position. This requires the user[']s viewpoint position and orientation to be tracked.

Id. at 4.

Billinghurst describes a prototype device comprising a “wearable computer” that is “a custom built 586 PC 104 based computer with 20mb of RAM running Windows 95”; display that is “a pair of Virtual i-O iglasses! converted into a monoscopic display by the removal of the left eyepiece” with a “26-degree field of view” and “a sourceless two-axis inclinometer and a magnetometer used as a three degree of freedom orientation tracker”; “soundBlaster compatible sound board with headmounted microphone”; and “hand held Logitech wireless radio trackball with three buttons” used as an input device. *Id.* at 5–6.

Figure 3.0 of Billinghamurst is reproduced below.



Figure 3.0 depicts the wearable computer, display, headphones and microphone, and handheld trackball. *Id.*

Billinghamurst's device provides a body-stabilized display with "one degree of orientation to give the user the impression they are surrounded by a virtual cylinder of visual and auditory information." *Id.* at 4. Figure 1.0b of Billinghamurst is reproduced below.



Figure 1.0b depicts the body-stabilized display with one degree of freedom. *Id.* "When using a head mounted display to navigate a cylindrical

body-stabilized space, only the portion of the information space in [the user's] field of view can be seen.” *Id.* The rest of the space can be viewed by “tracking the user’s head orientation as they look around the space” using “a simple one degree of freedom tracker.” *Id.* at 4–5. Billingham discloses:

With this display configuration a wearable conferencing space could be created that allows remote collaborators [to] appear as virtual avatars distributed about the user (figure 2.0). The avatars could be live video streams and as they speak their audio streams spatialized in real time so that they appear to emit from the corresponding avatar.

Just as in face-to-face collaboration, users could turn to face the collaborators they wanted to talk to while still being aware of the other conversations taking place. The user could also move about the space enabling them to choose their own viewpoint and the spatial relationships between the collaborators.

Id. at 5.

Figure 2.0 of Billingham is reproduced below.

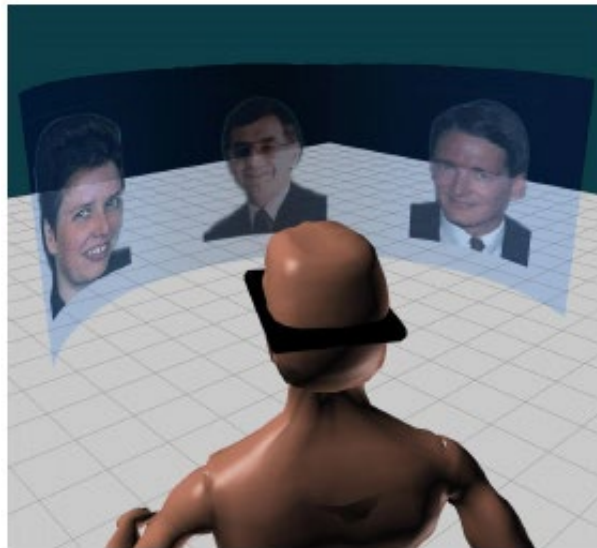


Figure 2.0 depicts the spatial conferencing space where the user is speaking with three other individuals. *Id.* The particular interface presented to the user in Billingham shows virtual images of other individuals in the

conference “superimposed on the real world.” *Id.* at 6, Fig. 4.0. “The wearable user has their head tracked so they can simply turn to face the speakers they are interested in. Users can also navigate through the space; by rolling the trackball forwards or backwards their viewpoint is moved forwards or backwards along the direction they are looking.” *Id.*

Billinghurst further discloses:

The wearable interface also supports 3D spatialized Internet telephony. When users connect to the conferencing space their audio is broadcast to all the other users in the space. This is spatialized according to the distance and direction between speaker and listener. As users face or move closer to different speakers the speaker volume changes due to the sound spatialisation. Since the speakers are constrained to remain in the same plane as the listener the audio spatialisation is considerably simplified. Audio culling is also used so that only the audio streams from the speakers closest to the listener are broadcast and spatialized. This significantly reduces the CPU load. The conferencing space uses custom developed telephony libraries that incorporate the Microsoft Direct Sound libraries.

Id. Audio from the individuals in the conference is “digitized and broadcast” to the group and “spatialized in real time . . . utilizing Microsoft’s Direct Sound technology.” *Id.* at 7.

2. Schröder

Schröder discloses a system for the “binaural reproduction of aural events using headphones,” in particular “headphones which detect the rotational movements of the head and are used to keep the position of a virtual sound source outside the head constant.” Ex. 1012, pg. 1, ll. 5–10.

Figures 7 and 8 of Schröder are reproduced below.

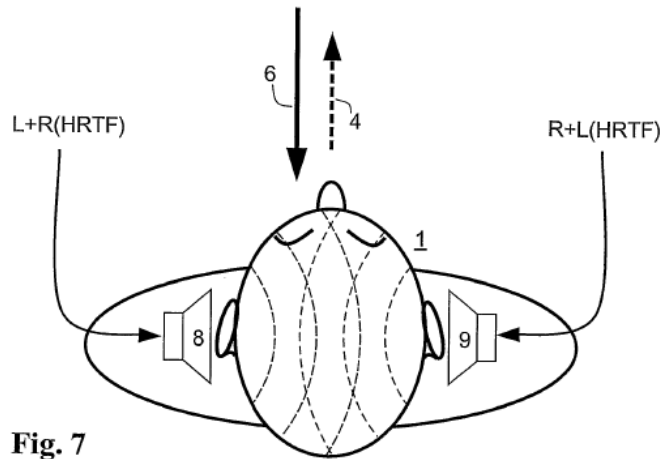


Fig. 7

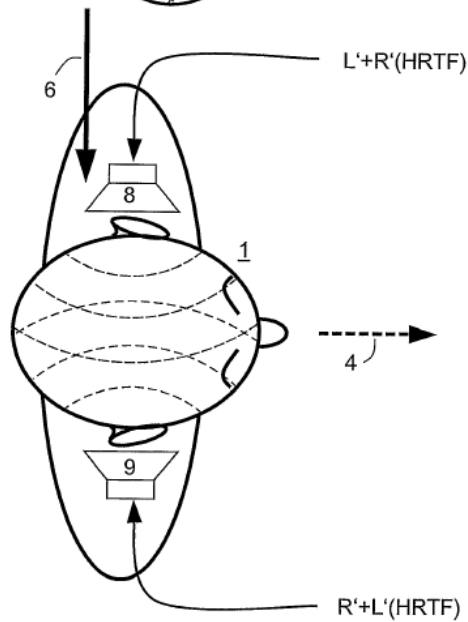


Fig. 8

Figures 7 and 8 depict listener 1 with headphones 8 and 9 outputting sound to the left and right ears, respectively. *Id.* at pg. 4, ll. 12–25. Figure 7 depicts an “initial situation” with signals $L+R(\text{HRTF})$ and $R+L(\text{HRTF})$ produced by applying a HRTF to original signals L and R so that “[t]he listener perceives the sound event as coming from outside the head.” *Id.* at pg. 3, ll. 6–19, pg. 4, ll. 18–19. “In Figure 8, the listener has changed his position” and “[t]he associated change in the signals for the left and right ears is illustrated by the signals $L', L'(\text{HRTF})$, $R', R'(\text{HRTF})$. Despite the

coincidentally moving loudspeakers 8, 9, the aural event is perceived as coming from the original direction 6.” *Id.* at pg. 4, ll. 19–25.

Schröder states that “[w]hen the listener is moving himself, such as when jogging, the aural event remains virtually still in space whenever there is a change of direction. If the listener now changes direction, then the virtual direction from which the listener hears the aural event also changes.” *Id.* at pg. 4, ll. 27–34. Schröder discloses that it would be desirable to implement a method “to perceive aural events as having a constant spatial direction on average, i.e. as coming from one preferred direction on average in virtually stationary fashion, even when the listener is moving, without restricting the ability to locate individual sound sources in the aural event.” *Id.* at pg. 5, ll. 4–10. Therefore, in Schröder’s disclosed system,

changes in the position of the listener or of his head which are for a limited time or are relatively frequent are detected and a control variable is derived therefrom. Normally, the head points in one preferred direction when listening to aural events, normally forwards in the direction of the front of the trunk. A change in the position of the listener which is for a limited time or is relatively frequent is when the listener turns his head, for example. The signals for the left and right ears are adjusted, on the basis of the position of the listener or of his head, using variable filters for the HRT function such that the direction from which the aural event appears to come remains stable in space, that is to say has a constant spatial direction. A change in the position of the listener which is for a longer time or is relatively infrequent results in the direction from which the aural event appears to come being matched to the new preferred direction.

Id. at pg. 5, l. 21–pg. 6, l. 3.

3. *Whether Petitioner Has Established a Reasonable Likelihood that Billinghurst is a Prior Art Printed Publication*

As an initial matter, we must determine whether Petitioner has shown sufficiently for institution that Billinghurst is a prior art printed publication under 35 U.S.C. § 102(a)(1).

The determination of whether a document is a “printed publication” under 35 U.S.C. § 102 “involves a case-by-case inquiry into the facts and circumstances surrounding the reference’s disclosure to members of the public.” *In re Klopfenstein*, 380 F.3d 1345, 1350 (Fed. Cir. 2004).

“Because there are many ways in which a reference may be disseminated to the interested public, ‘public accessibility’ has been called the touchstone in determining whether a reference constitutes a ‘printed publication’ bar under 35 U.S.C. § 102(b).” *Blue Calypso, LLC v. Groupon, Inc.*, 815 F.3d 1331, 1348 (Fed. Cir. 2016) (citing *In re Hall*, 781 F.2d 897, 898–899 (Fed. Cir. 1986)). “A reference will be considered publicly accessible if it was ‘disseminated or otherwise made available to the extent that persons interested and ordinarily skilled in the subject matter or art exercising reasonable diligence, can locate it.’” *Id.* (citing *Kyocera Wireless Corp. v. ITC*, 545 F.3d 1340, 1350 (Fed. Cir. 2008)). “When a reference is uploaded to a website or deposited in a library, the fact that the reference is indexed or cataloged in some way can indicate that it is publicly accessible.” *Samsung Elecs. Co. v. Infobridge Pte. Ltd.*, 929 F.3d 1363, 1369 (Fed. Cir. 2019); *Voter Verified, Inc. v. Premier Election Solutions, Inc.*, 698 F.3d 1374, 1380 (Fed. Cir. 2012) (“indexing is a relevant factor in determining accessibility of potential prior art, particularly library-based references”); *Hall*, 781 F.2d at 899–900 (Fed. Cir. 1986) (holding that a thesis indexed in a university library catalog was a prior art printed publication based on affidavits

explaining the “library’s general practice for indexing, cataloging, and shelving theses”). The U.S. Court of Appeals for the Federal Circuit has “interpreted § 102 broadly, finding that even relatively obscure documents qualify as prior art so long as the relevant public has a means of accessing them.” *GoPro, Inc. v. Contour IP Holding LLC*, 908 F.3d 690, 693 (Fed. Cir. 2018).

“[A]t the institution stage, the petition must identify, with particularity, evidence sufficient to establish a reasonable likelihood that the reference was publicly accessible before the critical date of the challenged patent and therefore that there is a reasonable likelihood that it qualifies as a printed publication.” *Hulu, LLC v. Sound View Innovations, LLC*, IPR2018-01039, Paper 29 at 13, 21 (PTAB Dec. 20, 2019) (precedential) (“*Hulu*”). The reasonable likelihood standard is “a higher standard than mere notice pleading,” but “lower than the ‘preponderance’ standard to prevail in a final written decision.” *Id.* at 13.

Petitioner argues that Billinghamhurst is a prior art printed publication under 35 U.S.C. § 102(a)(1), citing as support the testimony of Ingrid Hsieh-Yee, Ph.D. Pet. 5 n.1 (citing Ex. 1019 ¶¶ 1–46). Dr. Hsieh-Yee, a Professor Emerita in the Department of Library and Information Science of the Catholic University of America who holds a Ph.D. in Library and Information Studies, opines that Billinghamhurst “was publicly accessible as early as November 1998 and no later than April 1999.” Ex. 1019 ¶¶ 4, 46. Dr. Hsieh-Yee explains four bases in which Billinghamhurst allegedly was publicly accessible—the reference was (1) cataloged in the Linda Hall Library (*id.* ¶¶ 23–34); (2) cataloged in the Library of Congress (*id.* ¶¶ 37–44); (3) published in a set of conference proceedings, as evidenced by its copyright registration (*id.* ¶¶ 35–36); and (4) included in the IEEE Xplore

Digital Library (*id.* ¶¶ 20–22). *See id.* ¶ 46. For purposes of this Decision, we conclude that the evidence pertaining to Billinghamhurst’s alleged public accessibility through the two libraries is sufficient for Petitioner to meet the reasonable likelihood standard, and thus need not address at this time the evidence pertaining to the other two bases.

With respect to the Linda Hall Library, Dr. Hsieh-Yee testifies that she received a scanned version of the print copy of Billinghamhurst held at the library (attached as Appendix 1010B to the declaration).² *Id.* ¶ 23. The copyright page of the full conference proceedings includes a hand-written call number and, other than an IEEE notation and page numbers in the bottom margin, the provided copy of the Billinghamhurst article is identical to Exhibit 1010. *Id.* ¶¶ 25–26. Dr. Hsieh-Yee also provides Linda Hall Library bibliographic and MACHine Readable Cataloging (MARC) records (Appendix 1010C) for Billinghamhurst showing that it is available at the library via its call number and indexed by, for example, title and subjects (“Portable computers” and “Mobile computing”). *Id.* ¶¶ 28–29. She also explains why the dates listed in those records demonstrate that “the Linda Hall Library cataloged the conference proceedings containing Billinghamhurst as a book on November 5, 1998, making [it] discoverable in their online catalog from that

² Dr. Hsieh-Yee’s declaration includes a number of attached appendices that are not internally labeled, as Patent Owner points out. *See* Prelim. Resp. 13–15. Rather, the PDF file submitted as Exhibit 1019 includes bookmarks identifying each appendix. For example, page 80 of the PDF file is bookmarked “App 1010A – Billinghamhurst IEEE Metadata-1205,” corresponding to Appendix 1010A. To ensure a clear record, Petitioner shall file a substitute copy of Exhibit 1019 adding a label page for each appendix. In future filings, however, the parties should file documents as separately numbered exhibits, rather than as attachments to another exhibit. *See* 37 C.F.R. § 42.63.

date on, and the copy of the conference proceedings would have become publicly accessible no later than November 12, 1998.” *Id.* ¶¶ 25, 30–34 (noting, for example, a “hand-written notation” on the copy itself and the date when the MARC record was created) (emphasis omitted).

Similarly, with respect to the Library of Congress, Dr. Hsieh-Yee testifies that she received a scanned copy of Billinghamurst “from the Library of Congress through Wisconsin TechSearch (WTS), a document delivery service based at the University of Wisconsin-Madison” (Appendix 1010E). *Id.* ¶ 37. The front cover of the full conference proceedings includes a printed call number, the copyright page includes a hand-written call number and Library of Congress stamp dated October 30, 1998, and, again, other than the IEEE notation and page numbers in the bottom margin, the provided copy of the Billinghamurst article is identical to Exhibit 1010. *Id.* ¶¶ 38–39. Dr. Hsieh-Yee provides Library of Congress bibliographic and MARC records (Appendix 1010F) for Billinghamurst showing that it is available via the call number and indexed by title, subjects, etc., and testifies that based on the dates listed in those records, the Library of Congress’s copy “would have become publicly accessible as early as February 1999 and no later than April 1999 at the Library of Congress.” *Id.* ¶¶ 40–44 (noting, for example, the date when the MARC record was created and dates when the copy was sent to units within the library).

Regarding both copies of Billinghamurst, Dr. Hsieh-Yee testifies that “[i]nterested users would have been able to conduct subject searches by the [Library of Congress Classification (LCC)] number and the Library of Congress subject headings to discover” the reference, and “[t]hey would also have been able to discover [it] by the Library of Congress control number,

[International Standard Book Number (ISBN)], IEEE order numbers, conference name, title, and sponsors.” *Id.* ¶¶ 34, 44.

Patent Owner makes a number of arguments in its Preliminary Response. First, Patent Owner argues that Petitioner improperly incorporates Dr. Hsieh-Yee’s declaration by reference. Prelim. Resp. 10. Petitioner, however, identifies the statutory provision, 35 U.S.C. § 102(a)(1), under which Billingham is a prior art printed publication, and cites particular paragraphs of the declaration as supporting that contention, such that Patent Owner was able to address the substance of the allegedly supporting evidence in its Preliminary Response. *See* Pet. 5 n.1.

Second, Patent Owner contends that Dr. Hsieh-Yee’s testimony regarding authentication of Exhibit 1010 “call[s] into question the reliability of her opinions as a whole.” Prelim. Resp. 12. Specifically, Dr. Hsieh-Yee states that she followed a particular link to purchase Billingham from IEEE and “[t]he IEEE copy is presented as Ex. 1010.” Ex. 1019 ¶ 18 (misabeled as paragraph 72). Patent Owner correctly points out that Exhibit 1010 instead has a cover page stating “[d]ownloaded from Academia.edu.” *See* Prelim. Resp. 12; Ex. 1010, 1. The Billingham article in Exhibit 1010, though, appears to be identical to the physical copies obtained from the two libraries (except for the IEEE notation and page numbers in the bottom margin). *Compare* Ex. 1010, 2–9, with Ex. 1019, Appendices 1010B, 1010E. Given the other evidence in the record, we do not see reason to discount Dr. Hsieh-Yee’s testimony based solely on the apparent discrepancy with the cover page used for Exhibit 1010.³

³ To the extent Patent Owner challenges the *admissibility* of Exhibit 1010 (as opposed to the *sufficiency of proof* that Billingham is a prior art printed publication under 35 U.S.C. § 102(a)(1)), we note that it may raise such a

Third, Patent Owner argues that although Dr. Hsieh-Yee’s background may qualify her to “opine on library indexing, cataloging, and shelving practices in general, she does not purport to have any personal knowledge of the actual appearance of Billinghurst . . . on the shelves of any library.” Prelim. Resp. 11–12, 14–15. Dr. Hsieh-Yee, however, testifies that she personally obtained copies from the libraries themselves, and the call numbers written on those copies match the supporting electronic records. *See* Ex. 1019 ¶¶ 23, 37. She also explains in detail how those electronic records are created and how they indicate whether and when a work is cataloged and made accessible to the public at a library. *See id.* ¶¶ 10–17, 28–34, 40–44. And, importantly, Dr. Hsieh-Yee testifies as to how a person of ordinary skill in the art would have been able to search for and locate Billinghurst at the libraries (e.g., by title of the article, title of the conference proceedings, or subject). *See id.* ¶¶ 34, 44. We are persuaded that Dr. Hsieh-Yee’s testimony and supporting evidence are sufficient at this stage.

Based on the totality of the evidence currently in the record, Petitioner has established a reasonable likelihood that Billinghurst is a prior art printed publication under 35 U.S.C. § 102(a)(1).

4. *Claim 9*

Petitioner argues that Billinghurst and Schröder collectively teach the limitations of claim 9, with Billinghurst teaching all of the limitations “except the explicit use of HRTFs for localization.” Pet. 13–14, 20–48.

challenge during trial. *See* 37 C.F.R. § 42.64 (setting forth the procedures for objecting to the admissibility of evidence and filing a motion to exclude).

With respect to the preamble of claim 9,⁴ Petitioner argues that Billinghurst teaches a method executed by “one or more electronic devices” (i.e., the wearable hardware comprising a wearable computer, Virtual i-O iglasses! with inclinometer and magnetometer, and soundboard with microphone) in an “electronic system” (i.e., the videoconferencing system) that improves the experience of a “calling party” (i.e., one of the remote collaborators) and “called party” (i.e., the user of the wearable hardware) during a “telephone call” (i.e., the videoconference between the user and remote collaborators). *Id.* at 24–29.

Limitation 9[a] recites:

processing, during the telephone call and with a processor, a voice of the calling party with head related transfer functions (HRTFs) so the voice of the calling party localizes to the called party as binaural sound at a sound localization point (SLP) that is one meter to two meters away from the called party.

Petitioner argues that a person of ordinary skill in the art would have understood that the voice of a remote collaborator is provided as binaural sound localized at a SLP corresponding to avatar position, citing, for example, Billinghurst’s disclosure that users determine the “position and orientation” of their avatars and that audio is “spatialized according to the distance and direction between speaker and listener.” *Id.* at 29–31 (quoting Ex. 1010, 6). According to Petitioner, an ordinarily skilled artisan also would have understood that Billinghurst’s wearable computer has a “processor” (i.e., a CPU) that processes the audio streams and “would have

⁴ We need not resolve whether the preamble of claim 9 is limiting at this stage because, regardless of whether the preamble is limiting, Petitioner shows sufficiently for purposes of institution that Billinghurst satisfies the recitation in the preamble.

known to use HRTFs to position sound sources in 3D space,” given Billingham’s use of Microsoft Direct Sound technology. *Id.* at 32–34. And Petitioner asserts that, based on Figure 2.0 of Billingham and “as was common in videoconferencing,” the avatars of the remote collaborators would appear one to two meters away from the user of the wearable hardware. *Id.* at 36–37 (citing Exs. 1010, 1028, 1029, 1030).

In addition, Petitioner contends that, “to the extent that Billingham does not explicitly disclose that the voice is processed *with head related transfer functions (HRTFs)* to localize at [a] SLP,” doing so would have been obvious based on Schröder. *Id.* at 34. Petitioner points to Schröder’s description of applying HRTFs to signals L and R so that the sound localizes from a particular direction outside the listener’s head. *Id.* at 34–36. According to Petitioner, “[a]lthough Billingham does not detail the spatialization techniques used to localize the audio stream of the remote collaborators to their respective avatars, a [person of ordinary skill in the art] would have known to look for such details in known HRTF techniques such as those taught by Schröder.” *Id.* at 20–21. Petitioner argues, for example, that Billingham and Schröder share the same spatialization goals and using Schröder’s HRTF processing would have resulted in “a more realistic virtual experience” for the listener. *Id.* at 21–22, 36 (citing Ex. 1003 ¶¶ 102–106, 137). Petitioner also provides reasons why an ordinarily skilled artisan would have had a reasonable expectation of success in making the combination. *Id.* at 23–24 (citing Ex. 1003 ¶¶ 107–111).

Patent Owner makes two arguments in response. First, Patent Owner contends that Petitioner does not show sufficiently that Billingham teaches a SLP that is “one meter to two meters away from the called party,” as recited in limitation 9[a]. Prelim. Resp. 26–28. Patent Owner argues that

Billinghurst does not describe the perceived distance between the avatar and wearer, and the other evidence cited by Petitioner and Dr. Kyriakakis does not relate to Billinghurst's system, as it pertains to "audio conferencing" (Ex. 1028), "a different prototype videoconferencing system" (Ex. 1029), or general "human interaction research" (Ex. 1030). Prelim. Resp. 27–28 (emphasis omitted).

We disagree based on the current record. Although Patent Owner is correct that Billinghurst does not expressly disclose at what distance the avatars appear, Figure 2.0 shows the images relatively close to the face of the wearer. *See* Ex. 1010, 5. Billinghurst also states that "remote collaborators appear as virtual avatars distributed about the user," the spatial conferencing space is designed to mimic "face-to-face collaboration," and "the faces of remote users [can] appear life-size, a crucial factor for establishing equal relationships in remote collaboration." *Id.*

Petitioner's position is that a person of ordinary skill in the art "would have readily appreciated" that the avatars would appear (and have sound localized to) one to two meters away "because, as was common in videoconferencing, the avatars appear at typical communication distances." Pet. 36–37. Evidence in the record shows what a person of ordinary skill in the art would have understood to be a "typical" distance for face-to-face communication, such as in a videoconference system, at the time. *See, e.g.,* Ex. 1028, 797 (stating that "[f]or natural one-to-one conversation the typical distance is the *personal* distance around one meter," but "it seems that there is often an *optimal* interpersonal distance for communication" of 1–1.7 meters); Ex. 1030, 9 (citing a study finding an optimal "[p]ersonal distance" of 0.5–1.25 meters for "[c]onversation between friends" and "[s]ocial

distance” of 1.25–3.5 meters for “[i]mpersonal business dealings”). Dr. Kyriakakis explains the supporting evidence cited in Exhibits 1028–1030 and testifies that based on that evidence, “it was known for the optimal distance in one-to-one conversation, and therefore for the perceived life-like display of a participant in a one-on-one video conversation, to be one to two meters.” Ex. 1003 ¶¶ 138–143; *see Randall Mfg. v. Rea*, 733 F.3d 1355, 1362 (Fed. Cir. 2013) (“[T]he knowledge of [an ordinarily skilled] artisan is part of the store of public knowledge that must be consulted when considering whether a claimed invention would have been obvious.”); *Dow Jones & Co. v. Abblaise Ltd.*, 606 F.3d 1338, 1349 (Fed. Cir. 2010) (“[The obviousness] analysis requires an assessment of the . . . ‘background knowledge possessed by a person having ordinary skill in the art.’” (citing *KSR*, 550 U.S. at 401)). Petitioner has made a sufficient showing as to the distance requirement of limitation 9[a] at this stage.

Second, Patent Owner argues that Billinghamhurst does not expressly teach the use of HRTFs and a person of ordinary skill in the art would not have been motivated to combine the references’ teachings because “Schröder’s solution was incompatible with and would not have improved Billinghamhurst’s system.” Prelim. Resp. 19–27 (citing Ex. 2001 ¶¶ 10, 17–25, 28–31). Patent Owner contends that

Schröder’s system did not *consistently adjust* the perceived direction of a sound based on head movement—instead it “averaged” the perceived direction of the sound and periodically reset it to a new preferred direction based on the user’s movements. This is contrary to the location of dynamically changing sounds in a virtual world, where such arbitrary changes in preferred direction cannot be made without destroying the immersive experience. A [person of ordinary skill in the art] therefore would have understood the goal of Schröder’s system as distinct from the simulation of dynamically-changing virtual

sound sources in three-dimensional space and not relevant or related to Billinghamhurst's system, and thus would not have been motivated to combine Billinghamhurst with Schröder.

Id. at 25 (emphasis added) (citations omitted); *see also id.* at 22–23 (arguing that Schröder's method “runs counter to the claimed behavior of the '628 [p]atent, which is to *consistently* change the HRTFs in response to *any* head movements” (emphasis added)). Patent Owner further argues that Schröder performs “cross-talk filtering” in an “unusual way” that “is not necessary or sensible for the simulation of virtual sounds at [SLPs] in the '628 [p]atent.” *Id.* at 23. According to Patent Owner, an ordinarily skilled artisan would not have considered Schröder as a reference at all, given the differences in how its system operates. *Id.* at 25–26.

We disagree based on the current record. Schröder “must be considered for everything that it teaches, not simply the . . . preferred embodiment” that involves only adjusting the HRTFs to maintain the sound's direction when there are small, relatively frequent movements and performing cross-talk filtering in a particular way. *In re Applied Materials, Inc.*, 692 F.3d 1289, 1298 (Fed. Cir. 2012); *In re Mouttet*, 686 F.3d 1322, 1331 (Fed. Cir. 2012) (“A reference may be read for all that it teaches, including uses beyond its primary purpose.”). Petitioner's position is that (1) Billinghamhurst teaches spatializing sound for the avatar of a remote collaborator shown on the display, as well as changing the spatialized sound in response to the wearer's head movements, but does not explicitly describe how it does so, and, therefore, (2) a person of ordinary skill in the art would have looked to a reference like Schröder for details. *See* Pet. 21–22, 24, 34–36, 45–48. Petitioner relies on Schröder solely for its teachings regarding HRTF processing, not, for example, its description of a particular

way of cross-talk filtering. *See id.* Patent Owner does not dispute that Schröder processes voice using HRTFs and adjusts HRTFs in response to head movements to maintain direction *some of the time* (i.e., when there are small, relatively frequent movements); Schröder simply takes a different action in certain other circumstances (i.e., it resets the direction when there is a larger, relatively less frequent movement). *See* Ex. 1012, pg. 4, l. 12–pg. 6, l. 3; *Unwired Planet, LLC v. Google Inc.*, 841 F.3d 995, 1002 (Fed. Cir. 2016) (“combinations of prior art that sometimes meet the claim elements are sufficient to show obviousness”).

We also note that Patent Owner does not point to any specific language in claim 9—and we do not find any—requiring the HRTFs to be “consistently” changed in response to every head movement. *See* Prelim. Resp. 22–25. Rather, limitations 9[c] and 9[d] recite a single “tracking . . . head movements” step and a single “changing” the HRTFs “in response to the head movements” step.⁵

For similar reasons, we disagree on this record with Patent Owner’s arguments that a person of ordinary skill in the art would not have been motivated to combine the references because Billingham’s technical limitations make it incapable of “meaningful spatial audio rendering” in three dimensions and “Schröder does not consider the use of sound source elevation, and thus does not improve on Billingham’s own lack of elevation

⁵ By contrast, claims 2 and 3, which depend from unchallenged claim 1, recite that “the HRTFs change *in real-time* during the telephone call as the wearer moves from the room to . . . another room so the voice of the caller remains fixed at the SLP that is located in empty space at the image that represents the caller” and “the image that represents the caller moves *in real-time* with movements of the caller during the telephone call” (emphasis added).

cues,” as techniques for positioning “on a constant plane (e.g., amplitude panning) are different than those required to support dynamically-changing virtual images in a three-dimensional world.” Prelim. Resp. 19–21, 24–25 (citing Ex. 2001 ¶¶ 20–21, 28–29). Claim 9 does not appear to require considering elevation or consistently changing 3D images, just the steps of “processing” a voice with HRTFs to localize at a SLP, “displaying . . . an image,” “tracking . . . head movements,” and “changing” the HRTFs “in response to the head movements.” Indeed, the Specification of the ’628 patent discloses that a SLP can exist at either a “three-dimensional (3D position)” or “two-dimensional (2D) position.” Ex. 1001, col. 3, ll. 48–57, col. 9, ll. 53–57.

Next, limitation 9[b] recites:

displaying, during the telephone call and to the called party with a wearable electronic device worn on a head of the called party, an image that represents the calling party that is seen by the called party as being at the SLP that is one meter to two meters away from the called party.

Petitioner argues that Billingham’s wearable hardware includes glasses that display an avatar of a remote collaborator and “aligns the voice and the image so that the wearer perceives both to originate from the same location, the SLP.” Pet. 38–40 (emphasis omitted). Patent Owner does not make any additional arguments regarding limitation 9[b]. Prelim. Resp. 28.

With respect to limitation 9[c], “tracking, during the telephone call and with the wearable electronic device, head movements of the called party with respect to the image that represents the calling party and that is seen by the called party as being at the SLP,” Petitioner points out that Billingham’s “body-stabilized” display tracks “viewpoint orientation” and “world-stabilized” display tracks “viewpoint position and orientation.”

Pet. 40–42 (quoting Ex. 1010, 4). Both, therefore, track the wearer’s head movements in Petitioner’s view. *Id.* Petitioner also cites Billinghurst’s description that the device includes an inclinometer and magnetometer, and the wearer is able to “turn to face the collaborators” with which he wants to speak. *Id.* at 42–43 (quoting Ex. 1010, 5).

Patent Owner responds that “Billinghurst’s system only localized sounds in two dimensions, without any adjustments for elevation,” and does not “track[] in three dimensions.” Prelim. Resp. 29. Patent Owner states that the ’628 patent “teaches tracking of head movements in three-dimensional space across a full 6 degrees of freedom (‘6DOF’) including location, yaw, pitch, and roll, which teaches a [person of ordinary skill in the art] that compensation of both azimuth and elevation is required.” *Id.* at 29–30 (citing Ex. 2001 ¶¶ 12–18). Patent Owner does not point to any specific language in claim 9 requiring tracking in 3D space across 6DOF, however. *See id.* Dr. Begault emphasizes certain phrases in claims 9 and 11, including “head movements,” but does not explain why the claim language requires 3D tracking. *See* Ex. 2001 ¶¶ 12, 15. Dr. Begault also points to portions of the Specification describing the exemplary embodiments of Figures 16, 18, and 25, but again does not explain how the features of those examples impact the claims. *See id.* ¶¶ 12–16 (citing Ex. 1001, col. 31, l. 52–col. 32, l. 5, and stating that the ’628 patent “gives examples of head movement”). Absent additional explanation, we do not see how claim 9 requires tracking in 3D space across 6DOF,⁶ particularly

⁶ To the extent the parties disagree on whether any of the claims require tracking in 3D space across 6DOF, the parties are encouraged to provide in their papers during trial proposed interpretations for the relevant term(s) and

given the '628 patent's disclosure that a SLP can exist at a 3D or 2D position. *See* Ex. 1001, col. 3, ll. 48–57, col. 9, ll. 53–57.

Finally, limitation 9[d] recites:

changing, during the telephone call and in response to the head movements of the called party, the HRTFs processing the voice of the calling party so the voice of the calling party continues to localize to the SLP that is seen by the called party as being the image that represents the calling party that is one meter to two meters away from the called party while the head of the called party moves with respect to the image that represents the calling party.

Petitioner cites Billingham's description of spatializing audio according to distance and direction in real time, and changing the display and audio as the wearer moves his head, but acknowledges that "Billinghurst does not expressly provide detail regarding how the voice continues to localize to the SLP." Pet. 43–45 (emphasis omitted). Therefore, Petitioner relies on Schröder as teaching "changing HRTFs so the sound continues to localize to the SLP even while the head of the listener moves," and contends that Schröder's method would have been the "conventional way" to manipulate the audio in Billingham. *Id.* at 46–48.

Patent Owner again argues that Schröder teaches away from the recited arrangement because "Schröder's system does not *consistently* adjust its HRTFs to track head movements so that the audio continues to maintain a consistent perceived location" because it "overrides such tracking at certain times." Prelim. Resp. 30–31 (citing Ex. 2001 ¶¶ 30–31) (emphasis added). We disagree for the reasons explained above, and find Petitioner's

cite support in the Specification and/or prosecution history of the '628 patent for their respective interpretations.

arguments regarding the combined teachings of Billingham and Schröder sufficient on this record.

Petitioner’s contentions regarding the combination of Billingham and Schröder are supported by the testimony of Dr. Kyriakakis and are persuasive based on the current record. *See* Pet. 20–48; Ex. 1003 ¶¶ 100–175. Petitioner has shown a reasonable likelihood of prevailing on its assertion that claim 1 is unpatentable over Billingham and Schröder. Accordingly, we institute review “on all of the challenged claims and on all grounds of unpatentability asserted for each claim.” *See* 37 C.F.R. § 42.108(a).

5. *Claim 16*

Independent claim 16 recites a “non-transitory computer readable medium storing instructions that one or more electronic devices in an electronic system execute as a method during a telephone call between a calling party and a called party.” The method includes similar steps as claim 9, and recites that the voice of the calling party localizes as binaural sound at an image of the calling party that appears “at least one meter away” from the head of the called party (whereas claim 9 recites “one meter to two meters away” from the called party). In its analysis, Petitioner refers to many of its earlier arguments regarding similar limitations 9[a] (processing with HRTFs), 9[b] (displaying an image representing the calling party), 9[c] (tracking head movements of the called party), and 9[d] (changing the HRTFs), which we address above. *See* Pet. 57–59; *supra* Section II.E.4. Patent Owner likewise refers to its arguments regarding claim 9. Prelim. Resp. 31. Petitioner’s contentions regarding the combination of Billingham

and Schröder are supported by the testimony of Dr. Kyriakakis and are persuasive based on the current record. *See* Pet. 57–59; Ex. 1003

¶¶ 192–202. On this record, we are persuaded that Petitioner has shown a reasonable likelihood of prevailing on its assertion that claim 16 is unpatentable over Billingham and Schröder.

6. Claims 10–14 and 17–20

Patent Owner does not argue challenged dependent claims 10–14 and 17–20 separately. Prelim. Resp. 31–32. On this record, we are persuaded that Petitioner has shown a reasonable likelihood of prevailing on its assertion that independent claims 9 and 16 are unpatentable over Billingham and Schröder, and need not determine at this time whether Petitioner also has shown a reasonable likelihood of prevailing as to any of the challenged dependent claims. *See* 37 C.F.R. § 42.108(a).

F. Obviousness Ground Based on Billingham, Schröder, Zhou, and Haddick (Claims 9–14 and 16–20)

Petitioner contends that claims 9–14 and 16–20 are unpatentable over Billingham, Schröder, Zhou, and Haddick under 35 U.S.C. § 103, and Patent Owner responds. *See* Pet. 64–71; Prelim. Resp. 9–17, 32–36. We are persuaded that Petitioner has established a reasonable likelihood of prevailing on its asserted ground as to independent claims 9 and 16.

1. Zhou

Zhou describes the results of a study on “the effectiveness of 3D sound in the AR context,” including “the impact of 3D sound on depth

perception in a single-camera AR environment.” Ex. 1018, 1.⁷ The authors conducted two experiments with human subjects using a head mounted display (HMD) with an AR display. *Id.* at 1, 6. “In the first scenario, one participant must use vision only and vision with 3D sound to judge the relative depth of augmented virtual objects.” *Id.* at 1. Zhou discloses that “[e]xact spatial 3D sound in virtual and augmented environments requires perceptual externalization of the sound source, which can only be brought about by using head related transfer functions (HRTFs).” *Id.* at 3. The experiment generated 3D sound using open source software, namely “OpenAL . . . applying HRTFs.” *Id.* at 6, 25. Various AR markers were placed in the image displayed to the user so that the user could determine their perceived depth in the scene. *Id.* at 6–7. “In [the] first experiment the sound sources [were] always placed around 1.5 m away in the front of the listener.” *Id.* at 5.

2. *Haddick*

Haddick discloses a “wrist-worn [near field communication (NFC)]-enabled electronics device” that communicates with an “eyepiece” worn by the user with a “see-through display on which is displayed . . . data.” Ex. 1011, code (57). The disclosed eyepiece “may utilize sound projection techniques to realize a direction of sound for the wearer of the eyepiece” and “may be able to reproduce the 3D sound profile” for a particular sound. *Id.* ¶ 653. Haddick further discloses that the wearer may join a videoconference call and “[a]n image of the wearer 1512AA may . . .

⁷ Consistent with the parties’ usage, when referencing pages of Zhou, we refer to the page numbers added by Petitioner in the bottom-right corner of the reference.

be displayed on the display area 1518AA of the eyepiece and transmitted to others on the videoconference, such as along with the images 1514AA of other participants on the videoconference call.” *Id.* ¶ 636, Fig. 15AA. Also, the eyepiece may display a “visual indicator” indicating, for example, “an incoming phone call.” *Id.* ¶ 662.

3. Whether Petitioner Has Established a Reasonable Likelihood that Zhou is a Prior Art Printed Publication

Petitioner argues that Zhou is a prior art printed publication under 35 U.S.C. § 102(a)(1), citing Dr. Hsieh-Yee’s declaration. Pet. 6 n.3 (citing Ex. 1019 ¶¶ 47–72). Similar to her testimony regarding Billingham, Dr. Hsieh-Yee explains, and provides evidence in support to show, how Zhou was cataloged at the Library of Congress and University of Michigan. *See* Ex. 1019 ¶¶ 53–70, 72. Patent Owner argues that Petitioner has not shown sufficiently that Billingham and Zhou were publicly accessible, making arguments applicable to both. Prelim. Resp. 9–15. We disagree with those arguments for the reasons explained above, and conclude on this record that Dr. Hsieh-Yee’s testimony and supporting evidence pertaining to Zhou’s alleged public accessibility through the two libraries is sufficient to meet the reasonable likelihood standard. *See supra* Section II.E.3.

4. Claims 9 and 16

Petitioner’s asserted ground differs from its asserted ground based on Billingham and Schröder in two respects. Pet. 64. First, Petitioner argues that “[t]o the extent that Billingham does not explicitly disclose that the avatar’s position (SLP) is one meter to two meters away from the listener (called party), this would have been obvious in view of Zhou,” citing Zhou’s

description of sound at a SLP of 1.5 meters. *Id.* at 64–65, 68–69 (citing Ex. 1018, 5) (emphasis omitted). Second, Petitioner argues that “[t]o the extent that Billinghurst does not disclose that the method is performed during a telephone call, this would have been obvious in view of Haddick,” citing Haddick’s description of receiving a telephone call notification and conducting a videoconference using an eyepiece. *Id.* at 64–67, 69–71 (citing Ex. 1011 ¶¶ 636–637, 662, Fig. 15AA) (emphasis omitted). Petitioner further provides reasons why an ordinarily skilled artisan would have been motivated to “modify the system resulting from the Billinghurst-Schröder combination” based on the teachings of Zhou and Haddick, and had a reasonable expectation of success in making the combination. *Id.* at 64–68. Other than its arguments pertaining to whether Zhou is a prior art printed publication and the combination of Billinghurst and Schröder, which we address above, Patent Owner does not dispute Petitioner’s arguments for the asserted ground based on Billinghurst, Schröder, Zhou, and Haddick. *See* Prelim. Resp. 32–35; *supra* Sections II.E.4–5, II.F.3. Petitioner’s contentions are supported by the testimony of Dr. Kyriakakis and are persuasive based on the current record. *See* Pet. 64–71; Ex. 1003 ¶¶ 216–231. On this record, we are persuaded that Petitioner has shown a reasonable likelihood of prevailing on its assertion that independent claims 9 and 16 are unpatentable over Billinghurst, Schröder, Zhou, and Haddick.

5. *Claims 10–14 and 17–20*

Patent Owner does not argue challenged dependent claims 10–14 and 17–20 separately. Prelim. Resp. 35–36. On this record, we are persuaded that Petitioner has shown a reasonable likelihood of prevailing on its assertion that independent claims 9 and 16 are unpatentable over

Billinghurst, Schröder, Zhou, and Haddick, and need not determine at this time whether Petitioner also has shown a reasonable likelihood of prevailing as to any of the challenged dependent claims. *See* 37 C.F.R. § 42.108(a).

G. Obviousness Grounds Based on Billinghurst, Ballas, and Other References (Claims 9–14 and 16–20)

Petitioner contends, under 35 U.S.C. § 103, that claims 9–14 and 16–20 are unpatentable over the combinations of Billinghurst and Ballas, and Billinghurst, Ballas, Zhou, and Haddick. Pet. 71–76. Patent Owner responds. Prelim. Resp. 36–43. As explained above, we are persuaded, based on the current record, that Petitioner has shown a reasonable likelihood of prevailing on certain grounds based on combinations with Billinghurst and Schröder for the challenged independent claims, and we institute review “on all of the challenged claims and on all grounds of unpatentability asserted for each claim.” *See* 37 C.F.R. § 42.108(a).

To provide guidance to the parties regarding the other asserted grounds, however, we note the following. With respect to Petitioner’s asserted ground based on the combination of Billinghurst, Ballas, Zhou, and Haddick, Petitioner states that Zhou and Haddick teach the “one meter to two meters away” and “during a telephone call” limitations of claim 9 “[f]or the same reasons as discussed for” the asserted ground based on Billinghurst, Schröder, Zhou, and Haddick. Pet. 76 (citing Ex. 1003 ¶¶ 241–243, which similarly refer to Dr. Kyriakakis’s earlier analysis of the other asserted ground). Petitioner provides no additional analysis of why a person of ordinary skill in the art would have been motivated to combine the teachings of Zhou and/or Haddick with Billinghurst and Ballas. *See id.* At this stage, we question whether Petitioner’s approach is sufficient to meet

its burden, given that, as Patent Owner correctly points out, Petitioner’s earlier motivation to combine analysis is “explicitly in reference to the base combination of Billingham in view of Schröder, not Billingham in view of Ballas.” *See* Prelim. Resp. 41; *Magnum Oil*, 829 F.3d at 1372, 1379–80 (rejecting similar arguments regarding a motivation to combine where the petitioner merely incorporated its previous arguments regarding a first reference and stated that “[t]he same analysis applies to combinations using [a second reference],” “without presenting particularized arguments explaining why those arguments from [the first reference] would be cross-applicable to the [second] reference” that described a different device (emphasis omitted)).

III. CONCLUSION

Based on the arguments presented in the Petition, we conclude that Petitioner has demonstrated a reasonable likelihood of prevailing with respect to at least one claim of the ’628 patent challenged in the Petition. Accordingly, we institute a trial on all claims and all grounds asserted in the Petition. The Board has not made a final determination under 35 U.S.C. § 318(a) with respect to the patentability of the challenged claims.

IV. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that, pursuant to 35 U.S.C. § 314(a), an *inter partes* review of claims 9–14 and 16–20 of the ’628 patent is instituted with respect to all grounds set forth in the Petition;

FURTHER ORDERED that, pursuant to 35 U.S.C. § 314(c) and 37 C.F.R. § 42.4(b), *inter partes* review of the '628 patent shall commence on the entry date of this Decision, and notice is hereby given of the institution of a trial; and

FURTHER ORDERED that Petitioner shall file, within five business days of this Decision, a substitute copy of Exhibit 1019 adding a label page preceding each appendix and making no other changes, after which the originally filed version of Exhibit 1019 will be expunged.

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