

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC., AMAZON WEB SERVICES, INC., and
AMAZON.COM SERVICES LLC
Petitioner,

v.

ZENTIAN LIMITED,
Patent Owner.

IPR2023-00036¹
Patent 10,839,789 B2

Before KEVIN F. TURNER, JEFFREY S. SMITH, and
CHRISTOPHER L. OGDEN, *Administrative Patent Judges*.

SMITH, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining Some Challenged Claims Unpatentable
35 U.S.C. § 318(a)

¹ IPR2023-01195 has been joined with this proceeding.

I. INTRODUCTION

A. Background and Summary

Petitioner filed a Petition (Paper 1, “Pet.”) requesting *inter partes* review of claims 1, 2, 4, 6–14, 16–18, 20–29, 35, 37–39, and 42–45 of U.S. Patent No. 10,839,789 B2 (Ex. 1001, “the ’789 patent”). We issued an Institution Decision (Paper 10, “Dec.”) instituting the petitioned review. Patent Owner then filed a Patent Owner Response² to the Petition. Petitioner filed a Reply (Paper 21, “Reply”) to the Patent Owner Response. Patent Owner filed a Sur-reply (Paper 27, “PO Sur-Reply”) to the Reply. An oral hearing was held on March 12, 2024, for which the transcript was entered into the record (Paper 33, “Tr.”).

We have jurisdiction under 35 U.S.C. § 6(b)(4) and § 318(a). This Decision is a final written decision under 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73 as to the patentability of claims 1, 2, 4, 6–14, 16–18, 20–29, 35, 37–39, and 42–45 of the ’789 patent. We determine that Petitioner has shown by a preponderance of evidence that claims 10, 12–14, 16–18, 20–23, 25–28, 35, 37–39, and 42–45 are unpatentable. Petitioner has not shown by a preponderance of evidence that claims 1, 2, 4, 6–9, 11, 24, or 29 are unpatentable.

B. Related Matters

The parties indicate that the following matters relate to the ’789 patent: *Zentian Ltd v. Apple Inc.*, 6:22-cv-00122 (W.D. Tex. Feb. 2, 2022); *Zentian Ltd v. Amazon.com, Inc.*, 6:22-cv-00123 (W.D. Tex. Feb. 2, 2022); *Apple Inc. v. Zentian Ltd.*, *Inter Partes* Review No. IPR2023-00033; *Apple*

² Petitioner also filed a corrected Patent Owner Response (Paper 31, “Pet. Resp.”) and a comparison of the Corrected Patent Owner Response to the original (Paper 32).

Inc. v. Zentian Ltd., *Inter Partes* Review No. IPR2023-00034; *Apple Inc. v. Zentian Ltd.*, *Inter Partes* Review No. IPR2023-00035; and *Apple Inc. v. Zentian Ltd.*, *Inter Partes* Review No. IPR2023-00037. Paper 3, 1; Pet. 78.

C. The '789 Patent

The '789 patent is related to “speech recognition circuits and methods,” which are particularly applicable to mobile devices. *See* Ex. 1001, 1:20–23. The patent describes:

a circuit for providing state identifiers which identify states corresponding to nodes or groups of adjacent nodes in a lexical tree, and for providing scores corresponding to said state identifiers. The lexical tree includes a model of words. The speech recognition circuit also has a memory structure for receiving and storing state identifiers identified by a node identifier identifying nodes or groups of adjacent nodes, the memory structure being adapted to allow lookup to identify particular state identifiers, reading of the scores corresponding to the state identifiers, and writing back of the scores to the memory structure after modification of the scores.

Id. at 2:31–43. A “selector circuit is used for selecting at least one node or group of nodes of the lexical tree according to said scores.” *Id.* at 2:49–50. A “distance calculation engine may calculate one or more of a wide range of distance metrics and probability distributions.” *Id.* at 4:12–14. The distances may represent the likely correspondence of feature vectors to states in an acoustic model, such that “the distances can indicate the similarity of an audio data frame to each possible state in an acoustic model.” *Id.* at 4:14–17.

Figure 16 shows a block diagram of a speech recognition system of the '789 patent, and is reproduced below.

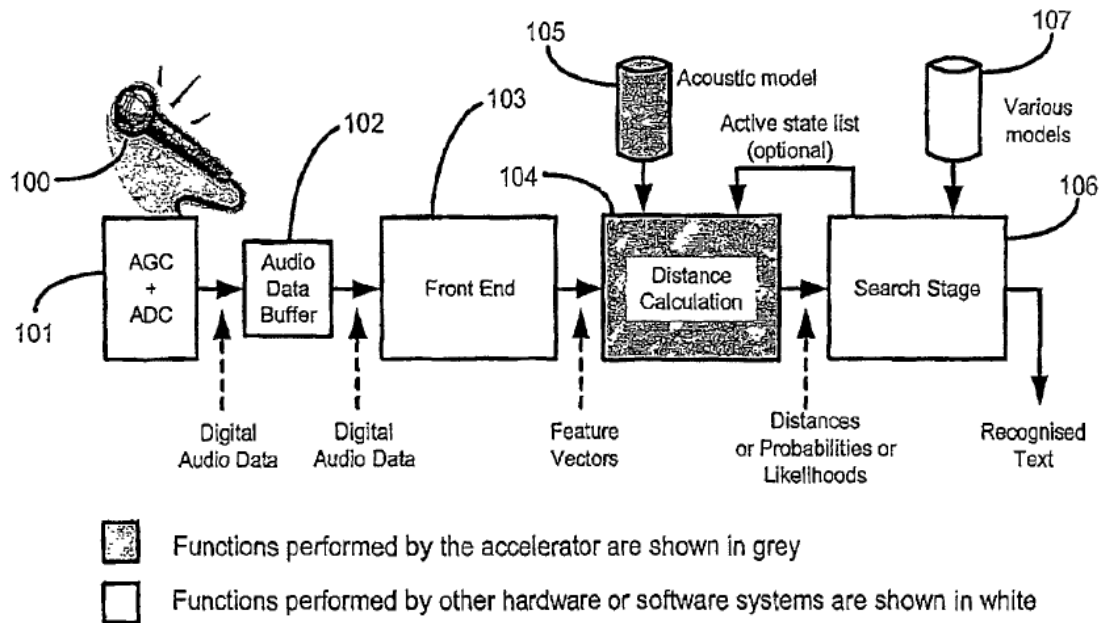


Figure 16 above shows a speech recognition system, including microphone 100, distance calculation engine 104, acoustic model 105, and search stage 106, which provides the distance calculation engine 104 with active state list 108. Ex. 1001, 23:52–24:59.

D. Illustrative Claims

Claim 1 of the '789 patent recites:

1. An acoustic coprocessor for processing data associated with an audio signal, comprising:
 - a first interface for receiving at least one feature vector, wherein the feature vector is determined from the audio signal;
 - an acoustic model memory for storing an acoustic model defining a plurality of acoustic states;
 - a calculating apparatus for calculating distances indicating a similarity between the at least one feature vector and respective acoustic states of the acoustic model read from the acoustic model memory; and
 - a second interface for sending at least one distance calculated by the calculating apparatus;
 - wherein the calculating apparatus and the acoustic model memory are fabricated on a single integrated circuit.

Claim 10 recites:

10. An acoustic coprocessor, comprising:
a first interface for receiving at least one feature vector;
a calculating apparatus for calculating distances
indicating a similarity between the at least one feature vector
and at least one acoustic state of an acoustic model read from an
acoustic model memory; and
a second interface for sending at least one distance
calculated by the calculating apparatus.

E. Evidence

Petitioner relies on the following prior art:

U.S. Patent No. 5,819,222, issued October 6, 1998 (Ex. 1005,
“Smyth”);

U.S. Patent No. 6,959,376 B1, issued October 25, 2005
(Ex. 1006, “Boike”);

“The Motorola DSP56000 Digital Signal Processor,” IEEE
Micro, pp. 29–48, published December 1986 (Ex. 1009, “Kloker”);

U.S. Patent No. 4,567,606, issued January 28, 1986 (Ex. 1038,
“Vensko”);

U.S. Patent No. 5,774,859, issued June 30, 1998 (Ex. 1040,
“Houser”);

U.S. Patent No. 7,171,358 B2, issued January 30, 2007
(Ex. 1041, “Whittaker”);

U.S. Patent No. 7,478,041 B2, issued January 13, 2009
(Ex. 1042, “Ichikawa”);

U.S. Patent No. 7,587,318 B2, issued September 8, 2009
(Ex. 1043, “Seshadri”);

U.S. Patent Appl. Publ. No. 2002/0091826 A1, published July
11, 2002 (Ex. 1044, “Comeau”);

U.S. Patent Appl. Publ. No. 2003/0012347 A1, published
January 16, 2003 (Ex. 1045, “Steinbiss”);

U.S. Patent No. 6,832,194 B1, issued December 14, 2004
(Ex. 1046, “Mozer”); and

U.S. Patent No. 6,879,954 B2, issued April 12, 2005 (Ex. 1047,
“Nguyen”).

F. Prior Art and Asserted Grounds

Petitioner asserts that claims 1, 2, 4, 6–14, 16–18, 20–29, 35, 37–39,
and 42–45 of the ’789 patent are unpatentable on the following grounds:

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1, 10, 11, 14, 17	103(a)	Smyth, Mozer
2, 4, 6–9, 12, 16, 18, 20, 21	103(a)	Smyth, Mozer, Nguyen
13	103(a)	Smyth, Mozer, Houser
22–24	103(a)	Smyth, Mozer, Nguyen, Vensko
25–28, 37	103(a)	Smyth, Mozer, Nguyen, Vensko, Comeau
29	103(a)	Smyth, Mozer, Nguyen, Vensko, Comeau, Boike
35	103(a)	Smyth, Mozer, Nguyen, Vensko, Comeau, Whittaker
38, 39	103(a)	Smyth, Mozer, Nguyen, Vensko, Comeau, Ichikawa
42–44	103(a)	Smyth, Mozer, Nguyen, Vensko, Comeau, Ichikawa, Seshadri
45	103(a)	Smyth, Mozer, Nguyen, Vensko, Comeau, Ichikawa, Steinbiss

Pet. 2. Petitioner relies on the declaration testimony of Christopher Schmandt. Ex. 1003. Patent Owner relies on the testimony of David Anderson, Ph.D. Ex. 2020.

II. ANALYSIS

A. Legal Standards

“In an [*inter partes* review], the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable.” *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016) (citing 35 U.S.C. § 312(a)(3) (requiring *inter partes* review petitions to identify “with particularity . . . the evidence that supports the grounds for the challenge to each claim”)); *see also* 37 C.F.R. § 42.104(b) (requiring a petition for *inter partes* review to identify how the challenged claim is to be construed and where each element of the claim is found in the prior art patents or printed publications relied upon).

A claim is unpatentable under 35 U.S.C. § 103(a) if “the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.” *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: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) when in evidence, objective evidence of obviousness or nonobviousness, i.e., secondary considerations. *See Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). An obviousness analysis “need not seek out precise teachings directed to the specific subject matter of the challenged claim, for a court can take account of the inferences

and creative steps that a person of ordinary skill in the art would employ.”
KSR, 550 U.S. at 418.

Additionally, the obviousness inquiry typically requires an analysis of “whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue.” *KSR*, 550 U.S. at 418 (citing *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006) (requiring “articulated reasoning with some rational underpinning to support the legal conclusion of obviousness”)). Furthermore, Petitioner does not satisfy its burden of proving obviousness by employing “mere conclusory statements,” but “must instead articulate specific reasoning, based on evidence of record, to support the legal conclusion of obviousness.” *In re Magnum Oil Tools Int’l, Ltd.*, 829 F.3d 1364, 1380 (Fed. Cir. 2016).

B. Level of Ordinary Skill in the Art

Petitioner contends that a person having ordinary skill in the art (“POSITA”) would have had “a master’s degree in computer engineering, computer science, electrical engineering, or a related field, with at least two years of experience in the field of speech recognition, or a bachelor’s degree in the same fields with at least four years of experience in the field of speech recognition,” and that “[a]dditional education or experience might substitute for the above requirements.” Pet. 3 (citing Ex. 1003 ¶¶ 24–25).

Patent Owner contends that the Petition and supporting evidence, including the testimony of Mr. Schmandt, does not demonstrate that a person of ordinary skill in the field of speech recognition would have been able to fabricate an integrated circuit. PO Resp. 1. Patent Owner contends that a person of ordinary skill in the field of speech recognition would not also be expected to have specialized knowledge in integrated circuit fabrication in

addition to speech recognition. *Id.* at 2–4 (citing Ex. 2020 ¶¶ 17–19).

Petitioner does not present arguments to the contrary. *See generally* Reply.

We agree with Petitioner, that a person of ordinary skill in the field of speech recognition would have had a master’s degree in computer engineering, computer science, electrical engineering, or a related field, with two years of experience in the field of speech recognition, or a bachelor’s degree in the same fields with four years of experience in the field of speech recognition.³ Ex. 1001, 1:25–2:27 (describing in the “Background of Invention” section of the ’789 patent various speech recognition systems and methods). We also agree with Patent Owner, and rely on the supporting testimony of Dr. Anderson, in finding that a person of ordinary skill in the field of speech recognition would not have been a person of ordinary skill in the field of integrated circuit fabrication, and would not have had the education, experience, or skill necessary to fabricate an integrated circuit.

C. Claim Interpretation

We interpret the challenged claims

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) (2022). “In determining the meaning of [a] disputed claim limitation, we look principally to the intrinsic evidence of record,

³ Petitioner’s formulation is open-ended as to the maximum number of years of experience in the field of speech recognition. *See* Pet. 3. This ambiguity has no bearing on whether the ordinarily skilled artisan would have had any experience in the field of integrated circuit fabrication. Thus, our decision would be the same with or without this ambiguity.

examining the claim language itself, the written description, and the prosecution history, if in evidence.” *DePuy Spine, Inc. v. Medtronic Sofamor Danek, Inc.*, 469 F.3d 1005, 1014 (Fed. Cir. 2006). Claim terms are given their plain and ordinary meaning as would be understood by a person of ordinary skill in the art at the time of the invention and in the context of the entire patent disclosure. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1313 (Fed. Cir. 2005) (en banc). “There are only two exceptions to this general rule: 1) when a patentee sets out a definition and acts as his own lexicographer, or 2) when the patentee disavows the full scope of a claim term either in the specification or during prosecution.” *Thorner v. Sony Comput. Entm’t Am. LLC*, 669 F.3d 1362, 1365 (Fed. Cir. 2012).

Petitioner “applies the plain and ordinary meaning of all claim terms as understood by a POSITA for all terms.” Pet. 5.

We conclude that no terms require express construction to resolve a dispute. *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.’” (internal citation omitted)).

D. Challenge Based on Smyth and Mozer

Petitioner contends that claims 1, 10, 11, 14, and 17 are unpatentable over the combination of Smyth and Mozer. Pet. 4.

1. Overview of Smyth

Smyth is a patent entitled “Task-Constrained Connected Speech Recognition of Propagation of Tokens Only If Valid Propagation Path Is Present.” Ex. 1005, code (54). Smyth is related to “applying grammar constraints to connected speech recognition,” particularly “in the area of

task-constrained connected word recognition where the task, for example, might be to recognise one of a set of account numbers or product codes.” *Id.* at 1:15–21.

Smyth states that it “is common in speech recognition processing to input speech data, typically in digital form, to a so-called front-end processor, which derives from the stream of input speech data a more compact, perceptually significant set of data referred to as a front-end feature set or vector.” Ex. 1005, 1:23–27. Smyth also states that, commonly, a “stored representation of the word or phrase, known as a template or model, comprises a reference feature matrix of that word as previously derived from, in the case of speaker independent recognition, multiple speakers.” *Id.* at 1:33–36. “The input feature vector is matched with the model and a measure of similarity between the two is produced.” *Id.* at 1:36–38. Smyth notes that, while it “is possible to construct a network enumerating all the possible word sequences, perhaps in the form of a tree,” this “becomes problematic as the recognition task size grows large.” *Id.* at 2:29–33. Smyth’s “system replaces a full tree network with a very much smaller one.” *Id.* at 3:4–5.

Figure 2, reproduced below, is a schematic diagram of the functional elements of a recognition processor according to Smyth.

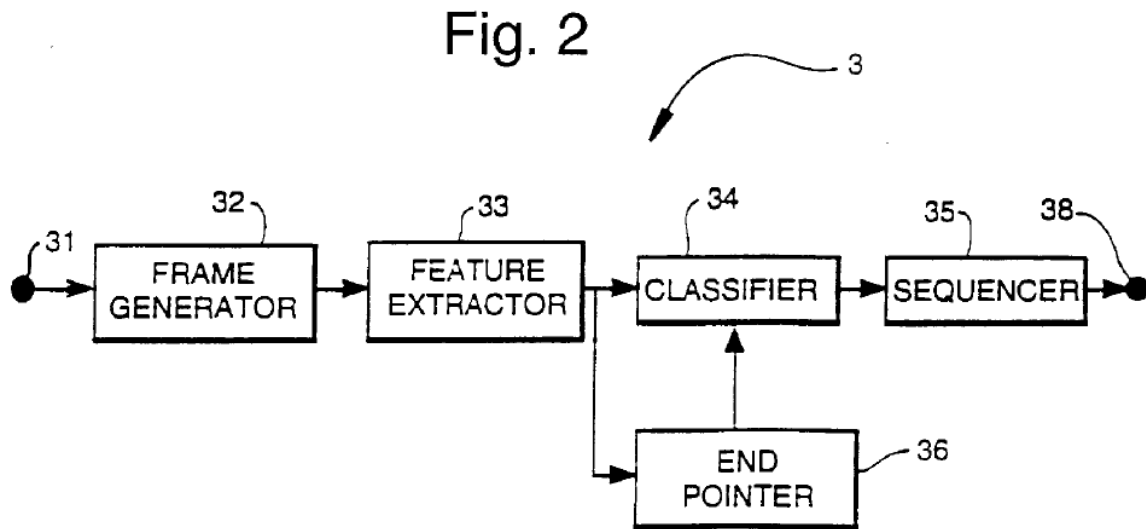


Figure 2 above shows a schematic of Smyth's recognition processor 3 showing input 31, frame generator 32, feature extractor 33, classifier 34, sequencer 35, end pointer 36, and output port 38. Ex. 1005, 5:1-18.

Figure 3, reproduced below, is a block diagram of classifier 34.

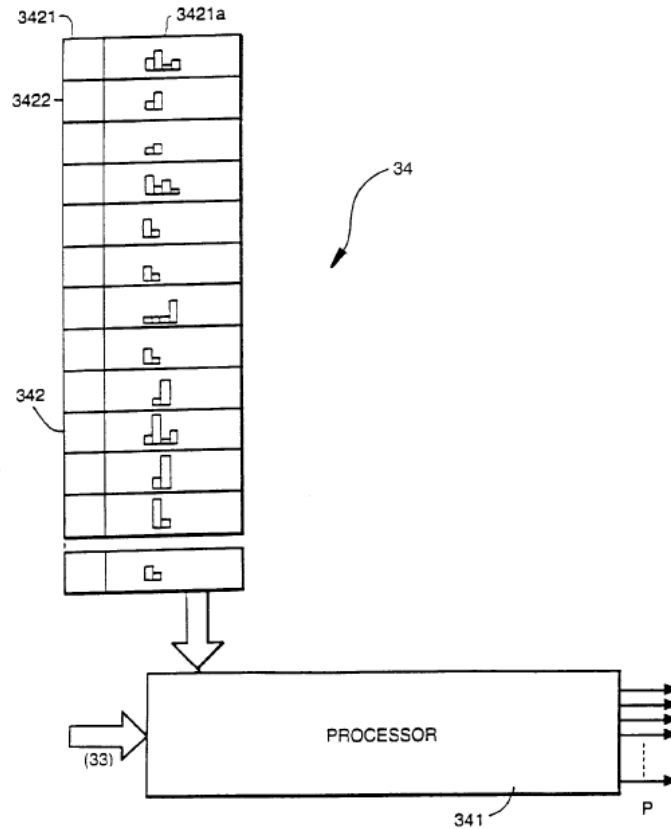


Figure 3 above shows classifying processor 341 and state memory 342. State memory 342 comprises state field 3421 and 3422, for example, for each of the plurality of speech states. Ex. 1005, 5:55–59.

“[C]lassification processor 34 is arranged to read each state field within the memory 342 in turn, and calculate for each, using the current input feature coefficient set, the probability that the input feature set or vector corresponds to the corresponding state.” *Id.* at 5:63–67.

2. Overview of Mozer

Mozer is a patent entitled “Audio Recognition Peripheral System.” Ex. 1046, code (54). Mozer concerns “providing an audio recognition peripheral system allowing for a highly efficient implementation of an audio recognition process.” *Id.* at 1:7–11. Mozer describes that “audio

recognition systems are problematic to realize because they typically require large amounts of data processing to implement.” *Id.* at 1:25–27. Mozer also describes that “application specific audio recognition systems have the disadvantage of increasing the costs of the overall system.” *Id.* at 1:39–41. Therefore, according to Mozer, “what is needed is an audio recognition system that allows users to efficiently implement audio recognition functionality into larger systems at reduced costs with both ease and flexibility of use.” *Id.* at 1:60–63. To address this need, Mozer “provides an audio recognition peripheral and audio recognition peripheral system,” which “allows system designers to easily add audio recognition functionality into a system by simply adding a low cost audio recognition peripheral to operate in conjunction with a processor.” *Id.* at 2:2–7.

Figure 3, reproduced below, illustrates an architectural diagram of an audio recognition peripheral on a single integrated circuit according to one embodiment of Mozer.

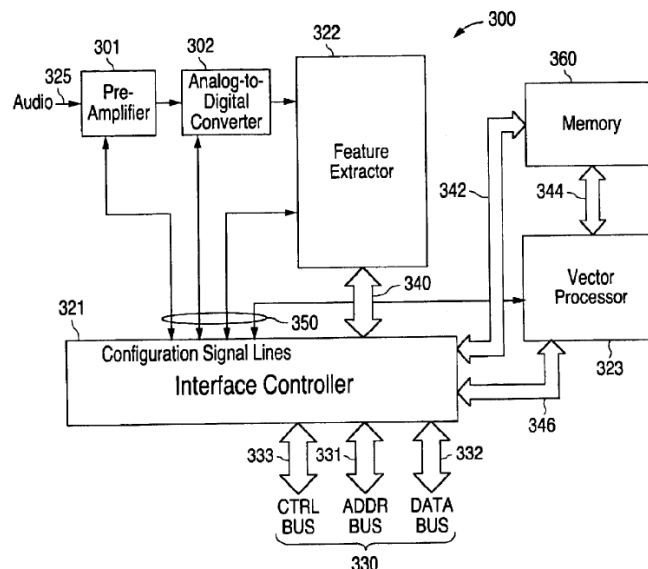
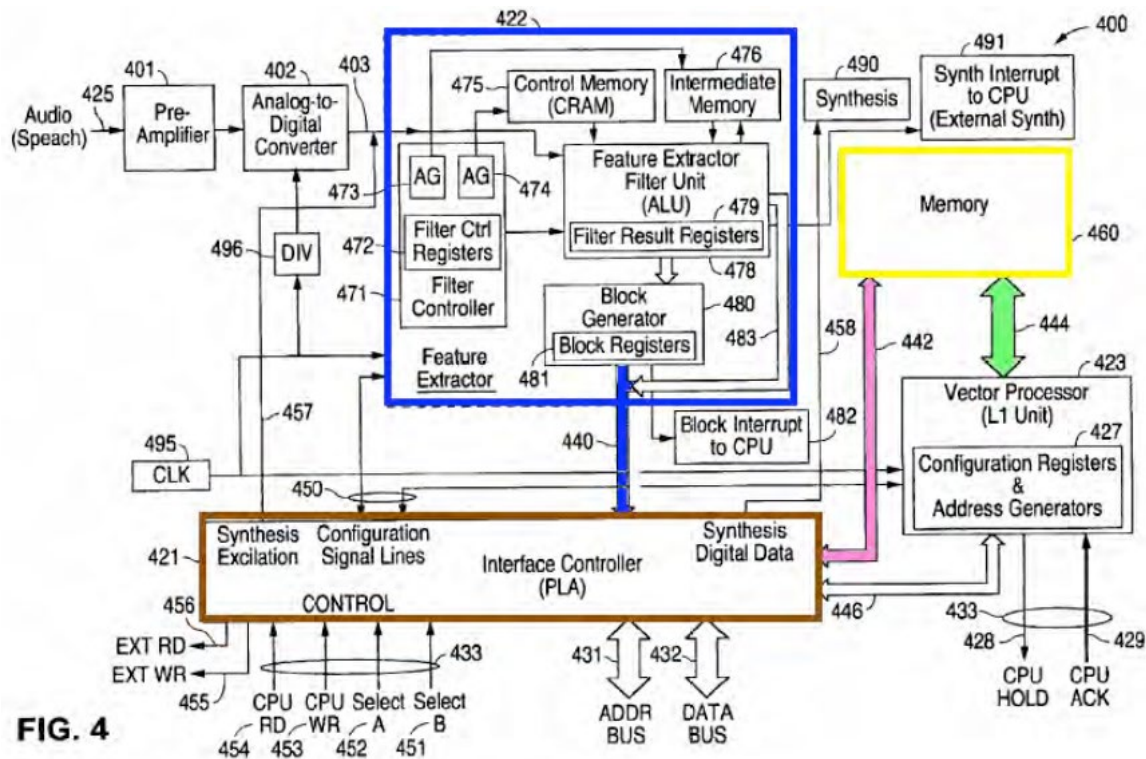


Figure 3 above illustrates an audio recognition peripheral 300 on a single integrated circuit, including feature extractor output lines 340, memory input lines 342, and memory interface lines 344. Ex. 1046, 6:1–67.

Petitioner’s annotated version of Mozer’s Figure 4, reproduced below, illustrates an audio recognition peripheral integrated circuit 400 according to another embodiment of Mozer. Pet. 23.



Annotated Figure 4 above illustrates an example of an audio recognition peripheral according to another embodiment of Mozer, highlighting interface controller 421 (in brown), feature extractor 422 (in blue), memory 460 (in yellow), feature extractor output lines 440 (in blue), and memory input lines 444 (in green). Ex. 1046, 7:53–9:56. Figure 4 also shows vector processor 423, and its configuration registers and address generators 427. *Id.* at 9:22–42.

3. *Claim 1*

Analysis of Smyth alone

Claim 1 recites “wherein the calculating apparatus and the acoustic model memory are fabricated on a single integrated circuit.” Petitioner contends that Smyth alone teaches this limitation, because, according to Petitioner, Smyth’s classifier processor 341 teaches the claimed “calculating apparatus” and Smyth’s state memory 342 teaches the claimed “acoustic model memory.” Pet. 38. Petitioner contends that Smyth’s classifier processor 341 may be a suitably programmed digital signal processor (DSP) such as the Motorola DSP56000, and that a person of ordinary skill would have understood that the Motorola DSP56000 would have had a processor and memory on an integrated circuit. *Id.* at 39 (citing Ex. 1009). Petitioner contends because the DSP56000 provides for a single integrated circuit with a processor and memory, Smyth alone teaches “the calculating apparatus and the acoustic model memory are fabricated on a single integrated circuit” as claimed. *Id.* at 40.

Patent Owner contends that Smyth’s classifier processor 341 is a distinct structure from its state memory 342. PO Resp. 1. Patent Owner contends that Smyth teaches that classifying processor 341 constitutes its own DSP, but does not teach that both classifying processor 341 and state memory 342 are on the same DSP or on a single integrated circuit. *Id.* at 5 (citing Ex. 2020 ¶ 35). In Reply, Petitioner contends that even though Smyth shows processor 341 and state memory 342 as separate components, a patent drafter would label distinct structures on the same integrated circuit with separate reference numerals and illustrate them as separate components in a figure. Reply 10–11 (citing Ex. 1006). Patent Owner contends that Petitioner’s Reply does not substantively rebut Patent Owner’s evidence and

argument that processor 341 and state memory 342 are not fabricated on a single integrated circuit. *See* PO Sur-Reply 1 (citing Ex. 2020 ¶¶ 34–45). Patent Owner contends that Petitioner’s Reply contention—that processor 341 and state memory 342 have separate reference numerals does not necessarily mean that they are distinct structures—fails to meet its burden of proof to show that processor 341 and state memory 342 are in fact fabricated on a single integrated circuit. *Id.* at 1–2 (citing Reply 10–11).

We agree with Patent Owner that Petitioner has not shown, by a preponderance of evidence, that state memory 342 of Smyth is fabricated on the same integrated circuit as processor 341. Petitioner, in asserting that processor 341 and state memory 342 are on the same integrated circuit, cites the following testimony of Mr. Schmandt:

In my opinion, the Motorola DSP56000 provides both memory and a processor fabricated on a single integrated circuit (IC). *Kloker* (Ex. 1009), 1 (discussing the Motorola DSP56000 includes “a core processor, RAM, ROM, peripheral interfaces, and a memory expansion interface on a single, 88-pin chip[”]). . . . A POSITA would have understood or at least found obvious that *Smyth* thus teaches a single IC on which both classifier processor 341 and state memory 342 are fabricated.

Ex. 1003 ¶ 165; Pet. 39. We do not credit Mr. Schmandt’s testimony because it is inconsistent with Smyth’s disclosure. Smyth discloses that classifier 34 comprises classifying processor 341 and state memory 342, and that “classifying processor 341 may be a suitably programmed digital signal processing (DSP) device.” Ex. 1005, 5:55–57, 6:5–6. Thus, Smyth itself, in discussing classifier 34, distinguishes processor 341 from state memory 342 in stating that only processor 341, and not both processor 341 and state memory 342, may be located on the DSP.

Further, Dr. Anderson persuasively testifies that Smyth does not describe processor 341 and state memory 342 as being fabricated on a single integrated circuit. Ex. 2020 ¶¶ 34–37. Dr. Anderson persuasively explains that processor 341 and state memory 342 could not be fabricated on the same integrated circuit, because the design of the DSP for processor 341 does not include any memory that meets the requirements of state memory 342. *Id.* ¶¶ 38–45. We rely on the testimony of Dr. Anderson in finding that Petitioner has not shown that Smyth teaches that processor 341 and state memory 342 are fabricated on a single integrated circuit.

Petitioner, in its Reply, contends that (a) Smyth’s DSP has a processor and memory on a single integrated circuit, and that the advantages from a processor and memory on an integrated circuit were known and (b) the memory of Smyth’s DSP is sufficient to store Smyth’s acoustic model. Reply 1–10. Patent Owner contends that Petitioner’s Reply presents a new theory, that the memory on the Motorola DSP56000 itself, which is not state memory 342, is sufficient to meet the claim. PO Sur-Reply 2. Patent Owner contends that this new theory is improper and should not be considered. *Id.* We need not reach the issue of whether Petitioner’s Reply presents a new theory, because even considering Petitioner’s Reply arguments, we find that Petitioner has not shown by a preponderance of evidence that the memory on Smyth’s DSP would have been able to store Smyth’s state memory, which the Petition maps to the claimed “acoustic model.”

Petitioner, in arguing that advantages from a processor and memory on an integrated circuit were known, contends that Dr. Anderson admitted that reducing off-chip memory access due to the processor and memory of the DSP56000 fabricated on an integrated circuit makes the system more efficient by performing some operations more quickly. Reply 1–2 (citing

Ex. 1069, 79:11–14, 91:8–10). Petitioner then contends that because Dr. Anderson admits that integrated circuits for speech recognition were known to have efficiency advantages, and because Smyth discloses a DSP56000 having a processor and memory for use as a classifying processor in speech recognition, Smyth alone teaches limitation 1(e). *Id.*

We disagree with Petitioner’s contention that Dr. Anderson admitted that the memory of the DSP56000 would have been able to store the claimed “acoustic model.” In particular, we disagree that Dr. Anderson’s testimony that “they put memory on the chip so that you could do some operations more quickly” and that “one way of making a system more efficient, was to reduce the off-chip memory access” means that “Dr. Anderson admits that ICs for speech recognition were known to have efficiency advantages.” *See* Reply 1–2 (quoting Ex. 1069, 79:11–14, 91:8–10). Dr. Anderson testified that “they put memory on the chip so that you could do *some operations* more quickly. And yet, *it was only a few K of memory.*” Ex. 1069, 79:12–15 (emphasis added). Similarly, immediately before testifying that it was known that reducing off-chip memory accesses makes a system more efficient, Dr. Anderson testified that “*I couldn’t tell you . . . if there were people that said ‘Oh yeah. That’s it. We just have to make a distance calculator that has all the memory on chip.’*” *Id.* at 91:4–10 (emphasis added).

We find that Dr. Anderson testified that the teachings of the ’789 patent itself, namely, putting an acoustic model memory on the same integrated circuit as a calculating apparatus, were unknown in the prior art. We find that Dr. Anderson did not admit that the memory of the DSP taught by Smyth would have been able to store the claimed “acoustic memory.” Further, to the extent that the advantages from a processor and a memory

fabricated on the same integrated circuit were known, such advantages by themselves do not show that the memory of the DSP taught by Smyth would have been able to store the claimed “acoustic model memory” such that the claimed “calculating apparatus and the acoustic model memory” would have been “fabricated on a single integrated circuit” as claimed.

Petitioner, in arguing that the memory of Smyth’s DSP is sufficient to store the claimed “acoustic model,” contends that the claim does not recite a required memory size for the acoustic model memory, but rather, recites that the acoustic model defines a plurality of states. Reply 2–3. We stated in our Decision to Institute that “[t]he scope of the claimed ‘acoustic model memory’ encompasses a memory storing ‘an acoustic model defining a plurality of acoustic states,’ such as two acoustic states.” Dec. 22.

Petitioner, in the Reply, did not address our statement, other than to cite to it in contending that “the claims recite storing a plurality of states, which is met by at least two states.” Reply 22 (citing Dec. 22). Petitioner, however, did not provide evidence or argument, either in the Petition or in the Reply, to show that only two acoustic states of Smyth’s state memory 342 would define an acoustic model as claimed. Nor did Petitioner explain how or why Smyth’s processor 341 would be able to operate on only two acoustic states of Smyth’s acoustic model, rather than the entire model, in order to successfully perform recognition.

We find that Petitioner has not provided sufficient evidence or argument to show that only two acoustic states of Smyth’s state memory teach the “acoustic model memory” as recited in claim 1. In particular, we find that Smyth discloses that the “classification processor 34 is arranged to read *each state field* within the memory 342,” not just two state fields, “and calculate *for each [state field]* the probability that the input feature set or

vector corresponds to the corresponding state.” Ex. 1005, 5:63–67 (emphasis added); *see id.* at 6:1–4. Further, in both the Petition and the Reply, Petitioner maps the claimed “acoustic model” to Smyth’s acoustic model stored in state memory 342. Reply 3, 4, 11; Pet. 11, 38, 41–42, 44; *see* Tr. 16:18–17:12. Therefore, in light of Smyth’s disclosure that the classification processor reads each state field within memory 342, and in light of Petitioner’s theory of unpatentability, in which “*Smyth’s* state memory 342 is mapped as the ‘acoustic model memory’” (Pet. 11), Petitioner has the burden of showing that the available memory in the integrated circuit of Smyth is large enough to store Smyth’s acoustic model of state memory 342, not just two acoustic states of Smyth’s model.

Petitioner contends that the scope of the recited “acoustic model” encompasses Smyth’s abbreviated model used to recognize digits. Reply 3. Petitioner, relying on the testimony of Dr. Anderson, contends that the memory of the DSP56000 is large enough to store Smyth’s abbreviated acoustic model. *Id.* at 3–4 (citing Ex. 1069, 76:7–23). We disagree with Petitioner’s interpretation of Dr. Anderson’s testimony. Dr. Anderson, in answering the question “[i]s the size of the acoustic model and, therefore, the number of states within the acoustic model dependent upon the lexicon being modeled,” answered “[i]f you had something that was very small, like a digits recognizer or something for account numbers like, I think, Smith was doing, then you might have an abbreviated model. And that’s why Smith could do the type of recognition he did.” Ex. 1069, 76:7–9, 76:19–23. Dr. Anderson did not state that Smyth’s abbreviated model is stored in the memory of the DSP56000. He also did not state that the memory available in the DSP56000 would have been large enough to store Smyth’s abbreviated acoustic model. Dr. Anderson’s testimony, at best, shows that

Dr. Anderson believes that the size of an acoustic model for a digits recognizer would be abbreviated, or less than, the size of a full acoustic model, which would allow a processor with limited capabilities to “do the type of recognition [that is, the type limited to recognition of digits] he did.”

Patent Owner contends that the on-chip memory of the Motorola DSP56000 is not nearly large enough to serve as Smyth’s state memory 342. PO Resp. 1. Patent Owner, relying on the testimony of Dr. Anderson, contends that only about 1.5 kilobytes of RAM memory on the DSP56000 could have been used for storing data structures such as Smyth’s state memory 342. *Id.* at 7–8 (citing Ex. 1009, Fig. 4; Ex. 2020 ¶¶ 38–45). Patent Owner contends that Smyth’s state memory 342 requires at least 720 kilobytes of memory. *Id.* at 8–9 (citing Ex. 2020 ¶ 43). Patent Owner contends that because the 1.5 kilobytes of memory available on the DSP56000 could not hold state memory 342, Smyth does not teach or suggest that its processor 341 and state memory 342 were fabricated on a single integrated circuit as claimed. *Id.* at 9–10 (citing Ex. 2020 ¶¶ 44–45).

Petitioner contends that Dr. Anderson is mistaken regarding the memory size required to store an acoustic model as taught in Smyth. Reply 5. According to Petitioner, “Mr. Schmandt testified that for *Smyth*’s allophone-based model, the size would be ‘around 4,700 bytes.’” *Id.* at 6 (quoting Ex. 2016, 55:11–13). Petitioner contends that Mr. Schmandt testified that the DSP56000 provides a large set of on-chip memory sufficient to store a large language model. *Id.* at 7 (citing Ex. 2016, 55:11–56:24). Petitioner relies on the testimony of Mr. Schmandt in contending that the large set of on-chip memory on the DSP56000 is sufficient to store an acoustic model. *Id.* Petitioner also contends that Patent Owner admitted that the DSP56000 has 9 kilobytes of RAM as well as ROM, which is

sufficient to store an acoustic model that requires 4.8 kilobytes of memory. *Id.* (citing PO Resp. 9).

Patent Owner contends that Mr. Schmandt does not testify about the amount of the available memory in the DSP56000, and that Dr. Anderson's testimony that the DSP56000 contained at most 1.5 kilobytes of available memory is unrebutted. *See* PO Sur-Reply 3–4. Patent Owner contends that Smyth's acoustic model, even accepting Mr. Schmandt's testimony that Smyth's acoustic model requires 4.7 kilobytes of memory, would have been too large for the available 1.5 kilobytes of available memory on the DSP56000. *Id.* at 2–4 (citing Ex. 2020 ¶¶ 40–41; Ex. 1068 ¶¶ 7–8).

We agree with Patent Owner and rely on Dr. Anderson's unrebutted supporting testimony in finding that Smyth's DSP contained at most 1.5 kilobytes of available memory in RAM to store Smyth's state memory 342. Neither Petitioner nor Mr. Schmandt provides sufficient evidence to rebut Dr. Anderson's persuasive declaration testimony. We rely on the testimony of Dr. Anderson in finding that the ROM on the DSP56000 would not be available for storing the acoustic model, because it is used for storing code for specialized operations, and is not modifiable by a user of the DSP. Ex. 2020 ¶ 42. We agree with Patent Owner that the 1.5 kilobytes of RAM available on the DSP56000 could not store Smyth's acoustic model, even accepting Mr. Schmandt's testimony that Smyth's acoustic model requires 4.7 kilobytes of memory.

During the hearing, Petitioner contended that Mr. Schmandt testified that four or five kilobytes of memory are needed to store a large language model, but that the amount of memory required for an abbreviated acoustic model would have been far less than that. *See* Tr. 17:22–18:8. However, Petitioner did not make this contention in the Petition or in the Reply.

Therefore, Petitioner’s contention made at the hearing is untimely. *See, e.g.*, Consolidated Trial Practice Guide 86 (Nov. 2019), <https://www.uspto.gov/TrialPracticeGuideConsolidated> (“TPG”) (stating that a party “may only present arguments relied upon in the papers previously submitted”). Further, Petitioner did not cite, and we do not discern, testimony from Mr. Schmandt contending that the memory required to store Smyth’s acoustic model would have been far less than the memory required to store a large language model. Also, Petitioner does not explain why Mr. Schmandt would testify to the amount of memory required by a large acoustic model, but not to the amount of memory required by Smyth’s abbreviated acoustic model. This is especially pertinent because the Petition and Mr. Schmandt map Smyth’s abbreviated model to the “acoustic model” as recited in claim 1. *See* Pet. 11; Ex. 1003 ¶ 150 (“In my opinion, *Smyth*’s collection of speech states in state memory 342 . . . is an acoustic model, as claimed.”).

Even were we to accept Petitioner’s untimely contention that the memory required by an abbreviated acoustic model would have been less than that required by a large language model, this contention does not allege, let alone support with evidence, that 1.5 kilobytes of memory would have been sufficient to store the abbreviated acoustic model. We decline to speculate on whether the memory required by Smyth’s abbreviated acoustic model would have been satisfied by the 1.5 kilobytes of available memory on Smyth’s DSP. Petitioner had the burden of identifying evidence to support its challenge and did not do so. We emphasize that “[i]n an [*inter partes* review], the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable.” *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016) (citing 35 U.S.C. § 312(a)(3) (requiring *inter partes* review petitions to identify “with

particularity . . . the evidence that supports the grounds for the challenge to each claim’’)). Here, neither Petitioner nor Mr. Schmandt provides persuasive evidence showing that Smyth’s acoustic model could have been stored in the 1.5 kilobytes of memory available on Smyth’s DSP.

Although Petitioner contends that the “Petition and supporting Declaration (Ex. 1003) established the ubiquity of ICs with processors and memories fabricated thereon” (Reply 2), the Petition and supporting Declaration do not establish that Smyth’s integrated circuit with a processor and a memory fabricated thereon could have stored an acoustic model as claimed. We rely on the unrebutted testimony of Dr. Anderson in determining that the integrated circuit relied on in the Petition to show that Smyth alone teaches limitation 1(e) (*see* Pet. 38–40), namely, the DSP56000, had 1.5 kilobytes of available memory, and that, even were we to accept Mr. Schmandt’s testimony that the acoustic model of Smyth requires 4,800 bytes of memory, the available memory on the DSP56000 of 1.5 kilobytes would have been too small to store the acoustic model. We find that Petitioner has not shown that processor 341 of Smyth and state memory 342 of Smyth, which Petitioner maps to the claimed “acoustic model memory,” could have both been on the DSP of Smyth. Petitioner has not shown, by a preponderance of evidence, that Smyth alone teaches that the “calculating apparatus and the acoustic model memory are fabricated on a single integrated circuit” as claimed.

Analysis of Smyth and Mozer

Petitioner contends that Mozer discloses “a single integrated circuit on which a vector processor 423 (i.e., calculating apparatus) and memory 460 (i.e., acoustic model memory) are fabricated.” Pet. 40. Petitioner contends that a person of ordinary skill in the art would have “been motivated to

modify *Smyth* to fabricate classifier processor 341 and state memory 342 of classifier 34 on a single integrated circuit according to *Mozer's* teachings.” *Id.* at 41–42.

Patent Owner contends that the Petition’s proposed modification requires that the ordinary artisan in the field of speech recognition would have fabricated a single integrated circuit with Smyth’s processor 341 and state memory 342, but that such task would have been beyond the skill of an ordinary artisan in the field of speech recognition. PO Resp. 14 (citing Ex. 2020 ¶ 55). Patent Owner contends that the Petition and supporting evidence do not show that an ordinary artisan in the field of speech recognition could have fabricated an integrated circuit comprising Smyth’s processor 341 and state memory 342 with a reasonable expectation of success. *Id.* at 16.

Petitioner contends that the Petition did not assert that a person of ordinary skill in the art would have fabricated the processor and memory on a single integrated circuit. Reply 22. Petitioner contends that the ’789 patent is silent on how the calculating apparatus and memory are fabricated on an integrated circuit, which suggests that a person of ordinary skill in the art would have known how to achieve that step, such as by purchasing a commercially available integrated circuit. *Id.* at 23–24.

Patent Owner contends that Petitioner’s contention that the Petition did not assert that a person of ordinary skill would have fabricated Smyth’s processor and state memory onto a single integrated circuit is false. PO Sur-Reply 12. Patent Owner contends that the Petition stated that “[a] POSITA would have found it obvious and been motivated to modify Smyth *to fabricate* classifier processor 341 and state memory 342 of classifier 34 on a single integrated circuit.” *Id.* at 12–13 (quoting Pet. 41–42). Patent Owner

contends that neither Petitioner nor Mr. Schmandt disputes Dr. Anderson’s showing that a person of ordinary skill would not have been capable of fabricating Smyth’s processor 341 and state memory 342 onto a single integrated circuit, as the Petition’s combination requires. *Id.* at 12 (citing Ex. 2020 ¶¶ 54–62).

In our Decision to Institute, we understood Petitioner’s theory based on the combination of Smyth and Mozer to include fabricating an integrated circuit in stating that we were sufficiently persuaded “that fabricating a single integrated circuit that includes a calculating apparatus and an acoustic model memory . . . was within the level of ordinary skill.” Dec. 23. Our understanding was based on the Petition’s multiple contentions that a person of ordinary skill would have found it obvious to fabricate Smyth’s processor and state memory on a single integrated circuit. *See* Pet. 41–44. For example, the Petition contends that “[a] POSITA would have found it obvious . . . *to fabricate* [Smyth’s processor and state memory] on a single integrated circuit” (Pet. 41–42 (emphasis added)); “a POSITA would have understood and found obvious . . . *to fabricate* a calculating apparatus and acoustic model memory on a single integrated circuit” (Pet. 42 (emphasis added)); “[s]uch a use of a known technique of *fabricating* a memory and processor on a single integrated circuit” (*id.* (emphasis added)); “it would have been obvious to modify Smyth *to form* the classifier processor and associated memory on a single IC” (Pet. 43 (emphasis added)); (“it was well known in the prior art *to fabricate* a single integrated circuit” (Pet. 43–44 (emphasis added)); “[t]hus, a POSITA would have been motivated . . . *to fabricate* [Smyth’s processor and state memory] on a single integrated circuit” (Pet. 44 (emphasis added)).

Petitioner, in its Reply, attempts to shift its theory from fabricating an integrated circuit to using integrated circuits that were already fabricated. Reply 22–25. According to Petitioner, “the Petition did not map a POSITA physically fabricating an IC, but rather mapped a POSITA modifying *Smyth* according to *Mozer*’s undisputed teachings of a single IC on which a calculating apparatus and acoustic model memory were already fabricated.” *Id.* at 23–24. However, as discussed in the previous paragraph, when discussing the combination of a processor and an acoustic model memory on an integrated circuit, the Petition used the verb “to fabricate” four times in the future tense and once in the present tense, as well as the verb “to form” once in the future tense. The Petition did not use the past tense phrase “were already fabricated” as alleged in the Reply.

Moreover, the Petition did not map *Smyth*’s state memory (which the Petition contends teaches the claimed “acoustic model memory” (*see* Pet. 11)) to a memory already fabricated on an integrated circuit in the prior art. Rather, the Petition relied on *Mozer* to support its contention that a person of ordinary skill would have fabricated the calculating apparatus and acoustic model memory of *Smyth* on an integrated circuit. *See* Pet. 42, 44. The Petition cited *Boike* and *Ozcelik* in contending that fabricating an integrated circuit with processors and memories was well known, and cited *Toyoda* in contending that fabricating an integrated circuit with a calculating apparatus and an acoustic model memory was well known. Pet. 43–44 (citing Ex. 1006; Ex. 1029; Ex. 1034). However, the Petition did not explain how a memory located in one of the integrated circuits of *Mozer*, *Boike*, *Ozcelik*, or *Toyoda* would have been able to store *Smyth*’s state memory.

Therefore, we disagree with Petitioner’s contention that “the Petition did not map a POSITA physically fabricating an IC, but rather mapped a

POSITA modifying *Smyth* according to *Mozer*'s undisputed teachings of a single IC on which a calculating apparatus and acoustic model memory were already fabricated." Reply 23–24. We find that this contention was untimely presented in the Reply. We do not permit Petitioner to propose a mapping of the prior art in the Petition and then completely change that mapping after Patent Owner argues the initial mapping was flawed. A "petitioner may not submit new evidence or argument in reply that it could have presented earlier, e.g., to make out a prima facie case of unpatentability." TPG 73; *see also Intelligent Bio-Sys., Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1369–70 (Fed. Cir. 2016) (holding that the Board did not err in refusing the reply brief as improper under 37 C.F.R. § 42.23(b) because petitioner relied on an entirely new rationale to explain why one of skill in the art would have combined the references at issue); 37 C.F.R. § 42.23(b); *Apple Inc. v. eWatch, Inc.*, IPR2015-00412, Paper 50, 44 (PTAB May 6, 2016) ("Respond," in the context of 37 C.F.R. § 42.23(b), does not mean embark in a new direction with a new approach as compared to the position originally taken in the Petition. Accepting such belatedly presented new arguments would be unjust to the Patent Owner and we decline to do so.").

We agree with Patent Owner and rely on the testimony of Dr. Anderson in finding that the Petition's combination requires fabricating Smyth's processor 341 and state memory 342 onto a single integrated circuit, which was beyond the level of ordinary skill in the art for a person in the field of speech recognition. *See* Pet. 3; Ex. 2020 ¶¶ 54–62; PO Resp. 13–18; PO Sur-Reply 12–15. Because Petitioner has not shown that fabricating an integrated circuit was within the level of ordinary skill for a person within the field of speech recognition, we find that the Petition does

not show by a preponderance of evidence that the combination of Smyth and Mozer teaches “the calculating apparatus and the acoustic model memory are fabricated on a single integrated circuit” as claimed.

Even if we were to accept Petitioner’s untimely contention that “[i]f a POSITA can be a consumer of an IC fabricated by others, then a POSITA does not need to be able to perform the actual fabrication” and that a person of ordinary skill would have mapped Smyth’s teachings to an integrated circuit that was already fabricated (Reply 24), we still would disagree. The Petition does not explain how a memory located in one of the integrated circuits relied on in the Petition would have been able to store Smyth’s state memory.

For example, Mozer discloses that an “external processor loads . . . a second vector representing a template into the memory 460,” where memory 460 is 4 kilobytes. Ex. 1046, 10:17–21. Petitioner has not explained how Smyth’s state memory, which, as Mr. Schmandt testifies, requires at least 4.7 kilobytes, would have been stored in Mozer’s 4kilobytes of memory. Similarly, Petitioner has not shown that Toyoda’s, Boike’s, or Ozcelik’s memory would have been large enough to store Smyth’s acoustic model. Further, we agree with Patent Owner and Dr. Anderson, that Boike and Ozcelik are not directed to speech recognition, and do not teach an integrated circuit that has an acoustic model memory as recited in claim 1. PO Sur-Reply 13–14 (citing Ex. 2020 ¶¶ 57–58).

We also agree with Patent Owner that Petitioner has not persuasively shown that the processor and acoustic model memory of Toyoda were fabricated on an integrated circuit. PO Sur-Reply 14. Although Petitioner relies on the testimony of Mr. Schmandt to show that Toyoda teaches an acoustic model memory and a processor fabricated on an integrated circuit,

Mr. Schmandt does not identify persuasive evidence to support this conclusion. *See* Ex. 1003 ¶ 74. Missing from Mr. Schmandt’s analysis is evidence to show that a person of ordinary skill in the art would have understood that the sensor signal processor would have been fabricated as an integrated circuit. *See id.* In contrast, Dr. Anderson testifies that Toyoda does not teach fabricating an integrated circuit with a processor and acoustic model memory. Ex 2020 ¶¶ 57–58; *see id.* ¶ 62. Given the persuasive testimony from Dr. Anderson and the lack of evidence to support Mr. Schmandt’s conclusion, we agree with Patent Owner (PO Resp. 16–18; PO Sur-Reply 14) in finding that Petitioner has not shown by a preponderance of evidence that the components of Toyoda’s sensor signal processor were fabricated on an integrated circuit.

Similarly, we agree with Patent Owner that Petitioner has not shown that Mozer discloses a calculating apparatus and an acoustic model memory fabricated on an integrated circuit as claimed. PO Sur-Reply 13. The Petition contends that “*Mozer* teaches a single integrated circuit on which a vector processor 423 (i.e., calculating apparatus) and memory 460 (i.e., acoustic model memory) are fabricated.” Pet. 40. We disagree. Petitioner has not persuasively explained how the memory of Mozer, which stores a vector representing a template (Ex. 1046, 10:17–21), teaches the claimed acoustic model memory. In particular, Petitioner has not explained how a vector representing a template teaches “an acoustic model defining a plurality of states” as claimed. We rely on the cross-examination testimony of Mr. Schmandt in which he agreed with Patent Owner that Mozer does not teach a single integrated circuit on which “the calculating apparatus and the acoustic model memory are fabricated” as recited in claim 1. PO Sur-Reply 13 (citing Ex. 2021, 31:15–21 (Mr. Schmandt testifying that the “vector

memory [460 of Mozer] is not the same as the full acoustic template memory”)).

Petitioner’s specific motivation statements to the contrary are not persuasive, because Mozer does not teach a calculating apparatus and an acoustic model memory fabricated on an integrated circuit as recited in claim 1. Therefore, the benefits of Mozer identified in the Petition are benefits that are achieved without “the calculating apparatus and the acoustic model memory [being] fabricated on a single integrated circuit” as recited. Petitioner presents two specific benefits taught by Mozer, namely, offloading vector processing operations, and not requiring a CPU HOLD to access data in the acoustic model memory. However, both of these benefits are achieved without fabricating the calculating apparatus and the acoustic model memory on an integrated circuit as discussed below. Petitioner further contends that Dr. Anderson provided a motivation to combine Smyth and Mozer in testifying that increasing on-chip memory to hold part of an acoustic model would have limited off-chip memory transfers as taught by Nguyen. Reply 12. Petitioner also contends that the Petition established that the combination of Smyth and Mozer was the use of the known technique of utilizing a memory and a processor fabricated on a single integrated circuit. *Id.* at 13–14. We address Petitioner’s specific motivation statements in the following paragraphs.

Petitioner contends that Mozer teaches the benefit of offloading vector processing operations to an audio recognition peripheral, and that this advantage is due to the processor and memory of the peripheral being on one integrated circuit. Pet. 42; Reply 15. In contrast, Patent Owner contends that Smyth already offloads vector processing operations to its classifier 34 without fabricating processor 341 and state memory 342 on a single

integrated circuit. PO Resp. 10–11; PO Sur-Reply 5. Patent Owner further contends that the advantage of offloading taught by Mozer exists with respect to all embodiments of Mozer, not only to Mozer’s embodiments that have a vector processor and memory on the same integrated circuit. PO Sur-Reply 6–7.

We agree with Patent Owner. Mozer discloses that “embodiments described herein are illustrative of the advantages of providing a recognition peripheral system on one integrated circuit” (Ex. 1046, 9:16–18), where some embodiments of the recognition peripheral system, such as Figures 3 and 4, disclose a processor and memory on the same integrated circuit, and other embodiments, such as Figures 1 and 2, do not. *See id.* at 5:3–7, Fig. 2. Mozer teaches that “*the addition of a vector processor on the audio recognition peripheral 220 (of Figure 2),*” not the addition of a vector processor and memory, “*further reduces the loading on the CPU 210.*” *Id.* at 5:61–64 (emphasis added). Dr. Anderson testifies that a person of ordinary skill would have known that Smyth, without modification, already achieves the benefit of offloading without fabricating processor 341 and state memory 342 on a single integrated circuit. Ex. 2020 ¶¶ 48–49. We rely on Dr. Anderson’s testimony in finding that the advantage of offloading vector processing taught by Mozer is achieved by both Mozer and Smyth without fabricating a processor and acoustic model memory on a single integrated circuit.

Petitioner contends that Mozer teaches a benefit in disclosing an embodiment where “the vector processor does not generate a CPU HOLD signal on control line 428 to carry out the vector operation because both vector inputs are accessed from peripheral memory 460.” Reply 16 (quoting Ex. 1046, 10:27–30) (emphasis omitted). Petitioner then cites to another

embodiment of Mozer where the vector processor generates a CPU HOLD and “accesses the template vector in external memory . . . over vector processor interface lines 446.” *Id.* at 18 (quoting Ex. 1046, 10:1–16).

Petitioner contends that when the template vector is stored in memory on the same chip as the vector processor, a CPU HOLD is not required, but when the template vector is stored in external memory, a CPU HOLD is required. *Id.* at 19. Petitioner contends that Mozer’s no CPU HOLD embodiment is a benefit that results from fabricating an acoustic model memory such as Smyth’s state memory and a calculating apparatus on the same integrated circuit. *Id.*

Patent Owner contends that a CPU HOLD is only required where an external memory is shared between multiple devices. PO Sur-Reply 8–9 (citing Ex. 1068 ¶ 10; Ex. 2021, 35:2–6, 36:2–12). Patent Owner contends that an external memory that is not shared between multiple devices, such as a vector processor and a CPU, would not require a CPU HOLD. *Id.* at 9. Patent Owner contends that Petitioner’s comparison between Mozer’s embodiment discussed at 9:35–10:16 with the embodiment discussed at 10:16–34 is incorrect, because the distinction is not between on-chip versus off-chip memory, but between a memory shared between devices and a memory accessible by only one device. *Id.* Patent Owner contends that Petitioner has not shown that Smyth’s state memory 342 is shared between multiple devices and would require a CPU HOLD. *Id.* at 10.

We agree with Patent Owner. Dr. Anderson testifies that the purpose of a CPU HOLD is to prevent memory collisions that would occur if two processors were to attempt to access the same memory at the same time. Ex. 2020 ¶ 53. Dr. Anderson testifies that Mozer’s “vector processor does not generate a CPU HOLD . . . because both vector inputs are accessed from

peripheral memory 460.” *Id.* ¶ 52 (quoting Ex. 1046, 10:17–34) (alteration in original). Dr. Anderson testifies that Smyth does not have multiple processors connected to its state memory, therefore, it already has the benefit of not requiring a CPU HOLD to access information from state memory. *Id.* ¶ 53.

Petitioner contends that Dr. Anderson admitted that limiting transfers from off-chip memory would make a system more efficient, and that there are benefits to Nguyen’s batch-based approach that could hold part of an acoustic model. Reply 12 (citing Ex. 1047; Ex. 1069, 79:18–21, 89:3–92:21). Patent Owner, in contrast, contends that Petitioner is citing to Dr. Anderson’s testimony about the teachings of the ’789 patent, not the prior art, and to Dr. Anderson’s testimony discussing the reason that Nguyen does not teach an acoustic model memory as claimed. PO Sur-Reply 10–11 (citing Ex. 1069, 88:17–91:10, 92:12–21).

We agree with Patent Owner. As discussed above in our analysis of Smyth alone, Dr. Anderson testified that the teachings of the ’789 patent itself were unknown in the prior art, and, to the extent that the advantages from a processor and a memory fabricated on the same integrated circuit were known, such advantages by themselves do not show that any of the prior art integrated circuits relied on in the Petition would have been able to store Smyth’s state memory.

With respect to Dr. Anderson’s testimony regarding the teachings of Nguyen, we disagree with Petitioner’s conclusion. Dr. Anderson testifies that “Ng[u]yen proposes . . . this batched-based approach . . . does provide some modest benefits to have . . . on-chip memory that could hold part of an acoustic model, but . . . that’s not something I considered closely, because that’s not what the claim requires [The claim requires] memory for

storing the acoustic model.” Ex. 1069, 92:12–21. Placing this testimony in the context of Dr. Anderson’s complete answer to the question “Is it beneficial to have a larger memory that is on chip to hold more of the acoustic states of the acoustic model” (*id.* at 91:21–23), he answered that the amount of memory in the Petition’s proposed combination of prior art would have to be increased by a factor of 480 in order to hold the acoustic model as claimed. *Id.* at 91:24–92:21. Contrary to Petitioner’s contention, Dr. Anderson was testifying that the memory of Nguyen, as well as the memory of the other references relied on in the Petition, was not large enough to store an acoustic model as claimed.

We highlight that the Petition did not rely on the teachings of Nguyen to support the contention that the combination of Smyth and Mozer teaches a processor and an acoustic model memory fabricated on an integrated circuit. Nor did the Petition identify any portion of Nguyen that teaches a processor and an acoustic model memory fabricated on an integrated circuit. Having reviewed Nguyen, we do not find that Nguyen teaches a processor and an acoustic model memory fabricated on an integrated circuit. We find that Dr. Anderson’s testimony with respect to Nguyen is consistent with his testimony in the context of his entire answer and is consistent with his declaration testimony that the prior art cited in the Petition neither discloses nor teaches a processor and an acoustic model memory fabricated on an integrated circuit as claimed.

Petitioner contends that “the Petition established the combination would have been ‘use of a known technique of fabricating a memory and processor on a single integrated circuit.’” Reply 13 (quoting Pet. 42) (emphasis omitted). Again, Petitioner is contending that the knowledge of a person of ordinary skill in the art of speech recognition would have included

knowledge of a technique of fabricating an integrated circuit. However, as discussed above, the Petition did not establish that a person of ordinary skill in the art of speech recognition would have known how to fabricate an acoustic model memory and processor on a single integrated circuit.

In Reply, Petitioner contends that “if there’s a known technique to address a known problem using ‘prior art elements according to their established functions,’ then there is a motivation to combine.” Reply 13 (quoting *Intel Corp. v. PACT XPP Schweiz AG*, 61 F.4th 1373, 1380 (Fed. Cir. 2023)). Petitioner contends that Patent Owner does not dispute that a processor and memory fabricated on an integrated circuit is known, that fabricating the components on the same integrated circuit improves efficiency, and that integrated circuits for speech recognition were ubiquitous. *Id.* Petitioner contends that the Smyth-Mozer combination would not have been beyond the level of ordinary skill because integrated circuits with a processor and a memory fabricated thereon were commonly available. *Id.* at 14. Petitioner contends that “the Petition established the *Smyth-Mozer* combination was use of a known technique of utilizing a memory and processor fabricated on a single IC, and [Patent Owner] admitted it was within the POSITA’s skillset to procure such hardware to utilize in a speech recognition system.” *Id.*

Patent Owner contends that Petitioner has not presented persuasive evidence showing that fabricating a single integrated circuit with a “calculating apparatus” and “an acoustic model memory for storing an acoustic model defining a plurality of states” as claimed was known. PO Sur-Reply 11. Patent Owner contends that Petitioner relies on generic knowledge regarding the benefits of integrated circuits writ large, which cannot serve to render the specific speech recognition circuit of the

challenged claims. *Id.* Patent Owner contends that Petitioner cannot identify the specific speech recognition circuit of the challenged claims anywhere in the prior art. *Id.*

We agree with Patent Owner. Petitioner has not shown that any of the integrated circuits cited in the Petition would have been able to include the claimed acoustic model memory. Further, we find, contrary to Petitioner's contention, that Patent Owner did not admit that procuring a processor and a memory capable of storing an acoustic model memory fabricated on an integrated circuit was within the level of ordinary skill. To the contrary, throughout the entire proceeding, Patent Owner has consistently argued that the claimed "calculating apparatus and the acoustic model memory are fabricated on a single integrated circuit" was unknown in the prior art. Petitioner has not shown that using the prior art elements relied on in the Petition according to their established functions would have resulted in "the calculating apparatus and the acoustic model memory are fabricated on a single integrated circuit" as recited in claim 1.

In summary, Petitioner relies on Mozer to teach the benefits of fabricating a calculating apparatus and an acoustic model memory on the same integrated circuit, but Mozer does not teach a calculating apparatus and an acoustic model memory fabricated on the same integrated circuit. Further, the benefits of Mozer identified by Petitioner are benefits that both Mozer and Smyth already have, without fabricating the calculating apparatus and the acoustic model memory on the same integrated circuit. Also, even if Petitioner had shown there was a reason to combine Smyth and Mozer, Petitioner does not persuasively show that the combination teaches "the calculating apparatus and the acoustic model memory are fabricated on a single integrated circuit" as recited in claim 1. The Petition identifies only

one integrated circuit that would have been able to include an “acoustic model memory for storing an acoustic model defining a plurality of acoustic states” as claimed, which is the one that “a POSITA would have been motivated . . . to fabricate” (Pet. 44), which was beyond the level of ordinary skill. We find that the Petition has not shown that claim 1 is unpatentable over Smyth and Mozer.

4. *Claim 10*

Petitioner relies on its contentions with respect to claim 1 for how the combination of Smyth and Mozer teaches the subject matter of independent claim 10. Pet. 44.

A first interface

Claim 10 recites “a first interface for receiving at least one feature vector.” Petitioner contends that the combination of Smyth and Mozer teaches this limitation. Pet. 17. Petitioner contends that Smyth describes “wherein the feature vector is determined from the audio signal” in disclosing a classifier that receives feature vectors generated from frames of speech samples. Pet. 17–19. Petitioner contends that Smyth describes “a first interface for receiving at least one feature vector” in disclosing a signal line that transmits feature vectors to the classifier. Pet. 19–22.

Petitioner contends that to the extent Smyth does not teach the claimed first interface, it would have been obvious to modify Smyth’s system to include Mozer’s signal lines. Pet. 22. Mozer describes “a ‘first interface’ for receiving at least one feature vector” in disclosing memory input lines and memory interface lines that send feature vectors from a feature extractor to memory. Pet. 22–23 (citing Ex. 1046, 6:55–7:27, 9:54–56, Fig. 3; Ex. 1003 ¶ 138). Petitioner, relying on the testimony of Mr. Schmandt, contends that Mozer’s technique of transmitting data between

electronic components over signal lines would have improved Smyth's feature vector extractor in the same way, namely, providing for transmission of data between the extractor and the classifier. Pet. 23–24 (citing Ex. 1003 ¶ 139); *see KSR*, 550 U.S. at 417 (“[I]f a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill.”).

Patent Owner does not present arguments to the contrary. We find that Petitioner has shown that Smyth alone as well as the combination of Smyth and Mozer teaches this limitation.

A calculating apparatus

Claim 10 recites “a calculating apparatus for calculating distances indicating a similarity between the at least one feature vector and at least one acoustic state of an acoustic model read from an acoustic model memory.” Petitioner contends that Smyth describes this limitation in disclosing a classifier that calculates state probabilities indicating the likelihood that the input feature vector corresponds to each acoustic state of the acoustic model read from state memory 342. Pet. 29–30. Petitioner contends that the probabilities are distances, because each probability represents the likelihood that the input feature vector corresponds to the corresponding acoustic state. Pet. 30–33.

Patent Owner does not present arguments to the contrary. We find that Petitioner has shown that Smyth teaches this limitation.

A second interface

Claim 10 recites “a second interface for sending at least one distance calculated by the calculating apparatus.” Petitioner contends that Smyth

describes this limitation in disclosing a signal line that transmits state probabilities from the classifier to the sequencer. Pet. 33–37.

Petitioner contends that to the extent that Smyth alone does not teach this limitation, the combination of Smyth and Mozer teaches this limitation. Pet. 37–38. Petitioner contends that Mozer describes this limitation in disclosing an interface for sending a calculated distance. Pet. 37–38. Petitioner contends that a person of ordinary skill in the art would have been motivated to combine the second interface of Mozer with the classifier and sequencer of Smyth for the reasons given in Petitioner’s analysis of the claimed “first interface.” Pet. 37.

Patent Owner does not present arguments to the contrary. We find that Petitioner has shown that Smyth alone as well as the combination of Smyth and Mozer teaches this limitation. We find that Petitioner has shown, by a preponderance of evidence, that claim 10 is unpatentable over Smyth alone as well as the combination of Smyth and Mozer.

5. Dependent Claims 11, 14, and 17

Claim 11 depends from claim 10 and recites “wherein the calculating apparatus and the acoustic model memory are fabricated on a single integrated circuit.” Petitioner contends that a person of ordinary skill would have been motivated to modify Smyth according to Mozer’s teachings for the reasons given in Petitioner’s analysis of the term “the calculating apparatus and the acoustic model memory are fabricated on a single integrated circuit” recited in claim 1. Pet. 44.

We find that the combination of Smyth and Mozer does not teach this limitation for the reasons given in our analysis of claim 1. We find that the Petition has not shown that claim 11 is unpatentable over Smyth and Mozer.

Claim 14 depends from claim 10 and recites “wherein the second interface for sending distances is a serial bus.” Petitioner contends that the combination of Smyth and Mozer teaches this limitation. Pet. 44–45. Petitioner contends that Smyth teaches a second interface for sending distances, and Mozer teaches sending information over a serial bus. *Id.* (citing Ex. 1046, 4:17–28; Ex. 1003 ¶ 174).

Petitioner contends that a person of ordinary skill would have been motivated to modify Smyth according to Mozer’s teachings for the reasons given in Petitioner’s analysis of the term “the calculating apparatus and the acoustic model memory are fabricated on a single integrated circuit” recited in claim 1, namely, to reduce resource loading on the programmable processing unit. Pet. 45 (citing Pet. 38–44; Ex. 1003 ¶ 175; Ex. 1046, 4:44–49). Petitioner also contends that a person of ordinary skill in the art would have understood that transmitting data in serial format provides the benefit of reducing trace complexity of a printed circuit board such as an integrated circuit by using a single line instead of multiple copper traces and thus requires less space. *Id.* (citing Ex. 1003 ¶ 175). Mr. Schmandt testifies that a person of ordinary skill would have understood that in some circumstances, using a serial bus would have been more efficient due to a limited number of connection lines. Ex. 1003 ¶ 175 (citing Ex. 1064, 6:64–7:11). Patent Owner does not present arguments to the contrary.

We find that fabricating an integrated circuit was beyond the level of ordinary skill in the art as discussed in our analysis of claim 1. Therefore, we find that a person of ordinary skill in the art would not have modified Smyth according to Mozer’s teachings for the reasons given in Petitioner’s analysis of the term “the calculating apparatus and the acoustic model memory are fabricated on a single integrated circuit” recited in claim 1, nor

for the benefit of reducing trace complexity of a printed circuit board such as an integrated circuit.

However, we are persuaded by Mr. Schmandt’s testimony that a person of ordinary skill in the art would have used a serial bus for the benefit of increasing efficiency due to a limited number of interconnection lines. The reference relied on by Mr. Schmandt teaches employing a serial bus to exchange data with an external device “due to the limited number of interconnection lines or yet other conditions where exchange of serial data is more feasible and practical.” Ex. 1064, 6:64–7:11. Further, Mozer teaches that a person of ordinary skill in the art would have understood that a serial bus may be used instead of a parallel bus to connect one device to another. Ex. 1046, 4:17–28 (“[T]he programmable processing unit 110 also transmits . . . information to the audio recognition peripheral 120 over the general purpose bus 130. . . . The bus 130 may include . . . parallel lines. . . . Of course, a serial bus may also be employed.”). We find that employing a serial bus instead of a parallel bus was within the knowledge of a person of ordinary skill. We rely on Mr. Schmandt’s testimony in finding that a person of ordinary skill in the art would have used a serial bus as Smyth’s second interface for sending distances for the benefit of increasing efficiency due to a limited number of interconnection lines or other conditions where exchange of serial data is more practical. We find that the Petition has shown by a preponderance of evidence that claim 14 is unpatentable over Smyth and Mozer.

Claim 17 recites “wherein the acoustic coprocessor is capable of, in response to receiving a feature vector, autonomously calculating the distances for each acoustic state of the acoustic model.” Petitioner contends that Smyth’s classifier is configured to autonomously calculate distances

because classifier processor 341 reads each state field stored in state memory 342 and calculates a distance for each state in response to receiving a feature vector. Pet. 46–47 (citing Ex. 1005, 5:7–9, 5:63–67; Ex. 1003 ¶ 176).

Patent Owner does not present arguments to the contrary.

We agree with Petitioner and Mr. Schmandt in finding that Smyth teaches this limitation of claim 17. We find that the Petition has shown by a preponderance of evidence that claim 17 is unpatentable over Smyth and Mozer.

E. Challenge Based on Smyth, Mozer, and Nguyen

Petitioner contends that claims 2, 4, 6–9, 12, 16, 18, 20, and 21 are unpatentable over Smyth, Mozer, and Nguyen. Pet. 4.

1. Overview of Nguyen

Nguyen discloses a method for improving pattern matching in a speech recognition system having a plurality of acoustic models. Ex. 1047, Abstract. Nguyen discloses that the method performs a similarity measure for a group of vectors by loading an acoustic model into memory, where Gaussian distribution data is the basis for the acoustic model. *Id.* at 3:35–46. Nguyen discloses computing a similarity measure for each acoustic feature vector by performing a Gaussian computation. *Id.* at 3:50–54.

2. Claims 2, 4, 6–9, 12, 16, 18, 20, and 21

Claims 2, 4, and 6–9 depend from claim 1. Petitioner has not shown that claim 1 is unpatentable over the combination of Smyth and Mozer, because the Petition has not shown that the combination teaches the claim limitation “the calculating apparatus and the acoustic model memory are fabricated on a single integrated circuit” as discussed above in our analysis of claim 1. Petitioner does not rely on Nguyen to teach this limitation. *See*

Pet. 47–59. Therefore, Petitioner has not shown that claims 2, 4, and 6–9 are unpatentable over the combination of Smyth, Mozer, and Nguyen.

Claim 12 depends from claim 10 and recites “wherein the acoustic model contains Gaussian parameters and the distances are probabilities.” Petitioner contends that this claim is unpatentable for the reasons given in the Petition’s analysis of claims 2 and 10. Pet. 58. Petitioner contends that Nguyen teaches this limitation in disclosing a method that performs a similarity measure for a group of vectors where Gaussian distribution data serves as the basis for the acoustic model, and the similarity measure is computed by performing a Gaussian computation for each acoustic feature vector. Pet. 47–48 (citing Ex. 1047, 2:30–38, 3:35–46, 3:50–54). Petitioner contends that Nguyen discloses that a mixture of Gaussian distributions may be used to represent probability values. Pet. 48 (citing Ex. 1047, 2:49–67, Fig. 1; Ex. 1003 ¶ 177). Petitioner contends that a person of ordinary skill in the art would have modified Smyth’s acoustic model to represent probability in terms of a Gaussian distribution for the benefits of providing probability values associated with each state that are more complex than a single value could represent and for providing a more robust model. Pet. 49 (citing Ex. 1003 ¶ 178).

Patent Owner does not present arguments to the contrary. We agree with Petitioner and rely on Mr. Schmandt’s testimony in finding that claim 12 is unpatentable over the combination of Smyth, Mozer, and Nguyen.

Claim 16 recites a “speech recognition system comprising the acoustic coprocessor of claim 10, the speech recognition system further comprising at least one CPU, wherein: the CPU executes software to perform or initiate a speech recognition word search using one or more distances calculated by the acoustic coprocessor in response to receiving a first feature vector, and a

time period for the speech recognition word search overlaps with a time period for the acoustic coprocessor to calculate one or more distances in response to receiving a second feature vector.”

Petitioner contends that this claim is unpatentable for the reasons given in the Petition’s analysis of claims 9 and 10. Pet. 58. Petitioner contends that Smyth teaches “at least one CPU” in describing that parsing processor 351 may be a microprocessor such as the Intel 486 microprocessor or the Motorola 68000 microprocessor. Pet. 53 (citing Ex. 1005, 6:47–51; Ex. 1003 ¶ 185). Petitioner contends that Smyth teaches that “the CPU . . . perform[s] . . . a speech recognition word search” as claimed in describing that the parsing processor reads probabilities, or “distances calculated by the acoustic processor” as claimed, output by classifying processor 341 and compares the probabilities with stored state sequences, where each state sequence corresponds to a word or phrase. Pet. 53–54. Petitioner contends that parsing processor 351 outputs the most probable state sequence indicating the recognized word or phrase. *Id.* (citing Ex. 1005, 6:36–61; Ex. 1003 ¶ 187).

Petitioner contends that Nguyen teaches that the “time period for the . . . word search overlaps with a time period . . . to calculate . . . distances” as claimed in disclosing computing a similarity measure for each feature vector in a first group of feature vectors, performing a word search process based on the similarity measures, and, contemporaneous with the word search process, retrieving a subsequent group of feature vectors and computing a similarity measure for each feature vector in the subsequent group. Pet. 55–57 (citing Ex. 1047, 2:30–38, 3:11–24, 3:51–52, 3:61–4:22, Fig. 1; Ex. 1003 ¶¶ 189–193). Petitioner contends that a person of ordinary skill in the art would have modified Smyth’s system so that classifier processor 341

performs distance calculations contemporaneous with parser processor 351 performing a word search for the benefit of improving system performance as taught by Nguyen.

Patent Owner does not present arguments to the contrary. We agree with Petitioner and rely on Mr. Schmandt's testimony in finding that claim 16 is unpatentable over the combination of Smyth, Mozer, and Nguyen.

Claim 18 depends from claim 17 and recites "one or more result memories configured to store the distances for each acoustic state of the acoustic model." Petitioner contends that this claim is unpatentable for the reasons given in Petitioner's analysis of claim 7. Pet. 58. Petitioner contends that Nguyen teaches a result memory in disclosing an output memory space that stores resulting similarity measures and is accessible to the processor performing computations. Pet. 50 (citing Ex. 1047, 4:1–7). Petitioner contends that a person of ordinary skill in the art would have added the result memory of Nguyen to Smyth's classifier for the benefit of writing distances to memory without waiting for the sequencer to be ready to accept the results. Pet. 51 (citing Ex. 1003 ¶ 182).

Patent Owner does not present arguments to the contrary. We agree with Petitioner and rely on Mr. Schmandt's testimony in finding that claim 18 is unpatentable over the combination of Smyth, Mozer, and Nguyen.

Claim 20 depends from claim 18 and recites "the calculating apparatus is capable of computing distances using acoustic models representing Gaussian probability distributions." Petitioner contends that this claim is unpatentable for the reasons given in Petitioner's analysis of claims 2 and 18. Pet. 58. Petitioner contends that Nguyen teaches this limitation in disclosing a method that performs a similarity measure for a group of vectors where Gaussian distribution data serves as the basis for the

acoustic model, and the similarity measure is computed by performing a Gaussian computation for each acoustic feature vector. Pet. 47–48 (citing Ex. 1047, 2:30–38, 3:35–46, 3:50–54). Petitioner contends that Nguyen discloses that a mixture of Gaussian distributions may be used to represent probability values. Pet. 48 (citing Ex. 1047, 2:49–67, Fig. 1; Ex. 1003 ¶ 177). Petitioner contends that a person of ordinary skill in the art would have modified Smyth’s acoustic model to represent probability in terms of a Gaussian distribution for the benefits of providing probability values associated with each state that are more complex than a single value could represent and for providing a more robust model. Pet. 49 (citing Ex. 1003 ¶ 178).

Patent Owner does not present arguments to the contrary. We agree with Petitioner and rely on Mr. Schmandt’s testimony in finding that claim 20 is unpatentable over the combination of Smyth, Mozer, and Nguyen.

Claim 21 depends from claim 20 and recites “the acoustic model uses a neural network to calculate at least one of the distances.” Petitioner contends that Mozer teaches an acoustic coprocessor using a neural network to calculate distances. Pet. 59 (citing Ex. 1046, 10:35–52). Petitioner contends that a person of ordinary skill in the art would have calculated distances in the system of Smyth using a neural network as taught by Mozer for the benefit of using Mozer’s known technique of calculating distances using a neural network to improve Smyth’s speech recognition system in the same way. Pet. 59 (citing Ex. 1003 ¶ 204). Mr. Schmandt testifies that using a neural network would improve Smyth’s system, citing to Jelinek to support his conclusion. Ex. 1003 ¶ 204; *see id.* ¶ 67 (citing Ex. 1020, 43). Jelinek teaches that “it is possible to use models other than HMMs as a basis

of speech recognition. Among these, artificial neural networks . . . are preeminent.” Ex. 1020, 43.

Patent Owner does not present arguments to the contrary. We agree with Petitioner and rely on Mr. Schmandt’s testimony in finding that claim 21 is unpatentable over the combination of Smyth, Mozer, and Nguyen.

F. Challenge Based on Smyth, Mozer, and Houser

Petitioner contends that claim 13 is unpatentable over the combination of Smyth, Mozer, and Houser. Pet. 4.

1. Overview of Houser

Houser discloses an information system having a speech interface for implementing spoken control of electronic devices. Ex. 1040, 2:19–21. The system includes a ROM for storing speech recognition software and phoneme definitions, a RAM for storing vocabulary, and a flash memory for maintaining the vocabulary after power is removed. *Id.* at 15:29–34. A processor performs speech recognition using the stored speech recognition software and vocabulary. *Id.* at 15:42–46. When words are spoken, the processor uses phonemic definitions and speech recognition software stored in ROM to compare the spoken words with the vocabulary data stored in RAM and/or flash memory. *Id.* at 15:48–55.

2. Claim 13

Claim 13 recites “the acoustic model memory is a FLASH memory.” Petitioner contends that Houser teaches a speech recognition system including flash memory for storing phonemic or template vocabulary data. Pet. 59 (citing Ex. 1040, 15:33, 15:46–48). Petitioner contends that a person of ordinary skill in the art would have modified Smyth to use flash memory for state memory 342 (which Petitioner maps to the claimed “acoustic model

memory”) for the benefits of providing fast and non-volatile memory. Pet. 60 (citing Ex. 1003 ¶ 205).

Patent Owner does not present arguments to the contrary. We agree with Petitioner and rely on the testimony of Mr. Schmandt in finding that claim 13 is unpatentable over the combination of Smyth, Mozer, and Houser.

G. Challenge Based on Smyth, Mozer, Nguyen, and Vensko

Petitioner contends that claims 22–24 are unpatentable over the combination of Smyth, Mozer, Nguyen, and Vensko. Pet. 4.

1. Overview of Vensko

Vensko discloses a continuous speech recognition system that includes a plurality of processors doing template comparisons of speech data. Ex. 1038, Abstract. Vensko discloses a plurality of template processors, where each template processor compares each received distance vector with its assigned templates stored in its memory using a dynamic programming algorithm (DPA). *Id.* at 5:67–6:3. When each template processor has run the DPA on each of the assigned templates for the distance vector and obtained a result, the template processors generate an interrupt to a master processor to inform the master processor that the results are ready for transfer. *Id.* at 6:29–33.

2. Claims 22–24

Claim 22 depends from claim 21 and recites “the acoustic coprocessor is capable of generating an interrupt in response to a completion of calculation of a set of distances.” Petitioner contends that Vensko teaches this limitation in describing a template processor that performs comparisons between a distance vector and its assigned templates, and generates an interrupt when results are ready for transfer. Pet. 60 (citing Ex. 1038, 6:22–

29; Ex. 1003 ¶ 206). Petitioner contends that a person of ordinary skill in the art would have modified Smyth's classifier 34 to generate an interrupt to inform Smyth's sequencer 35 that a set of distances have been calculated as taught by Vensko for the benefit of increasing the efficiency of transmitting data to the sequencer. Pet. 60–61 (citing Ex. 1003 ¶ 207).

Patent Owner does not present arguments to the contrary. We agree with Petitioner and rely on Mr. Schmandt's testimony in determining that claim 22 is unpatentable over the combination of Smyth, Mozer, Nguyen, and Vensko.

Claim 23 depends from claim 22 and recites “the acoustic model memory includes a plurality of storage locations within a static random access memory (SRAM).” Petitioner contends that Mozer teaches using SRAM to store a feature vector and a vector representing a template. Pet. 61 (citing Ex. 1046, 9:22–28; Ex. 1003 ¶ 208). Petitioner, relying on the testimony of Mr. Schmandt, contends that a person of ordinary skill in the art would have implemented Smyth's state memory using SRAM as taught by Mozer for the benefits of providing fast memory access and low power consumption. Pet. 60–61 (citing Ex. 1003 ¶ 209).

Patent Owner does not present arguments to the contrary. We agree with Petitioner and rely on Mr. Schmandt's testimony in determining that claim 23 is unpatentable over the combination of Smyth, Mozer, Nguyen, and Vensko.

Claim 24 depends from claim 23 and recites “the SRAM and the calculating apparatus are fabricated on a single integrated circuit.” Petitioner contends that a person of ordinary skill would have been motivated to modify Smyth according to Mozer's teachings for the reasons given in Petitioner's analysis of the term “the calculating apparatus and the

acoustic model memory are fabricated on a single integrated circuit” recited in claim 1. Pet. 62.

We find that the combination of Smyth and Mozer does not teach this limitation for the reasons given in our analysis of claim 1. Petitioner does not rely on Nguyen or Vensko to teach this limitation. *See* Pet. 62. We find that the Petition has not shown that claim 24 is unpatentable over the combination of Smyth, Mozer, Nguyen and Vensko.

H. Challenge Based on Smyth, Mozer, Nguyen, Vensko, and Comeau

Petitioner contends that claims 25–28 and 37 are unpatentable over the combination of Smyth, Mozer, Nguyen, Vensko, and Comeau. Pet. 4.

1. Overview of Comeau

Comeau discloses a resource sharing system which makes a resource connected to one processor available to a second processor. Ex. 1044, Abstract. Comeau discloses a coprocessor mailbox/status register 102 that notifies a host processor 40 when a host FIFO memory 76 that is used to transmit data from a coprocessor 48 to the host processor is full, empty, or not empty. *Id.* ¶¶ 151–161, 168, 181–182. Comeau discloses that status register 102 includes a bit to indicate that host FIFO 76 is empty, and a bit to indicate that host FIFO 76 is full. *Id.* ¶ 342 (Table 5).

2. Claims 25–28 and 37

Claim 25 depends from claim 22 and recites “a status register, wherein the acoustic coprocessor is capable of setting one or more bits in the status register to values that indicate the completion of calculation of the set of distances.” Petitioner contends that Smyth teaches an acoustic coprocessor for the reasons given in Petitioner’s analysis of claim 1, and that Comeau teaches a status register that sets a bit to notify a host processor whether the register is empty, full, or not empty. Pet. 62–63. Petitioner

contends that a person of ordinary skill would have modified the acoustic coprocessor of Smyth to include the status register of Comeau for the benefit of providing a flexible mechanism for status information to be shared with another processor. Pet. 64 (citing Ex. 1003 ¶¶ 215–216). Mr. Schmandt testifies that modifying the acoustic coprocessor of Smyth to include a status register and setting a bit in the status register when distance calculations are available provides the benefit of informing parsing processor 351 that distance calculations are available, thus providing a flexible mechanism for status information to be shared with the parsing processor as taught by Comeau. Ex. 1003 ¶¶ 213–215 (citing Ex. 1044 ¶ 201).

Patent Owner does not present arguments to the contrary. We agree with Petitioner and rely on Mr. Schmandt’s testimony in determining that claim 25 is unpatentable over the combination of Smyth, Mozer, Nguyen, Vensko, and Comeau.

Claim 26 depends from claim 25 and recites “the acoustic coprocessor further comprises a direct memory access (DMA) controller capable of copying distances from the one or more result memories to a buffer memory.” Petitioner contends that Vensko teaches a plurality of template processors that each compare speech data to templates, where each processor has an associated memory shared with other processors by direct memory access (DMA) through a shared data bus. Pet. 65 (citing Ex. 1038, 7:48–53). Petitioner contends that Vensko teaches that DMA transfers may be used to transfer vector data from an end processor to each template processor, to transfer template data among template processors, or to transfer template processor results data to a master processor. *Id.* (citing Ex. 1038, 10:3–9, 10:19–31, Figs. 4, 5, 7; Ex. 1003 ¶ 218). Petitioner contends that a person of ordinary skill in the art would have included a DMA controller as

taught by Vensko in Smyth's recognition processor 3 in order to copy distances from a result memory to a buffer memory for the benefit of reducing the load on the processors of Smyth. Pet. 65–66 (citing Ex. 1003 ¶ 219).

Patent Owner does not present arguments to the contrary. We agree with Petitioner and rely on Mr. Schmandt's testimony in determining that claim 26 is unpatentable over the combination of Smyth, Mozer, Nguyen, Vensko, and Comeau.

Claim 27 depends from claim 26 and recites “the DMA controller is capable of copying distances in a plurality of sequential bursts.” Petitioner, relying on the testimony of Mr. Schmandt, contends that a person of ordinary skill would have understood that a DMA controller as taught by Vensko would have transferred distances in a plurality of sequential bursts, such as 10 transfers of 50 bytes, rather than transferring 500 bytes all at once, for the benefit of accommodating other traffic on the bus. Pet. 66 (citing Ex. 1003 ¶¶ 220–224).

Patent Owner does not present arguments to the contrary. We agree with Petitioner and rely on Mr. Schmandt's testimony in determining that claim 27 is unpatentable over the combination of Smyth, Mozer, Nguyen, Vensko, and Comeau.

Claim 28 depends from claim 26 and recites “the speech recognition system further comprises at least one processor configured to execute software to perform or initiate a speech recognition word search using one or more distances calculated by the acoustic coprocessor in response to receiving a first feature vector, and a time period for the speech recognition word search overlaps with a time period for the acoustic coprocessor to calculate one or more distances in response to receiving a second feature

vector.” Petitioner contends that this claim is unpatentable for the reasons given in Petitioner’s analysis of claims 16 and 26. Pet. 67.

Patent Owner does not present arguments to the contrary. We agree with Petitioner in finding that claim 28 is unpatentable over the combination of Smyth, Mozer, Nguyen, Vensko, and Comeau.

Claim 37 depends from claim 27 and recites “the speech recognition system further comprising at least one microphone.” Petitioner contends that Smyth teaches this limitation in disclosing a speech recognition system with a microphone. Pet. 67 (citing Ex. 1005, 1:24–32, 4:22–24, 4:38–40, 4:46–67, Fig. 1; Ex. 1003 ¶ 228).

Patent Owner does not present arguments to the contrary. We agree with Petitioner and rely on Mr. Schmandt’s testimony in determining that claim 37 is unpatentable over the combination of Smyth, Mozer, Nguyen, Vensko, and Comeau.

I. Challenge Based on Smyth, Mozer, Nguyen, Vensko, Comeau, and Boike

Petitioner contends that claim 29 is unpatentable over the combination of Smyth, Mozer, Nguyen, Vensko, Comeau, and Boike. Pet. 4.

1. Overview of Boike

Boike discloses a system-on-a-chip (SoC) integrated circuit containing multiple DSPs. Ex. 1006, 2:1–9, Fig. 1. Boike discloses that by placing more than one DSP on a chip, the DSP/SoC system reduces the number of chips needed to perform digital signal processing, which leads to a decrease in power consumption and heat generation and a savings in cost, as well as an increase in processing speed and a decrease in circuit complexity. *Id.* at 2:21–35.

2. *Claim 29*

Claim 29 depends from claim 28 and recites “the acoustic coprocessor and the at least one processor are fabricated on a single integrated circuit.” Petitioner contends that Smyth’s classifier 34 corresponds to the recited “acoustic coprocessor” and Smyth’s sequencer 35 corresponds to the recited “at least one processor.” Pet. 68 (citing Ex. 1005, 5:55–57, 6:13–19). Petitioner, relying on the testimony of Mr. Schmandt, contends that a person of ordinary skill in the art would have implemented the three distinct processing circuits of Smyth on a single integrated circuit as taught by Boike for the benefits of reducing space and costs as well as conserving power. Pet. 68–70 (citing Ex. 1003 ¶¶ 230–233).

Given that Petitioner maps the claimed “acoustic coprocessor” to Smyth’s classifier 34, which includes classifier processor 341 and state memory 342, that the Petition has not shown that any of the integrated circuits cited in the Petition would have had enough memory to include both classifier processor 341 and state memory 342, and that the Petition has not shown that fabricating an integrated circuit was within the level of ordinary skill as discussed in our analysis of claim 1, we find that the Petition does not show that the combination of Smyth, Mozer, Nguyen, Vensko, Comeau, and Boike teaches an “acoustic coprocessor . . . fabricated on a single circuit” as recited in claim 29. In addition to the reasons given in our analysis of claim 1, we also find that the Petition does not show how an acoustic coprocessor located in the integrated circuit of Boike would have included one or more results memories as recited in claim 18 that would have had enough memory to store the distances for each acoustic state of the acoustic model of Smyth. We also find that the Petition does not show how

an acoustic coprocessor in the integrated circuit of Boike would have included a status register as recited in claim 25.

Petitioner maps the claimed “at least one processor” to Smyth’s sequencer 35. Pet. 68. Smyth’s state sequencer 35 includes state probability memory 353, which stores the state probabilities output by classifier processor 341. Ex. 1005, 6:13–15. Petitioner maps the buffer memory recited in claim 26 to state probability memory 353. Pet. 64. We find that the Petition does not show how Smyth’s state sequencer, when located in the integrated circuit of Boike, would have included the claimed buffer memory that would have been large enough to store the distances copied from the one or more results memories. We find that the combination does not show “at least one processor fabricated on a single circuit” as claimed.

We find that the Petition does not show by a preponderance of evidence that claim 29 is unpatentable over the combination of Smyth, Mozer, Nguyen, Vensko, Comeau, and Boike.

J. Challenge Based on Smyth, Mozer, Nguyen, Vensko, Comeau, and Whittaker

Petitioner contends that claim 35 is unpatentable over the combination of Smyth, Mozer, Nguyen, Vensko, Comeau, and Whittaker. Pet. 4.

1. Overview of Whittaker

Whittaker teaches integer values that represent a vocabulary of a language model of an automated speech recognition system. Ex. 1041, 2:32–38. Whittaker teaches providing for the compression of ordered integer arrays of the language model. *Id.* at 2:20–23. In particular, Whittaker converting ordered lists of monotonically increasing integer values of the language model into a variable-bit width tree structure so that

the most memory efficient configuration is obtained for each original list.
Id. at 2:23–28.

2. Claim 35

Claim 35 depends from claim 26 and recites “the acoustic model includes parameters represented with integer data.” Petitioner contends that a person of ordinary skill in the art would have modified Smyth’s acoustic model to include parameters represented with integer data for the benefit of obtaining a reduction in size of the language model with no increase in the word error rate as taught by Whittaker. Pet. 71 (citing Ex. 1003 ¶¶ 234–236).

Patent Owner does not present arguments to the contrary. We agree with Petitioner and rely on Mr. Schmandt’s supporting testimony in determining that claim 35 is unpatentable over the combination of Smyth, Mozer, Nguyen, Vensko, Comeau, and Whittaker.

K. Challenge Based on Smyth, Mozer, Nguyen, Vensko, Comeau, and Ichikawa

Petitioner contends that claims 38 and 39 are unpatentable over the combination of Smyth, Mozer, Nguyen, Vensko, Comeau, and Ichikawa. Pet. 4.

1. Overview of Ichikawa

Ichikawa discloses a speech recognition system and a method for eliminating noise by using a microphone array, where the microphone array includes a plurality of microphones. Ex. 1042, 1:8–10, 1:28–29.

2. Claims 38 and 39

Claim 38 depends from claim 27 and recites “a plurality of microphones.” Petitioner contends that a person of ordinary skill in the art would have modified the microphone of Smyth to use a plurality of

microphones for the benefit of eliminating noise as taught by Ichikawa. Pet. 72 (citing Ex. 1003 ¶¶ 237–238).

Patent Owner does not present arguments to the contrary. We agree with Petitioner and rely on Mr. Schmandt’s testimony in determining that claim 38 is unpatentable over the combination of Smyth, Mozer, Nguyen, Vensko, Comeau, and Ichikawa.

Claim 39 depends from claim 38 and recites the “speech recognition system . . . further comprising the buffer memory.” Petitioner contends that the combination teaches the claimed “buffer memory” for the reasons given in Petitioner’s analysis of claim 26. Pet. 73.

Patent Owner does not present arguments to the contrary. We agree with Petitioner and find that claim 39 is unpatentable over the combination of Smyth, Mozer, Nguyen, Vensko, Comeau, and Ichikawa.

L. Challenge Based on Smyth, Mozer, Nguyen, Vensko, Comeau, Ichikawa, and Seshadri

Petitioner contends that claims 42–44 are unpatentable over the combination of Smyth, Mozer, Nguyen, Vensko, Comeau, Ichikawa, and Seshadri. Pet. 4.

1. Overview of Seshadri

Seshadri discloses a speech recognition device that receives audio signals and video signals, and converts the audio signals and the video signals to recognizable speech. Ex. 1043, Abstract. Seshadri discloses configuring the speech recognition system on a laptop computer, a mobile phone, a PDA, an audio/video recording device, a home computer, a game console, a remote controller, or other comparable device. *Id.* at 3:54–65.

2. Claims 42–44

Claim 42 recites a “laptop or tablet personal computer comprising the speech recognition system of claim 39.” Petitioner contends that Seshadri teaches implementing a speech recognition system in a laptop computer, and that a person of ordinary skill would have done the same with Smyth’s system. Pet. 73 (citing Ex. 1003 ¶¶ 240–242). Mr. Schmandt testifies that a modifying the Smyth combination to be implemented using a laptop computer would have advantageously captured additional market share. Ex. 1003 ¶ 242.

Patent Owner does not present arguments to the contrary. We agree with Petitioner and rely on Mr. Schmandt’s testimony in determining that claim 42 is unpatentable over the combination of Smyth, Mozer, Nguyen, Vensko, Comeau, Ichikawa, and Seshadri.

Claim 43 recites a “mobile phone comprising the speech recognition system of claim 39.” Petitioner contends that Seshadri teaches implementing a speech recognition system in a mobile phone, and that a person of ordinary skill would have done the same with Smyth’s system. Pet. 73–74 (citing Ex. 1003 ¶¶ 243–245). Mr. Schmandt testifies that modifying the Smyth combination to be implemented using a mobile phone would have advantageously captured additional market share. Ex. 1003 ¶ 245.

Patent Owner does not present arguments to the contrary. We agree with Petitioner and rely on Mr. Schmandt’s testimony in determining that claim 43 is unpatentable over the combination of Smyth, Mozer, Nguyen, Vensko, Comeau, Ishikawa, and Seshadri.

Claim 44 recites an “electronic entertainment product comprising the speech recognition system of claim 39.” Petitioner contends that Seshadri

teaches implementing a speech recognition system in an electronic entertainment product in disclosing that the speech recognition system can be configured to a home computer, game console, audio/video recording device, or a PDA. Pet. 74–75 (citing Ex. 1003 ¶¶ 246–248). Mr. Schmandt testifies that modifying the Smyth combination to be implemented using an electronic entertainment product would have advantageously captured additional market share. Ex. 1003 ¶ 248.

Patent Owner does not present arguments to the contrary. We agree with Petitioner and rely on Mr. Schmandt’s testimony in determining that claim 44 is unpatentable over the combination of Smyth, Mozer, Nguyen, Vensko, Comeau, Ishikawa, and Seshadri.

M. Challenge Based on Smyth, Mozer, Nguyen, Vensko, Comeau, Ichikawa, and Steinbiss

Petitioner contends that claim 45 is unpatentable over the combination of Smyth, Mozer, Nguyen, Vensko, Comeau, Ichikawa, and Steinbiss. Pet. 4.

1. Overview of Steinbiss

Steinbiss discloses a speech recognition device, which is used to act upon functions of an electrical appliance, such as a mobile telephone, television sets, video recorders, hi-fi music systems, or kitchen appliances. Ex. 1045 ¶¶ 1–2.

2. Claim 45

Claim 45 recites an “appliance comprising the speech recognition system of claim 39.” Petitioner contends that Steinbiss discloses an appliance that includes a speech recognition system. Pet. 75–76 (citing Ex. 1003 ¶¶ 249–252). Mr. Schmandt testifies that modifying the Smyth

combination to be implemented using an appliance would have advantageously captured additional market share. Ex. 1003 ¶ 252.

Patent Owner does not present arguments to the contrary. We agree with Petitioner and rely on Mr. Schmandt's testimony in determining that claim 45 is unpatentable over the combination of Smyth, Mozer, Nguyen, Vensko, Comeau, Ichikawa, and Steinbiss.

III. CONCLUSION

In summary, we determine a preponderance of the evidence establishes that claims 10, 12–14, 16–18, 20–23, 25–28, 35, 37–39, and 42–45 are unpatentable, but does not establish that claims 1, 2, 4, 6–9, 24 and 29 are unpatentable, as shown in the following table:⁴

Claim(s)	35 U.S.C. §	Reference(s)/Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
1, 10, 11, 14, 17	103(a)	Smyth, Mozer	10, 14, 17	1, 11
2, 4, 6–9, 12, 16, 18, 20, 21	103(a)	Smyth, Mozer, Nguyen	12, 16, 18, 20, 21	2, 4, 6–9
13	103(a)	Smyth, Mozer, Houser	13	
22–24	103(a)	Smyth, Mozer, Nguyen, Vensko	22, 23	24
25–28, 37	103(a)	Smyth, Mozer, Nguyen, Vensko, Comeau	25–28, 37	

⁴ Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner’s attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. See 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. See 37 C.F.R. § 42.8(a)(3), (b)(2).

Claim(s)	35 U.S.C. §	Reference(s)/Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
29	103(a)	Smyth, Mozer, Nguyen, Vensko, Comeau, Boike		29
35	103(a)	Smyth, Mozer, Nguyen, Vensko, Comeau, Whittaker	35	
38, 39	103(a)	Smyth, Mozer, Nguyen, Vensko, Comeau, Ichikawa	38, 39	
42–44	103(a)	Smyth, Mozer, Nguyen, Vensko, Comeau, Ichikawa, Seshadri	42–44	
45	103(a)	Smyth, Mozer, Nguyen, Vensko, Comeau, Ichikawa, Steinbiss	45	
Overall Outcome			10, 12–14, 16–18, 20–23, 25–28, 35, 37–39, 42–45	1, 2, 4, 6–9, 11, 24, 29

IV. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that claims 10, 12–14, 16–18, 20–23, 25–28, 35, 37–39, and 42–45 of the '789 patent have been proven by a preponderance of evidence to be unpatentable;

FURTHER ORDERED that claims 1, 2, 4, 6–9, 11, 24, and 29 of the '789 patent have not been proven by a preponderance of evidence to be unpatentable; and

FURTHER ORDERED that, because this is a final written decision, parties to this proceeding seeking judicial review of the Decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

IPR2023-00036
Patent 10,839,789 B2

FOR PETITIONER:

Jennifer C. Bailey,
Adam P. Seitz,
Kevin Rongish
ERISE IP, P.A.
jennifer.bailey@eriseIP.com
adam.seitz@eriseIP.com
kevin.rongish@eriseip.com

J. David Hadden
Dargaye Churnet
Saina Shamilov
FENWICK & WEST LLP
dhadden@fenwick.com
dchurnet@fenwick.com
sshamilov@fenwick.com

FOR PATENT OWNER:

Peter C. Knops
Kayvan B. Noroozi (*Pro Hac Vice*)
NOROOZI P.C.
peter@noroozipc.com
kayvan@noroozipc.com

Katherine Rhoades
BARTLITBECK L.L.P.
katherine.rhoades@bartlitbeck.com