

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

INTEL CORPORATION
Petitioner,

v.

ADVANCED CLUSTER SYSTEMS, INC.,
Patent Owner.

IPR2025-00915
Patent 11,563,621 B2

Before KARL D. EASTHOM, ARTHUR M. PESLAK, and
SCOTT RAEVSKY, *Administrative Patent Judges*.

PESLAK, *Administrative Patent Judge*.

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

I. INTRODUCTION

Intel Corporation (“Petitioner”) filed a Petition requesting an *inter partes* review of claims 1–30 (“the Challenged Claims”) of U.S. Patent No. 11,563,621 B2 (Ex. 1001, “the ’621 patent”). Paper 3 (“Pet.”). Petitioner filed a Declaration of Chandrajit L. Bajaj, Ph.D. in support of the Petition. Ex. 1003. Advanced Cluster Systems, Inc. (“Patent Owner”) filed a Preliminary Response. Paper 9 (“Prelim. Resp.”). On November 19, 2025, we instituted this *inter partes* review as to all Challenged Claims and all grounds presented in the Petition. Paper 15.

After institution, Patent Owner filed a Response to the Petition. Paper 23 (“PO Resp.”). Petitioner filed a Reply. Paper 24 (“Pet. Reply”). Petitioner filed a Supplemental Declaration of Chandrajit L. Bajaj, Ph.D. with the Reply. Ex. 1163. Patent Owner filed a Sur-reply. Paper 25 (“Sur-reply”). An oral hearing was held on August 13, 2026, and the transcript is entered into the record. Paper 31 (“Tr.”).

We have jurisdiction under 35 U.S.C. § 6. This is a Final Written Decision under 35 U.S.C. § 318(a) as to the patentability of the Challenged Claims. For the reasons discussed below, we determine Petitioner establishes by a preponderance of the evidence that all Challenged Claims are unpatentable.

A. Related Matters

The parties state that the '621 patent is involved in *Advanced Cluster Systems, Inc. v. Intel Corp.*, No. 7:cv-00245 (W.D. Tex) and *Advanced Cluster Systems, Inc. v. Advanced Micro Devices, Inc.*, No. 7:cv-00244 (W.D. Tex.). Pet. 115; Paper 5, 1.

B. Real Parties-in-Interest

Petitioner identifies itself and Advanced Micro Devices, Inc.¹ as the real parties-in-interest. Pet. 115.

Patent Owner identifies itself as the real party-in-interest. Paper 5, 1.

C. Summary of the '621 Patent (Ex. 1001)

The '621 patent is entitled “Cluster Computing.” Ex. 1001, code (54). The '621 patent describes “a computer cluster system comprises a plurality of nodes and a software package comprising a user interface and a kernel for interpreting program code instructions.” *Id.* at code (57). Further, “a cluster node module is configured to communicate with the kernel and other cluster node modules” and “can accept instructions from the user interface and can interpret at least some of the instructions such that several cluster node modules in communication with one another and with a kernel can act as a computer cluster.” *Id.*

¹ On January 29, 2026, we terminated Advanced Micro Devices, Inc. as a Petitioner in this *inter partes* review pursuant to a Settlement Agreement between Patent Owner and Advanced Micro Devices, Inc. Paper 20.

Figure 1 of the '621 patent is reproduced below:

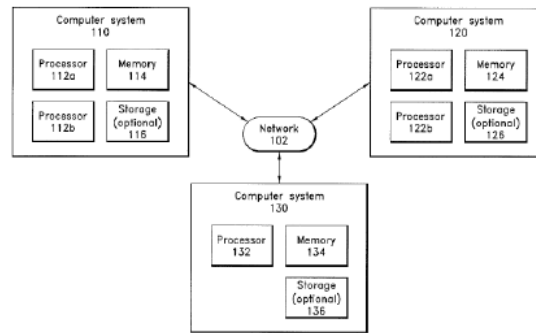


FIG. 1

Figure 1 “is a block diagram of one embodiment of a computer cluster 100 wherein computer systems 110, 120, 130 communicate with one another via a communication network 102.” Ex. 1001, 5:1–4.

In the embodiment shown in Figure 1, each of the first, second, and third computer systems 110, 120, and 130 includes one or more processors, a memory device, and an optional storage device. Ex. 1001, 6:60–67. Further, each of the computer systems 110, 120, and 130 “includes a network interface (not shown) for connecting to a communications network 102, which can include one or more of a LAN, a WAN, an intranet, a wireless network, and/or the Internet.” *Id.* at 6:67–7:4.

Figure 2 of the '621 patent is reproduced below:

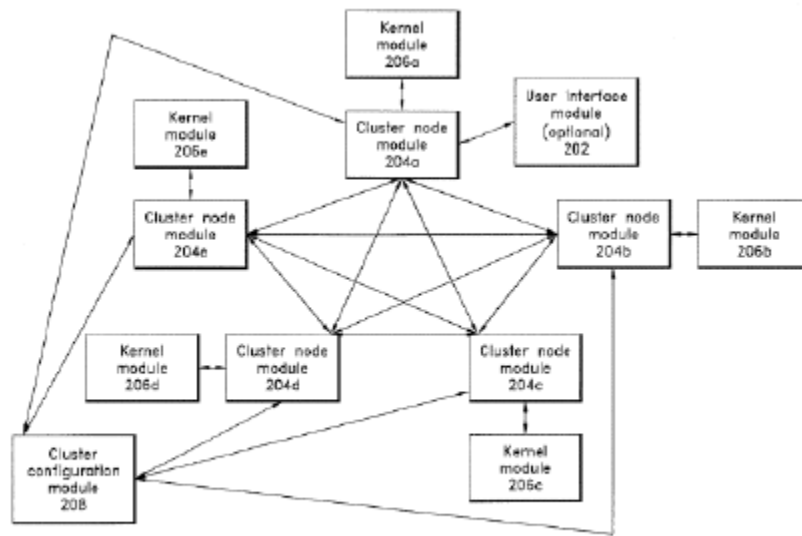


FIG. 2

Figure 2 “is a block diagram showing relationships between software modules running on one embodiment of a computer cluster.” Ex. 1001, 4:6–8.

In the embodiment shown in Figure 2, “a cluster system 100 includes a user interface module 202 that is able to access a plurality of kernel modules 206a-e by communicating with a first cluster node module 204a.” Ex. 1001, 11:19–22. Kernel modules 206a – 206e “can reside in the memory of one or more computer systems on which they run.” *Id.* at 11:27–29. Kernel modules 206a – 206e “include single-threaded program code and are each associated with one of the processors 112a, 112b, 122a, 122b, 132.” *Id.* at 11:34–36. “In the embodiment shown in Figure 2, each of the kernel modules 206a – 206e is in communication with a single cluster node module 204a – 204e, respectively.” *Id.* at 5:38–40. “[C]luster node module 204a is in communication with each of the other cluster node modules 204b – 204e.” *Id.* at 11:25–27. “[C]ommunication between the

cluster configuration module 208 and the cluster node modules 204a – 204e initializes the cluster node modules 204a – 204e to provide cluster computing support for the computer cluster 100.” *Id.* at 11:41–44. “In one embodiment, the cluster node modules 204a – 204e provide a way for many kernel modules 206a – 206e such as, for example, Mathematica kernels, running on a computer cluster 100 to communicate with one another.” *Id.* at 11:46–49.

D. Illustrative Claim

Independent claim 1 is reproduced below with Petitioner’s annotations for ease of reference:

A computer cluster comprising:

[1.1.1] a first processor;

[1.1.2] a second processor;

[1.1.3] a third processor;

[1.2] at least one computer readable medium in communication with at least one of the first processor, the second processor, or the third processor;

[1.3.1] a first kernel residing in the at least one computer-readable medium,

[1.3.2] said first kernel configured to translate commands into code for execution on the first processor;

[1.4.1] a first cluster node module residing in the at least one computer-readable medium;

[1.4.2] said first cluster node module configured to: receive first commands from a user interface without the first commands first passing through the first kernel, and

[1.4.3] after receiving the first commands from the user interface, send commands to the first kernel;

[1.5.1] a second kernel residing in the at least one computer-readable medium, [1.5.2] said second kernel configured to translate commands into code for execution on the second processor;

[1.6.1] a second cluster node module residing in the at least one computer-readable medium, [1.6.2] said second cluster node module configured to send commands to the second kernel and [1.6.3] communicates with the first cluster node module;

[1.7.1] a third kernel residing in the at least one computer-readable medium [1.7.2] said third kernel configured to translate commands into code for execution on the third processor; and

[1.8.1] a third cluster node module residing in the at least one computer-readable medium, [1.8.2] said third cluster node module configured to send commands to third kernel and [1.8.3] configured to communicate with the first cluster node module and the second cluster node module;

[1.9] wherein each of the first, second, and third cluster node modules can transmit tasks to any other of the first, second, and third cluster node modules without transmitting the tasks through a master node, and [1.10] wherein the first cluster node module comprises a data structure in which messages originating from the second and third cluster node modules are stored.

Ex. 1001, 29:19–62.

E. Asserted Grounds of Unpatentability

Petitioner asserts the following grounds of unpatentability (Pet. 13)²:

Claims Challenged	35 U.S.C. §	References/Basis
1–3, 5–16, 18–30	§ 103(a)	Menon, ³ Trefethen, ⁴ RS6000, ⁵ MPIref ⁶
4, 17	§ 103(a)	Menon, Trefethen, RS6000, MPIref, POEref ⁷

II. ANALYSIS

A. Overview

“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

² We apply the pre-AIA version of 35 U.S.C. § 103 because the claims at issue have an effective filing date prior to March 16, 2013, the effective date of the Leahy-Smith America Invents Act, Pub. L. No. 112-29, 125 Stat. 284 (2011) (“AIA”). See Ex. 1001, codes (60), (63).

³ “MultiMATLAB: Integrating MATLAB with High-Performance Parallel Computing,” Menon et al., SC ’97: Proceedings of the 1997 ACM/IEEE Conference on Supercomputing 1997. Ex. 1005 (“Menon”).

⁴ “MultiMATLAB: MATLAB on Multiple Processors,” Trefethen et. al., 1996 Computer Science Technical Report, Cornell University 1996. Ex. 1006 (“Trefethen”).

⁵ “RS/6000 SP: Planning Vol. 1, Hardware and Physical Environment,” IBM 2001. Ex. 1007 (“RS/6000”).

⁶ “MPI: A Message-Passing Interface Standard,” Message Passing Interface Forum 1994. Ex. 1017 (“MPIref”).

⁷ “Operation and Use, Volume, 1, Using the Parallel Operating Environment.” IBM 2001. Ex. 1008 (“POEref”).

grounds for the challenge to each claim”)). This burden of persuasion never shifts to Patent Owner. *See Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015) (discussing the burden of proof in inter partes review).

A claim is unpatentable under § 103 if the differences between the claimed subject matter 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 indicia of non-obviousness (i.e., secondary considerations).⁸ *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

The Supreme Court explained in *KSR* that

[o]ften, it will be necessary for a court to look to interrelated teachings of multiple patents; the effects of demands known to the design community or present in the marketplace; and the background knowledge possessed by a person having ordinary skill in the art, all in order to determine whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue.

550 U.S. at 418 (citing *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir.

⁸ No evidence of secondary considerations has been entered into the record by the parties.

2006) (“[R]ejections on obviousness grounds cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.” (alteration in original)).

“Whether an ordinarily skilled artisan would have been motivated to modify the teachings of a reference is a question of fact.” *WBIP, LLC v. Kohler Co.*, 829 F.3d 1317, 1327 (Fed. Cir. 2016) (citations omitted).

“[W]here a party argues a skilled artisan would have been motivated to combine references, it must show the artisan ‘would have had a reasonable expectation of success from doing so.’” *Arctic Cat Inc. v. Bombardier Recreational Prods. Inc.*, 876 F.3d 1350, 1360–61 (Fed. Cir. 2017) (quoting *In re Cyclobenzaprine Hydrochloride Extended-Release Capsule Patent Litig.*, 676 F.3d 1063, 1068–69 (Fed. Cir. 2012)).

B. Level of Ordinary Skill in the Art

Petitioner, supported by Dr. Bajaj’s testimony (Ex. 1003 ¶¶ 24–27) submits that a person of ordinary skill in the art “would have been someone knowledgeable of and familiar with computer cluster systems and cluster computing techniques” in June 2006. Pet. 12. According to Petitioner, a person of ordinary skill in the art

would have had a bachelor’s degree in computer science, computer engineering, electrical engineering, or an equivalent training, and approximately two years of experience working in the field of cluster computing or parallel processing and would be knowledgeable regarding high-level scientific computing languages. Additional work experience can substitute for specific educational background, and vice versa.

Id. (citing Ex. 1003 ¶¶ 24–27).

Patent Owner does not address Petitioner’s proposed level of ordinary skill in the art. *See generally* PO Resp.

We adopt Petitioner’s undisputed level of ordinary skill in the art because it appears consistent with the problems addressed in the ’621 patent and the cited prior art.

C. Claim Construction

Petitioner “submit[s] that no claim term requires express construction.” Pet. 12–13.

Patent Owner applies the plain and ordinary meaning of the claim terms. PO Resp. 9.

We determine that we need not expressly construe any claim terms to resolve the controversy before us. *See Realtime Data, LLC v. Iancu*, 912 F.3d 1368, 1375 (Fed. Cir. 2019) (“The Board is required to construe ‘only those terms . . . that are in controversy, and only to the extent necessary to resolve the controversy.’” (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999))).

D. Ground 1: Alleged Obviousness of Claims 1–3, 5–16, and 18–30 over Menon, Trefethen, RS6000, and MPIref

Petitioner contends that claims 1–3, 5–16, and 18–30 are obvious over the combined teachings of Menon, Trefethen, RS6000, and MPIref. Pet. 22–105.

As an initial matter, Patent Owner contends Petitioner has not shown that Menon, Trefethen, RS6000, POEref (asserted in Ground 2), and MPIref qualify as printed publications under 35 U.S.C. § 311(b). PO Resp. 7, 39–46. According to Patent Owner, Petitioner’s failure to show that these references are printed publications “defeats the affected grounds.” *Id.* at 7.

We begin with brief summaries of Menon, Trefethen, RS6000, POEref, and MPIref and then address the parties' respective contentions concerning whether these references qualify as printed publications.

1. Menon (Exhibit 1005)

Menon is a technical article published by the IEEE Computer Society in connection with the ACM/IEEE SC97 Conference. Ex. 1005, 1. Menon is titled "MultiMATLAB: Integrating MATLAB with High-Performance Parallel Computing." *Id.*

Menon discloses:

MATLAB is the most popular scientific computing environment available on uniprocessors today. Unfortunately, no such environment is currently available for multiprocessors. MultiMATLAB [1] is a general extension of the MATLAB environment to any distributed memory multiprocessors. This paper presents a new MultiMATLAB system designed to provide high-performance on multiprocessors while maintaining the functionality and usability of the MATLAB environment. This system will enable users to access high-performance parallel routines from within the MATLAB environment, to extend the environment with new parallel routines, and to use these routines to develop parallel applications with the MATLAB language.

Ex. 1005, 1.

Figure 1 of Menon is reproduced below:

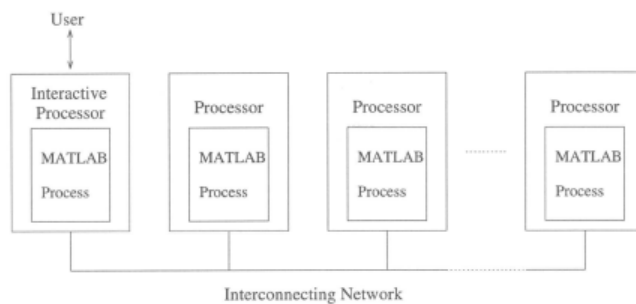


Figure 1: MultiMATLAB Architecture

Figure 2 of Menon is reproduced below:



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All parallel functionality in the MULTIMATLAB system is provided through MEX routines.” *Id.*

2. Trefethen (Exhibit 1006)

Trefethen is a technical article titled “MultiMATLAB: MATLAB on Multiple Processors.” Ex. 1006, 1. Trefethen discloses a user “connected to a node of the IBM SP2 running MATLAB” and then “decid[ing] to start MATLAB on five new processors.” *Id.* at 3. Trefethen then goes on to disclose using send and receive commands for sequential processing from node to node using MATLAB. *Id.* at 5–6.

3. RS6000 (Exhibit 1007)

RS6000 is a chapter in an IBM publication for its RS6000 SP computer Ex. 1007, 1. The chapter “is an overview of the IBM RS/6000 SP.” *Id.* This document discloses “the processor nodes, model and expansion frames, the standard and optional hardware, and installation site planning . . . of an RS/6000 SP system.” *Id.* The RS/6000 SP “is IBM’s family of scalable, parallel computing solutions.” *Id.*

4. POEref (Exhibit 1008)

POEref, titled, “Operation and Use, Volume 1, Using the Parallel Operating Environment” is an IBM product manual for its “Parallel Operating Environment” (hereinafter “POE”) running on an RS6000 system, as referenced in Menon. Pet. 14–15 (citing Ex.1003 ¶¶ 134–136; Ex.1005, 6; Ex.1008, 157⁹; Ex. 1029; Ex. 1039; Ex. 1036, 14; Ex. 1047). POEref discloses an initialization process where a user enters the “poe” command,

⁹ We cite to the exhibit page numbers added to the lower right corner of Ex. 1008, rather than the internal page numbers of POEref.

such that “[w]hen you invoke **poe**, the Partition Manager allocates processor nodes for each task and initializes the local environment. It then loads your program, and reproduces your local environment, on each processor node.”

Ex.1008, 46.

5. MPIref (Exhibit 1017)

MPIref is titled “MPI: A Message Passing Interface Standard.”

Ex. 1017, 1. It is subtitled as “Message Passing Interface Forum.” *Id.* It explains that “[t]he goal of the Message Passing Interface . . . is to develop a widely used standard for writing message-passing programs” but it “is not sanctioned or supported by any official standards organization.” *Id.* at 2.

6. Printed Publication Status of Petitioner’s Asserted Prior Art

The Federal Circuit instructs that “[t]o qualify as a printed publication, a reference ‘must have been sufficiently accessible to the public interested in the art.’” *Blue Calypso, LLC v. Groupon, Inc.*, 815 F.3d 1331, 1348 (Fed. Cir. 2016) (citing *In re Cronyn*, 890 F. 3d 1158, 1160 (Fed. Cir. 1989)). “A reference will be considered publicly accessible if it was ‘disseminated or otherwise made available to the extent that persons interested and ordinarily skilled in the subject matter or art exercising reasonable diligence, can locate it.” *Id.* (citing *Kyocera Wireless Corp. v. Int’l Trade Comm’n*, 545 F. 3d 1340, 1350 (Fed. Cir. 2008)). Further, the question of whether a document qualifies as a “printed publication” for the purposes of 35 U.S.C. § 102 “involves a case-by-case inquiry into the facts and circumstances surrounding the reference’s disclosure to a member of the public.” *Medtronic, Inc. v. Barry*, 891 F.3d 1368, 1380 (Fed. Cir. 2018) (citing *In re Klopfenstein*, 380 F.3d 1345, 1350 (Fed. Cir. 2004)).

The Petition assumes that the “earliest possible priority date [for the ’621 patent] is June 13, 2006.” Pet. 11. Patent Owner does not dispute this date. *See generally* PO Resp. We apply June 13, 2006 as the priority date in our analysis.

For each of Exhibits 1005–1008 and 1017, Petitioner contends that each “is (i) more than 20 years old; (ii) is regular on its face with no signs of obvious alterations; and (iii) was found in a place where it could be expected to be found.” Pet. 15. According to Petitioner, “each document is prima facie authenticated as an ancient document.” *Id.* (citing Fed. R. Evid. 901(8)). Patent Owner does not challenge the authenticity of any of these exhibits. *See generally* PO Resp. We, thus, find that Petitioner establishes the authenticity of each exhibit.

We now turn to the parties’ arguments and evidence addressing the facts and circumstances surrounding the publication of the asserted references.

a. Overview of the evidence and arguments

The Petition provides substantial supporting evidence that Menon, Trefethen, RS6000, POEref, and MPIref were publicly accessible to a POSITA exercising reasonable diligence prior to June 13, 2006. Pet. 13–16; Pet. Reply 17–24.

Patent Owner argues that Petitioner failed to prove public accessibility and “none of its references qualifies as prior art.” PO Resp. 39. As one example, Patent Owner contends “Petitioner provides no evidence that a POSITA using typical search methods at the time could have located [RS6000 and POEref (Exs. 1007–1008)].” *Id.* at 40. Patent Owner’s argument, directed to these two IBM manuals, is Petitioner has not shown a “link chain” or web page that would allow “users to search for [the

references] by topic” or “how the public could have navigated to the manuals.” *Id.* Patent Owner similarly argues that “Petitioner offers no evidence that anyone outside the MPI Forum ever knew of or accessed the draft [MPIref].” *Id.* at 41. For the following reasons, we find Petitioner’s evidence to be more persuasive.

The publication evidence submitted with the Petition includes five declarations.¹⁰ Ex. 1003 (Bajaj Declaration) ¶¶ 121–123 (Menon), 127–128 (Trefethen), 130–131 (RS6000), 134–136 (POEref), and 140–142 (MPIref); Ex. 1027 (IEEE Declaration); Ex. 1029 (Internet Archive Declaration); Ex. 1047 (IBM Declaration); Ex. 1048 (Internet Archive Declaration); Ex. 1049 (exhibits to Ex. 1048). The IEEE Declaration of Gordon MacPherson (Ex. 1027) is directed to the publication of the Menon reference. The Internet Archive Declaration of Mina Ching (Ex. 1029) is directed to establishing the date of archived website URLs for accessing Menon, Trefethen, RS6000, POEref, and MPIref. The IBM Declaration of Carol Edwards (Ex. 1047) is directed to the publication of POEref. The Internet Archive Declaration of Tanya Zeif (Ex. 1048) is directed to establishing the date of archived website URLs for accessing MPIref (June 24, 1997 (Ex. 1049, 11)) and “Mathworks,” which provides a detailed discussion of MATLAB (March 31, 2004 (Ex. 1049, 248)). *See also* Ex. 1003 ¶¶ 141, 142 (“Menon, while citing to MPIref, provided a website address of Argonne National Laboratory (<http://www.mcs.anl.gov/mpi>) for retrieving MPIref.” (citing Ex. 1005, 16)).

¹⁰ Patent Owner did not depose any of Petitioner’s declarants or submit rebuttal declarations with its Response.

Patent Owner’s arguments, summarized above, do not undermine Petitioner’s evidence, which is specific, consistent, and persuasive in establishing public accessibility of the references prior to June 13, 2006. Petitioner is not required to prove a searchable “link chain” as argued by Patent Owner. PO Resp. 40–41; Sur-Reply 21, 23–26; *see Medtronic*, 891 F.3d at 1380 (“Because there are many ways in which a reference may be disseminated to the interested public, ‘public accessibility’ has been called the touchstone in determining whether a reference constitutes a ‘printed publication’ bar under 35 U.S.C. § 102(b).” (citing *Blue Calypso*, 815 F.3d at 1348)). Petitioner’s burden is to establish by a preponderance of the evidence that each reference was publicly accessible to a POSITA exercising reasonable diligence prior to June 13, 2006. *Id.* We find Petitioner satisfies that burden.

Petitioner’s Reply is supported by the comprehensive expert librarian Declaration of Dr. Ingrid Hsieh-Yee. Ex. 1086; Ex. 1087 (Curriculum Vitae). Patent Owner objects to Petitioner’s reliance on Dr. Hsieh-Yee’s Declaration in Reply as advancing a “new theory” of public accessibility. Sur-Reply 21 (“Petitioner has added new theories”). Patent Owner further contends that Reply evidence “may not establish a public-access channel the Petition never identified.” *Id.* (citing *VidStream LLC v. Twitter, Inc.*, 981 F.3d 1060, 1064-67 (Fed. Cir. 2020)). For the following reasons, Patent Owner’s “new theory” argument is unavailing.

In *VidStream*, the Federal Circuit rejected a very similar argument that “the Board violated its own rules in considering evidence that was not provided with the IPR petitions, but only with the replies,” and that by relying on reply evidence the Board “departed from the specific grounds of unpatentability set forth in the petitions and thus exceeded its statutory

authority.” *VidStream*, 981 F.3d at 1064, 1066. The Federal Circuit, in *VidStream*, found nothing wrong with the Board’s reliance on a declaration Dr. Hsieh-Yee submitted with petitioner’s reply brief, which cited Machine-Readable Cataloging (“MARC”) records of the type Petitioner relies on here to establish the date a reference was cataloged in a public library. *Id.* at 1063, 1066–1067; *see, e.g.*, Pet. Reply 19 (“MARC records” (Ex. 1091) “showing Menon was cataloged in the Academia Sinica Library on ‘December 14, 1998’” (citing Ex. 1086 ¶¶ 37–43)), 20 (“MARC records” (Ex. 1101) showing that Trefethen was cataloged by “Washington State University Library” on “November 3, 1997” (citing Ex.1086 ¶¶ 79–85)). The *VidStream* court found “the Board acted appropriately, for the Board permitted both sides to provide evidence concerning the reference date of the [prior art] in pursuit of the correct answer.” *VidStream*, 981 F.3d at 1065. We have followed the same course here.

In short, *VidStream* fully supports the Board’s reliance on additional evidence of public accessibility submitted in support of Petitioner’s Reply, including Dr. Hsieh-Yee’s expert librarian Declaration.

Petitioner’s Reply evidence and arguments, moreover, do not constitute new theories, and the Board may consider such reply arguments and evidence when deciding the question of public accessibility. *See Rembrandt Diagnostics, LP v. Alere, Inc.*, 76 F.4th 1376, 1384–1385 (Fed. Cir. 2023) (reply argument not improper if it “simply expands on previously raised arguments” or “is offered ‘to explain, repel, counteract, or disprove the evidence of the adverse party’”) (citations omitted). Petitioner’s Reply and Dr. Hsieh-Yee’s Declaration are direct rebuttal to Patent Owner’s arguments. Consequently, Patent Owner’s new theory argument is unavailing.

For example, Petitioner replies to Patent Owner’s argument that “Petitioner has not proven that the SC’97 conference proceedings (including Menon) were actually disseminated to the public in 1997” (PO Resp. 44), by arguing “Menon qualifies as a printed publication because it was published and distributed at the Proceedings of the 1997 ACM/IEEE Conference on Supercomputing 1997.” Pet. Reply 17 (citing Ex. 1005; Ex. 1026; Ex. 1027). Petitioner further argues with evidence of Menon being catalogued, indexed, and actually referenced in publications dated 1998, 1999, and 2000. *Id.* at 17–19 (citing, inter alia, Ex. 1086 ¶¶ 28–70). Petitioner’s Reply expands on the argument in the Petition by citing to Dr. Hsieh-Yee’s Declaration to establish that “Menon was sufficiently disseminated and was located by POSITAs” who cited Menon in articles published prior to June 13, 2006. *Id.* at 17–18 (citing Ex. 1086 ¶¶ 54–63; Ex. 1094, 16 (note 14); Ex. 1095, 19 (note 2)¹¹; Ex. 1096, 14 (note 17); Ex. 1097, 72).

Patent Owner’s Sur-Reply does not challenge the facts established in Dr. Hsieh-Yee’s Declaration with any cross-examination testimony of Dr. Hsieh-Yee. Sur-Reply at 20–22. Nor does Patent Owner cite inconsistent documentary evidence of record. *Id.*; *see also id.* at 22 (acknowledging that “Internet Archive captures of Menon (Ex. 1092) corroborate the same kind of evidence the Petition already relied on (Ex. 1029)”). Patent Owner’s position appears to be that Petitioner is not permitted to rebut Patent Owner’s arguments with evidence submitted in reply; a position that is unfounded. We find that Dr. Hsieh-Yee’s expert librarian declaration is

¹¹ We cite the exhibit page number rather than the internal page number of the document.

reliable and persuasive rebuttal testimony corroborated by documentary evidence of publication dates for each asserted reference prior to the June 13, 2006 priority date of the '621 patent.

In sum, we find Petitioner did not add new theories of public accessibility in the Petitioner Reply, but rather properly responded to Patent Owner's arguments by introducing rebuttal evidence that each prior art reference at issue was publicly accessible to a POSITA exercising reasonable diligence before June 13, 2006, and therefore qualifies as a prior art printed publication pursuant to 35 U.S.C. § 102.

Patent Owner also challenges the admissibility of the Petition's publication evidence regarding all asserted prior art references and expresses an intent to "address those issues in a forthcoming motion to exclude." PO Resp. 45. Motions to exclude were due July 23, 2026, but none were filed. Paper 16, 13. Accordingly, Patent Owner waived its right to challenge the admissibility of Petitioner's evidence. 37 C.F.R. § 42.64(c) ("A motion to exclude evidence must be filed to preserve any objection.").

We address specific publication evidence for each reference and additional Patent Owner arguments below.

b. Menon (Ex. 1005)

The Petition contends that Menon "is a paper authored by Vijay Menon and Anne Trefethen of the Cornell research team" and "qualifies as a printed publication because it was published and distributed at the Proceedings of the 1997 ACM/IEEE Conference on Supercomputing 1997 [SC '97]." Pet. 13 (citing Ex. 1005; Ex. 1026; Ex. 1027). The Petition also contends that Menon was "published and distributed on Cornell's website at least as early as 2001." *Id.* (citing Ex. 1023; Ex. 1029). The Petition further contends that "Menon was reasonably located by POSITAs because it had

been cited 17 times in papers prior to the priority date of the '621 patent.”

Id. at 14 (citing Ex. 1003 ¶¶ 121–123; Ex. 1028, 4–9; Ex. 1029, 1–3).

The Declaration of Gordon MacPherson, Director, Board Governance & Policy Development at The Institute of Electrical and Electronics Engineers, Inc. (“IEEE”), establishes that Menon was publicly accessible to attendees of the IEEE SC '97 conference in November 1997. Mr. MacPherson testifies as follows:

7. It is the regular practice of IEEE to publish articles and other writings including article abstracts and make them available to the public through IEEE Xplore. IEEE maintains copies of publications in the ordinary course of its regularly conducted activities.

8. The [Menon] article below has been attached as Exhibit A to this declaration:

9. I obtained a copy of Exhibit A through IEEE Xplore, where it is maintained in the ordinary course of IEEE’s business. Exhibit A is a true and correct copy of the Exhibit as it existed on or about March 4, 2025.

10. The article and abstract from IEEE Xplore show the date of publication. IEEE populates this information using the metadata associated with the publication.

11. [Menon] was published in SC '97: Proceedings of the 1997 ACM/IEEE Conference on Supercomputing, held on November 15–21, 1997, in San Jose, CA, USA. *Copies of the conference proceedings were made available no later than the last day of [the] conference.* . . .

Ex. 1027, 1–2 (emphasis added).

Patent Owner’s arguments, that Petitioner has not proven Menon was “actually disseminated to the public in 1997” and Exhibit A to the MacPherson Declaration is “uncorroborated” by IEEE Xplore and “does not display any publication date for Menon,” are unavailing. PO Resp. 44–45.

Mr. MacPherson’s un rebutted testimony is clear and specific: “[c]opies of the [SC ’97] conference proceedings were made available no later than the last day of conference,” i.e., no later than November 21, 1997. *Id.* ¶ 11. Mr. MacPherson’s testimony is at least partially corroborated by the formal copyright notice and International Standard Book Number (“ISBN”) assigned to Menon and printed in the footer at the bottom of all 18 pages of Menon:

Proceedings of the ACM/IEEE SC97 Conference (SC’97)
0-89791-985-8/97 \$ 17.00 © 1997 IEEE

Ex. 1027, 4–21; *see also* Ex. 1005. We note the 1997 copyright date for the SC ’97 proceedings is consistent with the last three digits of the ISBN—“8/97”—indicating a date of August 1997.

Even so, there is little doubt that Menon was publicly available before the June 13, 2006 priority date of the ’621 patent, the legally relevant consideration, given Dr. Hsieh-Yee’s authoritative and un rebutted testimony:

The ACM metadata record shows Menon was published on November 15, 1997. . . . [L]ibrary records inform my opinion that the conference proceedings containing Menon became publicly discoverable and accessible in libraries no later than December 1998. . . .

Public access to the conference proceedings containing *Menon* was actually earlier than July 1998. The General Information webpage of the SC’97 conference website, archived on February 26, 1998 (**Ex. 1093**), informed users that the conference proceedings [were] available online, and *interested users could use workstations at the conference to view the conference proceedings during the November 1997 conference. These dates inform my opinion that the SC’97 conference proceedings containing Menon was publicly accessible as early as November 1997, and no later than February 1998* when the

webpage was archived by Internet Archive. Copies of the conference main page, table of contents, technical papers, and abstracts of technical papers archived in April 1998 (included in **Ex. 1093**), confirm that *Menon* was included in the SC'97 conference, and the conference proceedings [were] publicly discoverable on the Internet no later than April 1998.

Ex. 1086 ¶¶ 65, 67 (emphasis added in part); *see also id.* at ¶¶ 28–70 (establishing authenticity and public availability of Menon).

The Internet Archive Affidavit of Mina Ching further supports Petitioner's contention that Menon was publicly available on the Cornell website prior to June 13, 2006. Ex. 1029. The Affidavit states that the copy of Menon attached as Exhibit A is a “true and accurate cop[y] of browser screenshots . . . of the archived files for the URLs and the dates specified in the attached coversheet of each screen shot.” *Id.* ¶ 6. The dates shown on Exhibit A to the Affidavit indicate that Menon was available on the Cornell website no later than November 18, 2003. *Id.* Ex. A at 5–10. Patent Owner's argument, that “Petitioner offers no evidence that the Menon PDF was indexed or that anyone actually located it on Cornell's site within the relevant timeframe” (PO Resp. 45), does not undermine the Petition's contention of public accessibility, at least to the extent each archived link was accessible before June 13, 2006.¹² *See also* Ex. 1003 ¶ 121 (Menon

¹² For example, the link on page 5 of Exhibit 1028 leads to an article dated March 15, 2006 that cites Menon in footnote 19. Ex. 1028, 5 (Karpievitch Y and Almeida J. (2006). “*mGrid: A load-balanced distributed computing environment for the remote execution of the user-defined Matlab code.*” BMC Bioinformatics. 10.1186/1471-2105-7-139. 7:1. Online publication date: 15-Mar-2006, available at <https://doi.org/10.1186/1471-2105-7-139>.). The earliest citation to Menon is July 1, 1998. *Id.* at 7 (FN 5 in linked article).

“has been cited 17 times in papers with online publication dates between the original publication of Menon and the earliest priority date of the ’621 patent.” (citing Ex. 1028, 4–9)). We find the Internet Archive Affidavit of Mina Ching and the Declaration of Dr. Bajaj provide persuasive support for Petitioner’s argument.

For the reasons given above, we determine Petitioner establishes by a preponderance of the evidence that Menon was publicly accessible before June 13, 2006 and qualifies as a prior art printed publication under 35 U.S.C. § 102.

c. Trefethen (Ex. 1006)

The Petition contends that Trefethen “qualifies as a printed publication because it was published and distributed on the webpage of one of its authors at least as early as 2001” and “was published on a Cornell University website no later than May 10, 1996.” Pet. 14 (citing Ex. 1023; Ex. 1029). The Petition also contends that Trefethen was “reasonably located by POSITAs because it had been cited 10 times in papers prior to the priority date of the ’621 patent.” *Id.* (citing Ex. 1003 ¶¶ 127–128; Ex. 1035, 2–3). The Petition further contends that a “POSITA seeking to understand MultiMATLAB’s capabilities would have consulted the Cornell website dedicated to MultiMATLAB, which contained links to [Trefethen and Menon].” *Id.* at 23–24 (citing Ex. 1003 ¶ 82; Ex. 1023).

Patent Owner responds that “Petitioner offers no competent evidence that such a hyperlink existed or that anyone actually found the page in the 1990s.” Resp. 42 (citing Ex. 1023). Patent Owner also argues that “[t]he record contains no proof of indexing, public discoverability, or that the site was accessed by any member of the public,” such that “one would have needed to know the exact URL to load the page – which is not public

accessibility unless that URL was advertised or indexed somewhere.” *Id.* Patent Owner further emphasizes that “it is undisputed that before the June 2006 critical date, Trefethen had not been formally published in any journal or conference, nor is there evidence it was available in libraries. Petitioner relies entirely on alleged web availability.” *Id.* at 43 (citing *Blue Calypso*, 815 F.3d at 1349).

First, although indexing and cataloging is an important consideration, the lack of indexing and cataloging is not dispositive. As the Federal Circuit explained in *Blue Calypso*, “we found that a particular article that was available only through an on-line publication was publicly accessible . . . [because] the particular on-line publication was well known to the community interested in the subject matter of the reference.” *Blue Calypso*, 815 F. 3d at 1349 (citing *Voter Verified, Inc. v. Premier Election Sols., Inc.*, 698 F.3d 1374, 1380 (Fed. Cir. 2012)). Here, Dr. Bajaj testifies as follows:

During the relevant timeframe, researchers commonly made their findings available on websites, particularly the websites associated with their research institution, here Cornell University. *A POSITA working with the MultiMATLAB system would have consulted the Cornell website dedicated to MultiMATLAB, which contained links to both papers.* Co-author Vijay Menon likewise included links to both papers within his web page on the Cornell website. Furthermore, the authors “Vijay Menon” and “Anne E. Trefethen” are common across both papers. The authors Menon and Trefethen were both at the same university, Cornell University, *working on the same research team to develop the MultiMATLAB system.* Accordingly, any POSITA seeking to understand MultiMATLAB would have been presented with both papers to consider.

Ex. 1003 ¶ 151 (citing Ex. 1005, 1; Ex. 1006, 1; Ex. 1023, 1–41) (emphases added). Dr. Bajaj continues:

Cornell was recognized at the relevant timeframe as a *pioneer in ‘the development of high-performance “cluster” computers made by linking off-the-shelf computers in parallel,’* and an ordinarily skilled artisan “interested in computer cluster systems and cluster computing techniques and exercising reasonable diligence would have located Trefethen from either the Cornell website and/or the ACM Digital Library, as evidenced by the afore-mentioned 10 citations to Trefethen.”

Ex. 1003 ¶ 128 (quoting Ex. 1033, 2; citing Ex. 1034, 1) (emphasis added). Dr. Bajaj’s testimony is consistent with the evidence of record, unrebutted, and aligns with the Federal Circuit’s reasoning in *Blue Calypso*.

Patent Owner does not offer cross-examination testimony of Dr. Bajaj. Patent Owner does not offer rebuttal testimony that would call into question Dr. Bajaj’s testimony that Cornell was a recognized leader in the field of high-performance cluster computing during the timeframe in question. We credit Dr. Bajaj’s testimony that, given the prominence of the Cornell research team, a POSITA exercising reasonable diligence would have located Trefethen from the Cornell website or ACM Digital Library.

Dr. Hsieh-Yee adds further weight to Petitioner’s argument. Dr. Hsieh-Yee testifies that Trefethen was disseminated and actually located by POSITAs:

Based on the records and documents I have reviewed, it is my opinion that *Trefethen* was published in May 1996, and was archived by Internet Archive on May 10, 1996, making this work discoverable on the Internet on that date. In 1996, 1997 and beyond, interested users could use search engines to search for MultiMATLAB or MATLAB to discover *Trefethen*. They could also use search engines to discover the lead author’s webpage and follow the link for MultiMATLAB on that webpage to access *Trefethen*. The Washington State University Library cataloged *Trefethen* on November 3, 1997, making this work discoverable at this library on that date. *Three early citations were published*

in 1997 and 1998, and became publicly accessible at libraries in 1998 and 1999. The earliest citation is a dissertation completed and approved in September 1997.

Ex. 1086 ¶ 104 (emphasis added); *see also id.* ¶¶ 76–104. We agree with Petitioner; a preponderance of the evidence establishes that “Trefethen was cataloged, indexed, and read and used by POSITAs” prior to June 13, 2006. Pet. Reply 20 (citing Ex. 1023; Ex. 1029; Ex.1035, 2–3; Ex. 1003 ¶¶ 127–128; Ex.1086 ¶¶ 71–104).

Patent Owner’s rebuttal evidence consists of one instance of self-citation in Menon, which Patent Owner argues is an indication that “[c]itation alone does not prove that the public could locate [Trefethen].” PO Resp. 43 (citing Ex. 1005, 1–2). However, Patent Owner does not dispute that “Trefethen was ‘cited 10 times’ before the relevant date.” *Id.* Such evidence is weak and unavailing when weighed against the substantial evidence presented by Petitioner. Moreover, even without a known URL or hyperlink to Trefethen, Menon’s and other prior art’s citations to Trefethen provide additional motivation for an interested artisan to pursue finding Trefethen on the Cornell website or ACM Digital Library by exercising reasonable diligence to supplement the teachings of Menon and/or parallel MultiMATLAB teachings in general. We find Petitioner establishes by a preponderance of the evidence that a POSITA exercising reasonable diligence would have located Trefethen from the Cornell website or ACM Digital Library prior to June 13, 2006.

For the reasons given above, we determine Petitioner has established by a preponderance of the evidence that Trefethen was publicly accessible before June 13, 2006 and qualifies as a prior art printed publication under 35 U.S.C. § 102.

d. RS6000 (Ex. 1007), POEref (Ex. 1008), MPIref (Ex. 1017)

The Petition contends that RS6000 “is a product manual by IBM in support of the IBM RS6000 SP computing solution.” Pet. 14. According to Petitioner, “RS6000 qualifies as a printed publication because it was cataloged and indexed in IBM’s online document library at least as early as 2002 on IBM’s website.” *Id.* (citing Ex. 1003 ¶¶ 130–131; Ex. 1007; Ex. 1029; Ex. 1038). The Petition also contends that “Menon . . . teach[es] that MultiMATLAB uses the ‘IBM SP2’” and “RS6000 provides ‘an overview of the IBM RS/6000 SP.’” *Id.* at 25 (citing Ex. 1003 ¶ 88; Ex. 1005, 5; Ex. 1007, 1). The Petition further contends that a “POSITA seeking to understand MultiMATLAB would be motivated to review the documentation corresponding to the systems for which ‘MultiMATLAB was design[ed] specifically.’” *Id.* at 25 (citing Ex. 1005, 6).

The Petition contends that POEref “is a product manual published by IBM in support of the Parallel Operating Environment running on an RS/6000 system.” Pet. 15. The Petition also contends that “POEref qualifies as a printed publication because it was catalogued and indexed in IBM’s online document library at least as early as 2001” and “was distributed with the IBM SP2 systems and published at least as early as 2001.” *Id.* (citing Ex. 1003 ¶¶ 134–136; Ex. 1008, 157; Ex. 1029; Ex. 1036, 14; Ex. 1039; Ex. 1047).

The Petition contends that “MPIref qualifies as a printed publication because it was distributed to POSITAs using FTP mail servers by the University of Tennessee and Oak Ridge National Library in 1994.” Pet. 15 (citing Ex. 1017, cover page; Ex. 1029, 1–3). The Petition also contends that MPIref “was published on MPI Forum’s website no later than July 3, 1998” and “was reasonably located by POSITAs because it had been cited

74 times in papers with online publications dates before the earliest priority date of the '621 patent.” *Id.* (citing Ex. 1003 ¶¶ 140–142; Ex. 1029, 1–3; Ex. 1037, 2–16). The Petition further contends that Menon “expressly cite[s] to ‘the MPI communication standard’” and “MPIref is the MPI communication standard referenced by Menon.” *Id.* at 26 (quoting Ex.1005, 5; citing Ex. 1017, 1 (“MPI: A Message-Passing Interface Standard”)).

Most of Patent Owner’s arguments contesting the public accessibility of RS6000, POEref, and MPIref have been addressed above. PO Resp. 39–42.

Having considered the evidence of record, we determine the Petition presents evidence establishing that artisans of ordinary skill were aware of the IBM SP2 product and POE at least through publication of Menon and via distribution of POEref with the IBM SP2product. *See* Pet. 14–15 (citing Ex.1003 ¶¶ 130–131, 134–136, 140–142; Ex.1007; Ex. 1008, 157; Ex.1029; Ex. 1036, 14; Ex.1038; Ex. 1039; Ex. 1047). For example, POEref provides specific instructions for locating “IBM product information for RS/6000 SP products on the World Wide Web”:

Most of the RS/6000 SP hardware and software books are available from the IBM Web site at:

<http://www.ibm.com/servers/eserver/pseries>

The serial and parallel programs that you find in the *IBM Parallel Environment for AIX: Hitchhiker’s Guide* are also available from this Web site, in the same location as the PE online library.

You can view a book, download a Portable Document Format (PDF) version of it, or download the sample programs from the IBM Parallel Environment for *AIX: Hitchhiker’s Guide*.

At the time this manual was published, the Web address of the *RS/6000 SP Product Documentation Library* page was:

http://www.rs6000.ibm.com/resource/aix_resource/sp_books

Ex. 1008, 157. Dr. Hsieh-Yee testifies:

My research found that archived webpages on the IBM website show *POE-2001* was available no later than February 2002 and continued to be available beyond early 2004. Internet Archive does not archive every web file or resource, and it has not archived *POE-2001*. Changes in IBM servers and system architecture may have contributed to this situation. I have obtained several archived webpages from the IBM website to show how interested users could discover *POE-2001* in 2002, 2003, and 2004, and how this document was presented as available for online browse or download on IBM webpages in those years. These webpages are presented in **Ex. 1113** in this declaration. In addition, two citing documents are included to show *POE-2001* was known and used by researchers in 2004 and 2005.

Ex. 1086 ¶ 128. Dr. Hsieh-Yee’s testimony is unrebutted. Further as to POEref, the Petition shows Menon teaches “that ‘POE . . . is used to start and assign identification numbers to all the MATLAB processes when implementing the MultiMATLAB architecture in IBMSPP2, and POEref is directed to describe[ing] . . . [the] Parallel Operating Environment (POE)”, and an ordinarily skilled artisan “seeking to understand MultiMATLAB would be motivated to review the documentation corresponding to the systems expressly discussed in Menon.” Pet. 107–108 (citing Ex. 1005, 6; Ex. 1008, ix). We agree with Petitioner’s analysis supported by Dr. Hsieh-Yee’s Declaration testimony. Pet. 107–108; Pet. Reply 21–22 (citing Ex. 1086 ¶¶ 105–148).

For the reasons given above, we find Petitioner establishes that RS6000 and POEref were accessible to a POSITA exercising reasonable diligence prior to June 13, 2006.

Petitioner next argues “Menon describes that a POSITA would look to use the MPI standard because of MPI’s ‘broad popularity, its suitability to high performance parallel computing, and the virtually universal availability of vendor-optimized versions on modern parallel computers.’” Pet. 26–27 (quoting Ex.1005, 5). Petitioner further shows that Menon teaches “an implementation of MultiMATLAB using MPI as its communication layer and MPIref describing ‘all technical features’ of MPI.” *Id.* at 27 (citing Ex. 1005, 3–10). This evidence further supports Petitioner’s contention that an artisan of ordinary skill would have been motivated and able to locate MPIref as documentation of Menon’s implementation of MPI on the IBM system.

Patent Owner contends that “Petitioner offers no evidence that anyone outside the MPI Forum ever knew of or accessed the draft [MPIref].” PO Resp. 41. Petitioner replies with authoritative evidence from Dr. Hsieh-Yee:

Based on the documents and records I have reviewed, it is my opinion that *MPI-1994* became publicly accessible by November 1994 when a citing document was published, and when the National Science Library of Canada created their original MARC record for this standard. *MPI-1994* was definitely available no later than July 1998 when it was first archived by Internet Archive.

Ex. 1086 ¶ 182; Pet. Reply 23–24 (citing Ex. 1086 ¶¶ 149–182).

Patent Owner’s unsupported Sur-Reply contention, that “Petitioner offers no contemporaneous evidence that any skilled person actually accessed” the references “through the cataloging records or citation chains the Reply now invokes” (Sur-Reply 26–27), is unavailing because it does not undermine the substantial evidence of record satisfying Petitioner’s burden of proof by a preponderance of the evidence that MPIref was

publicly accessible to a POSITA exercising reasonable diligence prior to June 13, 2006.

5. Conclusion as to Public Accessibility

For all the foregoing reasons, we determine Petitioner establishes by a preponderance of the evidence that Menon, Trefethen, RS6000, POEref, and MPIref were publicly accessible prior to June 13, 2006 and qualify as prior art printed publications under 35 U.S.C. § 102.

7. Analysis of Claim 1

Petitioner provides contentions and evidence concerning why an ordinarily skilled artisan would have been motivated to combine Menon, Trefethen, RS6000, and MPIref with a reasonable expectation of success. Pet. 16–26. Petitioner also provides a proposed mapping of the prior art to the limitations of claim 1. Pet. 27–67.

Patent Owner argues that Petitioner fails to establish a motivation to combine Menon and Trefethen, that Menon teaches away, and that Petitioner fails to establish limitations 1.4.2 and 1.9. PO Resp. 22–27, 29–33, and 12–16.

a. Motivation to Combine

Petitioner first contends that “Menon and Trefethen are analogous prior art because they pertain to the same field of endeavor as the ’621 patent, namely, the ‘field of cluster computing’ and are reasonably pertinent to the problem of the ’621 patent, namely executing a single program on multiple nodes.” Pet. 22 (citing Ex. 1001, 1:15–16; Ex. 1003 ¶¶ 75–79; Ex. 1005, 2; Ex. 1006, Abstract); *id.* at 24 (arguing that RS6000 is analogous art for substantially the same reasons (citing Ex. 1001, 1:14–15; Ex. 1003 ¶¶ 84–87; Ex. 1007, 1)); *id.* at 26 (arguing that MPIref is analogous art for

substantially the same reasons (citing Ex. 1001, 1:14–15; Ex. 1003 ¶¶ 92–94.)).

Petitioner next contends that “Menon suggests the combination by expressly citing Trefethen and explaining that Menon builds on the teachings of Trefethen.” Pet. 23 (citing Ex. 1003 ¶ 81; Ex. 1005, 1–2).¹³

Petitioner next contends that “Trefethen describes ‘how the [MultiMATLAB] system is used’ using code examples that perform parallel mathematical calculation using MATLAB” and “Menon describes ‘tak[ing] advantage of high performance distributed memory processors’ to enable MATLAB to perform parallel mathematical calculations.” Pet. 23 (citing Ex. 1005, Abstract, 16; Ex. 1006, 2). According to Petitioner, “Menon and Trefethen together represent a combination of prior art elements according to known methods (executing MATLAB code on a multiprocessor system) to yield the predictable result discussed in both papers: the MultiMATLAB system executing MATLAB in parallel to perform mathematical calculations.” *Id.* (citing Ex. 1003 ¶ 80; Ex. 1005, Abstract; Ex. 1006, 2–7).

Petitioner next contends that combining “Menon and Trefethen to parallelize MATLAB would have been predictable because researchers had a strong desire to parallelize MATLAB,” “[t]he goal of parallelizing MATLAB was ‘inevitable,’ and the combination “achieved this goal: the MultiMATLAB system executes MATLAB in parallel to perform

¹³We note that Menon and Trefethen are authored by the same research group at Cornell University and together disclose integrating MATLAB software with a high-performance parallel computing platform that uses multiple microprocessors—the IBM SP2 parallel operating platform. Ex. 1005, 1 (Abstract), 2, 5–6; Ex. 1006, 1–2, 10, 12.

mathematical calculations.” Pet. 24 (citing Ex. 1003 ¶ 83; Ex. 1005, 2; Ex. 1006, 11–12).

For RS6000, Petitioner contends that an ordinarily skilled artisan would have been motivated to “combine[] RS6000 with Menon because Menon suggests the combination by teaching MultiMATLAB uses the ‘IBM SP2, a modern high performance distributed memory multiprocessor.” Pet. 24–25 (citing Ex. 1003 ¶ 88; Ex. 1005, 5; Ex. 1007, 1). In support of this contention, Petitioner argues that an ordinarily skilled artisan “seeking to understand MultiMATLAB would be motivated to seek documentation corresponding to the systems for which ‘MultiMATLAB was design[ed] specifically.” *Id.* at 25 (citing Ex. 1005, 6). According to Petitioner, “Menon and RS6000 together represent a combination of prior art elements . . . according to known methods . . . to yield the predictable result of MultiMATLAB implemented on an IBM SP2 having the physical attributes disclosed by RS6000.” *Id.* (citing Ex. 1003 ¶ 90; Ex. 1005, Abstract, 6; Ex. 1007, 1, 11).

Petitioner next contends that an ordinarily skilled artisan would have had a reasonable expectation of success “because Menon expressly discloses implementing MultiMATLAB on an IBM SP2 and that MultiMATLAB ‘was design[ed] specifically for the IBM SP2.” Pet. 25–26 (citing Ex. 1003 ¶ 91; Ex. 1005, 6, 14).

For MPIref, Petitioner contends that Menon “expressly cit[es] to ‘the MPI communication standard” and “MPIref is the MPI communication standard referenced by Menon.” Pet. 26 (citing Ex. 1005, 5; Ex. 1017, 1). Petitioner next contends that “Menon describes that a POSITA would look to use the MPI standard because of MPI’s ‘broad popularity, its suitability to high performance parallel computing, and the virtually universal availability

of vendor-optimized versions on modern parallel computers.” *Id.* at 26–27 (citing Ex. 1005, 5). Petitioner next contends that “[t]he combination of MPIref with Menon would have been obvious because Menon and MPIref together represent a combination of known prior art elements . . . to yield the predictable result of an implementation of MultiMATLAB utilizing the features of MPI disclosed by MPIref.” *Id.* at 27 (citing Ex. 1005, 3–10, Ex. 1017, ii). According to Petitioner, “there would have been a reasonable expectation of success at least because Menon expressly discusses using MPI, which is the subject of MPIref, to establish communication between all the MATLAB processes of MultiMATLAB.” *Id.* (citing Ex. 1003 ¶¶ 95–99; Ex. 1005, 3; Ex. 1017, 2).

Patent Owner responds that Petitioner’s argument “reduces to the unremarkable proposition that researchers wanted to parallelize high-level mathematical computing environments,” which is an insufficient reason to combine the references and fails to “explain why a POSITA would have selected and implemented the particular multicore, result-return, and ordered sequence architecture recited in the claims.” PO Resp. 22.

Patent Owner next argues that Menon refutes Petitioner’s premise that Menon is “an incremental extension of Trefethen” because Menon “distinguishes the first MultiMATLAB architecture (Trefethen) from the newer one, describing the first as ‘different’ and identifying performance and extensibility limitations that prompted a new design.” PO Resp. 23–24 (citing Ex. 1005, 14); *id.* at 25 (“Menon identifies structural limits that prevented the first architecture (Trefethen) from supporting the kinds of extensions and performance the users wanted.”).

Patent Owner next argues that the proposed combination would not yield the claimed system. PO Resp. 26. According to Patent Owner, the

control model of the asserted reference “is not the claimed control model” because “Menon expressly describes an ‘interactive process’ from which the other MATLAB processes ‘wait for commands,’ i.e., a master-controlled dispatch architecture.” *Id.* Patent Owner contrasts this with what it argues is “the ’621 Patent’s peer-to-peer task-transmission model in which cluster node modules can transmit tasks among themselves ‘without transmitting the tasks through a master node’ (claims 1, 13, 24) or ‘directly transmit’ tasks’ (claim 27).” *Id.*

Patent Owner also argues that the combination is based on impermissible hindsight. PO Resp. 27–29.

Patent Owner does not provide any argument against motivation to combine in connection with RS6000 or MPIref. PO Resp. 22–29.

In the Petitioner Reply, Petitioner argues that Patent Owner ignores the multiple reasons set forth in the Petition that are supported by Dr. Bajaj’s expert testimony as to why an ordinarily skilled artisan would have been motivated to combine Menon and Trefethen. Pet. Reply 14–15 (citing Pet. 23–24; Ex. 1003 ¶¶ 75–83; Ex. 1005, Abstract, 1–2; Ex. 1006, 2–7; Ex. 1163 ¶¶ 33. Petitioner further argues that “Patent Owner’s position is entirely attorney argument with no supporting expert testimony.” *Id.* at 15 (citing Ex. 1163 ¶¶ 34–35).

Petitioner provides testimony from Dr. Bajaj with the Petitioner Reply that a POSITA would have been motivated to combine Menon and Trefethen in the manner claimed in the ’621 patent:

- Menon suggesting the combination by **expressly citing** Trefethen and explaining that Menon builds on the teachings of Trefethen. Ex.1005, 1-2; Ex.1003, ¶71;

- Menon and Trefethen both describe aspects of how the same MultiMATLAB system enables MATLAB to perform parallel mathematical calculations. Ex.1005, Abstract, 16; Ex.1006, 2; Ex.1003, ¶72;

- Menon and Trefethen together represent a combination of prior art elements according to known methods (executing MATLAB code on a multi-node system) to yield the predictable result discussed in both references: the MultiMATLAB system executing MATLAB in parallel to perform mathematical calculations. Ex.1005, Abstract; Ex.1006, 2-7; Ex.1003, ¶70.

Pet. Reply 14 (citing Ex. 1163 ¶ 33).

Dr. Bajaj further testifies as follows:

A POSITA would have had an especially strong reason to read these references together *because they address the same project, the same MATLAB-based parallel-computing problem, and the same MultiMATLAB command environment*. Ex. 1005, 1–2; Ex. 1006, 2–7. Menon expressly identifies Trefethen’s MultiMATLAB work and then describes a redesigned architecture that preserves the same user-level objective—parallel MATLAB computations—while improving implementation details and extensibility. Ex. 1005, 2, 14.

A POSITA therefore would not view the references as mutually exclusive alternatives. Rather, a POSITA would understand Trefethen as teaching specific MultiMATLAB commands and examples, including Eval, Send, Recv, and the cycle example, and Menon as teaching *how the MultiMATLAB architecture was implemented and improved in a later version*. Ex. 1005, 2–4, 14; Ex. 1006, 4–7.

Ex. 1163 ¶¶ 34–35 (emphases added). We find this above reasoning by Dr. Bajaj to be persuasive and adopt it as our own.

Petitioner and Dr. Bajaj demonstrate a sound technical motivation for a POSITA to combine Menon and Trefethen, i.e., to improve MATLAB’s operational performance and extensibility in a parallel operating environment. Menon builds on Trefethen to improve and extend the parallel

processing capabilities of MultiMATLAB: “This system will enable users to access high-performance parallel routines from within the MATLAB environment, to extend the environment with new parallel routines, and to use these routines to develop parallel applications with the MATLAB language.” Ex. 1005 Abstract. Menon is *intended* to be read in conjunction with Trefethen, as would be expected from two references generated by the same research group at the same university addressed to the same technical subject matter about a year apart. Ex. 1005,1; Ex. 1006, Ex. 1086 ¶¶ 65, 101, 102. The very first citation in Menon is to Trefethen. Ex. 1005, 2, 16.

Patent Owner’s Response and Sur-Reply assert a lack of motivation to combine references based on mere unsupported attorney argument. *See* PO Resp. 22–26; Sur-Reply 16–20. Patent Owner contends Petitioner’s argument “reduces to the unremarkable proposition that researchers wanted to parallelize high-level mathematical computing environments,” which Patent Owner asserts is an insufficient reason to combine the references because “[m]otivation must be tied to the claimed configuration, not to an abstract goal.” PO Resp. 22–23 (citing *KSR*, 550 U.S. at 418). Patent Owner’s argument overlooks Petitioner’s evidence that Menon specifically references, builds on, and expands the teachings of Trefethen—published by the same Cornell research team—to improve MATLAB’s parallel computing performance and extensibility. Moreover, in an obviousness inquiry, there is no requirement that an artisan's reasons for modifying the prior art be the same as that of the patent applicant. *See In re Kemp*, 97 F. 3d 1427, 1430 (Fed. Cir. 1996) (“Although the motivation to combine here differs from that of the applicant, the motivation in the prior art to combine the references does not have to be identical to that of the applicant to

establish obviousness.”) (citing *In re Dillon*, 919 F.2d 688, 693 (Fed. Cir. 1990) (en banc)).

With respect to Patent Owner’s argument that “[t]he asserted references’ control model is not the claimed control model,” Patent Owner fails to explain what it refers to as “the claimed control model” other than referring to snippets of claim limitations 1.9, 13.9, 14.9 (“without transmitting the tasks through a master node”) and 27.9 (“directly transmit”). PO Resp. 26. As explained below, we determine, in connection with limitation 1.9, that Petitioner’s proposed combination teaches these claim limitations. Consequently, to the extent that Patent Owner argues that Petitioner’s purported failure to establish an undefined “claimed control model” undermines Petitioner’s motivation to combine showing, the argument is unavailing.

b. Teaching Away

“A reference may be said to teach away when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant.” *DePuy Spine, Inc. v. Medtronic Sofamor Danek, Inc.*, 567 F.3d 1314, 1327 (Fed. Cir. 2009) (quoting *Ricoh Co., Ltd. v. Quanta Comput. Inc.*, 550 F.3d 1325, 1332 (Fed. Cir. 2008)).

Patent Owner contends that Menon teaches away from the combination with Trefethen. PO Resp. 6. According to Patent Owner, “Menon does not treat Trefethen’s design as a suitable foundation for the desired high-level interactive cluster environment” but rather “explains that the first generation architecture suffers from structural constraints including tight coupling to the MATLAB interpreter and incompatibility with parallel

MEX extensions, that motivated a ‘completely different’ design.” *Id.* (citing Ex. 1005, 10–11); *id.* at 29 (“Menon does not present Trefethen’s first-generation MultiMATLAB work as a stable platform to extend; it presents it as an architecture with meaningful limitations that required a different approach.” (citing Ex. 1005, 14)); *id.* at 30 (arguing that Menon explains Trefethen “could not take advantage of vendor-optimized MPI implementations” and “expressly states that Trefethen’s first-generation architecture as inadequate.”) (citing Ex. 1005, 14)).

Patent Owner next argues that “Menon’s most pointed teaching-away statement is directed to extensibility: the first MultiMATLAB architecture ‘does not permit extensions via parallel MEX routines.’” PO Resp. 31 (citing Ex. 1005, 14).

Petitioner replies that Menon and Trefethen “share two of the same authors” and both “describe aspects of the same system—MultiMATLAB.” Pet. Reply 15 (citing Pet. 23–24; Ex. 1005, 1; Ex. 1006, 1.). Petitioner argues that “Menon explicitly cites Trefethen and explains that Menon builds on the teachings of Trefethen.” *Id.* (citing Pet. 23; Ex. 1003 ¶ 81; Ex. 1005, 1–2; Ex. 1163 ¶ 38).

Petitioner next contends that “Menon describes *enhancing* the system of Trefethen,” “describes a list of ‘goals’ already achieved by MultiMATLAB and then states that the architecture has been ‘redesigned to achieve two **further goals**’”, and one of the goals “is ‘extensibility,’ which Menon achieves by its description of ‘MEX routines’ to the system of Trefethen.” Pet. Reply 16 (citing Ex. 1005, 2–3; Ex. 1163 ¶ 37). According to Petitioner, “Menon’s addition of the ‘MEX routines’ to MultiMATLAB shows that such a modification was within the capabilities of a POSITA—in

fact, the authors of the Menon paper *actually implemented* the modification.” *Id.* (citing Ex. 1005, 2–3; Ex. 1163 ¶¶ 36–37.

For the following reasons, we disagree with Patent Owner’s argument.

First, Patent Owner’s teaching away argument is inconsistent with the strong evidence of a motivation to combine Menon and Trefethen discussed above. Second, Patent Owner’s teaching away argument is contrary to the evidence of record for the reasons given in Petitioner’s Reply. Pet. Reply 15–16 (e.g., “Menon explicitly cites Trefethen and explains that Menon builds on the teachings of Trefethen.”) (citing Pet. 23; Ex. 1003 ¶ 81; Ex. 1005, 1–3; Ex. 1163 ¶ 38). We are further persuaded by Dr. Bajaj’s reply testimony:

Menon does not “distinguish” the “MultiMATLAB” teachings of Trefethen. Menon explicitly cites Trefethen and explains that Menon builds on the teachings of Trefethen. Menon describes *enhancing* the system of Trefethen. For example, Menon describes a list of “goals” already achieved by MultiMATLAB and then states that the architecture has been “redesigned to achieve two further goals.” One of these two “further goals” is “extensibility.” Menon achieves this extensibility by adding “MEX routines” to the system of Trefethen. The “MEX routines” do not show an “incompatibility” between Menon and Trefethen. Instead, Menon’s addition of the “MEX routines” to MultiMATLAB shows that such a modification was within the capabilities of a POSITA because the authors of the Menon paper actually implemented the modification.

Ex. 1163 ¶ 37 (citing Ex. 1003 ¶ 71; Ex. 1005, 1–3). We credit Dr. Bajaj’s testimony which is unrebutted and supported by the record. We, thus, agree with Dr. Bajaj’s reasoning which is based on Menon. We further agree with Dr. Bajaj’s conclusion that Menon does not teach away from the combination with Trefethen. *Id.* ¶ 75.

Menon’s description of building on and enhancing the teachings of Trefethen—the earlier work of the same research group at Cornell—by adding MEX routines to achieve high-performance parallel computing and extensibility for MATLAB, demonstrates a classic motivation for a POSITA to combine. RS6000 is specifically referenced in Menon-Trefethen and adds operational details of the parallel operating platform that teach a POSITA how to implement the MultiMATLAB system with a reasonable expectation of success. Considering Menon as a whole, these facts are inconsistent with Patent Owner’s teaching away arguments.

For these reasons, Patent Owner’s teaching away argument is unavailing.

Motivation to Combine Conclusion

We have reviewed Petitioner’s evidence and contentions which we find to be persuasive. Patent Owner’s unsupported attorney arguments do not undermine Petitioner’s showing. Consequently, we find that Petitioner establishes that an ordinarily skilled artisan would have been motivated to combine Menon, Trefethen, RS6000, and MPIref¹⁴ with a reasonable expectation of success. *See Intel Corp. v. PACT XPP Schweiz AG*, 61 F.4th 1373, 1381 (Fed. Cir. 2023) (explaining that it is sufficient for motivation to combine “that there was a known problem . . . in the art, that Bauman[] . . . helped address that issue, and that combining the teachings of Kabemoto and

¹⁴ Patent Owner does not dispute Petitioner’s contentions that Menon, Trefethen, RS6000, and MPIref are analogous art. *See generally* PO Resp.

Bauman wasn't beyond the skill of an ordinary artisan. Nothing more is required to show a motivation to combine under *KSR*").¹⁵

c. Limitation [1.0]¹⁶ A computer cluster comprising:

Petitioner provides the following annotated version of Menon's Figure 1 to illustrate its contentions:

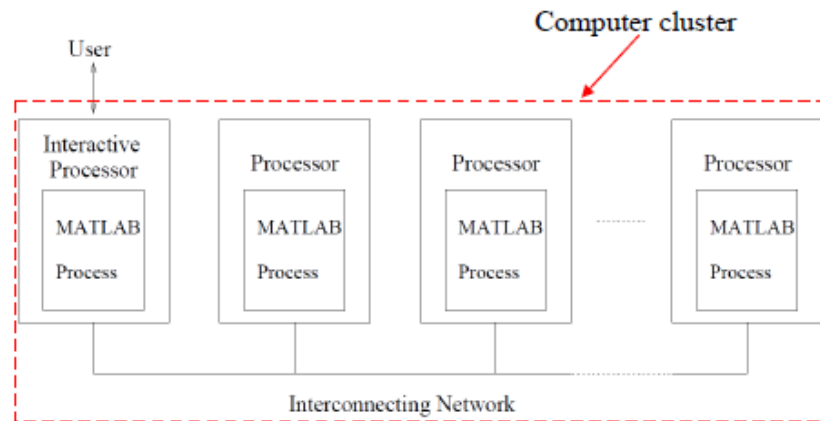


Figure 1: MultiMATLAB Architecture

Ex.1005, FIG. 1 (annotated); Ex.1003, ¶170

Pet. 28. Figure 1 is a block diagram illustrating “MultiMATLAB Architecture.” Ex. 1005, 3. Petitioner annotates Figure 1 with a broken red rectangle around Figure 1 with black text “Computer cluster” with a red arrow pointing to the broken red rectangle. Pet. 28.

Petitioner contends that Menon discloses that “MultiMATLAB was designed ‘specifically for the IBM SP2,’” that “[t]he IBM SP2 system ‘execute[s] parallel programs on ... a **networked cluster** of RS/6000

¹⁵ Because we determine that the Petitioner has established, by a preponderance of the evidence, factually supported reasons why an ordinarily skilled artisan would have been motivated to combine Menon and Trefethen, Patent Owner’s conclusory hindsight argument fails to undermine that showing. *See In re Cree*, 818 F.3d 694, 702, n.3 (Fed. Cir. 2016).

¹⁶ We use Petitioner’s limitation identifiers for ease of reference.

processors,” and “us[es] a plurality of processor nodes to perform mathematical calculations. Pet. 28 (citing Ex. 1005, 5, 6, 13, Figs. 7, 8; Ex. 1008, 1). Petitioner argues that the combined teachings of Menon and RS/6000 teach the preamble. *See id.* (citing Ex. 1003 ¶¶ 169–175).

Patent Owner does not address the preamble. *See generally* PO Resp.

We have reviewed Petitioner’s evidence and argument and find Petitioner establishes that the combination of Menon and RS/6000 teaches the subject matter of the preamble. Consequently, we need not determine whether the preamble is limiting.

d. Limitations 1.1.1, 1.1.2, 1.1.3: “a first processor,” “a second processor,” and “a third processor”

Petitioner contends that the combination of Menon and RS6000 teaches each of these limitations. Pet. 29–31. Petitioner provides the following annotated version of Menon’s Figure 1 to illustrate its contentions (*id.* at 29):

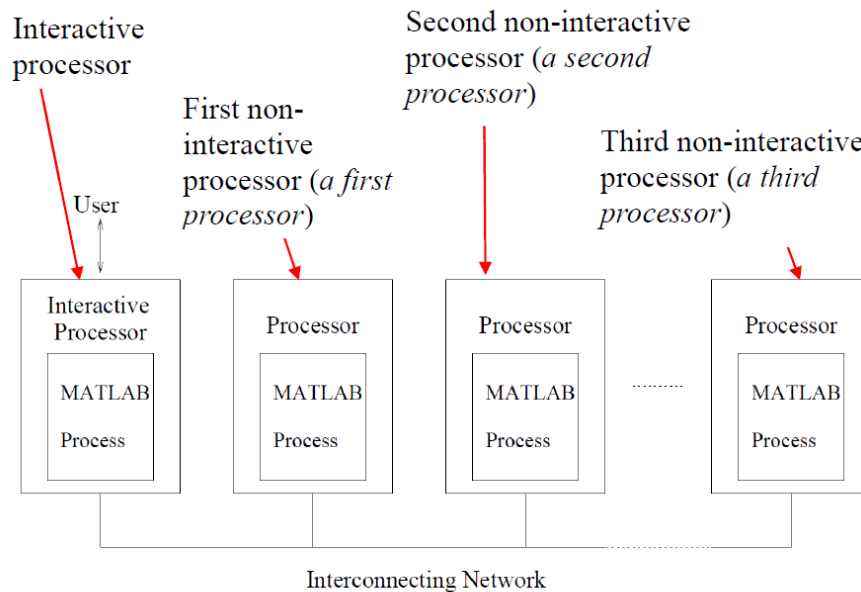


Figure 1: MultiMATLAB Architecture

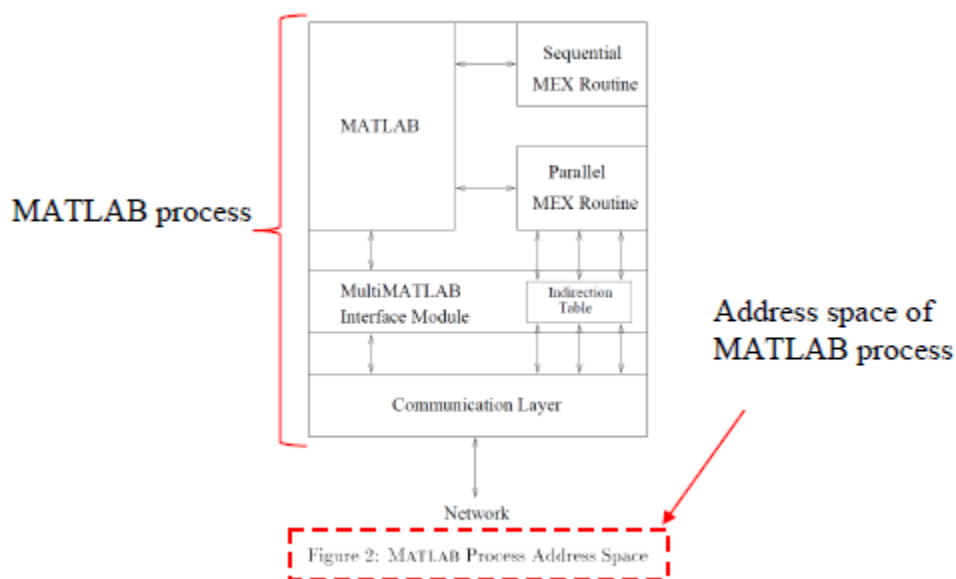
In the above figure, Petitioner annotates the three non-interactive processors from Menon's MultiMATLAB architecture that Petitioner contends correspond to the recited first processor, second processor, and third processor. *Id.* at 29–31 (citing Ex. 1003 ¶¶ 176–179; Ex. 1005, 3 (“each processor in a parallel platform individually runs a MATLAB process”)).

Patent Owner does not address these limitations. *See generally* PO Resp.

We have reviewed Petitioner's evidence and argument and find Petitioner establishes that the combination of Menon and RS/6000 teaches these limitations.

e. Limitation 1.2: “at least one computer-readable medium in communication with at least one of the first processor, the second processor, or the third processor”

Petitioner contends that the combination of Menon and RS6000 teaches limitation 1.2. Pet. 32–33. Petitioner provides the following annotated version of Menon's Figure 2 to illustrate its contentions (*id.* at 32):



Ex.1005, FIG. 2 (annotated); Ex. 1003, ¶188

Petitioner annotates Figure 2 with a red solid line on the left edge with text “MATLAB process” and a red broken rectangle around the title on the bottom of Figure 2 with text “Address space of MATLAB process.” *Id.*

Petitioner first contends that an ordinarily skilled artisan “would understand Menon’s ‘address space’ to be ‘memory locations . . . contain[ing] the executable program’” and “would recognize that MATLAB is in, and accessed by, for example, the *first processor*, from, a *computer readable medium* . . . of the IBM SP2 processor nodes [that] can be disk drives or memory cards, as taught by RS6000.” Pet. 32 (citing Ex. 1007, 6, 10; Ex. 1018, 67–68).

Petitioner next contends that “[e]ach MATLAB process ‘does the computation required for its local data’” and “MATLAB causes the hardware processors of the IBM SP2 node to perform computations (*in communication with at least one of the first processor, the second processor, or the third processor*).” Pet. 33 (citing Ex. 1005, 11–13). According to Petitioner, “each MATLAB process address space . . . that the processors accesses [sic] . . . in view of RS6000 teaching that the IBM SP2 has disk drives and memory cards for storing program code accessible by the node’s hardware processors” teaches this limitation. *Id.* (citing Ex. 1003 ¶¶ 186–191).

Patent Owner does not address this limitation. *See generally* PO Resp.

We have reviewed Petitioner’s evidence and argument and find Petitioner establishes that the combination of Menon and RS/6000 teaches this limitation.

f. Limitations 1.3.1, 1.5.1, and 1.7.1: “a first kernel residing in the at least one computer-readable medium,” “a second kernel residing

in the at least one computer readable medium,” and “a third kernel residing in the at least one computer readable medium”

Petitioner contends that “Menon discloses the first non-interactive processor having MATLAB (*first kernel*) in an address space (*computer-readable medium*), rendering obvious . . . limitation [1.3.1].” Pet. 35 (citing Ex. 1003 ¶¶ 192–196). Petitioner notes that “[t]he ’621 patent identifies MATLAB as an example of a *kernel*.” *Id.* at 33, n.3 (citing Ex. 1001, 1:16–17, 4:21–26). For the second kernel and third kernel recited in limitations 1.5.1 and 1.7.1, Petitioner relies on a similar showing and contends that each MATLAB process on a processor of the three processors in Menon’s Figure 1 teaches a *kernel*. Pet. 45 (MATLAB’s second non-interactive processor corresponding to recited “second processor”), 53–54 (MATLAB’s third non-interactive processor corresponding to recited “third kernel”).

Petitioner annotates Menon’s Figure 1 to illustrate its showing, as follows (Pet. 34):

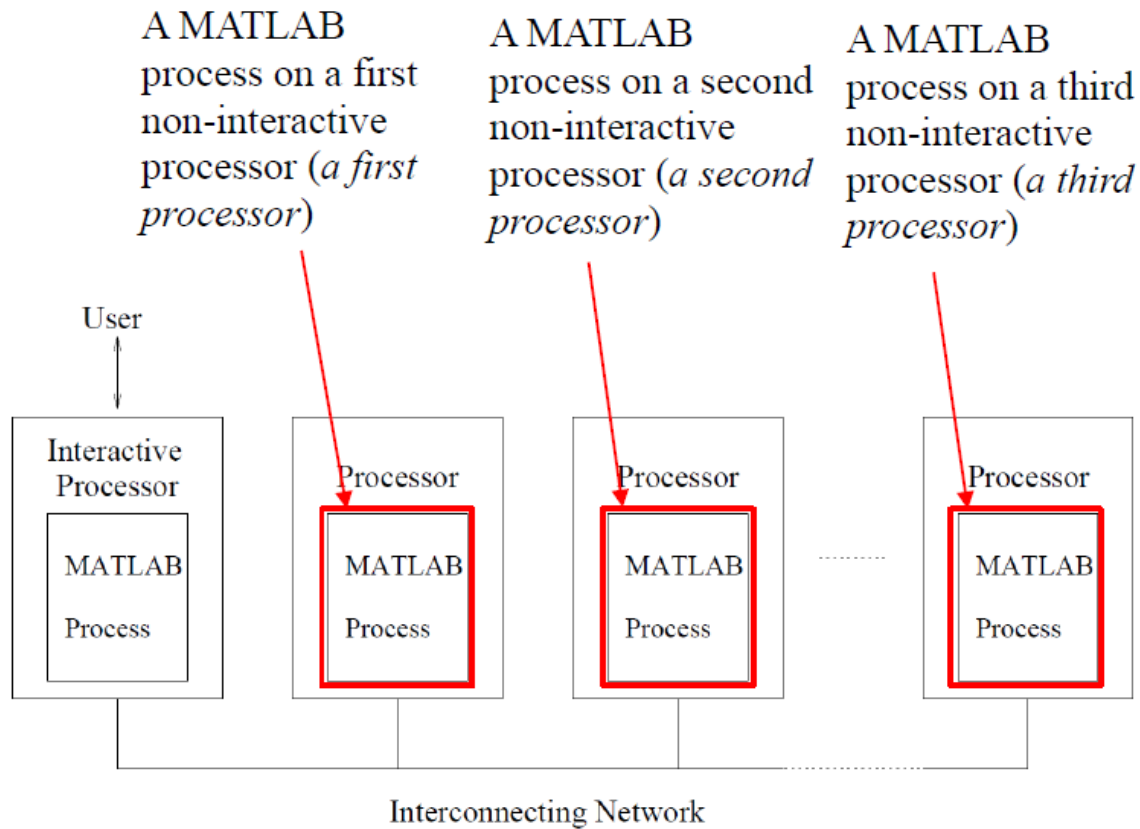


Figure 1: MultiMATLAB Architecture

Ex.1005, FIG. 1 (annotated); Ex.1003, ¶192

As annotated by Petitioner, Figure 1 illustrates MATLAB as a process running in each of three non-interactive processors (red box, italics) in Menon's system. Pet. 34. Petitioner contends that "Menon explains that each MATLAB process of MultiMATLAB contains MATLAB, 'the numerical computing environment of choice on uniprocessors for hundreds of thousands of engineers and scientists.'" *Id.* (citing Ex. 1005, 1, Fig. 2).

Petitioner also refers to its contentions for limitation 1.2 (based on the combined teachings of Menon and RS6000) and asserts each MATLAB process is in an address space in memory (*computer readable medium*). Pet. 33–35 (annotating Ex. 1005, Figs. 1, 2).

Patent Owner does not address these limitations. *See generally* PO Resp.

We have reviewed Petitioner’s evidence and argument and find Petitioner establishes that the combination of Menon and RS6000 teaches these limitations.

g. Limitations 1.3.2, 1.5.2, 1.7.2: “said first kernel configured to translate commands into code for execution on the first processor”, “said second kernel configured to translate commands into code for execution on the second processor;” and “said third kernel configured to translate commands into code for execution on the third processor”

For limitation 1.3.2, Petitioner refers to its contentions for limitation [1.3.1] and contends that “Menon discloses that ‘each processor in a parallel platform [in the MultiMATLAB architecture] individually runs a MATLAB process.’” Pet. 36 (citing Ex. 1005, 3). Petitioner further contends that “Trefethen provides several examples of MATLAB receiving commands that are translated into code for execution” and referring to its contentions for limitation [1.1.1] that “RS6000 discloses the *first processor* for executing ‘parallel applications.’” *Id.* (citing Ex. 1006, 3–7; Ex. 1007, 1). According to Petitioner, combining the teachings of Menon, Trefethen, and RS6000 teaches limitation 1.3.2. *Id.* (citing Ex. 1003 ¶¶ 197–199).

For limitation 1.5.2, Petitioner refers to its contentions for limitations [1.1.2] and [1.3.1] for the second processor and second kernel limitations and asserts substantially similar contentions for translating commands into code for execution on the second processor. Pet. 45–47 (citing Ex. 1003 ¶¶ 224–228; Ex. 1007, 1).

For limitation 1.7.2, Petitioner refers to its contentions for limitations [1.1.3] and [1.3.1] for the third processor and third kernel limitations and

asserts substantially similar contentions for translating commands into code for execution on the second processor. Pet. 54–56 (citing Ex. 1003 ¶¶ 248–253; Ex. 1007, 1).

Patent Owner does not address these limitations. *See generally* PO Resp.

We have reviewed Petitioner’s evidence and argument and find that Petitioner establishes that the combination of Menon, Trefethen, and RS6000 teaches these limitations.

h. Limitation 1.4.1: “a first cluster node module residing in the at least one computer-readable medium,”

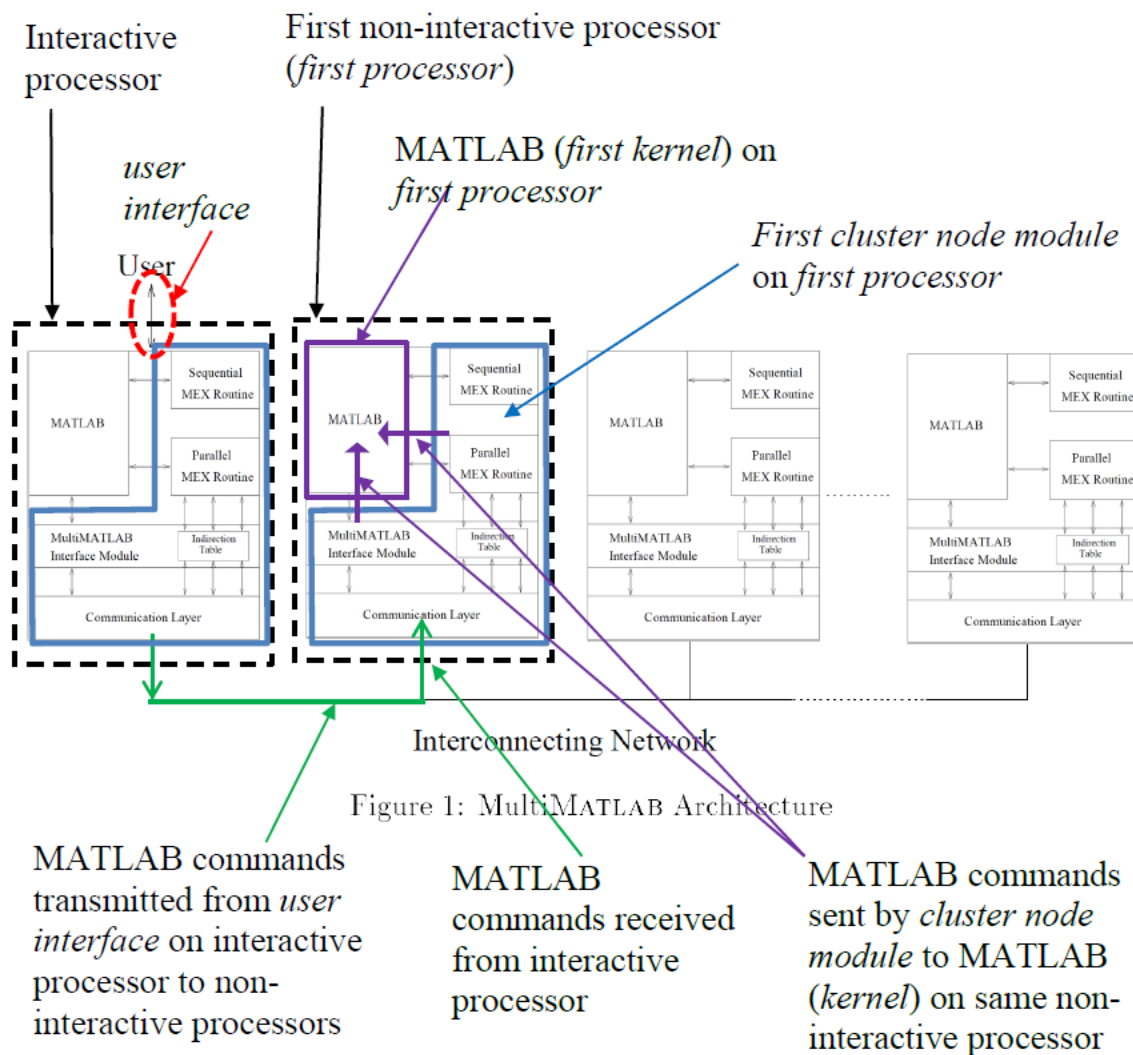
Relying on its contentions for limitation [1.2], Petitioner contends “that the MATLAB process resides in an address space located in memory (*computer readable medium*).” Pet. 37. Petitioner contends that Menon’s “MATLAB process address space . . . includes a set of components to provide interconnection with other processes: ‘MEX Routines,’ ‘MultiMATLAB interface module,’ ‘indirection table’ and ‘communication layer’ (collectively, the *cluster node module*).” *Id.* (citing Ex.1005, 3, 5). Petitioner further contends that Menon’s “interface module . . . is responsible for initializing an underlying communication layer, such as MPI . . . , and exposing it to the system.” *Id.* (citing Ex. 1005, 3). Petitioner compares Menon’s Figure 2 and Figure 3 of the ’621 patent, to illustrate its contentions that Menon teaches a cluster node module residing in memory. *Id.* at 38–39 (citing Ex. 1003 ¶¶ 200–205).

Patent Owner does not address this limitation. *See generally* PO Resp.

We have reviewed Petitioner’s evidence and argument and find that Petitioner establishes that Menon teaches this limitation.

- i. Limitation 1.4.2: “said first cluster node module configured to: receive first commands from a user interface without the first commands first passing through the first kernel, and”

To illustrate its contentions for this limitation, Petitioner combines Menon’s Figures 1 and 2 and provides the following annotated version thereof (Pet. 41):



Ex.1005, FIGs. 1 and 2 (combined and annotated); Ex.1003, ¶217

As annotated above, Petitioner illustrates the first cluster node module (blue) on the asserted first processor (black dashed rectangle second from left) (with parallel and sequential MEX routines, MultiMATLAB Interface

module, and communication module), in communication with a first (MATLAB) kernel (purple and purple arrows), receiving MATLAB commands (green) from a user interface (red) to Menon's interactive processor (black dashed rectangle on the left). *See* Pet. 41–42 (citing Ex. 1005, 3–5).

Petitioner relies on Menon's disclosure "that a 'user interacts directly with one MATLAB process, called the interactive process' to have user instructions executed in parallel by the other processor nodes." Pet. 40 (citing Ex. 1005, 3.)

Petitioner also relies on Trefethen's disclosure of a user "enter[ing] commands that are sent directly to the other processes. The 'MEX routine [Eval] accepts [the] MATLAB command [and] sends the command[s]' to the MATLAB process on each non-interactive processor of MultiMATLAB." Pet. 40 (citing Ex. 1005, 3–4, 6; Ex. 1006, 3). Petitioner further contends that Trefethen discloses "[f]or example, 'the user now types Eval('sqrt(2)'),' which causes 'the MATLAB command sqrt(2) [to be] executed on all six processors.'" *Id.* (citing Ex. 1006, 3). Petitioner also relies on Trefethen's disclosure of a user "identif[ying] a subset of processes by providing the process IDs to perform the command, such as 'Eval([4 5], 'cond(hilb(ID))'," which causes the MATLAB command 'cond(hilb(ID))' to be performed by processes ID=4 and ID=5." *Id.* (citing Ex. 1003 ¶ 210).

Based on the above teachings and its stated reasons for combining the teachings of Menon and Trefethen (*supra* § II.D.6.a), Petitioner contends Menon and Trefethen collectively teach the following sequence which corresponds to the recited command entered by the user is received by the first cluster node module "without the command first passing through the first kernel":

(i) the user enters a command via the user interface on the interactive processor, (ii) that command is provided “directly” to the MEX routine of the cluster node module on the interactive processor, (iii) the cluster node module on the interactive processor communicates the command to the cluster node modules on the first processor, second processor and third processor, (iv) the cluster node module of the first processor receives the command via the interconnecting network, and (v) the cluster node module of the first processor communicates the command to the first kernel.

Pet. 41–42 (citing Ex.1003 ¶¶ 215–220).

Patent Owner responds that “[t]he asserted prior art does not describe the user interface flow path.” PO Resp. 12. Patent Owner argues that Menon discloses that a user “interacts directly with one MATLAB process called the interactive process” as shown in Menon’s Figure 1 but “does not provide the details as to what components of the Interactive Process the user communicates.” *Id.* at 12–13.

Patent Owner next argues that Petitioner’s combined Figures 1 and 2 of Menon, reproduced above, “moves the line representing communication between the user and the Interactive Processor (red circle in the Petition) to touch its annotated blue box, that Petitioner alleges is a cluster node module on the Interactive Processor.” PO Resp. 14–15. Patent Owner further argues that Petitioner has presented no evidence that Menon’s graphical user interface “is part of the alleged cluster node module of the Interactive Processor.” *Id.* at 15. According to Patent Owner, Menon’s alleged deficiencies are not cured by Trefethen, which discloses various commands but fails to disclose that the “commands are received at the cluster node module, without first passing through the first kernel.” *Id.* (citing Pet. 34).

Patent Owner next argues that Dr. Bajaj’s testimony on this point is not supported by Menon or Trefethen. According to Patent Owner, “[w]hen

Dr. Bajaj asserts that a command entered by the user is received by the first cluster node module without the command first passing through the first kernel, such assertion is made without any citation to Menon or Trefethen.” PO Resp. 16 (citing Ex. 1003 ¶¶ 213, 359).

In the Petitioner Reply, Petitioner contends that “Menon and Trefethen teach that the user enters commands (*first commands*) that are received by the ‘first non-interactive processor’ directly from the ‘interactive processor’ without first passing through the ‘MATLAB process’ on the ‘first non-interactive processor’ (*the first kernel*).” Pet. Reply 2 (citing Pet. 40–42; Ex. 1003 ¶¶ 210–214; Ex. 1005 3–4, 6; Ex. 1006, 3). Petitioner further contends that “Menon teaches that ‘the routine Eval’—which is a ‘MEX routine’ and thus part of the *first cluster node module*—‘accepts’ MATLAB commands and ‘send the command[s]’ to the MATLAB process on each non-interactive processor of MultiMATLAB.” *Id.* (citing Ex. 1005 3–4, 6; Ex. 1006, 3). Petitioner also contends that “‘the user now types Eval(‘sqrt(2)’),’ which causes ‘the MATLAB command sqrt(2) [to be] executed on all six processors.’” *Id.* (citing Pet. 40; Ex. 1003 ¶ 210; Ex. 1006, 3).

In the Sur-reply, Patent Owner argues that Petitioner’s mapping of Menon to claim 1 is inconsistent with its mapping of Menon to claim 1 of U.S. Patent 11,570,034 in co-pending IPR2025-00913 (“the ’913 case”). Sur-reply 10–14. Patent Owner contends that in this case, “Petitioner ignores the leftmost node of Menon by labelling it an ‘Interactive’ node, and alleges that the second node is a ‘first node’ with a ‘first kernel’ and ‘first cluster node module.’” *Id.* at 11. Patent Owner further contends that “[t]his is contradictory to how Petitioner and Bajaj read the combination of Menon and Trefethen in connection with its co-pending petition against Patent

Owner's U.S. Patent No. 11,570,304.” *Id.*; *see also id.* at 12 (reproducing Menon Figure 1 annotated by Petitioner (citing IPR2025-00913, Paper 3, 31)). Patent Owner further argues that, in the '913 case, “Petitioner and its expert read the leftmost node as the ‘first node.’” *Id.* at 12.

Patent Owner next contends, based on Petitioner's mapping in the '913 case, that “[t]he commands the first non-interactive processor receives are not raw user-interface inputs; they are interpreted and dispatched commands that have already passed through the interactive processor's MATLAB.” Sur-reply 15. Patent Owner further contends that “Bajaj's characterization of the interactive processor's MATLAB into ‘the user interface’ is improper hindsight reconstruction.” *Id.* (citing Ex. 1162 ¶ 12). According to Patent Owner, “Menon and Trefethen do not describe MATLAB-as-user-interface; they describe MATLAB as the program code that interprets and executes mathematical expressions.” *Id.*

For the following reasons, we find Petitioner establishes that the combination of Menon and Trefethen teaches this limitation.

As discussed above, Patent Owner does not dispute, and we find in connection with limitation 1.4.1 that an ordinarily skilled artisan would “understand that the MEX routines, MultiMATLAB interface module, indirection table, and communication layer of the first non-interactive processor (*first processor*) teach the *first cluster node module*.” Ex. 1003 ¶ 207. Further, Patent Owner does not dispute, and we find, in connection with limitation 1.3, “that the MATLAB in the MATLAB process on the first non-interactive processor (*first processor*) teaches *the first kernel*.” *Id.*

Dr. Bajaj testifies that

Menon discloses an example user interface, a ‘toolkit’ that provides ‘an intuitive graphical interface’ to allow users to

specify equations. Ex. 1005, 6. This toolkit is “MATLAB’s Partial Differential Equation Toolkit,” in which “users may interactively create and solve rather general PDE systems using the finite element method. The PDE toolkit provides an intuitive graphical user interface allowing users to specify geometries, differential equations, and boundary conditions.’ Ex.1005, 6. That is, MATLAB’s partial differential equation (PDE) toolkit has a graphical user interface that allow users to directly interact with a MATLAB process. Ex. 1005,6. Accordingly, the PDE toolkit graphical user interface teaches *a user interface*.

Ex. 1003 ¶ 209.

Patent Owner does not dispute that MATLAB’s PDE toolkit with graphical user interface corresponds to the recited “user interface.” PO Resp. 15 (“Menon discloses a graphical user interface). Based on the undisputed testimony of Dr. Bajaj which is based on the disclosure of Menon and which we credit, we find that MATLAB’s PDE toolkit with graphical user interface corresponds to the recited “user interface.”

Menon discloses that

[o]n the interactive process, the Eval routine is implemented as a MEX routine which accepts a vector of MATLAB process IDs and a MATLAB command. This routine sends commands over the underlying communication layer to the processes corresponding to the specified IDs. On non-interactive processes, a separate top-level MEX routine is immediately run upon initialization of the system. This MEX routine runs in a loop in which it waits for MATLAB commands to arrive from the interactive process and executes them in its own MATLAB environment. All parallel MEX routines access the underlying communication layer and, hence, the network, through the MultiMATLAB interface module.

Ex. 1005, 4.

Dr. Bajaj testifies that

Trefethen provides an example illustration where a user directly interacts with a MATLAB process and “Eval” is “[t]he standard MultiMATLAB command for executing commands on one or more

processors[.]” Ex. 1006, 2. “[T]he user now types Eval(‘sqrt(2)’)” in an interactive MATLAB process on “the IBM SP2” implementing a MultiMATLAB architecture having “6 MultiMATLAB processes running.” Ex. 1006, 3. “[T]hen the MATLAB command sqrt(2) is executed on all six processors. The result is six repetitions of 1.4142.” Ex. 1006, 3. Because “sqrt(2)” is a “MATLAB command,” a POSITA would recognize and understand that it is MATLAB in the MATLAB process on each processor that executes the MATLAB command sqrt(2). Trefethen also provides an example where the Eval command receives the processor IDs “[4 5],” and a MATLAB command. The interactive processor sends the MATLAB command to the non-interactive processors (i.e., processor IDs=4 and 5):

Eval([4 5] , ‘cond(hilb(ID))’)

might return

ans=1.5514e+04

ans=4.7661e+05

the condition numbers of the Hilbert matrices of
dimensions 4 and 5.

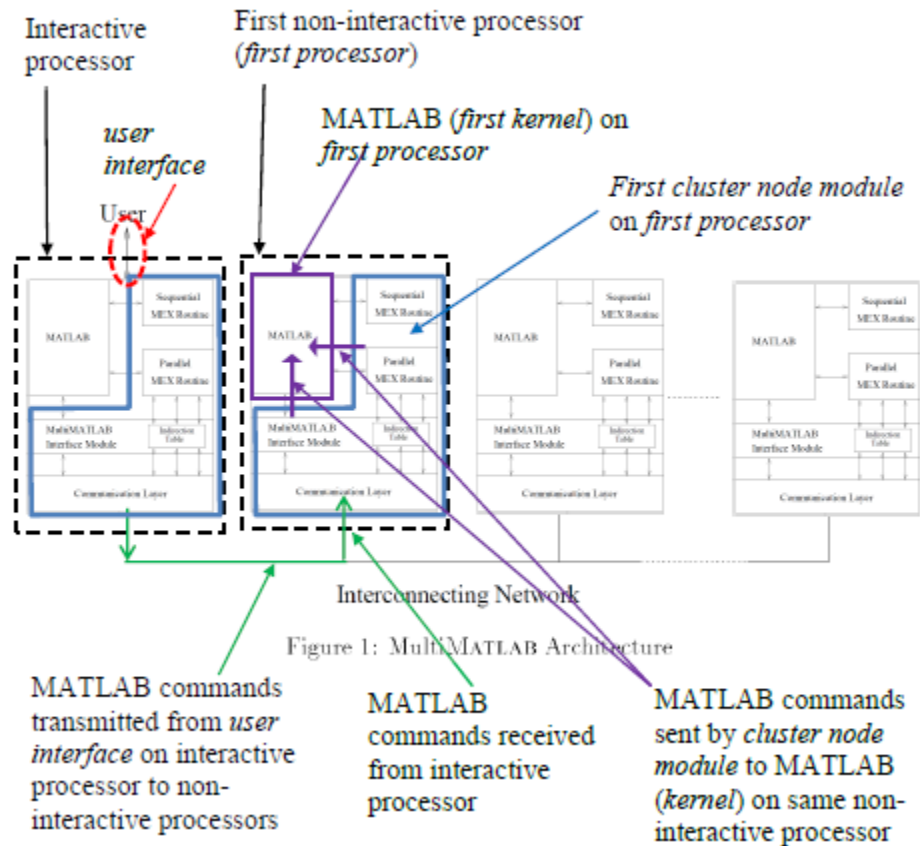
Ex. 1006, 4.

Ex. 1003 ¶ 210.

In other words, Menon and Trefethen teach that when a user interacting with a MATLAB process on the interactive processor via a user interface, the ‘MEX routine [Eval] accepts . . . [the] MATLAB command [and] sends the command[s]” to the MATLAB process on each non-interactive processor of the MultiMATLAB architecture. Ex. 1005, 3–4, 6; Ex. 1006, 3. The MEX routines are “run directly from MATLAB.” Ex. 1005, 3. The MATLAB command arrives at each MATLAB process’s communication layer (part of the *cluster node module*) because “[e]ach process is [] provided with the ability to communicate with other processes through a communication layer that runs over the parallel platform’s interconnection network.” Ex. 1005, 3. Then, “[o]n non-interactive processes, a separate top-level MEX routine” (part of the *cluster node module*) of each MATLAB process receives the MATLAB command for execution “in [the separate top-level MEX routine’s] own MATLAB environment.” Ex. 1005, 4.

Ex. 1003 ¶ 211.

Because Trefethen teaches that “sqrt(2)” or “cond(hilb(ID))” are each an example of a “MATLAB command” that is executed by the MATLAB process on each processor, a POSITA would recognize and understand that “the MATLAB command” is executed by MATLAB in the MATLAB process on each processor and that the MEX routines (*cluster node modules*) in a MATLAB process on each non-interactive processor sends the MATLAB command to MATLAB (*kernel*) on the MATLAB process for execution by that MATLAB, as shown in the combined figure of Figures 1 and 2 of Menon below. Ex. 1006, 3.



Ex. 1003 ¶ 212.

Accordingly, Menon and Trefethen teach MEX routines in a MATLAB process on the first non-interactive processor of the MultiMATLAB architecture receive MATLAB commands from a user interface such as a PDE toolkit graphical interface on the interactive processor and send the MATLAB commands to MATLAB in the MATLAB process on the same first non-interactive processor for execution by that MATLAB, rendering obvious *said first cluster node module configured to: receive*

first commands from a user interface without the first commands first passing through the first kernel.

Ex. 1003 ¶ 214.

We credit Dr. Bajaj’s testimony because it is supported by and consistent with the disclosure of Menon and Trefethen cited therein.

Patent Owner’s various attorney arguments that Menon does not describe “the user interface flow path” or “the details as to what components of the Interactive Process the user communicates” or its improper hindsight arguments or its criticism of Dr. Bajaj’s testimony concerning Menon’s interactive processor (PO Resp. 12–15) are all unavailing because they are not responsive to Petitioner’s contentions for this limitation. We agree with Petitioner that “in the Menon-Trefethen combination, only the *user interface* is part of the interactive process. The components mapped to the *first cluster node module . . .* and the *first kernel . . .* are components of the first non-interactive process, not the interactive process.” Pet. Reply 5 (citing Pet. 41–44; Ex. 1003 ¶¶ 215–220; Ex. 1006, 3; Ex. 1005, 3–4, 6); *see also* Ex. 1163 ¶ 13 (“The claim limitation is directed to the first cluster node module on the first non-interactive processor receiving commands without those passing through the first kernel: it does not require identifying every component inside the interactive process that handles the user’s keystrokes or graphical-input events.”); *id.* at ¶ 14 (“additional implementation details of the user-interface path within the interactive process are not necessary to understand the mapping of Menon and Trefethen to claim 1, because the first kernel and first cluster node module are mapped to components of the first non-interactive process, not the interactive process.” (citing Ex. 1003 ¶¶ 215–220; Ex. 1005, 3–4; Ex. 1006, 3)).

Patent Owner's argument in the Sur-reply that Petitioner's mapping of Menon to claim 1 is inconsistent with the mapping of Menon to the claims challenged in the '913 case is unavailing because the claim at issue in the '913 case is different than claim 1 of the '621 patent.

Patent Owner's argument in the Sur-reply that the commands received by the first non-interactive processor "are not raw user-interface inputs; they are interpreted and dispatched commands that have already passed through the interactive processor's MATLAB" (Sur-reply 15) is also unavailing for three reasons. First, the argument is unsupported attorney argument. Second, the argument improperly attempts to add a limitation to claim 1 that the recited "first commands from a user interface" must be "raw user-interface inputs." Third, Trefethen discloses that if the user "types Eval ('sqrt(2)')" then the MATLAB command sqrt(2) is executed on all six processors." Ex. 1006, 3. Consequently, assuming *arguendo* the user command Eval ('sqrt(2)') received at the "user interface" is "interpreted" by the MATLAB kernel in the interactive process, Trefethen discloses that the user input Eval ('sqrt(2)') is in fact received by the "first cluster node module . . . without passing through the first kernel." *See id.*

We have reviewed Petitioner's evidence and argument for this limitation, in light of Patent Owner's contentions, and find that Petitioner establishes that the combination of Menon and Trefethen teaches this limitation.

j. Limitation 1.4.3: after receiving the first commands from the user interface send second commands to the first kernel;

Petitioner contends that Menon discloses "that on the first non-interactive processor, 'a separate top-level MEX routine' (part of the *first cluster node module*) 'waits for MATLAB commands to arrive from the

interactive process’ and then commands are executed ‘in its own MATLAB environment.’” Pet. 42 (citing Ex. 1005, 4).

Petitioner further contends that Trefethen provides a similar example. Pet. 43. Petitioner argues that Trefethen’s “MEX routine Eval on the interactive processor sends ‘the MATLAB commands sqrt(2)’ to each non-interactive MATLAB process, where it is received by the MEX routine that ‘waits for MATLAB commands to arrive” and “then passes the MATLAB command (*e.g.*, ‘sqrt(2)’) to MATLAB for it to be executed to generate the result 1.4142.” *Id.* (citing Ex. 1005, 4; Ex. 1006, 3–4).

According to Petitioner, Menon and Trefethen teach this limitation because “the MEX routine on the first-[non-] interactive processor, after receiving the MATLAB commands from the user interface of the interactive processor, sending MATLAB commands to its local MATLAB for execution” teaches this limitation. Pet. 44 (citing Ex. 1003 ¶¶ 215–220).

Patent Owner does not address this limitation. *See generally* PO Resp.

We have reviewed Petitioner’s evidence and argument and find that Petitioner establishes that the combination of Menon and Trefethen teaches this limitation.

k. Limitations 1.6.1, 1.6.2, and 1.6.3: “a second cluster node module residing in the at least one computer-readable medium,” “said second cluster node module configured to send commands to the second kernel and” “communicates with the first cluster node module”

In connection with limitation [1.6.1], Petitioner relies on its contentions for limitation [1.4.1] and identifies “a second cluster node module” as residing on Menon’s second non-interactive processor. Pet. 47;

see Pet. 44 (annotating Menon's Figures 1 and 2 combined) (citing Ex. 1003 ¶¶ 229–230).

In connection with limitation [1.6.2], Petitioner relies on its contentions for limitation [1.6.1] and identifies “the MATLAB process on the second non-interactive processor” as corresponding to “the second kernel.” Pet. 47–48 (annotating Menon's Figures 1 and 2 combined) (citing Ex. 1003 ¶¶ 231–233).

In connection with limitation [1.6.3], Petitioner contends that “each MultiMATLAB process has ‘the ability to communicate with other processes through a communication layer that runs over the parallel platform's interconnection network.’” Pet. 49 (citing Ex. 1005, 3). Petitioner further contends that “it is the ‘MEX routines’ of the cluster node module that provide ‘access [to] the underlying communication layer and hence, the network, through the MultiMATLAB interface module.’” *Id.* at 49–50 (citing Ex. 1005, 4). Petitioner illustrates its position with the following annotated version of Menon's Figure 1 highlighting the interconnecting network between the processors of Menon (*id.* at 50):

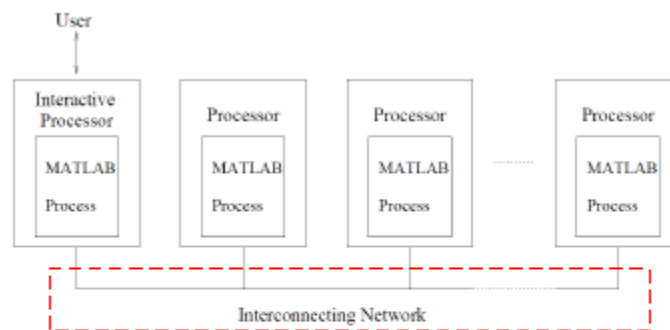


Figure 1: MultiMATLAB Architecture

Interconnecting network connecting each MATLAB process on a processor to any other in the MultiMATLAB architecture

Ex.1005, FIG. 1 (annotated); Ex.1003, ¶236

see also id. at 51–52 (arguing that “Trefethen provides multiple examples where MATLAB processes use the MEX routines Send() and Recv() to communicate results of mathematical expression evaluation to other MATLAB processes on other processors.”) (citing 1005, 9; Ex. 1006, 6).

Based on the foregoing, Petitioner contends that the combination of Menon and Trefethen teaches limitation 1.6.3 because each “teach that the MATLAB processes on the second non-interactive processor and the first non-interactive processor use their respective MEX routines, MultiMATLAB interface module, indirection table, and communication layer . . . to communicate commands (e.g., tasks) and data directly with each other.” Pet. 53 (citing Ex. 1003 ¶¶ 234–244).

Patent Owner does not address these limitations. *See generally* PO Resp.

We have reviewed Petitioner’s evidence and argument and find that Petitioner establishes that the combination of Menon and Trefethen teaches these limitations.

1. Limitation 1.7.2: “said third kernel configured to translate commands into code for execution on the third processor; and”

Relying on its contentions for limitation [1.1.3], Petitioner contends that “MATLAB in a MATLAB process on a processor of the MultiMATLAB architecture teaches a *kernel*” and “MATLAB in a MATLAB process on the third non-interactive processor teaches a *third kernel*.” Pet. 55 (citing Ex. 1003 ¶ 249; Ex. 1005, Fig. 1). Relying on its contentions for limitation [1.3.2], Petitioner argues “MATLAB in the MATLAB process translates the MATLAB command . . . into code that can be executed by that processor and RS6000 discloses a *third processor* for executing ‘parallel applications.’” *Id.* (citing Ex. 1007, 1). According to

Petitioner, the combination of Menon, Trefethen, and RS6000 “teach that MATLAB (*said third kernel*) in the MATLAB process on the third non-interactive processor translates the MATLAB command into code that can be executed by a processor, in view of RS6000’s disclosure that the IBM SP2 has a third processor for executing ‘parallel applications.’” *Id.* at 55–56 (citing Ex. 1003 ¶¶ 248–252).

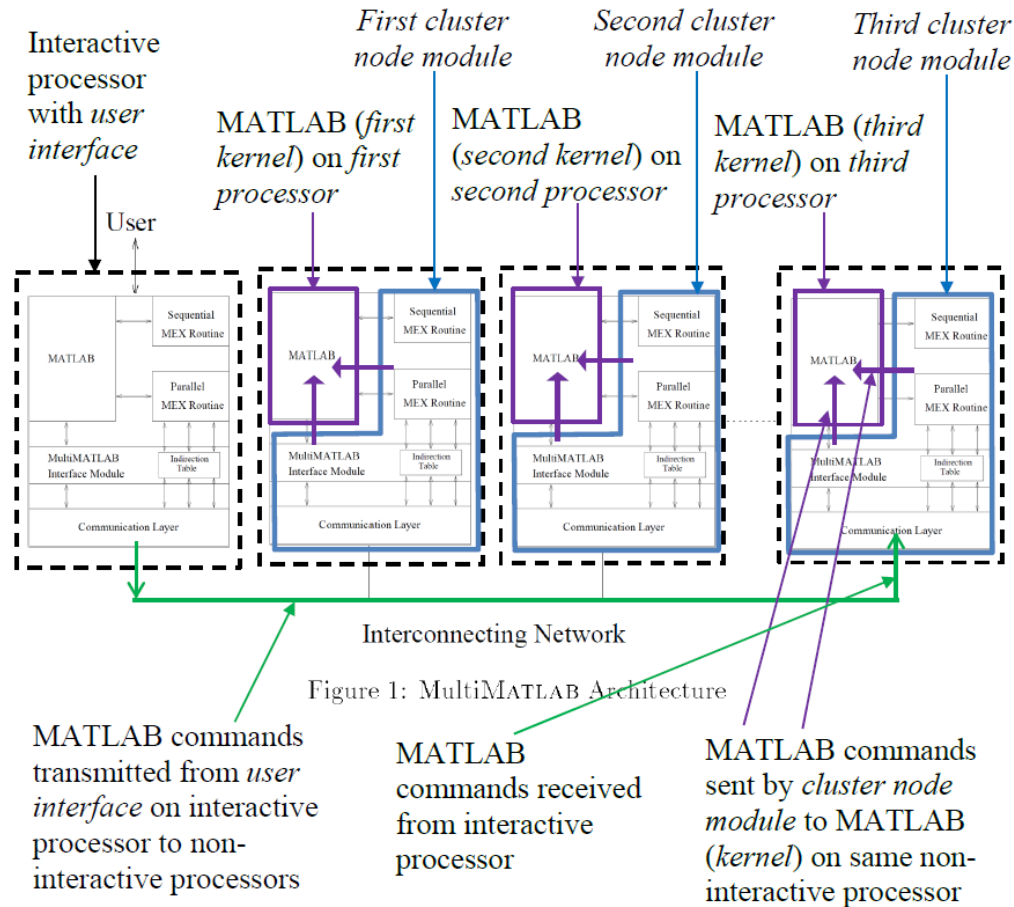
Patent Owner does not address this limitation. *See generally* PO Resp.

We have reviewed Petitioner’s evidence and argument and find that Petitioner establishes that the combination of Menon, Trefethen, and RS/6000 teaches this limitation.

m. Limitations 1.8.1, 1.8.2, and 1.8.3: “a third cluster node module residing in the at least one computer-readable medium,” “said third cluster node module configured to send commands to the third kernel and” “configured to communicate with the first cluster node module and the second cluster node module;”

To address limitations [1.8.1] and [1.8.2], Petitioner relies on its showings for limitation 1.4.1 (“the MEX routines, MultiMATLAB interface module, indirection table, and communication layer (*a third cluster node module*) of the MATLAB process on the second non-interactive processor are in (*residing in*) the MATLAB process address space (*the at least one computer readable medium*)”), limitation 1.7.1 (“MATLAB in the MATLAB process on the third non-interactive processor teaches the *third kernel*”), and 1.4.2 (“the interactive processor sends the user commands to the cluster node module of each non-interactive processor, which provides the MATLAB command to its respective MATLAB (*kernel*) for execution”). Pet. 56–57.

To illustrate its showing, Petitioner provides an annotated version of a combination of Menon's Figures 1 and 2 as follows:



Ex.1005, FIGs. 1 and 2 (combined and annotated); Ex.1003 ¶258

Pet. 57 (citing Ex. 1003 ¶¶ 256–260). Petitioner's figure above shows three non-interactive processors (purple) of Menon's four processors as MATLAB kernels connected directly to corresponding first, second, and third cluster node modules (blue), all to the right of Menon's interactive processor (black dotted line) with a user interface.

For limitation [1.8.3], Petitioner contends that “[a]s discussed in [1.6.3], each MATLAB process has a cluster node module for communicating with the other cluster node modules. Further, each MATLAB process is configured to use the Eval(), Send(), and Recv()

commands to send data from one process to another.” Pet. 58 (citing Ex. 1005, Table 1 (showing commands for point-to-point communication); Ex. 1003 ¶ 261). Petitioner further relies on Trefethen’s multiple examples of using the same MEX routines “to communicate results of mathematical expression evaluation to other MATLAB processes on other processors.” *Id.* at 58–59 (citing Ex.1005, 8–9, Table 1; Ex.1006, 6).

Based on the above, Petitioner contends that

Menon and Trefethen teach that the MATLAB processes on the third non-interactive processor, the second non-interactive processor, and the first non-interactive processor use their respective MEX routines, MultiMATLAB interface module, indirection table, and communication layer (*said third cluster node module, the first cluster node module and the second cluster node module*) to communicate commands (e.g., tasks) and data with each other, rendering obvious this limitation.

Pet. 59–60 (citing Ex. 1003 ¶¶ 261–264).

Patent Owner does not address these limitations. *See generally* PO Resp.

We have reviewed Petitioner’s evidence and argument and find Petitioner establishes that the combination of Menon and Trefethen teaches these limitations.

n. Limitation 1.9: “wherein each of the first, second, and third cluster node modules can transmit tasks to any other of the first second, and third cluster node modules without transmitting the task through a master node, and”

Petitioner first refers to its contentions for limitation [1.8.2] and contends that “Menon discloses that ‘[e]ach process is [] provided with the ability to communicate with other processes through a communication layer that runs over the parallel platform’s interconnection network.’” Pet. 60 (citing Ex. 1005, 3, Fig. 1; Ex. 1003 ¶ 265). Petitioner next contends that

“Trefethen teaches that ‘MultiMATLAB is currently built upon the standard send and receive variants of’ MPI” and “[t]hat is, ‘[m]ore general point-to-point communication is accomplished by send and receive commands, which can be executed on any of the MATLAB processes.’” *Id.* at 61 (citing Ex. 1006, 5, 10). Petitioner further contends that “Menon’s MEX routines are implemented using ‘point to point . . . communication’ paradigm used to enable communication between MATLAB processes operating in parallel in the MultiMATLAB architecture” and “in contrast to a ‘master/slave paradigm’ Menon’s SPMD/Message Passing paradigm ‘accommodate[s] applications requiring a finer degree of communication’ and provides ‘point to point . . . communication.’” *Id.* (citing Ex. 1005, 6–9).

Petitioner illustrates its contention that Menon discloses SPMD point-to-point communication with the following annotated version of Menon’s Table 1 (Pet. 62):

MultiMATLAB commands	
Starting and stopping MultiMATLAB (MPICH only)	
Start(n)	Initializes n remote MATLAB processes.
Quit	Closes remote MATLAB processes.
Running commands on multiple processors	
Nproc	Returns number of MATLAB processes.
ID	Returns ID of calling MATLAB process.
Eval(pid,'command')	Evaluates a command on one or more MATLAB process.
Master/Slave Communication	
Put(pid,dataname)	Put data from the master process onto one or more remote processes.
Get(pid,dataname)	Get data from a remote process onto the master process.
SPMD Communication	
Send(pid,data)	Send data from one process to another.
Recv(pid)	Receive data sent from another process.
Barrier	Synchronize processes.
Bcast(pid,data)	Broadcasts data from processor pid to all processes.
Sum(data)	Adds data across all processors to form a global sum.
Collect(data)	Collects local data segments into a single global one.

Table 1: Selected commands in the MultiMATLAB system

Commands for point to point communication

Ex.1005, Table 1 (annotated); Ex.1003, ¶268

Petitioner annotates Table 1 with broken red rectangles around entries titled “Running commands on multiple processors” and “SPMD Communication” with red text “Commands for point-to-point communication” and red arrows pointing to the broken red rectangles. *See also id.* at 62–63 (arguing Trefethen provides an example of point-to-point communications using MultiMATLAB (citing Ex. 1003 ¶ 269; Ex. 1005, 9; Ex. 1006, 6)).

According to Petitioner, the combination of Menon and Trefethen teaches this limitation because

Menon discloses MEX routines that enable point-to-point communication so that each processor can communicate directly with each other, using their respective MEX routines, MultiMATLAB interface module, indirection table, and communication layer (*cluster node module*), over an interconnecting network and Trefethen teaches using send and recv calls to directly communicate tasks and data by designating a processor ID.

Pet. 63–64 (citing Ex. 1003 ¶¶ 264–273).

In connection with its arguments against motivation to combine, Patent Owner refers to a snippet of limitation 1.9 (“without transmitting the tasks through a master node”) and argues that “[t]he asserted references’ control model is not the claimed control model.” PO Resp. 26.¹⁷ For limitation 1.9, Petitioner provides evidence and argument supported by Menon, Trefethen, and Dr. Bajaj’s testimony. Pet. 60–63; Ex. 1003 ¶¶ 264–273. Patent Owner fails to explain what it means by the “claimed control model” and offers no argument or evidence why claim limitation 1.9 is not

¹⁷ Patent Owner’s argument is directed to limitation 1.9 and substantially similar limitations in claims 13, 24, and 27. PO Resp. 26.

met in Petitioner's proposed combination. *See* PO Resp. 12–18.

Consequently, we determine that Patent Owner's argument is unavailing.

We have reviewed Petitioner's evidence and argument and find that Petitioner sufficiently establishes that the combination of Menon, Trefethen, MPIref, and RS6000 teaches this limitation.

o. Limitation 1.10: “wherein the first cluster node module comprises a data structure in which messages originating from the second and third cluster node modules are stored.”

Petitioner contends that “Menon discloses that “MATLAB communication routines’ work with ‘data structures,’ such as sparse matrices, cell arrays, and structures and these are ‘communicated data structures.’” Pet. 64 (citing Ex. 1005, 9).¹⁸ Petitioner further contends that Menon discloses

that the MEX routines, such as Recv(), allocate memory for storing received data, stating ‘MATLAB communication routines do not expose any memory management issues to users. Routines do any allocation necessary for received data. Routines block until any data to be sent can safely be overwritten and any data to be received has arrived.’

Id. at 65 (citing Ex. 1005, 9–10). Petitioner further contends that “Trefethen teaches that the ‘allocation necessary for received data’ disclosed by Menon is ‘memory allocation for received matrices.’” *Id.* (citing Ex. 1005, 10; Ex. 1006, 10).

Petitioner next contends that “MPIref discloses an MPI receive buffer (of the MPI_RECV call) for storing received data having the type specified by datatype.” Pet. 65 (citing Ex. 1017, 15–21). Petitioner further

¹⁸ The Petition also cites to page 250 of Exhibit 1005 which appears to be a typographical error.

contends that “Menon teaches that MEX routines (such as Recv()) are mapped (using the indirection table) to the analogous MPI calls (such as MPI_RECV()) found in the communication layer” and “[t]he communication layer, using the MPI calls, communicates over the interconnection network with the communication layer in the other processor.” *Id.* (citing Ex. 1005, 3, 6).

According to Petitioner, this limitation would have been obvious to an ordinarily skilled artisan because of “Menon and Trefethen’s combined teaching of a memory allocation of a MEX routine for received data for ‘MATLAB data structures such as sparse matrices, cell arrays, and structures.’” Pet. 66. Alternatively, Petitioner argues that

Menon and Trefethen disclose that each MATLAB process in the MutltiMATLAB architecture communicates tasks and data directly with any other MATLAB process using its MEX routines, MultiMATLAB interface module, indirection table, and communication layer (cluster node module), where MEX routines implement standard variants of MPI calls to enable SPMD point-to-point communication so that the MATLAB processes communicate directly with each other, where the data have MATLAB datatypes such as sparse matrices, cell arrays, and structures, and that the MEX routines store the received data in a memory allocated for storing data having datatype of the host language (i.e., data having MATLAB datatypes) in view of MPIref disclosing a message buffer and queue for storing messages, rendering obvious this limitation.

Id. at 66–67 (citing Ex. 1003 ¶¶ 274–286).

Patent Owner does not address this limitation. *See generally* PO Resp.

We have reviewed Petitioner’s evidence and argument and find Petitioner establishes that the combination of Menon, Trefethen, and MPIref teaches this limitation.

p. Summary of Claim 1

For all the foregoing reasons, we determine Petitioner shows by a preponderance of the evidence that claim 1 would have been obvious over Menon, Trefethen, RS6000, and MPIref.

8. Claim 2

Referring to its combined Figures 1 and 2 of Menon, Petitioner contends “[t]he *first cluster node module* on the first non-interactive processor is logically positioned between (i) the user interface on the interactive processor and (ii) the MATLAB kernel (*the first kernel*) on the first non-interactive processor, rendering obvious this limitation.” Pet. 68 (citing Ex. 1003 ¶¶ 287–288).

Patent Owner argues that Petitioner “ignores the entirety of the Interactive Processor” which Patent Owner asserts “is an intermediary between the user interface and the first non-interactive processor and its components.” PO Resp. 18.¹⁹ According to Patent Owner “[e]ven assuming Petitioner’s assertion that the annotated blue box of the first non-interactive processor is a cluster node module, that cluster node module is logically positioned between the first kernel and the first Interactive processor—not between the first kernel and the user interface.” *Id.*

Petitioner replies that “Patent Owner provides no explanation or evidence that the presence of . . . an ‘intermediary component’ [the Interactive Processor] precludes the components of the first non-interactive processor mapped to the first cluster node module from being ‘*logically positioned* between’ those mapped to the *first kernel* and the *user interface*.”

¹⁹ Patent Owner argues limitations 24.4.3 and 27.4.3 together with claim 2. PO Resp. 18.

Pet. Reply 9. Petitioner argues that Dr. Bajaj’s testimony in support of the Petition “interprets this arrangement, including the supposed ‘intermediary’ component, as the first cluster node module ‘*logically positioned between*’ the first kernel and the user interface” and that an ordinarily skilled artisan would have understood this arrangement of components. *Id.* (citing Pet. 67–68; Ex. 1003 ¶¶ 287–288; Ex. 1163 ¶ 16).

For the following reasons, Patent Owner’s argument is unavailing. Dr. Bajaj testifies by reference to the combined drawing of Figures 1 and 2 of Menon reproduced above in connection with limitation 1.4.2 that

the MEX routines of *the first cluster node module* on the first non-interactive processor of the MultiMATLAB architecture receive MATLAB commands from a user interface such as a PDE toolkit graphical user interface (*the user interface*) on the interactive processor and send the MATLAB commands to MATLAB (*the first kernel*) in the MATLAB process on the first non-interactive processor for execution by the MATLAB, i.e., the MEX routines of *the first cluster node module* in a MATLAB process on the first non-interactive processor are operationally positioned between (*is logically positioned between*) the user interface on the interactive processor and the MATLAB on the first non-interactive processor (*the first kernel*), rendering obvious *wherein the first cluster node module is logically positioned between the user interface and the first kernel*.

Ex. 1003 ¶ 288.

Dr. Bajaj’s testimony is not disputed by Patent Owner with contrary evidence. Further, his testimony is supported by the disclosure of Menon as explained by Dr. Bajaj in the combined Figures 1 and 2 of Menon and therefore is entitled to weight. “[E]xtrinsic evidence may be considered when it is used to explain, but not expand, the meaning of a reference.” *In re Baxter Travenol Labs.*, 952 F.2d 388, 390 (Fed. Cir. 1991) (citing *Scripps Clinic & Research Foundation v. Genentech, Inc.*, 927 F.2d 1565, 1576–77 (Fed. Cir. 1991)). The crux of Patent Owner’s attorney argument is that

Menon’s “Interactive Processor is an intermediary between the user interface and the first non-interactive processor and its components” which, according to Patent Owner, means that “the first non-interactive processor is a cluster node module . . . positioned between the first kernel and the first Interactive Processor—not between the first kernel and the user interface.” PO Resp. 18.

Claim 2 recites “the first cluster node module is logically positioned between the user interface and the first kernel.” The plain language of claim 2 does not preclude intermediary components between the user interface and the first cluster node module. Essentially, Patent Owner’s argument is based on adding a negative limitation to claim 2, and is, thus, unavailing.

We have reviewed Petitioner’s evidence and arguments in light of Patent Owner’s contentions and determine that Petitioner establishes by a preponderance of the evidence that claim 2 would have been obvious over Menon, Trefethen, RS6000, and MPIref.

9. Independent Claims 13, 24, 27

Independent claims 13, 24, and 27 are each directed to a “computer cluster.” Ex. 1001, 30:43–31:18, 31:61–32:36, 32:46–67. For each limitation of claims 13, 24, and 27, Petitioner relies on its contentions for substantially similar limitations in claim 1. *See* Pet. 91–93, 99–101, 102–104.

Patent Owner does not address claims 13, 24, and 27 apart from its contentions for claims 1 and 2. *See* PO Resp. 12, 17

For all the reasons discussed above for claims 1 and 2, and after a review of the full record, we determine Petitioner establishes by a

preponderance of the evidence that claims 13, 24, and 27 would have been obvious over Menon, Trefethen, RS6000, and MPIref.

10. Claims 20 and 25

Both claims 20 and 25 recite “wherein the first processor and the second processor reside on the same die.” Ex. 1001, 31:47–48, 32:37–38.

Relying on its contentions for limitation 1.1.1, Petitioner contends that “Menon teaches the first non-interactive processor of MultiMATLAB is implemented in IBM SP2 in view of RS6000 teaching a node having four processors renders obvious a first processor.” Pet. 97 (citing Ex. 1007, 9). Relying on its contentions for limitation 1.1.2, Petitioner provides substantially similar arguments that the second non-interactive processor of Menon in view of RS6000 renders obvious a second processor. *Id.*

Petitioner next contends that “RS6000 teaches that the IBM SP2 node ‘require[s] a minimum of four 375 MHz 630FP processors **mounted on one card**’ and “it was well-known to POSITAs that one implementation for multiple CPUs on a single card is multiple processor cores on the same die.” Pet. 97 (citing Ex. 1007, 10; Ex. 1050, 1:12–13; Ex. 1051, 10:5–30). Petitioner further contends that “[c]ombining multiple processors onto a single die is a matter of obvious engineering choice.” *Id.* at 98 (citing *In re Larson*, 340 F. 2d 965, 968 (CCPA 1965)). According to Petitioner, an ordinarily skilled artisan would understand “that the first non-interactive processor . . . and the second non-interactive processor . . . mounted on one card renders obvious *wherein the first processor and the second processor reside on the same die.*” *Id.* (citing Ex. 1003 ¶¶ 383–386).

Patent Owner contends that the claim language “the first processor and the second processor reside on the same die . . . means fabricated

together on a single semiconductor substrate.” PO Resp. 4 (citing Ex. 1001, claims 20, 25). According to Patent Owner, “the claim requires two processors be integrated on a single semiconductor substrate—a single chip” and “is not satisfied by processors that are merely co-located with the same node, mounted on the same card . . . or installed in the same slot.” *Id.* at 18 (citing Ex. 1007, 10). Patent Owner further contends that the ’621 patent “differentiates among processors, processor cores, and system-level constructs such as nodes.” *Id.* at 19 (citing Ex. 1001, 5:11–16, 6:60–67, 11:33–15). While conceding that the ’621 patent discloses computing systems with differing arrangements, the ’621 patent “deliberately claimed a narrower one.” *Id.*

Patent Owner next contends that Petitioner’s reliance on the disclosure in RS6000 of “four processors ‘on one card’ mounted in one slot (Ex. 1007, 10–12)” fails to meet the claim limitation because a “card” does not equate to “a die.” PO Resp. 4, 19–20, 37. According to Patent Owner, Petitioner “relies on early-2000s materials describing multi-core CPUs to argue that integrating multiple processors on one die was a known design trend,” but those materials “post-date the relevant timeframe by several years.” *Id.* at 20 (citing Pet. 97–98, Ex. 1050; Ex. 1051).

In the Sur-reply, Patent Owner argues that “[t]he specification’s framework—single-chip packages with internal cores—is the proper anchor for ‘die’” and that “[b]orrowing assembly level ‘substrate’ usage from unrelated patents to broaden ‘die’ to card-mounted discrete processors is not [a] *Phillips*-compliant claim construction; it is hindsight driven reconstruction designed to fit RS6000’s actual disclosure.” Sur-reply 6.

For the following reasons, Patent Owner’s arguments are unavailing.

There is no dispute between the parties that RS6000 discloses “four 375 MHz, 630 FP processors mounted on one card.” Ex. 1007, 10; Pet. 97; PO Resp. 19–20. The crux of the present dispute is whether or not it would have been obvious to a person of ordinary skill in the art to implement the multiple processors of RS6000 as “multiple processor cores on the same die.” Pet. 97; *see* PO Resp. 21 (arguing that Petitioner does not “explain[] why a person of ordinary skill in the art in the **mid-1990’s** would have modified the RS/6000 SP2 architecture to integrate multiple processors onto a single chip with a reasonable expectation of success.” (emphasis added)).

In support of its argument that it was well known to ordinarily skilled artisans to implement multiple processor cores on the same die, Petitioner relies on the testimony of Dr. Bajaj in addition to the cited disclosure in Exhibits 1050 and 1051. Pet. 97–98. Exhibit 1050 discloses that “[p]rocess technology scaling has enabled many-core superscalar microprocessors, e.g., there may be 250 processor cores on a single die.” Ex. 1050, 1:11–13. Exhibit 1051 claims “a semiconductor die comprising: a first processing core and a second processing core.” Ex. 1051, 10:5–6. Dr. Bajaj cites to Exhibits 1050 and 1051 in support of his opinion that “POSITAS knew that one implementation for multiple CPUs on a single card is multiple processor cores on the same die.” Ex. 1003 ¶ 385. We credit Dr. Bajaj’s testimony on this point because it is supported by the disclosure of Exhibit 1050 and Exhibit 1051.

Patent Owner argues that “[a] disclosure that processors are merely located on the same card, within the same node, or within the same package therefore cannot satisfy—or render obvious—the distinct die-level integration that the claims require.” PO Resp. 19. But, consistent with the disclosure of Exhibit 1050 and 1051, Patent Owner concedes that multiple

processors implemented on a single die was known in the art. Tr. 66:17–20.

Patent Owner attempts to circumvent its concession by arguing that Exhibits 1050 and 1051 “post-date the relevant time frame by several years and reflect technological advances that had not yet occurred in 1996–1997.” PO Resp. 20. We disagree with Patent Owner’s assertion that the “relevant time frame” for the obviousness inquiry in this case is “1996–1997.”

The earliest possible priority date of the ’621 patent is June 13, 2006. Ex. 1001, code (60); *see also* Pet. 11. The priority date of Exhibit 1050 is September 28, 2005 and the priority date of Exhibit 1051 is July 2, 2004. Ex. 1050, code (22); Ex. 1051, code (63). Consequently, we find that both Exhibit 1050 and Exhibit 1051 are prior art to the ’621 patent and reflect the knowledge of a person of ordinary skill in the art as of the earliest possible priority date of the ’621 patent.

Patent Owner next argues that Petitioner’s reliance on *In re Larson*, 340 F.2d 965, 968 (CCPA 1965) for the proposition that “[c]ombining multiple processors onto a single die is a matter of obvious engineering choice” does not cure a purported “defect” in the Petition. PO Resp. 21. Patent Owner further argues that *Larson* “addressed a mechanical substitution in which a known multi-part assembly was replaced with a one-piece construction without introducing new functionality or technological complexity” and that “[s]emiconductor processor integration in the **1990’s** is not analogous.” *Id.* (emphasis added). Patent Owner next argues that “[c]ombining two processors onto a single die” is not disclosed or suggested by “Menon and the RS6000 SP2 materials” and requires “a significant technological leap into hindsight.” *Id.* According to Patent Owner, the Petition does not “explain[] why a person of ordinary skill in the art in the **mid-1990s** would have modified the RS6000 SP2 architecture to integrate

multiple processors onto a single chip with a reasonable expectation of success.” *Id.*

Patent Owner’s arguments are unavailing because the arguments are based on its incorrect “relevant time frame” of the mid-1990s, not the proper time frame for the obviousness inquiry in this case, i.e., June 13, 2006. Further, reliance on the state of the art as disclosed is Exhibits 1050 and 1051 is clearly not “a significant technological leap into hindsight” as Patent Owner asserts. In sum, Patent Owner’s unsupported attorney argument based on a legally incorrect timeframe for the obviousness inquiry does not undercut Petitioner’s showing.

The Supreme Court in *KSR* stated that “[w]hen a work is available in one field of endeavor, design incentives and market forces can prompt variations of it, either in the same field or a different one. If a person of ordinary skill can implement a predictable variation, § 103 likely bars its patentability.” 550 U.S. at 417. There is no dispute that it was known to ordinarily skilled artisans in June 2006 that multiple discreet processors could be implemented as multiple processing cores on a single die. Ex. 1050; Ex. 1051. We agree with Petitioner that it would have been an obvious engineering choice to combine RS6000’s four processors as multiple processing cores on a single die. Pet. 97; Ex. 1003 ¶¶ 383–386.

For the foregoing reasons, Petitioner establishes by a preponderance of the evidence that claims 20 and 25 would have been obvious over Menon, Trefethen, RS6000, and MPIref.

11. Dependent Claims

Claims 2, 3, 5–12, 14–16, 18–23, 25, 26, and 28–30 depend from one of claims 1, 13, 14, or 27. Ex. 1001, 29:63–30:42, 31:19–60, 32:37–45, 34:3–17.

Petitioner sets forth evidence and argument concerning why the combination of Menon, Trefethen, RS/6000, and MPIref teach the limitations of these dependent claims. Pet. 67–90, 94–98, 101–102, 105–106.

Patent Owner does not address these dependent claims. *See generally* PO Resp.

We have reviewed Petitioner’s evidence and argument and find that Petitioner sufficiently establishes that the combination of Menon, Trefethen, RS6000 and MPIref teaches the limitations of these dependent claims. Consequently, we determine that Petitioner establishes by a preponderance of the evidence that claims 2, 3, 5–12, 14–16, 18–23, 26, and 28–30 would have been obvious over the combination of Menon, Trefethen, RS/6000, and MPIref.

E. Ground 2: Alleged Obviousness of claims 4 and 17

Petitioner contends that dependent claims 4 and 17 would have been obvious over the combined teachings of Menon, Trefethen, RS/6000, MPIref, and POEref. Pet. 110–114. Patent Owner does not address this ground in the Patent Owner Response. *See generally* PO Resp.

1. Motivation to Combine

Petitioner first contends that POEref is analogous art because it “pertain[s] to the same field of endeavor as the ’621 patent, namely, ‘the field of cluster computing’ and is reasonably pertinent to the problem of the

'621 patent, namely, executing a single program on multiple nodes.”

Pet. 107 (citing Ex. 1001, 1:14–15; Ex. 1003 ¶¶ 449–452; Ex. 1008, ix).

Petitioner next contends that an ordinarily skilled artisan would have combined the teachings of POEref with Menon because Menon suggests the combination via its teaching that “POE, IBM’s Parallel Operating Environment’ is used to start and assign identification numbers to all the MATLAB processes when implementing the MultiMATLAB architecture in IBM SP2 and POEref is directed to ‘describ[ing] . . . [the] Parallel Operating Environment (POE).

Pet. 107 (citing Ex. 1005, 6; Ex. 1008, ix).

Petitioner further contends that an ordinarily skilled artisan “would be motivated to seek the documentation corresponding to the systems expressly discussed in Menon, namely, the POE system expressly discussed in Menon.” Pet. 107–108 (citing Ex. 1005, 6). Petitioner further contends that it would have been obvious to combine POEref and Menon resulting in “a combination of prior art elements . . . according to known methods (as taught by Menon of using POE in implementing the MultiMATLAB architecture) to yield the predictable result of an implementation of MultiMATLAB architecture utilizing a POE with the command **poe** as disclosed by POEref.” *Id.* at 108 (citing Ex. 1005, 6; Ex. 1008, ix, 28). According to Petitioner, the results would have been predictable with a reasonable expectation of success “because Menon expressly discusses using POE, which is the subject of POEref, to implement its MultiMATLAB architecture in IBM SP2, with ‘results [that] demonstrate that the MultiMATLAB system can be an effective platform for parallel computing.” *Id.* at 108–109 (citing Ex. 1003 ¶¶ 453–456; Ex. 1006, 6, 14; Ex. 1008, ix.).

We have reviewed Petitioner’s evidence and arguments, which are not disputed by Patent Owner, and find that a person of ordinary skill in the art

would have been motivated to combine Menon, Trefethen, RS6000, MPIref, and POEref with a reasonable expectation of success for the reasons stated by Petitioner and Dr. Bajaj. Pet. 107–109; Ex. 1003 ¶¶ 453–456.

Claim 4 depends from claim 1 and recites “further comprising a cluster configuration module that initializes at least one of the first cluster node module, the second cluster node module, or the third cluster node module.” Ex. 1001, 30:8–11. Claim 17 depends from claim 13 and contains the same limitations as claim 4. *Id.* at 31:34–37.

Petitioner contends that Menon discloses that a POE starts MATLAB processes and “all non-interactive processes ‘wait for commands from the interactive MATLAB process.’” Pet. 109 (citing Ex. 1005, 6). Petitioner further contends that “the user invokes the initialization process on a ‘home node’ and ‘a number of **remote nodes**’ using the ‘poe’ command to ‘allocate[] processor nodes for each task and initialize[] the local environment’” and “POE then ‘loads your program, and reproduces your local environment, on each processor node.’” *Id.* (citing Ex. 1008, 3, 38). According to Petitioner, “when a user invokes **poe**, local environment, i.e., a MATLAB process, is reproduced on each of the other IBM SP2 processors (called ‘remote nodes’ by POEref), and the MATLAB processes (called ‘non-interactive processes’ by Menon) on these remote nodes wait for commands from the interactive MATLAB process” which “renders this limitation obvious.” *Id.* at 109, 112–113 (citing Ex. 1003 ¶¶ 457–462; Ex. 1005, 4, 6; Ex. 1008, 3, 28).

We have reviewed Petitioner’s contentions and evidence, which are not disputed by Patent Owner, and find that the combination of Menon, Trefethen, RS6000, MPIref, and POEref teaches the limitations of claims 4 and 17. Consequently, Petitioner establishes by a preponderance of the

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evidence that claims 4 and 17 would have been obvious over Menon, Trefethen, RS6000, MPIref, and POEref.

III. CONCLUSION²⁰

Weighing the competing evidence and testimony, we determine that Petitioner establishes by a preponderance of the evidence that the Challenged Claims are unpatentable.

In summary:

Claim(s)	35 U.S.C. §	Reference(s)/ Basis	Claim(s) Shown Unpatentable	Claim(s) Not Shown Unpatentable
1–3, 5–16, 18–30	103	Menon, Trefethen, RS6000, MPIref	1–3, 5–16, 18–30	
4, 17	103	Menon, Trefethen, RS6000, MPIref, POEref	4, 17	
Overall Outcome			1–30	

²⁰ 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).

IV. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that claims 1–30 of the '621 patent have been shown by a preponderance of the evidence to be unpatentable; and

FURTHER ORDERED that any party seeking judicial review must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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