

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

INTEL CORPORATION and ADVANCED MICRO DEVICES, INC.
Petitioner,

v.

ADVANCED CLUSTER SYSTEMS, INC.,
Patent Owner.

IPR2025-00916
Patent 11,811,582 B2

Before KARL D. EASTHOM, ARTHUR M. PESLAK, and BRIAN P.
MURPHY, *Administrative Patent Judges*.

EASTHOM, *Administrative Patent Judge*.

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

I. INTRODUCTION

Intel Corporation and Advance Micro Devices, Inc. (collectively “Petitioner”) filed a Petition requesting an *inter partes* review of claims 1–20 (the “challenged claims”) of U.S. Patent No. 11,811,582 B2 (Ex. 1001, the “’582 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”) timely filed a Preliminary Response. Paper 9 (“Prelim. Resp.”).

We have authority, acting on the referral from the Director, to determine whether to institute an *inter partes* review under 35 U.S.C. § 314(a). *See* 37 C.F.R. § 42.4(a) (2024) (“The Board institutes the trial on behalf of the Director.”).¹ Under 35 U.S.C. § 314(a), an *inter partes* review may not be instituted unless the information presented in the Petition shows “there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition.”

Considering the Petition, the Preliminary Response, and the supporting evidence, we conclude that the information presented in the Petition establishes a reasonable likelihood that Petitioner would prevail in its challenge of at least one claim of the ’582 patent as unpatentable. Pursuant to 35 U.S.C. § 314, we hereby institute an *inter partes* review of all challenged claims of the ’582 patent on the grounds stated in the Petition.

¹ The Director denied Patent Owner’s request for discretionary denial and referred the Petition to the Board. Paper 12, 3.

A. Related Matters

The parties state that the following cases involve the '582 patent: *Adv. Cluster Sys., Inc. v. Intel Corp.*, No. 7:24-cv-00245 (W.D. Tex) and *Adv. Cluster Sys., Inc. v. Advanced Micro Devices, Inc.*, No. 7:24-cv-00244 (W.D. Tex.). Pet. 115, Paper 5, 1.

B. Real Parties-in-Interest

Petitioner identifies Intel Corporation and Advance Micro Devices, Inc. as real parties-in-interest. Pet. 116.

Patent Owner identifies Advanced Cluster Systems, Inc. as the sole real party-in-interest. Paper 5, 1.

C. Summary of the '582 Patent (Ex. 1001)

The '582 patent, entitled "Cluster Computing," 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." Ex. 1001, codes (54, 57). "[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.* at code (57).

Figure 1 of the '582 patent follows:

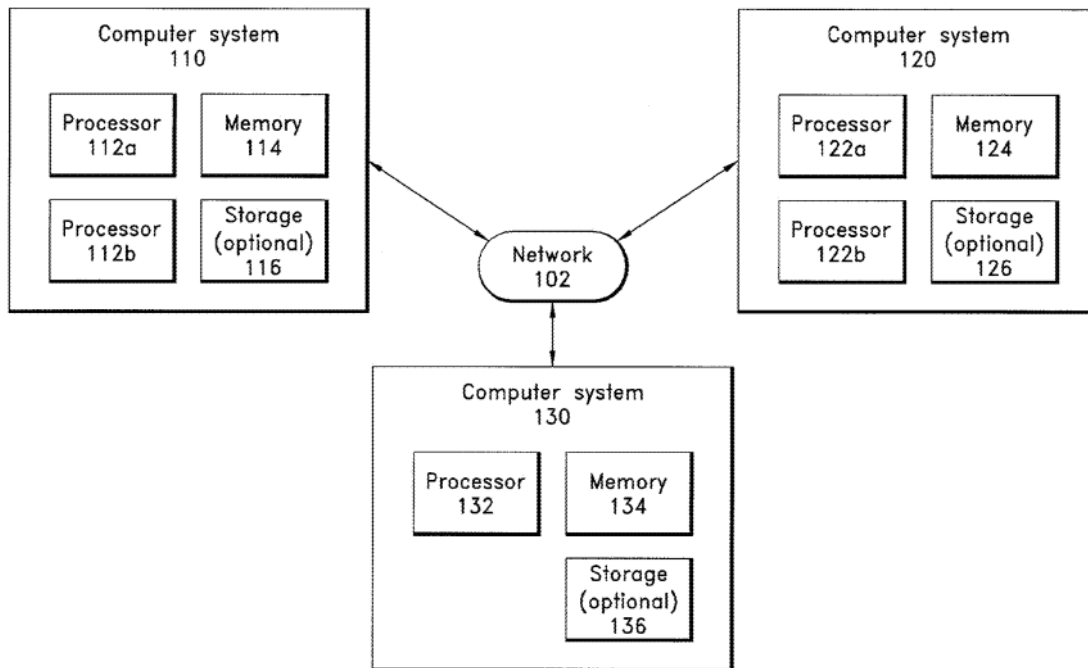


FIG. 1

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, “a cluster system 100 includes computer systems 110, 120, 130 in communication with one another via a communications network 102.” Ex. 1001, 6:57–59. 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. *Id.* at 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 '582 patent follows:

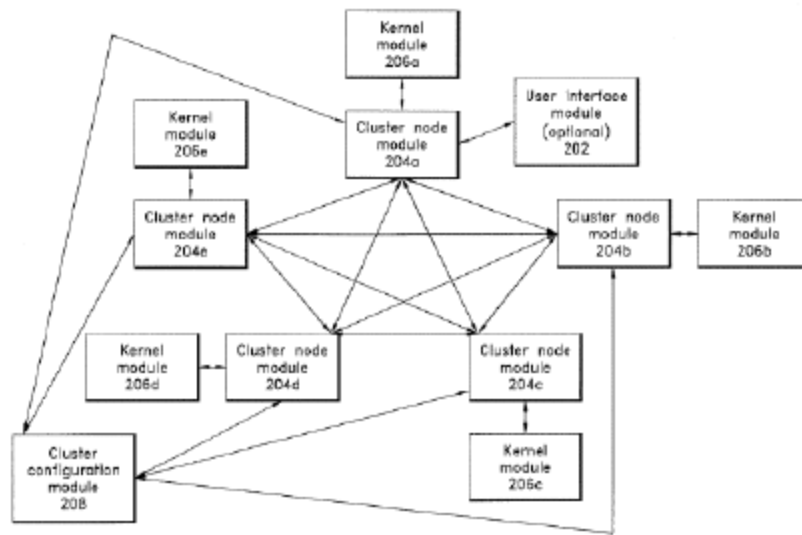


FIG. 2

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 embodiments of Figures 1 and 2, “a cluster system 100 includes a user interface module 202 that is able to access a plurality of kernel node 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. Each of the kernel modules 206a–206e is in communication with a single cluster node module 204a–204e, respectively. *Id.* at 5:38–40. Cluster node module 204a is in communication with each of the other cluster node modules 204b–204e. *Id.* at 11:25–27. Communication 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. 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, with Petitioner’s annotations, follows:

1. [1.0] 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 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 user commands into calls for execution of matrix operations on an array of data elements;

[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 communicate with the first kernel and receive commands from a user interface;

[1.5.1] a second kernel residing in the at least one computer readable medium, [1.5.2] said second kernel configured to execute of [sic] the matrix operations on the array of data elements and return a first result using 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 receive the first result and execute additional matrix operations on the first and return a second result to one or more of the first, second, or third cluster node modules using 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 the third kernel and [1.8.3] configured to communicate with the first cluster node module and the second cluster node module

[1.9] wherein the first cluster node module is configured to return, based on the second result, a final result.

E. Asserted Grounds of Unpatentability

Petitioner asserts the following grounds of unpatentability (Pet. 14): ²

Claims Challenged	35 U.S.C. §	References/Basis
1–3, 5–19	§ 103	Menon, ³ Trefethen, ⁴ RS6000, ⁵ MPIref ⁶
4, 20	§ 103	Menon, Trefethen, RS6000, MPIref,

² The pre-AIA versions of 35 U.S.C. §§ 102, 103 apply because the challenged claims rely on an effective filing date (at the earliest) of June 13, 2006, which is 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, code (63); Pet. 12.

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.

⁴ “MultiMATLAB: MATLAB on Multiple Processors,” Trefethen et al., 1996 Computer Science Technical Report, Cornell University 1996. Ex. 1007.

⁵ “RS/6000 SP: Planning Vol. 1, Hardware and Physical Environment,” IBM 2001. Ex. 1008.

⁶ “MPT: A Message-Passing Interface Standard,” Message Passing Interface Forum 1994. Ex. 1017.

Claims Challenged	35 U.S.C. §	References/Basis
		POEref ⁷

II. ANALYSIS

A. Overview

Petitioner bears the burden of persuasion to prove unpatentability of the claims challenged in the Petition, and that burden never shifts to Patent Owner. *Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015). At this stage of the proceeding, Petitioner bears the burden of demonstrating a reasonable likelihood that it would prevail with respect to at least one challenged claim for the Petition to be granted. 35 U.S.C. § 314(a).

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). *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

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

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 (“POSITA”) in June 2006 would have been someone knowledgeable of and familiar with computer cluster systems and cluster computing techniques available at the time. Such a POSITA would have 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.

Pet. 12–13 (citing Ex. 1003 ¶¶ 24–27).

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

For the purposes of this Decision, we adopt Petitioner’s undisputed level of ordinary skill in the art because it appears consistent with the level reflected in the ’582 patent and the cited prior art.

C. Claim Construction

Petitioner “submit[s] that no claim term requires express construction” except for the limitation “peer-to-peer architecture” as recited in claim 15. Pet. 12–13. Patent Owner does not address claim construction in the Preliminary Response. *See generally* Prelim. Resp. 13.

We adopt the construction offered by Petitioner. *See* Pet. 13 (construing “peer-to-peer architecture” as requiring “an architecture in which each node can communicate tasks and data with other nodes without the tasks and data being required to go through a central server or master

node” based on Patent Owner’s construction in a prior *inter partes* review proceeding) (citing IPR2021-00019, Ex. 1040, 8).

No other term requires express construction at this stage of the proceeding. *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))).

The parties are free to address the construction of any claim term in subsequent authorized briefing during trial. If either party chooses to present claim construction arguments, the arguments should be in a separately delineated portion of the brief labelled accordingly.

D. Ground 1: Alleged Obviousness of Claims 1–3 and 5–19 over
Menon, Trefethen, RS6000, and MPIref

Petitioner contends that claims 1–3 and 5–19 would have been obvious over the combined teachings of Menon, Trefethen, RS6000, and MPIref. Pet. 23–110.

Patent Owner contends that Petitioner fails to show that Menon, Trefethen, RS6000, and MPIref qualify as printed publications under 35 U.S.C. § 311(b). Prelim. Resp. 1–2. According to Patent Owner, Petitioner’s failure to show that these references are printed publications “is fatal to all asserted grounds.” *Id.* at 2.

1. Menon (Exhibit 1005)

Menon is a technical article purportedly 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’s Abstract follows:

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 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.

Id.

Figure 1 of Menon follows:

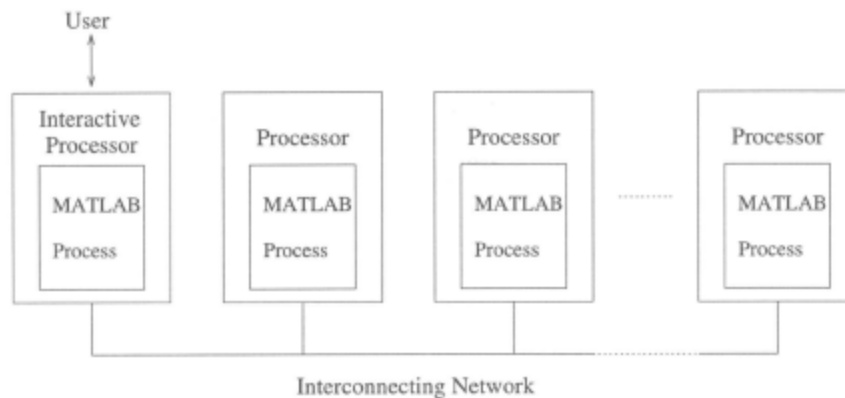


Figure 1: MultiMATLAB Architecture

Figure 1 is block diagram illustrating “MultiMATLAB Architecture.”

Ex. 1005, 3. Menon discloses that “each processor in a parallel platform individually runs a MATLAB process” and “[e]ach process is then provided with the ability to communicate with other processes through a communications layer that runs over the parallel platform’s

interconnection network.” *Id.* Further, “[t]he user interacts directly with one MATLAB process, called the interactive process, and operates within that process’s MATLAB environment.” *Id.*

Figure 2 of Menon follows:

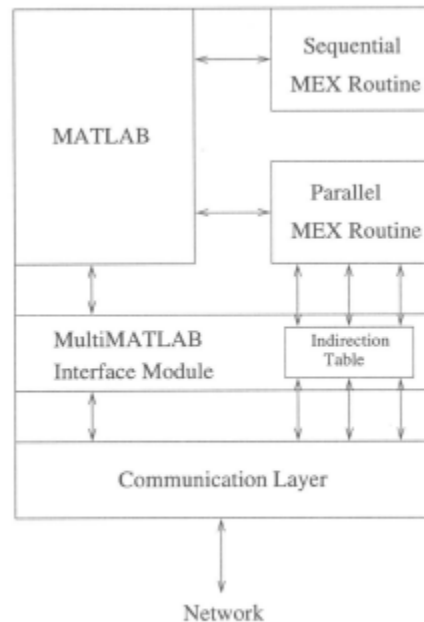


Figure 2: MATLAB Process Address Space

Figure 2 is a block diagram illustrating the “MATLAB Process Address Space.” Ex. 1005, 4. Figure 2 shows an interface module which “is responsible for initializing an underlying communication layer such as MPI [2], PVM [3], BLACS [4], or any other package.” *Id.* at 3. Further “MEX routines, also shown in the Figure 2, are executables originally written in C or Fortran that may be run directly on MATLAB. All parallel functionality in the MULTIMATLAB system is provide 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. 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.*

4. MPIref (Exhibit 1017)

MPIref, titled “MPI: A Message Passing Interface Standard,” and subtitled “Message Passing Interface Forum,” 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.” Ex. 1017, 1–2.

5. 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) (quoting *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.* (quoting *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)).

At this stage of the proceeding, Petitioner “must identify, with particularity, evidence sufficient to establish a reasonable likelihood that the reference was publicly accessible before the critical date of the challenged patent and therefore that there is a reasonable likelihood that it qualifies as a printed publication.” *Hulu, LLC v. Sound View Innovations, LLC*, IPR2018-01039, Paper 29, 13 (PTAB Dec. 20, 2019) (precedential). The reasonable likelihood standard “is lower than the ‘preponderance’ standard to prevail in in a final written decision.” *Id.*

The Petition is based on an assumption that the “earliest possible priority date [for the ’582 patent] is June 13, 2006.” Pet. 11. Patent Owner does not dispute this in the Preliminary Response. *See generally* Prelim. Resp.

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* Prelim. Resp. We preliminarily find, based on the present record, that Petitioner establishes the authenticity of each exhibit.

Petitioner also contends the exhibits are “printed publications.”

a. Menon (Ex. 1005)

Petitioner 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.” Pet. 14 (citing Ex. 1005; Ex. 1026; Ex. 1027). Petitioner further contends that Menon was “published and distributed on Cornell’s website at least as early as 2001.” *Id.* (citing Ex. 1023; Ex. 1029). Petitioner next contends that “Menon was reasonably located by POSITAs because it had been cited 17 times in papers prior to the priority date of the ’582 patent.” *Id.* at 14 (citing Ex. 1003 ¶¶ 121–123; Ex. 1028, 4–9; Ex. 1029, 1–3).

Patent Owner first contends that “there is no evidence that interested members of the public could have found the particular internet address of Exhibit 1005 with reasonable diligence if they did not already know about it,” and the Petition is “silent as to whether the department website or the authors were known to interested persons.” Prelim. Resp. 16 (citing Ex. 1033). Patent Owner further contends that the Petition offers no “evidence or explanation for how an interested person would have located particular URL addresses where Exhibit 1005 was allegedly accessible—only the bare and conclusory statement of Petitioner’s expert.” *Id.* (citing Ex. 1003 ¶ 123).

Patent Owner next contends that Petitioner “relies on what appears to be the schedule of the [1997] conference from Exhibit 1026.” Prelim. Resp. 17 (citing Ex. 1003 ¶ 123; Ex. 1026, 2–5). Patent Owner argues that “the schedule says nothing about whether Exhibit 1005 was actually presented at the conference” and “there is no percipient testimony that Exhibit 1005 was presented.” *Id.*

Patent Owner next contests the testimony of the IEEE custodian that “[c]opies of the conference proceedings were made available no later than the last day of the conference” (Ex. 1027 ¶ 11) as lacking “a foundational basis.” Prelim. Resp. 17. According to Patent Owner, the custodian “does

not purport to have witnessed Exhibit 1005 being made available . . . nor does he include any business records that can corroborate his testimony or otherwise explain how or to who Exhibit 1005 was allegedly made available.” *Id.* at 17–18.

Patent Owner next contends that “the purported technical availability of Exhibit 1005 on the conference website is not evidence that interested member of the public could have found the particular URL address where Exhibit 1005 was purportedly available with reasonable diligence if they did not already know about it.” PO Resp. 19. Patent Owner argues that even if “the conference itself was well known, the Petition contains no evidence that the alleged URL address of the conference website, i.e., Ex. 1026, was known to interested members of the public.” *Id.*

For the following reasons, based on the present record at this stage of the proceeding, Patent Owner’s arguments are unavailing.

Patent Owner contends that Petitioner’s evidence that Menon “has been cited 17 times in papers prior to the priority date of the ’582 patent” (Pet. 14) is hearsay and the evidence thereof (Ex. 1028) lacks authenticity. Prelim. Resp. 19–21. Patent Owner cites a Board case holding that articles citing a thesis were insufficient to establish public availability because the articles’ authors had personal knowledge of the thesis. *See* Prelim. Resp. 21 (citing *Argentum Pharm. v. Research Corp. Tech. Inc.*, IPR2016-00204, Paper 19 at 11–12 (PTAB May 23, 2016)).

Contrary to these arguments and related arguments, Exhibit 1028 shows corroborating evidence of public accessibility on this preliminary

record.⁸ *See Blue Calypso*, 815 F.3d at 1350 (“[A] published article with an express citation to the potentially invalidating reference would similarly provide the necessary guidance.”). In *Argentum*, the Board found the evidence “indicat[ed] the authors had personal knowledge regarding the cited thesis.” *Argentum*, IPR2016-00204, Paper 10 at 11–12. There is no similar evidence on this preliminary record with respect to the authors of the linked papers listed in Exhibit 1028.

Regarding authenticity, Dr. Bajaj testifies that Menon was “cited 17 times in papers [linked in Ex. 1028] with online publication dates” prior to the earliest effective filing date of the ’582 patent. Ex. 1003 ¶ 123 (citing Ex. 1028, 4–9). It appears that 14 of the linked papers of Exhibit 1028 have online publication dates before the earliest possible effective filing date of the ’582 patent. *See* Exhibit 1028, 5–10. On this preliminary record, for purposes of institution, Petitioner’s showing is sufficient to show the authenticity of Exhibit 1028.⁹ Regarding alleged hearsay, the Board rules on motions to exclude evidence under the procedures as set forth in 37 C.F.R. § 42.64 and per timing in the Scheduling Order.

⁸ Patent Owner advances the same arguments with respect to Trefethen and MPIRef and Exhibits 1035 and 1037, which list articles citing Trefethen and MPIRef prior to the earliest effective date of the invention, as discussed below. *See* Prelim. Resp. 20–21. These arguments are unavailing for similar reasons.

⁹ For example, the link for the first listed article on page 5 of Exhibit 1028 cites Menon in the “References” section at the end of the linked document as footnote 19. *See id.* (listing 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>).

With respect to the conference, Mr. McPherson who is the Director, Board Governance & Policy Development at IEEE, testifies that “[i]t is the regular practice of IEEE to publish articles including article abstracts and make them available to the public through IEEE Xplore,” he “obtained a copy of [Menon] through IEEE Xplore, where it is maintained in the ordinary course of IEEE’s business,” “[t]he article and abstract from IEEE Xplore show the date of publication” by “populating this information using metadata associated with the publication,” and “[c]opies of the [1997] conference proceedings were made available no later than the last day of conference.” Ex. 1027 ¶¶ 1, 7, 9, 10, 11. Additionally, the footer of each page states “Proceedings of the ACM/IEEE SC97 Conference (SC’97)”. Ex. 1005, 1–18. This evidence supports Petitioner’s position that Menon was published and distributed at the proceedings of the 1997 ACM/IEEE Conference on Supercomputing.

The Internet Archives Affidavit and the records relating to Menon attached thereto also support Petitioner. Ex. 1029. In particular, the date shown on the web archive page entry sufficiently supports Petitioner’s position that Menon was published at least as early as 2001. *Id.*, Ex. A.

After reviewing the evidentiary record at this stage of the proceeding, we find that Petitioner shows a reasonable likelihood that Menon qualifies as a printed publication under 35 U.S.C. § 102.

b. Trefethen (Ex. 1006)

Petitioner 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. 15 (citing Ex. 1023, 1029).

Petitioner also contends that Trefethen was available publicly because “it

has been cited 10 times in papers prior to the priority date of the '582 patent.” *Id.* (citing Ex. 1003 ¶¶ 129–130; Ex. 1035, 2–3).

Patent Owner responds that “there is no evidence that Exhibit 1006 was reachable as alleged from the webpage of the author prior to the critical date.” Prelim. Resp. 14. According to Patent Owner, “the purported webpage of the author . . . does not include any active hyperlinks—much less a hyperlink to the specific internet address of Exhibit 1006.” *Id.* Patent Owner further argues that “there is no evidence that interested members of the public could have found the particular internet address of Exhibit 1006 or the internet address of the author’s webpage with reasonable diligence if they did not already know about them.” *Id.* Patent Owner further contends that Petitioner offers “only the bare and conclusory statement of Petitioner’s expert” in support of its assertion that “an interested person would have located the particular URL addresses where Exhibit 1006 was allegedly accessible.” *Id.* at 14–15 (citing Ex. 1003 ¶ 129).

Patent Owner next contends that “there is no evidence that Exhibit 1006 was indexed or cataloged in a library or published in a journal prior to the critical date.” Prelim. Resp. 15. Patent Owner argues that “[w]hile Petitioner’s expert testifies that Exhibit 1006 is ‘currently’ available on the ACM digital library (Ex. 1003 ¶ 129), such testimony is facially insufficient as evidence of pre-critical date availability or accessibility via the ACM digital library.” *Id.*

For the following reasons, based on the present record at this stage of the proceeding, Patent Owner’s arguments are unavailing.

As discussed above, for the same reasons it faults Petitioner’s showing of the public availability of Menon, Patent Owner faults Petitioner’s evidence that Trefethen “has been cited 10 times in papers prior

to the priority date of the '582 patent.” *See* Prelim. Resp. 20–21; Pet. 15 (citing Ex. 1035, 2–3); *supra* note 9. For reasons similar to those discussed in connection with Menon above, the citations to Trefethen in Exhibit 1035 at pages 2–3 supports Petitioner’s position that Menon was publicly available prior to the date of the invention. *See Blue Calypso*, 815 F.3d at 1350 (“[A] published article with an express citation to the potentially invalidating reference would similarly provide the necessary guidance”).

While 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 that “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 either from the Cornell website and/or the ACM Digital Library, as evidenced by the aforementioned 10 citations to Trefethen.” Ex. 1003 ¶ 130 (quoting Ex. 1033, 2); citing Ex. 1034, 1).

After reviewing the evidentiary record at this stage of the proceeding, we find that Petitioner shows that there is a reasonable likelihood that Trefethen qualifies as a printed publication under 35 U.S.C. § 102.

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

Petitioner 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). Petitioner also contends that “Menon describes the MultiMATLAB architecture on an ‘IBM SP2’ and RS6000 provides details of that system.” Pet. 26 (citing Ex. 1005, 5–6); *id.* at n.2 (explaining that “‘IBM SP2’ is the same as ‘IBM RS/6000 SP.’” (citing Ex. 1010, 6 (“[T]he SP2 was renamed to simply the SP.”))). Petitioner further contends that a “POSITA seeking to understand MultiMATLAB would be motivated to seek the documentation corresponding to the systems for which ‘MultiMATLAB was design[ed] specifically.’” *Id.* at 26 (quoting Ex. 1005, 6).

Petitioner contends that POEref “is a product manual published by IBM in support for the Parallel Operating Environment running on an RS/6000 system.” Pet. 15. According to Petitioner, “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. 1036, 14; Ex. 1047). Dr. Bajaj testifies that “the IBM SP2 parallel computing platform was distributed with manuals, including the ‘IBM AIX Parallel Environment—Operations and Use’ manuals.” Ex. 1003 ¶ 137 (citing Ex. 1036, 14; Ex. 1008, 157–159 (stating “PE documentation is shipped with the PE licensed program in a variety of formats” and indicating “IBM Parallel Environment for AIX: Operation and Use, Volume 1, SA22-7425” (Ex. 1008) as one of the PE publications)).

Petitioner 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). Petitioner also contends that MRIref “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 ’582 patent.” *Id.* (citing Ex. 1003 ¶¶ 140–142; Ex. 1037, 2–16). Petitioner further contends that Menon “expressly cite[s] to ‘the MPI communication standard’” and “MPIref is the MPI communication standard referenced by Menon.” *Id.* at 27 (quoting Ex.1005, 5; citing Ex.1017, 1 (“MPI: A Message-Passing Interface Standard”)).

With regard to the RS6000 and POEref, Patent Owner contends that “the Petition provides no evidence of library indexing or cataloging” and “also fails to demonstrate that Exhibits 1007 and 1008 were publicly accessible by practical searchability because it fails to offer any evidence that a query of any search engine before the critical date would have led to the particular URL addresses where the references were allegedly available.” Prelim. Resp. 4. Patent Owner also contends that the link chain on the IBM website Petitioner relies upon reveals different pages for the links each with different archival dates such that Petitioner “provide[s] no proof that these pages and links existed at the same time or were even navigable.” *Id.* at 6.

Patent Owner also argues that “Petitioners’ proposed navigation of ‘link chains’ . . . fails to demonstrate public accessibility because it requires the searcher to already know that the desired content exists and is associated with IBM’s company name and its product names (e.g., ‘RS6000,’ ‘AIX’), prior to searching.” Prelim. Resp. 6–7. With respect to Dr. Bajaj’s

testimony that IBM shipped POEref with the associated software according to a license agreement, Patent Owner argues the testimony relies on hearsay that the Board “cannot rely on.” *See id.* (citing Ex. 1003 ¶ 137).

At this stage of the proceeding, Petitioner presents sufficient evidence for institution that artisans of ordinary skill were aware of IBM SP2 and POE products at least through publication of Menon and via shipment of POEref with the product. *See* Pet. 25–26 (citing Ex. 1005, 5). The Petition also adequately supports the contention that RS6000 and POEref were “sufficiently accessible to the public interested in the art” via the links Petitioner cites, in order to implement known MultiMATLAB products in the known POE system for which the known IBM SP2 was designed. *See Blue Calypso, LLC.*, 815 F.3d at 1348; Ex. 1005, 5; Ex. 1008, 157. Further as to POEref, as Petitioner shows, “Menon describes using POE to initialize the MATLAB processes,” and “MultiMATLAB uses ‘POE, IBM's Parallel Operating Environment,’” so that an artisan of ordinary skill “seeking to understand MultiMATLAB would be motivated to review the documentation corresponding to the systems expressly discussed in Menon.” Pet. 111 (quoting Ex. 1005, 6).

Patent Owner’s allegation, that different links in the link chains leading to RS6000 and POEref bear different dates of creation per the web crawler, does not undermine Petitioner’s showing. Prelim. Resp. 5–7 (citing (Ex. 1038; Ex. 1039). On this preliminary record, the Petition sufficiently shows that the dates are much earlier than June 13, 2006, the earliest possible priority date of the ’582 patent. Pet. 15–16 (citing Ex. 1003 ¶¶ 132–133, 136–138; Ex. 1038; Ex. 1039).

Patent Owner’s argument that the statements in POEref (summarized above) are hearsay is unavailing. On this preliminary record, the statements

indicate that IBM intended to make the manual available online to artisans interested in the POE product and to ship POEref with the PE software for the RS/6000 SP system.¹⁰ *See* Ex. 1008, 157–159; Fed. R. Evid. 803(3) (state of mind exception to the hearsay rule).

Another statement in POEref similarly indicates an intent by IBM to disseminate it to a wide variety of artisans of ordinary skill:

This book is designed primarily for end users and application developers. It is also intended for those who run parallel programs, and some of the information covered should interest system administrators. Readers should have knowledge of the AIX operating system and the X-Window system. Where necessary, this book provides some background information relating to these areas. More commonly, this book refers you to the appropriate documentation.

Ex. 1008 ix.

Patent Owner also faults as hearsay the statement in MPIref quoted in the Petition, that “[t]he University of Tennessee and Oak Ridge National Laboratory made the draft available by anonymous FTP mail servers and were instrumental in distributing the document.” Prelim. Resp. 9–10 (citing Pet. 16 (quoting Ex. 1017, 7)). However, the statement may qualify as an exception to the hearsay rule on this preliminary record—it is circumstantial evidence of the author’s perception that IBM intended to distribute the document to the public. *See* Fed. R. Evid. 803(3) (“A statement of the declarant’s then-existing state of mind (such as motive, intent, or plan)”); *Nuance Comm’ns, Inc. v. Abbyy Software House*, 626 F.3d 1222, 1230 n.1 (Fed. Cir. 2010) (“Statements of a declarant’s then-existing state of

¹⁰ The Board rules on motions to exclude evidence under the procedures as set forth in 37 C.F.R. § 42.64 and per timing in the Scheduling Order.

mind, such as intent, plan, or motive, are exceptions to hearsay. Fed. R. Evid. 803(3).”).

Regardless, as Petitioner shows, “Menon indicates 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. 27 (quoting Ex.1005, 5 (“IBM’s proprietary version of MPI [is] specifically optimized for the SP2”)). This evidence further supports the Petition’s contention that an artisan of ordinary skill would have been motivated and able to locate MPIref as documentation of IBM’s optimized MPI for use in the SP2 system.

As discussed above, for the same reasons it faults Petitioner’s showing of the public availability of Menon, Patent Owner faults Petitioner’s evidence that MPIref, a recognized communication standard, “was reasonably located by POSITAs because it had been cited 74 times in papers,” See Pet. 16 (citing Ex. 1037, 2–16; Ex. 1003 ¶¶ 142–144); Prelim. Resp. 20–21; *supra* note 9. For the reasons similar to those discussed in connection with Menon above, Petitioner’s evidence is sufficient to show public availability.

On this preliminary record, the evidence cited in the Petition sufficiently shows an intent to distribute RS/6000, MPIref, and POEref via the IBM website, product shipments, or otherwise, to allow users to successfully implement the known products using well-known standards associated therewith. See *Jockmus v. Leviton*, 28 F.2d 812 (2nd Cir. 1928) (“[T]he catalogue itself . . . bear[s] its own evidence of existence since 1908, but no one can seriously suppose that such a document, printed in quantity, was intended to be kept secret; its whole purpose was to be spread broadcast

as far as possible. It had been printed at some expense in French for French customers, and, unless some accident happened to prevent, it would in due course have gone upon its intended errand.”) (Judge L. Hand).

After reviewing the evidentiary record at this stage of the proceeding, we find that Petitioner has shown a reasonable likelihood that RS6000, MPIref, and POEref qualify as printed publications under 35 U.S.C. § 102.

6. Analysis of Claim 1

Petitioner contends that claim 1 would have been obvious over the combined teachings of Menon, Trefethen, RS6000, and MPIref. Pet. 23–67.

Petitioner presents arguments 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. *Id.* at 23–28. Petitioner also maps the prior art to the limitations of claim 1. *Id.* at 27–67. Patent Owner does not address motivation to combine or the mapping. *See generally* Prelim. Resp.

a. Motivation to Combine Menon and Trefethen

Petitioner contends that “Menon suggests the combination by expressly citing Trefethen and explaining that Menon builds on the teachings of Trefethen.” Pet. 24 (citing Ex. 1005, 1–2).

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 mathematical calculations.” Pet. 24 (quoting Ex. 1005, Abstr.; Ex. 1006, 2; citing Ex. 1005, 16). 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. 1005, Abstr.; Ex. 1006, 2–7).

Petitioner also 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 mathematical calculations.” Pet. 25 (citing Ex. 1003 ¶¶ 151–154; Ex. 1005, 2; Ex. 1006, 11–12; quoting Ex. 1006, 12).

b. Motivation to Combine Menon and 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” and RS6000 “provides ‘an overview of the IBM RS/6000 SP.’” Pet. 25–26 (citing Ex. 1003 ¶ 88; quoting 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 26 (quoting 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 ¶¶ 159–162; Ex. 1005, Abstr., 6; Ex. 1007, 1, 11).

Petitioner also 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. 26–27 (citing Ex. 1003 ¶¶ 159–162; Ex. 1005, 6, 14).

c. Motivation to Combine Menon and MPIref

Petitioner contends that “Menon suggests the combination by expressly citing to ‘the MPI communication standard’” and “MPIref *is* the communication standard referenced by Menon.” Pet. 27 (quoting Ex. 1005, 5; citing Ex. 1017, 1). Petitioner next contends that “Menon indicates 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.* (quoting Ex. 1005, 5). Petitioner also 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 28 (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. 1005, 3; Ex. 1017, 2; Ex. 1003 ¶¶ 166–170).

d. Preamble 1.0: “A computer cluster comprising:”

Petitioner provides the following annotated version of Menon’s Figure 1:

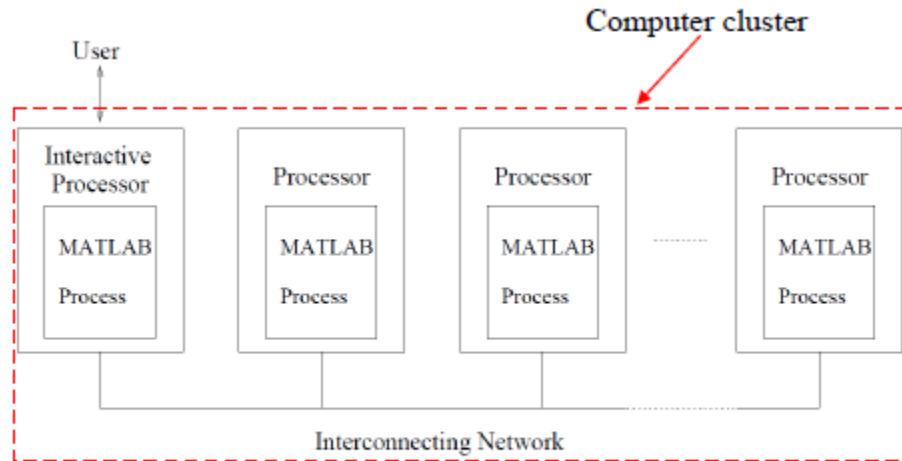


Figure 1: MultiMATLAB Architecture

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 line red rectangle surrounding four interconnected processors and text to indicate a “Computer cluster.” *Id.* at 29.

Petitioner relies on Menon’s disclosure that “MultiMATLAB was designed ‘specifically for the IBM SP2.’” Pet. 29 (quoting Ex. 1005, 3). Petitioner also relies on POEref’s disclosure that “[t]he IBM SP2 system ‘execute[s] parallel programs on ... a **networked cluster** of RS/6000 processors’” using a plurality of process nodes to perform mathematical calculations according to Menon. *Id.* at 29 (quoting Ex. 1008, 1) (citing Ex. 1005 13, Figs. 7–8 (using “8 processors” and “32 processors,” respectively)). Therefore, Petitioner asserts that the combined teachings render the preamble obvious (even if it is limiting). *See id.* (citing Ex. 1003 ¶¶ 171–177).

e. Limitations 1.1.1–1.1.3: “a first processor,” “a second processor,” and “a third processor”

Petitioner relies the combined teachings of Menon and RS6000 to address the three processors as recited in claim 1. Pet. 32–33.

Petitioner annotates Menon’s Figure 1 as follows (Pet. 32):

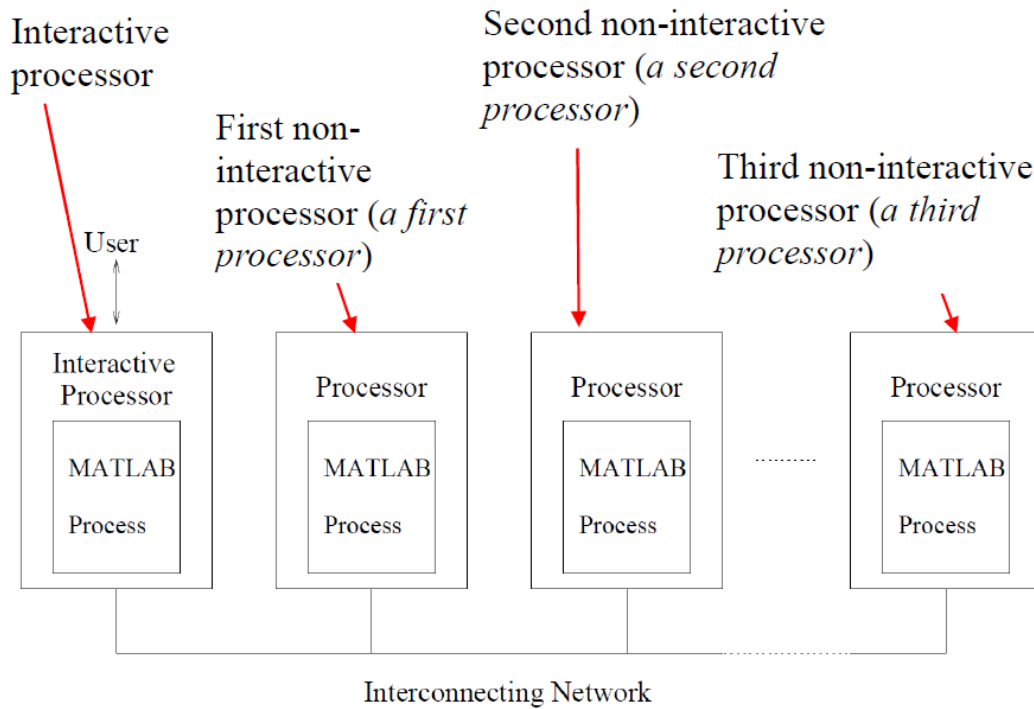


Figure 1: MultiMATLAB Architecture

Petitioner’s annotated version of Menon’s Figure 1 shows how Petitioner reads Menon’s MultiMATLAB architecture on the IBM SP2 as including the claimed first, second, and third processors (as annotated by Petitioner in italics). Pet. 32–33 (citing Ex. 1003 ¶ 180; Ex. 1005, 3 (“[E]ach processor in a parallel platform individually runs a MATLAB process”).

f. 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 relies the combined teachings of Menon and RS6000 to address limitation 1.2. Pet. 33–34. Petitioner contends that each processor runs a MATLAB process with each including a MATLAB Process Address Space for communication with memory, and RS6000 teaches that “the IBM SP2 has disk drives and memory cards for storing program code accessible by the node’s hardware processors,” which “renders obvious” “at least one computer-readable medium” in communication with the recited processors. *See id.* at 33–34 (citing Ex. 1005, 3, Fig. 1; Ex. 1007, 6, 10; Ex. 1003 ¶¶ 186–190); *supra* § II.D.6.b (reasons for combining Menon and RS6000).

g. 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 this limitation.” Pet. 36 (citing Ex. 1003 ¶¶ 191–195, Fig. 1). Petitioner notes that “[t]he ’582 patent identifies MATLAB as an example of a *kernel*.” *Id.* (citing Ex. 1001, 1:16–17, 4:21–26). For the second and third kernels of 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 (second kernel), 56 (third kernel).

Petitioner annotates Menon’s Figure 1 to illustrate its showing, as follows (Pet. 35):

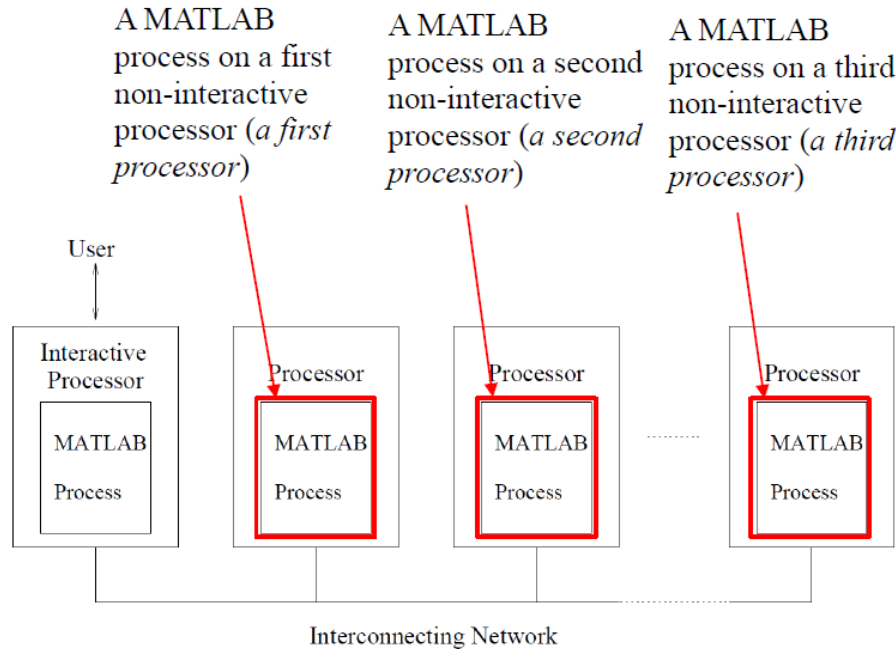


Figure 1: MultiMATLAB Architecture

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

As annotated by Petitioner, Figure 1 above illustrates MATLAB as a process running in each of three non-interactive processors (red box, italics) in Menon’s system. Pet. 35. 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.* (quoting Ex. 1005, 1; citing Fig. 2 (showing a MATLAB process)).

Petitioner also refers to its showing with respect to limitation 1.2 (based on the combined teachings of Menon and RS600) and asserts each MATLAB process in each processor is a kernel in “at least one computer-readable medium.” Pet. 34–35 (annotating Ex. 1005, Figs. 1, 2).

h. Limitations 1.3.2 and 1.5.2: “said first kernel configured to translate user commands into calls for execution of matrix operations on an array of data elements,” and “said second kernel

configured to execute of [sic] the matrix operations on the array of data elements and return a first result using the second processor”

Addressing limitation 1.3.2, Petitioner relies on its showing above that Menon teaches MATLAB as the first kernel. Pet. 37. Petitioner asserts that “Menon describes MATLAB as performing ‘high-level MATLAB operations’ such as ‘matrix multiplications [and] solve for eigenvalues,’ and provides example ‘MultiMATLAB implementations of the conjugate gradients algorithm’ that ‘consists of a **matrix-vector multiplication** at every iteration.’” *Id.* at 39 (quoting Ex. 1005, 10) (emphasis in original).

Petitioner also relies on Trefethen’s disclosure of “several examples of a MATLAB receiving commands that are translated into calls for execution.” Pet. 38–39 (citing Ex. 1006, 3, 4, 6 (describing calls executed by each MATLAB process)). Petitioner contends it would have been obvious to combine the teachings of Menon and Trefethen based on their similar use of MATLAB to perform mathematical operations using matrices in order to implement parallel processing with code according to implementation details in Trefethen. *See id.* at 38–40; *supra* § II.D.6.a (reasons for combining Menon and Trefethen).

Addressing limitation 1.5.2, Petitioner relies on similar teachings in Menon and Trefethen, contending that the limitations would have been obvious. *See* Pet. 46–47. Petitioner further relies on Trefethen’s “example algorithm (the ‘cycle.m’ m-file) where mathematical results are returned from one processor to the next.” Pet. 47 (citing Ex. 1006, 6).

Petitioner also asserts that

Menon teaching MATLAB in the MATLAB process of the second non-interactive processor, in view of Trefethen teaching an m-file where that MATLAB in the MATLAB process on the second non-interactive processor receives the variable “a=2,”

doubles it to “a=4,” outputs the result “a=4,” and then sends it to the next MATLAB process, in further view of Menon and Trefethen teaching that each MATLAB process performs matrix-related mathematical evaluations on the array of data elements, renders obvious this limitation.

Pet. 47 (citing Ex.1003 ¶¶ 223–228).

i. Limitation 1.4.1: “a first cluster node module residing in the at least one computer-readable medium,” and limitation 1.4.2, “said first cluster node module configured to communicate with the first kernel and receive commands from a user interface”

As summarized above in connection with limitation 1.2, Petitioner contends that the MATLAB process resides in an address space located in memory (computer readable medium). Pet. 40. Petitioner adds that Menon’s “MATLAB process 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.* (quoting Ex.1005, 3, 5). Petitioner further contends that “‘MEX routines’ provide ‘[a]ll parallel functionality in the MultiMATLAB system.’” *Id.* (quoting Ex.1005, 3). Petitioner also relies on Menon’s teaching that “[t]he interface module . . . is responsible for initializing an underlying communication layer, such as MPI . . . , and exposing it to the rest of the system.” *Id.* (quoting Ex. 1005, 3).

j. Limitation 1.4.2: “said first cluster node module configured to communicate with the first kernel and receive commands from a user interface”

To address this limitation, Petitioner combines Menon’s Figures 1 and 2 and provides an annotated version thereof as follows (Pet. 44):

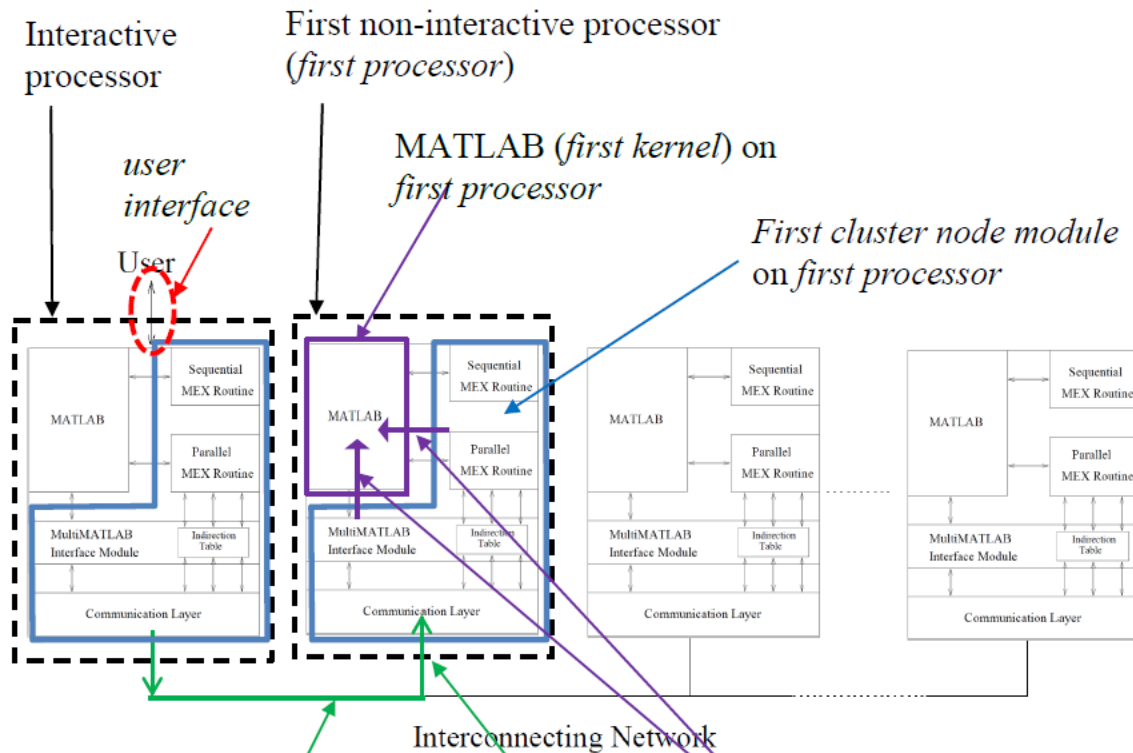


Figure 1: MultiMATLAB Architecture

MATLAB commands transmitted from *user interface* on interactive processor to non-interactive processors

MATLAB commands received from interactive processor

MATLAB commands sent by *cluster node module* to MATLAB (*kernel*) on same non-interactive processor

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

As annotated above, Petitioner illustrates the first cluster node module (blue) on a first processor (black dashed rectangle middle 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 commands (green) from a first user interface (red) to Menon's interactive processor (black dashed rectangle left). See Pet. 42–43 (citing Ex. 1005, 3–5).

Petitioner relies on Menon's disclosure "that the 'user interacts directly with one MATLAB process, called the interactive process, and

operates within that process's MATLAB environment' to have user instructions executed in parallel by the MultiMATLAB architecture.” Pet. 43 (quoting Ex.1005, 3; citing Ex. 1005, 3–4 (“On non-interactive processes, a separate top-level 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.”)).

Petitioner also relies on Trefethen's similar disclosure of a user entering commands sent directly to multiple processors: “For example, ‘the user now types Eval(“sqrt(2)”),’ which causes ‘the MATLAB command sqrt(2) [to be] executed on all six processors.”” Pet. 44–45 (quoting Ex. 1006, 3). Petitioner also relies on Trefethen's example of selecting a subset of processes by providing different process IDs. *Id.* at 44 (selecting processes ID=4 and ID=5).

Based on the above teachings and its stated reasons for combining the teachings (*supra* § II.D.6.a), Petitioner contends that Menon and Trefethen collectively teach the following sequence:

- (i) the user enters a command via the user interface on the interactive processor, (ii) that command is provided 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 of the other processors, (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. 45 (citing Ex.1003 ¶¶ 211–219).

- 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”

Petitioner relies on its similar showing for limitations 1.4.1 and 1.4.2 to address limitations 1.6.1, 1.6.2, and 1.6.3. *See* Pet. 48–55. Petitioner identifies a second cluster node module as residing on Menon’s second non-interactive processor. *See id.* at 55 (annotating Menon’s Figures 1 and 2 combined), 62 (same). Petitioner contends that “each MATLAB process is provided with ‘the ability to communicate with other processes through a communication layer that runs over the parallel platform’s interconnection network.’” *Id.* at 51 (quoting Ex.1005, 3). Petitioner further contends that “it is the ‘MEX routines’ of the cluster node module that ‘access the underlying communication layer and, hence, the network, through the MultiMATLAB interface module.’” *Id.* (quoting Ex.1005, 4).

According to Petitioner,

Menon and Trefethen 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 (*said second cluster node module* and *the first cluster node module*) to communicate commands (e.g., tasks) and data directly with each other, rendering obvious this limitation.

Pet. 55 (citing Ex.1003 ¶¶ 234–243).

1. Limitation 1.7.2: “said third kernel configured to receive the first result and execute additional matrix operations on the first result and return a second result to one or more of the first, second, or third cluster node modules using the third processor”

Referring to its showing for limitations 1.1.3 and 1.5.2 (which addresses matrix operations), Petitioner contends that Trefethen’s “cycle.m” example “teaches that MATLAB in MATLAB process ID=3 doubles the received variable (‘a=4’) to ‘a=8’ (*a second result*) and sends it to the next

MATLAB process, i.e., MATLAB process ID=4, as shown” in Trefethen’s process of doubling variables and sending successive results to different processors. *See* Pet. 56–57 (citing Ex. 1006; Ex. 1003 ¶ 249).

Petitioner also contends that

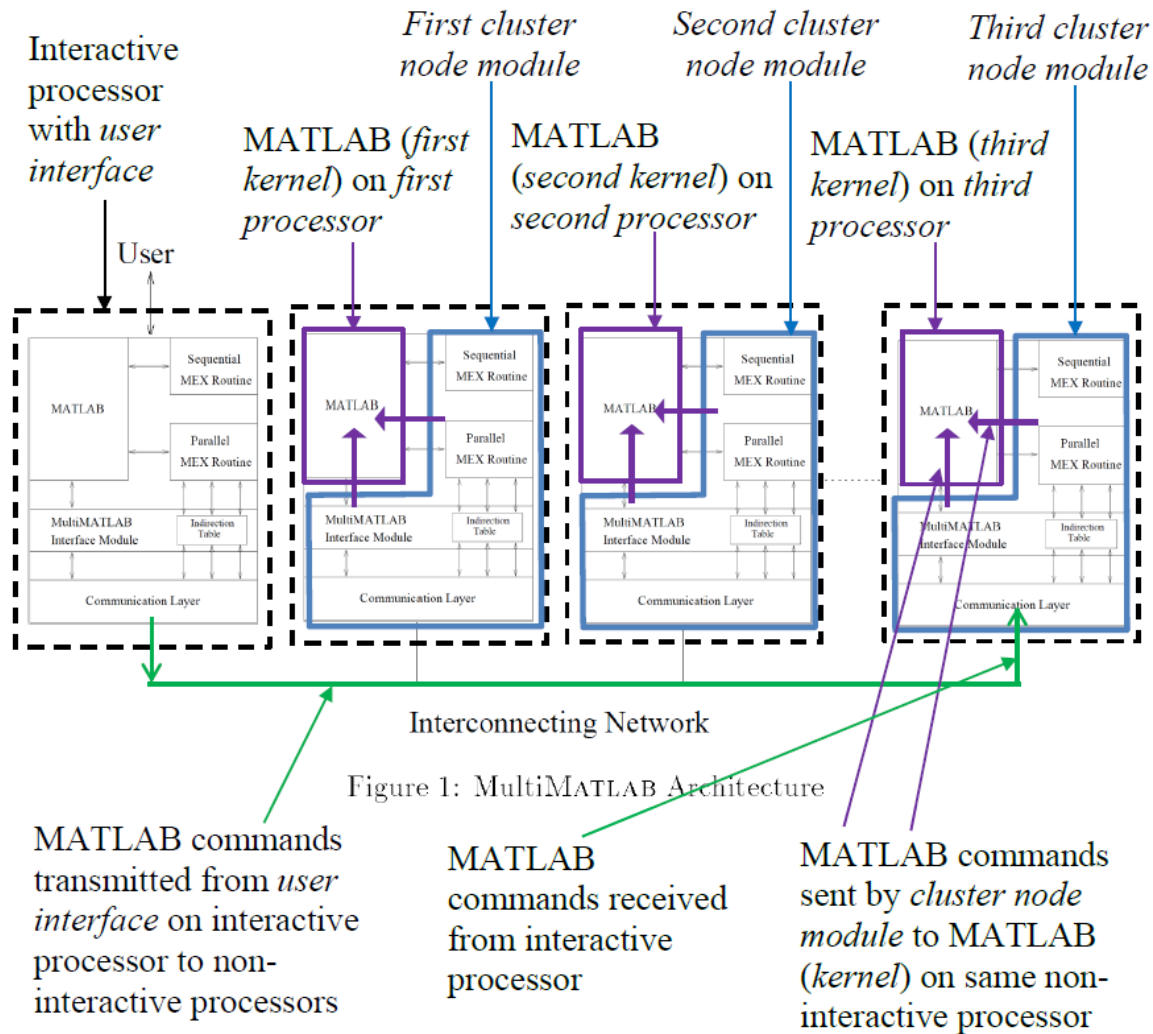
MATLAB (the kernel) communicates with other processes using its cluster node module; that is, for example, MATLAB process ID=3 on the third non-interactive processor sends the result “a=8” (a second result) to the next MATLAB process ID=4 via its third cluster node module (for the result to arrive at the next MATLAB process ID=4). A POSITA would recognize and understand that for the third cluster node module in MATLAB process ID=3 to send the result “a=8” (a second result) to the next MATLAB process, the third cluster node module receives the result “a=8” from MATLAB (third kernel).

Pet. 57 (citing Ex. 1005, Fig. 1, 2; Ex. 1003 ¶ 250).

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 these limitations, Petitioner relies on its showings for limitation 1.4.1 (explaining “the MEX routines, MultiMATLAB interface module, indirection table, and communication layer (*cluster node module*) of each MATLAB process on a processor of MultiMATLAB are in the MATLAB process address space”), limitation 1.7.1 (explaining “MATLAB in the MATLAB process on the third non-interactive processor (third processor) teaches the third kernel”), 1.4.2 (explaining “the interactive processor sends the user commands to the cluster node module of each non-interactive processor, which provides MATLAB commands to its respective MATLAB (*kernel*) for execution”).

To illustrate its showing, Petitioner provides an annotated version of a combination of Menon's Figures 1 and 2 as follows (Pet. 62):



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

Pet. 62 (citing Ex. 1003 ¶¶ 256–258). 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. Petitioner contends that as illustrated above in the combined Figures 1 and 2 of Menon,

the MEX routines (part of *said third cluster node module*) in the MATLAB process of the third non-interactive processor receive MATLAB commands from the interactive processor and send the MATLAB commands (*configured to send commands*) to the MATLAB (*to the third kernel*) in that MATLAB process for execution by that MATLAB.

Pet. 61 (citing Ex. 1003 ¶¶ 256–258).

Petitioner also 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. 62–63 (citing Ex. 1005, Table 1 (showing commands for point to point communication); Ex. 1003 ¶ 239). 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 63 (citing Ex.1006, 6; Ex.1005, 8–9, Table 1).

Based on the above-summarized teachings, 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 second cluster node module and the first cluster node module*) to communicate commands (e.g., tasks) and data with each other, rendering obvious this limitation.

Pet. 64 (citing Ex. 1003 ¶¶ 259–261).

n. Limitation 1.9: “wherein the first cluster node module is configured to return, based on the second result, a final result.”

Petitioner contends that, as discussed with respect to its showing for limitation 1.7.2, “Trefethen teaches that, when executing ‘the m-file cycle.m,’ the final MATLAB process is programmed to output the results to

the screen of the interactive process.” Pet. 65 (citing Ex. 1006, 6; Ex. 1003 ¶ 263). Petitioner also contends that “[t]o use MultiMATLAB in the complicated mathematical algorithms contemplated by Menon and Trefethen, Trefethen describes that ‘any of the MATLAB processes’ can perform ‘general point-to-point communication’ using ‘send and receive commands.’” *Id.* at 66 (quoting Ex.1006, 5). Relying on its showing for limitation 1.4.2, Petitioner also asserts that “the interactive processor has a user interface for providing intermediary and final results of the mathematical calculations to the user.” *Id.* at 67.

Petitioner relies on other MATLAB teachings in Menon and Trefethen (Pet. 65–67) and contends as follows:

[B]ecause Menon and Trefethen teach that each MATLAB process (e.g., the first non-interactive process) is configured to receive a result from any other MATLAB process via its cluster node module, and to perform subsequent processing and returning the final result to the interactive processor, Menon and Trefethen render obvious this limitation.

Pet. 67 (citing Ex.1003 ¶¶ 262–270).

m. Summary of Claim 1

The preliminary record supports Petitioner’s showing for claim 1 as summarized above. Patent Owner does not address Petitioner’s motivation to combine or claim mapping. *See generally* Prelim. Resp.

On this preliminary record, we determine Petitioner shows a reasonable likelihood of prevailing on showing the obviousness of claim 1.

7. Analysis of Claims 2, 3, and 5–19

Petitioner contends that claim 1 would have been obvious over the combined teachings of Menon, Trefethen, RS6000, and MPIref. Petitioner presents 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. *Id.* at 68–110.

Petitioner also maps the prior art to the limitations of claims 2, 3, and 15–19. *Id.* Patent Owner does not address motivation to combine or claim mapping. *See generally* Prelim. Resp.

On this preliminary record, Petitioner shows a reasonable likelihood of prevailing on its obviousness contentions with respect to claims 2, 3, and 5–19.

E. Ground 2: Alleged Obviousness of claims 4 and 19

Petitioner contends that claim 4 and 19 would have been obvious over the combined teachings of Menon, Trefethen, RS6000, MPIref, and POEref. Pet. 110–114.

Petitioner presents contentions and evidence concerning why an ordinarily skilled artisan would have been motivated to combine Menon, Trefethen, RS6000, MPIref, and POEref with a reasonable expectation of success. Pet. 110–114. Petitioner also maps the prior art to the limitations of claims 4 and 19. *Id.* Patent Owner does not address motivation to combine or the claim mapping. *See generally* Prelim. Resp.

On this preliminary record, Petitioner shows a reasonable likelihood of prevailing on showing the obviousness of claims 4 and 20.

III. CONCLUSION

After considering the evidence and arguments presented in the Petition and the Preliminary Response, we determine that Petitioner demonstrates a reasonable likelihood of prevailing on its assertion that at least one claim of the '582 patent is unpatentable. Accordingly, we institute an *inter partes* review of the challenged claims on all of the grounds

presented in the Petition. *See* 37 C.F.R. § 42.108(a); *SAS Inst., Inc. v. Iancu*, 138 S. Ct. 1348, 1359–60 (2018); *AC Techs. S.A. v. Amazon.com, Inc.*, 912 F.3d 1358, 1364 (Fed. Cir. 2019) (“[I]f the Board institutes an IPR, it must . . . address all grounds of unpatentability raised by the petitioner.”). At this stage of the proceeding, we have not made a final determination as to the patentability of the challenged claims.

IV. ORDER

In consideration of the foregoing, it is hereby

ORDERED that *inter partes* review of claims 1–20 of U.S. Patent No. 11,811,582 B2 is instituted with respect to all grounds of unpatentability set forth in the Petition; and

FURTHER ORDERED that pursuant to 35 U.S.C. § 314(a), *inter partes* review of U.S. Patent No. 11,811,582 B2 is instituted commencing on the entry date of this Order, and pursuant to 35 U.S.C. § 314(c) and 37 C.F.R. § 42.4, notice is given of the institution of a trial.

FOR PETITIONER:

Andrew Ehmke
David McCombs
Dan Smith
Dagim Tilahun
HAYNES AND BOONE, LLP
andy.ehmke.ipr@haynesboone.com
david.mccombs.ipr@haynesboone.com
bedan.smith.ipr@haynesboone.com
dagim.tilahun.ipr@haynesboone.com

Brian Ferguson
Chaoxuan Liu
James Kappos
WINSTON & STRAWN LLP
ferguson@winston.com
ccliu@winston.com
jkappos@winston.com

FOR PATENT OWNER:

David Lindner
Jon Gurka
CROWELL & MORING, LLP
dlindner@crowell.com
jgurka@crowell.com

Reynaldo Barcelo
BARCELO, HARRISON & WALKER, LLP
rey@bhiplaw.com