

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.

IPR2025-00915
Patent 11,563,621 B2

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

PESLAK, *Administrative Patent Judge*.

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

I. INTRODUCTION

Intel Corporation and Advanced Micro Devices, Inc. (collectively “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”) timely filed a Preliminary Response. Paper 9 (“Prelim. Resp.”).

On September 19, 2025, the Director referred the Petition to the Board to determine whether or not to institute an *inter partes* review. Paper 12, 2–3. We, thus, have authority, acting on the designation of 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.”). 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 all 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 ’621 patent as unpatentable. Pursuant to 35 U.S.C. § 314, we hereby institute an *inter partes* review of all challenged claims of the ’621 patent on the grounds stated in the Petition.

A. Related Matters

The parties state that the ’621 patent is involved in *Adv. Cluster Sys., Inc. v. Intel Corp.*, No. 7:cv-00245 (W.D. Tex) and *Adv. Cluster Sys., 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 Intel Corporation and Advanced Micro Devices, Inc. as real parties-in-interest. Pet. 115.

Patent Owner identifies Advanced Cluster Systems, Inc. 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.*

Figure 1 of the '621 patent is reproduced below:

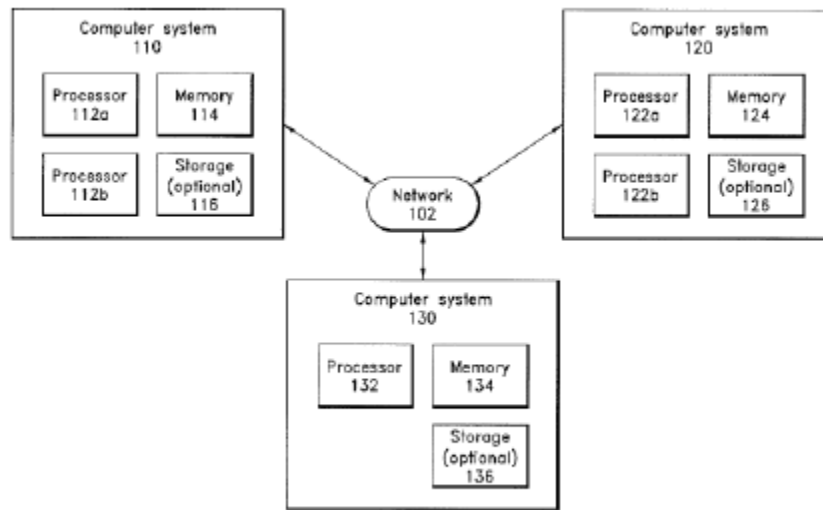


FIG. 1

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:

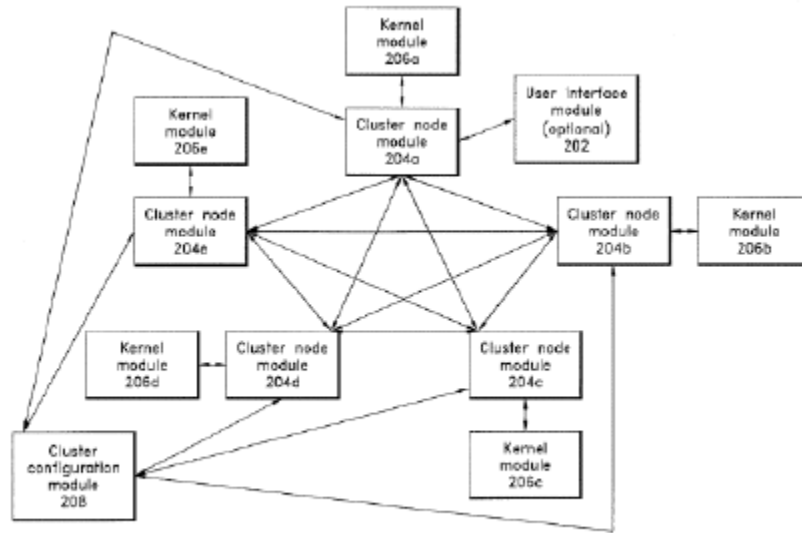


FIG. 2

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 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. “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 annotations¹:

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 We use Petitioner’s annotations herein for ease of reference.

[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, 18–39	§ 103	Menon, ³ Trefethen, ⁴ RS6000, ⁵ MPIref ⁶
4, 17	§ 103	Menon, Trefethen, RS6000, MPIref, 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

² We apply the pre-AIA version of 35 U.S.C. § 102 and 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 “MPT: 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”).

burden of demonstrating a reasonable likelihood that it would prevail with respect to at least one challenged claim for a 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).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. 2006)) (“[R]ejections on obviousness grounds cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning

⁸ No evidence of secondary considerations has been presented at this stage of the proceeding.

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* Prelim. 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 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 does not address claim construction in the Preliminary Response.

We determine, at this stage of the proceeding, that we need not 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))).

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, 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.

Patent Owner contends that 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). 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.

We begin with brief summaries of Menon, Trefethen, RS6000, POEref, and MPIref and then address the parties' respective contentions.

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:

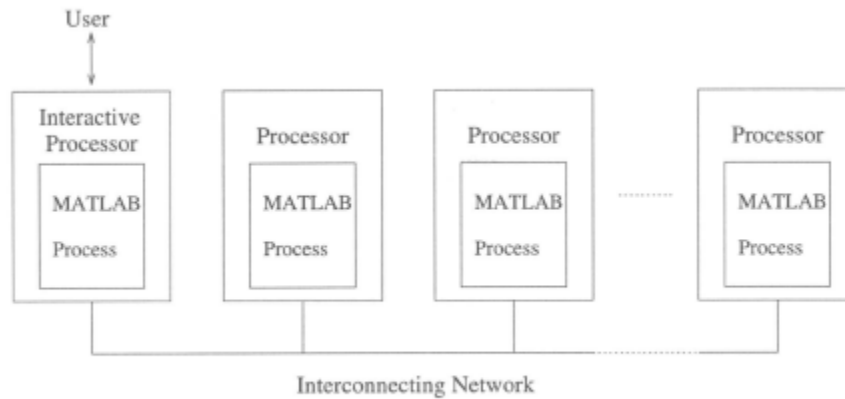


Figure 1: MultiMATLAB Architecture

Figure 1 is a 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 with that process’s MATLAB environment.” *Id.*

Figure 2 of Menon is reproduced below:

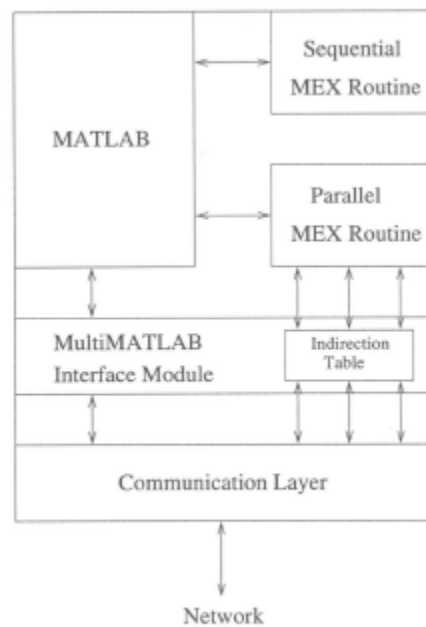


Figure 2: MATLAB Process Address Space

Figure 2 is a block diagram illustrating the “MATLAB Process Address Space.” Ex. 1005, 4. Menon discloses that Figure 2 shows its 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 from 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. 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 asserted to be an IBM product manual for “the IBM Parallel Environment (PE)” and “its Parallel Operating Environment (POE)” running on an RS6000 system, as referenced in Menon. Pet. 14–15 (citing Ex.1003 ¶¶ 134–136; Ex.1005, 6; Ex.1008, 11⁹; Ex. 1029; Ex. 1039; Ex. 1047). POEref discloses an initialization process where a user enters the “poe” command, 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.

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.

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)).

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 ’621 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, thus, preliminarily find, based on the present record, that Petitioner establishes the authenticity of each exhibit.

We now turn to the question of whether the exhibits constitute “printed publications.”

Exhibit 1005 - Menon

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. 13 (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 ’621 patent.” *Id.* at 14 (citing Ex. 1003 ¶¶

121–123; Ex. 1028, 4–9; Ex. 1029, 1–3). Dr. Bajaj opines that an ordinarily skilled artisan with interest in computer cluster systems and cluster computing techniques and acting with reasonable diligence “would have located Menon from the SC ’97 conference proceedings, the SC ’97 conference website, IEEE Xplore and/or the Cornell websites before the earliest priority date of the ’621 patent as evidenced by the aforementioned 17 citations to Menon.” Ex. 1003 ¶ 123.

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. 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 ¶ 121).

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 ¶ 121; Ex. 1026, 2–5). Patent Owner argues that “the schedule says nothing about whether Exhibit 1005 was actually presented the conference” and “there is no percipient testimony that Exhibit 1005 was presented.” *Id.*

Patent Owner next contends that the declaration of the IEEE custodian stating that “conference proceedings including Exhibit 1005 were made available on the last day of the conference” (Ex. 1003 ¶ 11) lacks “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.” Prelim. 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.*

Patent Owner next contends that Exhibit 1028 which Petitioner offers to show evidence that Menon “has been cited 17 times in papers prior to the priority date of the ’621 patent” (Pet. 14) is hearsay and lacks authenticity. Prelim. Resp. 19–21. According to Patent Owner, Petitioner fails to present a “custodian’s declaration authenticating the content or explaining the source of these documents” and that the documents are inadmissible hearsay “because they are out-of-court statements offered to prove that the underlying references were publicly available at a certain time.” *Id.* at 20. Patent Owner cites a Board case allegedly holding that articles citing a thesis were insufficient to establish public availability because the articles’ authors had personal knowledge of the thesis. *See id.* at 21 (citing *Argentum Pharm. v. Research Corp. Tech. Inc.*, IPR2016-00204, Paper 19 at 11–12 (PTAB May 23, 2016)).

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

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 conference.” Ex. 1027 ¶¶ 1, 7, 9, 10, 11. Additionally, we note that 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.

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

Turning to Exhibit 1028, for the following reasons, we preliminarily find that Exhibit 1028 corroborates Petitioner’s position that Menon was publicly accessible based on the current record.¹⁰ *See Blue Calypso*, 815 F.3d at 1350 (“[A] published article with an express citation to the

¹⁰ 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.

potentially invalidating reference would similarly provide the necessary guidance.”).

In *Argentum*, cited by Patent Owner, the Board found the evidence “indicat[ed] the authors [of the citing articles] had personal knowledge regarding the cited thesis.” *Argentum*, IPR2016-00204, Paper 19 at 11–12. There is no similar evidence in the current record with respect to the knowledge of any of the authors of the 17 articles listed in Exhibit 1028.

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 ’621 patent. Ex. 1003 ¶ 121 (citing Ex. 1028, 4–9). The first link on page 5 of Exhibit 1028 leads to an article dated March 15, 2006 that cites Menon in footnote 19. Ex. 1028, 5 (link to 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-2006,¹¹ available at <https://doi.org/10.1186/1471-2105-7-139>.). Based on the current record at this stage of the proceeding, Petitioner sufficiently shows the authenticity of Exhibit 1028.¹²

We are mindful of the issues raised in the Preliminary Response, but none of the issues raised by Patent Owner are dispositive based on the current record. After reviewing the evidentiary record at this stage of the proceeding, we find that Petitioner has shown a reasonable likelihood that

¹¹ The earliest possible priority date for the ’621 patent is June 13, 2006. Ex. 1001, code (60).

¹² Motions to exclude evidence based, *inter alia*, on hearsay or authenticity are dealt with after the record has been fully developed during trial. See 37 C.F.R. § 42.64 (b), (c).

Menon qualifies as a printed publication. We encourage the parties to more fully develop the record during subsequent authorized briefing during trial.

Ex. 1006 - Trefethen

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. 14 (citing Ex. 1023, 1029). Petitioner next contends that “Trefethen was reasonably located by POSITAs because it has 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).

Patent Owner first contends 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 ¶ 128).

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 ¶ 127), 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.

Patent Owner faults Petitioner’s evidence that Trefethen “has been cited 10 times in papers prior to the priority date of the ’621 patent” for the same reasons discussed above for Menon. *See* Prelim. Resp. 20–21; Pet. 14 (citing Ex. 1035, 2–3). For reasons similar to those discussed in connection with Menon above, the citations to Trefethen in Exhibit 1035 at pages 2–3 corroborates Petitioner’s position that Trefethen was publicly available prior to the date of the invention.

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)). In this case, 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 from . . . the Cornell website.” Ex. 1003 ¶ 128.

We are mindful of the issues raised in the Preliminary Response, but none of the issues raised by Patent Owner are dispositive based on the current record. After reviewing the evidentiary record at this stage of the proceeding, we find that Petitioner has shown that there is a reasonable likelihood that Trefethen qualifies as a printed publication. We encourage the parties to more fully develop the record during subsequent authorized briefing during trial.

Ex. 1007 - RS/6000, Ex. 1008 - POEref, Ex. 1017 - MPIref

The Petition contends that RS6000 “is a product manual by IBM in support of the IBM RS/6000 SP computing solution.” Pet. 14. According to the Petition, “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 teaches “that MultiMATLAB uses the ‘IBM SP2, a modern high performance distributed memory multiprocessor’” and “RS6000 provides ‘an overview of the IBM RS/6000SP.’” Pet. 24–25 (citing Ex. 1003 ¶ 88; Ex. 1005, 5; Ex. 1007, 1). The Petition further contends that an ordinarily skilled artisan “seeking to understand MultiMATLAB would be motivated to review the documentation corresponding to the systems for which ‘MultiMATLAB was design[ed] specifically.’” *Id.* at 26 (citing Ex. 1005, 6).

The Petition contends that POEref “is a product manual published by IBM in support for the Parallel Operating Environment running on an RS/6000 system.” Pet. 14–15. 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.* at 15 (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 (citing Ex. 1005, 5; Ex. 1017, 1 (“MPI: A Message-Passing Interface Standard”)).

Patent Owner contends that “the Petition provides no evidence of library indexing or cataloging” of RS/6000 or POEref 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. 4–5. Patent Owner also contends that the link chain on the IBM website 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 to Exhibit 1007 as suggested by their expert.” *Id.* at 6. With respect to Dr. Bajaj’s testimony that POEref was distributed with the associated IBM SP2 parallel computing

program, Patent Owner argues the testimony relies on hearsay that the Board “cannot rely on.” *See id.* at 8 (citing Ex. 1003 ¶ 135).

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

Petitioner’s contentions are sufficiently supported with evidence to establish a reasonable likelihood that ordinarily skilled artisans were aware of IBM SP2 and POE products at least through publication of Menon and via distribution of POEref with the products. *See* Pet. 14–15. The Petition also adequately supports the contention that RS6000 and POEref were “sufficiently accessible to the public interested in the art” via the links to which Petitioner cites, in order to implement known MultiMATLAB products in the known POE system for which the known IBM SP2 was designed. *Blue Calypso*, 815 F.3d at 1348; *see* Ex. 1005, 5; Ex. 1008, 157. With respect to POEref, Petitioner sufficiently shows Menon teaches “that ‘POE, IBM’s Parallel Operating Environment’ is used to start and assign identification numbers to all MATLAB processes when implementing the MultiMATLAB architecture in IBM SP2 and POEref is directed to describ[ing] . . . [the] Parallel Operating Environment” so that an artisan of ordinary skill “seeking to understand MultiMATLAB would be motivated to seek the documentation corresponding to the systems expressly discussed in Menon.” Pet. 107–108 (citing Ex. 1005, 6; Ex. 1008, ix).

Patent Owner’s arguments, that statements in POEref and MPIref cited in the Petition are hearsay (Prelim. Resp. 8, 10, 31) are not dispositive based on the present record but, can be pursued after institution based on a fully developed record. 37 C.F.R. § 42.64 (b), (c). Regardless, Petitioner sufficiently shows, “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). This evidence further supports the Petition’s contention that an artisan of ordinary skill would have been motivated and been reasonably able to locate MPIref as documentation of IBM’s optimized MPI for use in the SP2 system.

We are mindful of the issues raised in the Preliminary Response, but none of the issues raised by Patent Owner are dispositive based on the current record. After reviewing the evidentiary record at this stage of the proceeding, we find that Petitioner has shown there is a reasonable likelihood that RS6000, MPIref, and POEref each qualify as a printed publication. We encourage the parties to more fully develop the record during subsequent authorized briefing during trial.

7. Analysis of Claim 1

Petitioner sets forth 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 sets forth a proposed mapping of the prior art to the limitations of claim 1. Pet. 27–67. Patent Owner does not address motivation to combine or the mapping of the prior art to the claim limitations. *See generally* Prelim. Resp.

Because Petitioner bears the burden of establishing a reasonable likelihood of showing that at least one of the challenged claims is unpatentable, we analyze Petitioner’s undisputed contentions.

a. Motivation to Combine Menon and Trefethen

Petitioner first contends that “Menon and Trefethen are analogous 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). We reviewed Petitioner’s evidence and contentions and, based on the present record, find that Petitioner sufficiently establishes that Menon and Trefethen are analogous art.

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).

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

Patent Owner does not address motivation to combine or reasonable expectation of success in the Preliminary Response.

We have reviewed Petitioner’s evidence and contentions and, based on the current record, preliminarily find that Petitioner sufficiently establishes that an ordinarily skilled artisan would have been motivated to combine Menon and Trefethen 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 Bauman wasn’t beyond the skill of an ordinary artisan. Nothing more is required to show a motivation to combine under *KSR*”).

b. Motivation to Combine Menon and RS6000

Petitioner first contends that RS6000 is analogous art because it pertains to “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. 24 (citing Ex. 1001, 1:14–15; Ex. 1003 ¶¶ 84–87; Ex. 1007, 1). We reviewed Petitioner’s evidence and contentions and, based on the present record, find that Petitioner sufficiently establishes that RS6000 is analogous art.

Petitioner first 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 or 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).

Patent Owner does not address motivation to combine or reasonable expectation of success in the Preliminary Response.

We have reviewed Petitioner’s evidence and contentions and, based on the present record, preliminarily find that Petitioner sufficiently establishes that an ordinarily skilled artisan would have been motivated to combine Menon and RS6000 with a reasonable expectation of success.

c. Motivation to Combine Menon and MPIref

Petitioner first contends that MPIref is analogous art because it pertains to “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. 26 (citing Ex. 1001, 1:14–15; Ex. 1003 ¶¶ 92–94.). We reviewed Petitioner’s evidence and contentions and, based on the current record, find that Petitioner sufficiently establishes that MPIref is analogous art.

Petitioner first contends that “Menon suggests the combination by expressly citing 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 does not address motivation to combine or reasonable expectation of success in the Preliminary Response.

We have reviewed Petitioner’s evidence and contentions and, based on the current record, preliminarily find that Petitioner sufficiently establishes that an ordinarily skilled artisan would have been motivated to combine Menon and MPIref with a reasonable expectation of success.

d. Limitation [1.0]¹³ A computer cluster comprising:

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

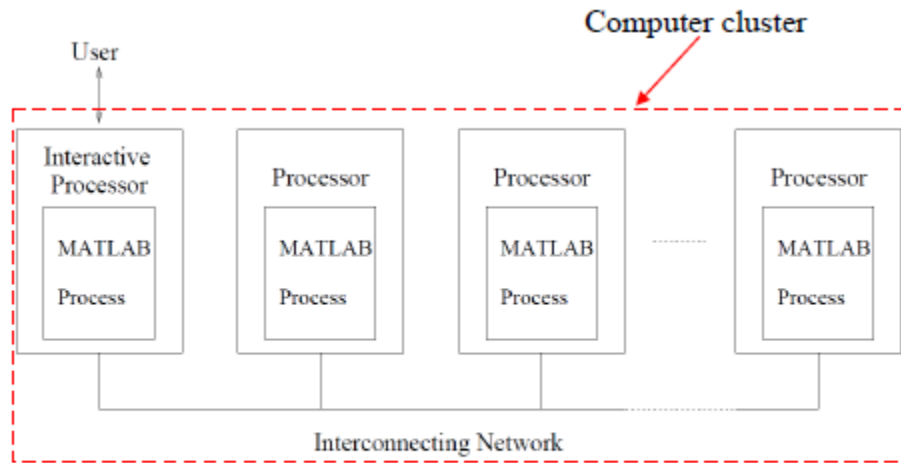


Figure 1: MultiMATLAB Architecture

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 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 asserts that the combined teachings of Menon and RS/6000 teach the preamble. *See id.* (citing Ex. 1003 ¶¶ 169–175).

¹³ We use Petitioner’s limitation identifiers for ease of reference.

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

We reviewed Petitioner evidence and argument and find that Petitioner sufficiently establishes that the combination of Menon and RS/6000 teaches the subject matter of the preamble. Based on the present record, we need not determine whether the preamble is limiting.

e. 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 these limitations. Pet. 29–31. Petitioner provides the following annotated version of Menon’s Figure 1 to illustrate its contentions (*id.* at 29):

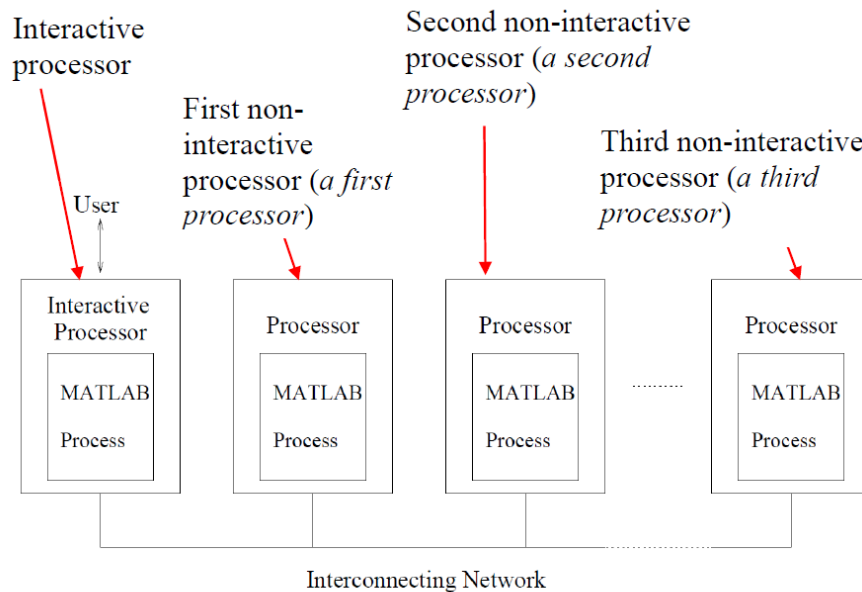


Figure 1: MultiMATLAB Architecture

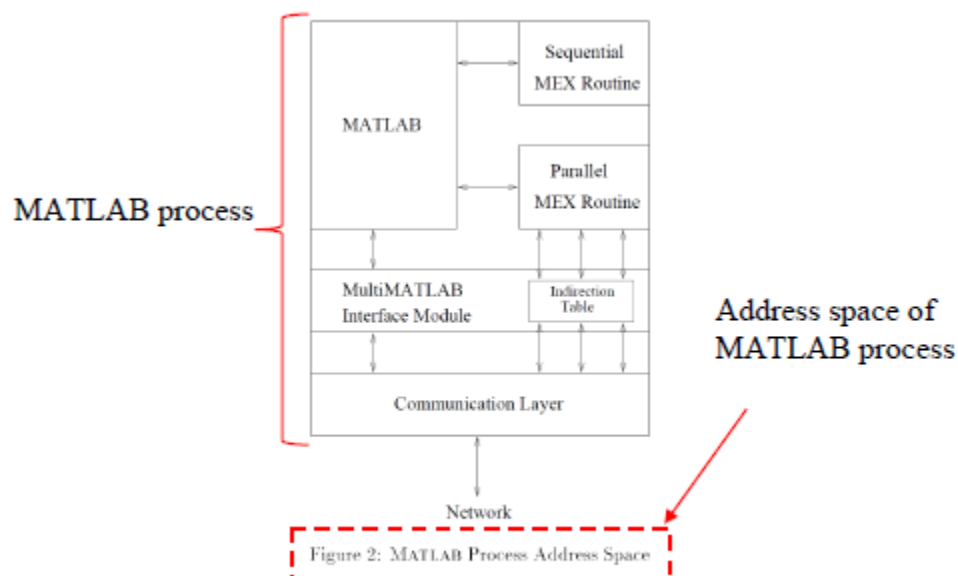
In the above figure, Petitioner annotates the three non-interactive processors from Menon’s MultiMATLAB architecture that Petitioner contends correspond to the recited first processor, second processor, and third processor. *Id.* at 29–31 (citing Ex. 1003 ¶¶ 176–179; Ex. 1005, 3 (“each processor in a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

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

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

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 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* Prelim. Resp.

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

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[] 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. 45–47 (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):

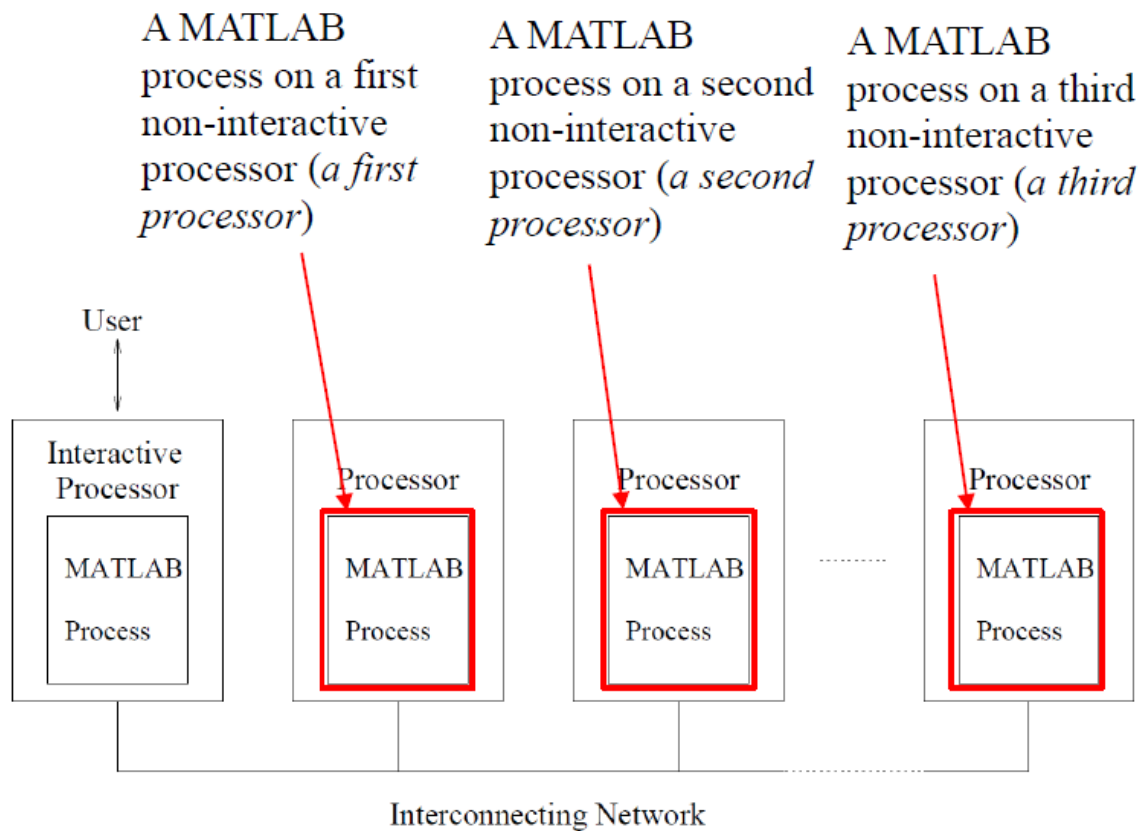


Figure 1: MultiMATLAB Architecture

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 (showing a MATLAB process)).

Petitioner also refers to its contentions for limitation 1.2 (based on the combined teachings of Menon and RS/6000) 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* Prelim. Resp.

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

h. 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 "RS/6000 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 RS/6000 teaches limitation 1.3.2.

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* Prelim. Resp.

We reviewed Petitioner evidence and argument and find that Petitioner sufficiently establishes that the combination of Menon, Trefethen, and RS/6000 teaches these limitations.

- i. 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* Prelim. Resp.

We reviewed Petitioner evidence and argument and find that Petitioner sufficiently establishes that Menon teaches this limitation.

j. 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):

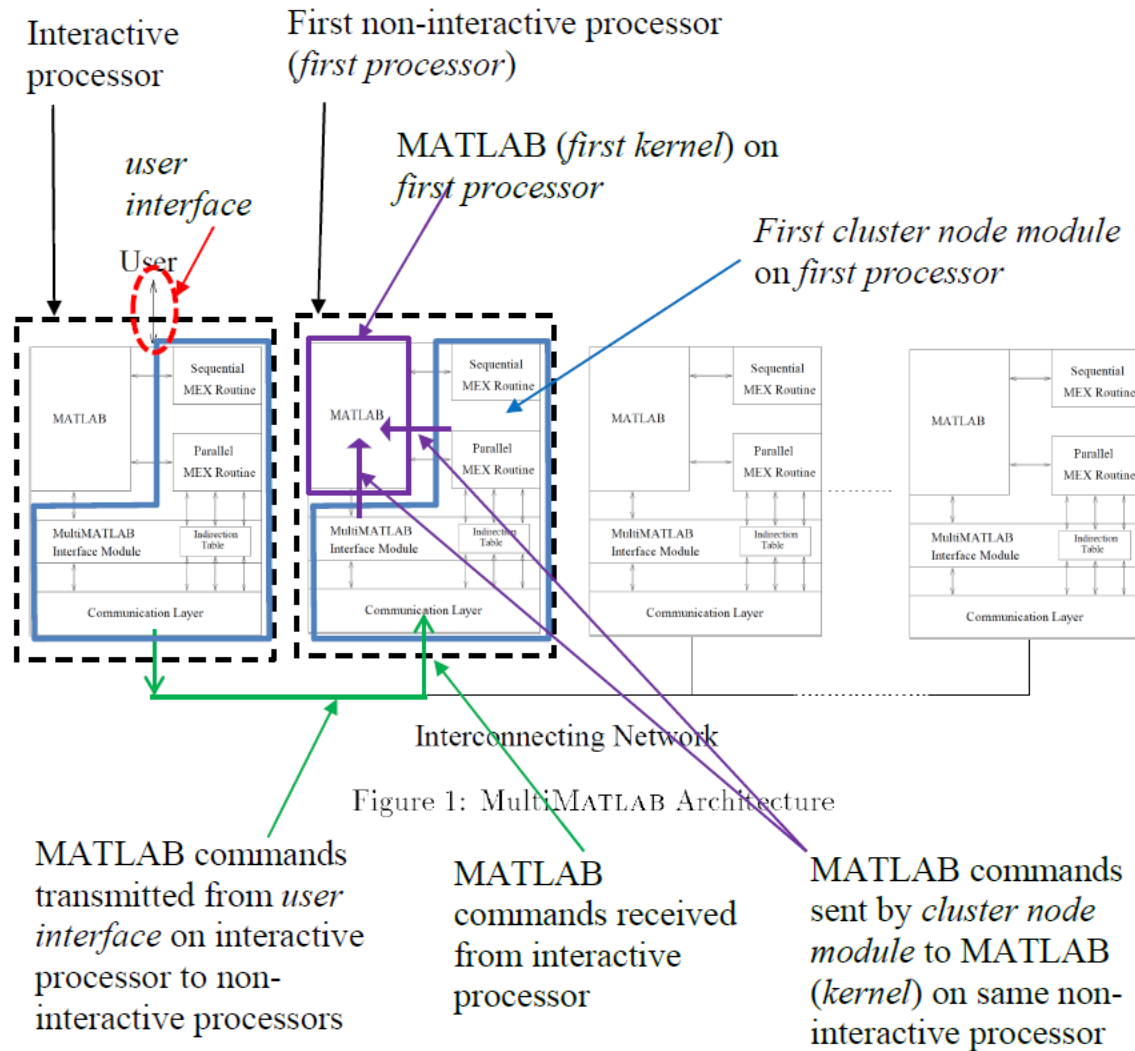


Figure 1: MultiMATLAB Architecture

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. 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 similar disclosure of a user “enter[ing] commands that are sent directly to the other processes . . . For example, ‘the user now types Eval(‘sqrt(2)’),’ which causes ‘the MATLAB command sqrt(2) [to be] executed on all six processors.’” Pet. 40 (citing Ex. 1006, 3). Petitioner also relies on Trefethen’s disclosure of a user “identif[y]ing 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 (*supra* § II.D.6.a), according to Petitioner 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 does not address this limitation. *See generally* Prelim. Resp.

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

k. 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 $\text{sqrt}(2)$ ’ 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.*, ‘ $\text{sqrt}(2)$ ’) 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 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* Prelim. Resp.

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

1. 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) :

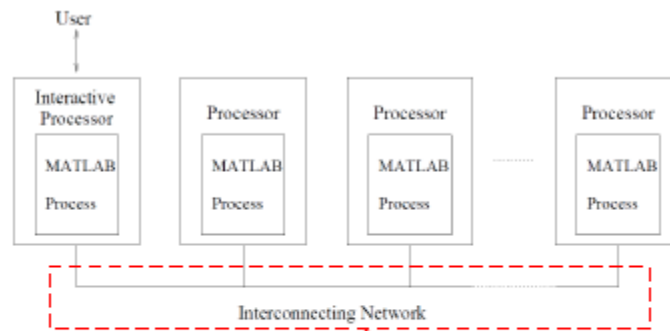


Figure 1: MultiMATLAB Architecture

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 teach 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* Prelim. Resp.

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

m. 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 translate 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 RS/6000 “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).

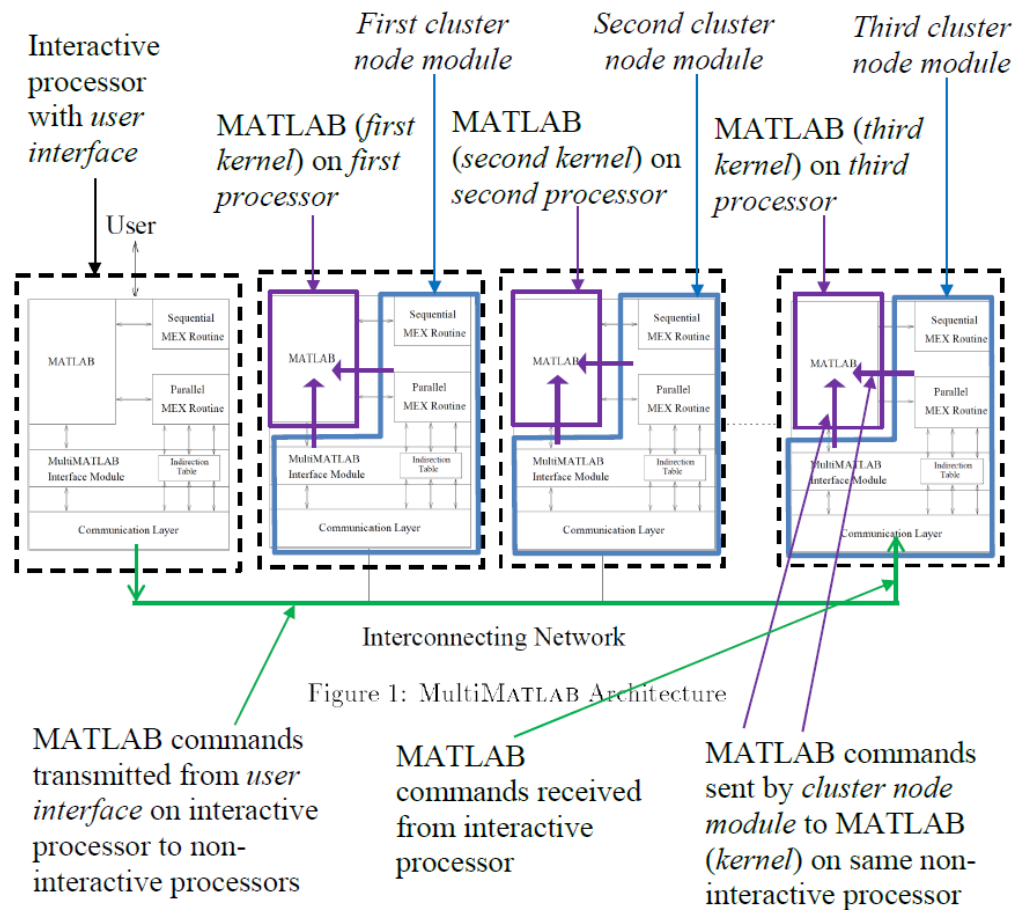
Patent Owner does not address this limitation. *See generally* Prelim. Resp.

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

n. 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* Prelim. Resp.

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

e. 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 contract 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 title “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).

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

We reviewed Petitioner evidence and argument and find that Petitioner sufficiently establishes that the combination of Menon, Trefethen, and RS/6000 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)¹⁴. 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 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 is obvious 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

¹⁴ The Petition also cites to page 250 of Exhibits 1005 which appears to be a typographical error.

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* Prelim. Resp.

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

Summary of Claim 1

For all the foregoing reasons, we determine Petitioner shows a reasonable likelihood of establishing that claim 1 is obvious over Menon, Trefethen, RS/6000, and MPIref.

8. Claims 2, 3, 5–16, and 18–30

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. *See generally* Prelim. Resp.

For all reasons discussed above for claim 1, we determine Petitioner shows a reasonable likelihood of establishing that claims 13, 24, and 27 are obvious over Menon, Trefethen, RS/6000, and MPIref.

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 13, 24, and 27. *See generally* Prelim. Resp.

We reviewed Petitioner’s evidence and argument and find that Petitioner sufficiently establishes that the combination of Menon, Trefethen, RS/6000 and MPIref teaches the limitations of these dependent claims. Consequently, we determine that Petitioner establishes a reasonable likelihood that claims 2, 3, 5–12, 14–16, 18–23, 25, 26, and 28–30 are obvious over the combination of Menon, Trefethen, RS/6000, and MPIref.

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

Petitioner contends that claim 4 and 17 would have been obvious over the combined teachings of Menon, Trefethen, RS/6000, MPIref, and POEref. Pet. 110–114.

Petitioner sets forth contentions and evidence concerning why an ordinarily skilled artisan would have been motivated to combine Menon,

Trefethen, RS/6000, MPIref, and POEref with a reasonable expectation of success. Pet. 107–109. Petitioner also sets forth a proposed mapping of the prior art to the limitations of claims 4 and 17. *Id.* at 109–113.

Patent Owner does not address motivation to combine or the mapping of the prior art to the claim limitations. *See generally* Prelim. Resp.

We reviewed Petitioner’s evidence and argument and find that Petitioner sufficiently establishes that the combination of Menon, Trefethen, RS/6000, MPIref, and POEref teaches the limitations of these dependent claims and that a person of ordinary skill in the art would have been motivated to combine these references with a reasonable expectation of success. Consequently, we determine that Petitioner establishes a reasonable likelihood that claims 4 and 17 are obvious over the combination of Menon, Trefethen, RS/6000, MPIref, and POEref.

III. CONCLUSION¹⁵

Based on the present record, we determine that Petitioner demonstrates a reasonable likelihood that it would prevail in establishing that at least one challenged claim of the ’621 patent is unpatentable. We, thus, institute an *inter partes* review of all Challenged Claims of the ’621 patent based on all grounds in the Petition.

Our factual findings, claim construction, and legal conclusions at this stage of the proceeding are based on the evidentiary record developed thus

¹⁵ Patent Owner is cautioned that any arguments not raised in the Patent Owner Response may be deemed waived. *See In re NuVasive, Inc.*, 842 F.3d 1376, 1379–82 (Fed. Cir. 2016) (holding that a patent owner waived an argument addressed in a Preliminary Response by not raising the same argument in the Patent Owner Response).

far. This decision to institute trial is not a final decision as to the unpatentability of the claims for which *inter partes* review is instituted. Our final decision will be based on the full record developed during trial.

IV. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that *inter partes* review of the '621 patent is instituted with respect to all Challenged Claims and 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 the '621 patent 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.

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Patent 11,563,621 B2

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