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Paper 11
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UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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NVIDIA CORP.,
Petitioner,

v.

ADVANCED CLUSTER SYSTEMS, INC.,
Patent Owner.

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IPR2020-01608
Patent 8,082,289 B2

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Before KARL D. EASTHOM, ARTHUR M. PESLAK, and SEAN P. O'HANLON, *Administrative Patent Judges*.

O'HANLON, *Administrative Patent Judge*.

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

# I. INTRODUCTION

## A. Background

NVIDIA Corporation ("Petitioner") filed a Petition for *inter partes* review of claims 1, 4–6, 8, 10, 11, 13, 14, 16–19, 21–23, 27, and 29–32 ("the challenged claims") of U.S. Patent No. 8,082,289 B2 (Ex. 1001, "the '289 patent"). Paper 1 ("Pet."), 1. Advanced Cluster Systems, Inc. ("Patent Owner") filed a Preliminary Response. Paper 7 ("Prelim. Resp."). Pursuant to our order (Paper 8), Petitioner filed a Reply to Patent Owner's Preliminary Response (Paper 9, "Pet. Reply") and Patent Owner filed a Sur-reply to Petitioner's Reply (Paper 10, "PO Sur-reply").

Institution of an *inter partes* review is authorized by statute only when "the information presented in the petition . . . and any response . . . shows that there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition." 35 U.S.C. § 314(a) (2018). A decision to institute may not institute on fewer than all claims challenged in the petition. *SAS Inst. Inc. v. Iancu*, 138 S. Ct. 1348, 1354, 1359–60 (2018). If the PTAB institutes a trial, the PTAB will institute on all challenges raised in the petition. *See* Patent Trial and Appeal Board Consolidated Trial Practice Guide 64 (Nov. 2019) ("The Board will not institute on fewer than all claims or all challenges in a petition.");[1] *see also 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.").

[1] *Available at* https://www.uspto.gov/TrialPracticeGuideConsolidated.

For the reasons set forth below, upon considering the parties' briefs and evidence of record, we conclude that the information presented shows that there is a reasonable likelihood that Petitioner would prevail in establishing the unpatentability of at least one of the challenged claims. Thus, we institute *inter partes* review of all challenged claims based on all asserted grounds.

B. Real Parties in Interest

Petitioner identifies itself as the sole real party in interest. Pet. 3.

Patent Owner identifies itself as the sole real party in interest. Paper 3, 1.

C. Related Matters

The parties indicate that the '289 patent is the subject of the following district court proceeding:

> *Advanced Cluster Systems, Inc. v. NVIDIA Corp.*, No. 19-cv-02032 (D. Del. filed Oct. 28, 2019).

Pet. 3; Paper 3, 1. Patent Owner further notes various patents and patent applications in the priority chain of the '289 patent and petitions for *inter partes* review concerning three of the identified patents. Paper 3, 1; Paper 4, 1.

D. The Challenged Patent

The '289 patent is titled "Cluster Computing Support for Application Programs" and discloses "systems and methods for adding cluster computing functionality to a computer program." Ex. 1001, code (54), 1:17–20. The '289 patent recognizes that computer clusters "include a group of two or

more computers, microprocessors, and/or processor cores ('nodes') that intercommunicate so that the nodes can accomplish a task as though they were a single computer." *Id.* at 1:22–25. Grid computing is one manner in which nodes can cooperatively act together. *Id.* at 1:49–51. One form of grid computing, known as "distributed computing," involves a master node that manages a plurality of slave nodes or computational nodes, which work independently and receive commands and data only from the master node. *Id.* at 1:53–67. However, the nodes "generally do not communicate with one another as peers." *Id.* at 1:52–53.

The '289 patent purports to improve upon grid computing by "adding cluster computing functionality to a computer application." Ex. 1001, 2:8–10. Figure 1 shows a block diagram of a computer cluster system and is reproduced below:

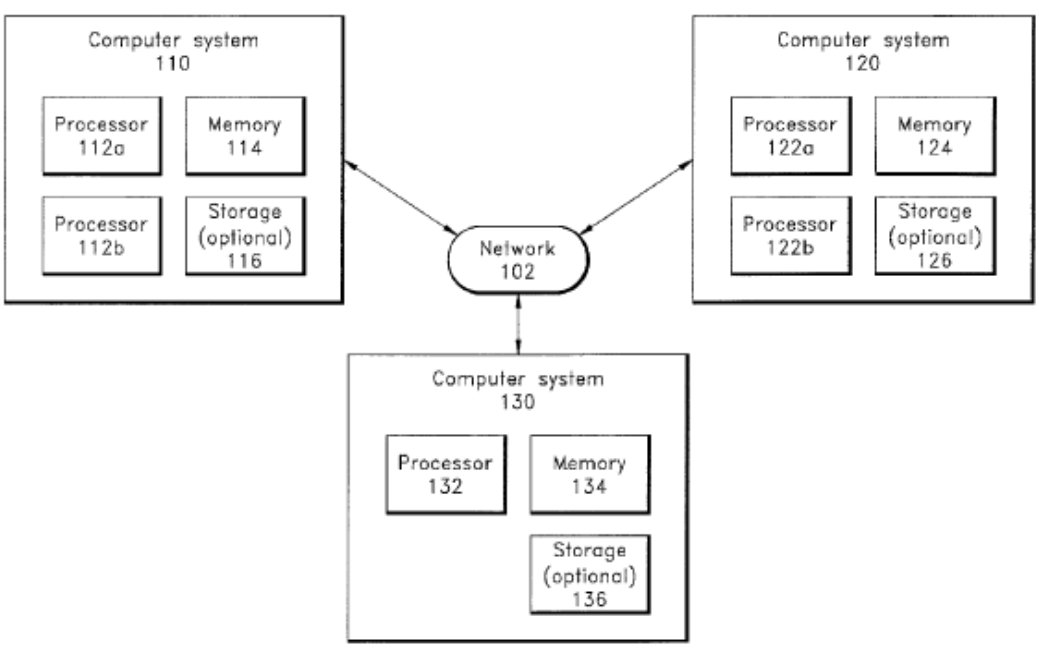


*FIG. 1*

Figure 1 is a block diagram of a computer cluster wherein computer systems 110, 120, 130 communicate with one another via communications network 102. *Id.* at 4:59–62. Each computer system includes at least one processor 112a, 112b, 122a, 122b, 132, memory 114, 124, 134, and, optionally, storage 116, 126, 136. *Id.* at 4:63–5:2. Each processor includes an independent processing core, or "node," that is capable of single-threaded execution. *Id.* at 4:39–44, 5:2–7.

Figure 2 shows a block diagram of the computer cluster's software modules and is reproduced below:

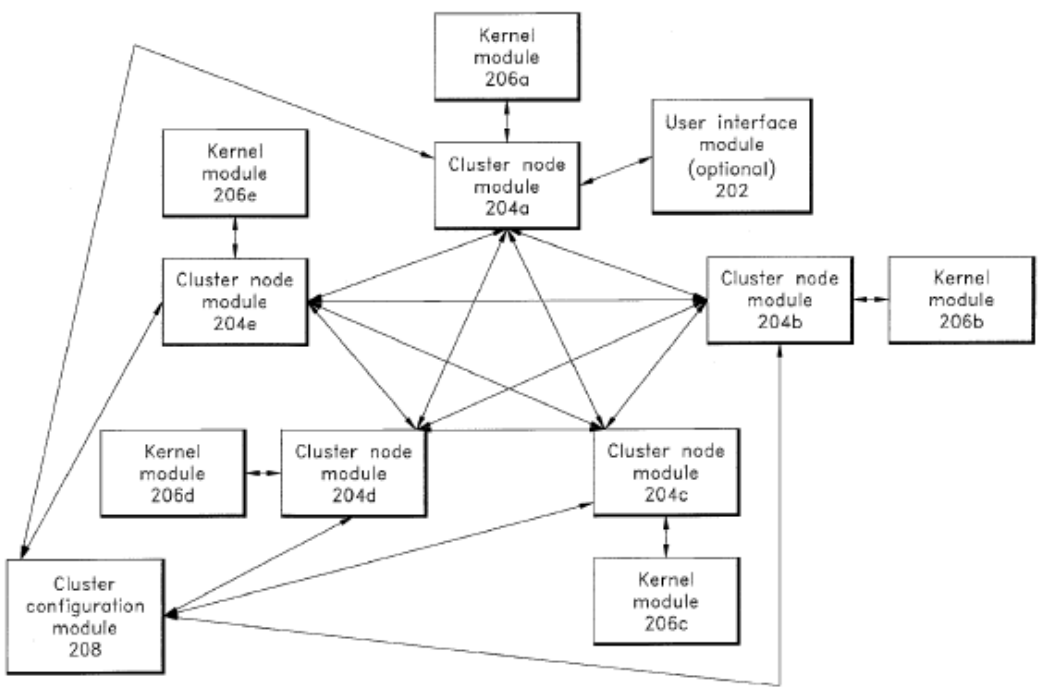


*FIG. 2*

Figure 2 is a block diagram showing the relationships among software modules running on one embodiment of computer cluster 100. Ex. 1001, 5:12–14. Software modules, or "kernels," run on the nodes within the interconnected computer systems. *Id.* at 4:52–54, 23:1–17. A kernel

"executes instructions provided to the program by a user, a script, or another source" and "can manage at least some hardware resources of a computer system and/or can manage communications between those resources and software." *Id.* at 1:33–41. The kernel modules are designed for single-threaded execution. *Id.* at 5:14–15. Software code designed for single-threaded execution can generally run on one node at a time. *Id.* at 5:7–9.

Each node includes a cluster node module in communication with a single kernel module. Ex. 1001, 5:29–31. Cluster node modules are software modules that include at least a portion of the message-passing interface (MPI) application programming interface (API) to interact with an application, such as Mathematica. *Id.* at 11:29–45. In addition to communicating with its respective kernel module in the embodiment of Figure 2, each cluster node module is also in communication with each of the other cluster node modules. *Id.* at 5:37–40. One of the cluster node modules (module 204a) is in communication with user interface module 202. *Id.* at 11:2–5. That cluster node module receives commands from the user interface and submits the commands to all of the other cluster node modules. *Id.* at 24:38–44. Each cluster node module communicates the command to its respective kernel module. *Id.* at 24:54–60. Each kernel module processes the command and returns a result to its respective cluster node module. *Id.* at 24:61–65. The cluster node module can report the result to the other cluster node modules. *Id.* at 24:65–25:1. This peer-to-peer behavior of the cluster node modules allows code running within multiple, simultaneously running kernel modules to interact on a collective basis, performing calculations, processing, or other work on a larger scale and faster than one kernel acting alone. *Id.* at 25:21–28.

E. The Challenged Claims

Petitioner challenges claims 1, 4–6, 8, 10, 11, 13, 14, 16–19, 21–23, 27, and 29–32 of the '289 patent. Pet. 1. Claims 1, 17, and 29 are independent. Claim 1 is illustrative of the challenged claims and is reproduced below:

1. A computer cluster comprising:
a first processor;
a second processor;
a third processor;
at least one computer-readable medium in communication at least one of the first processor, the second processor, or the third processor;
a first kernel residing in the at least one computer-readable medium, said first kernel configured to translate commands into code for execution on the first processor;
a first cluster node module residing in the at least one computer-readable medium, said first cluster node module configured to send commands to the first kernel and receives commands from a user interface;
a second kernel residing in the at least one computer-readable medium, said second kernel configured to translate commands into code for execution on the second processor;
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;
a third kernel residing in the at least one computer-readable medium, said third kernel configured to translate commands into code for execution on the third processor; and
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;

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, 28:61–29:28.

F. Asserted Grounds of Unpatentability

The Petition relies on the following references in challenging the claims of the '289 patent:

Schreiner1: Wolfgang Schreiner et al., *Distributed Maple: Parallel Computer Algebra in Networked Environments*, 35 Journal of Symbolic Computation 305 (2003), filed as Exhibit 1008;

Schreiner2: Wolfgang Schreiner, *Distributed Maple – User and Reference Manual (V 1.1.12)* (2001), filed as Exhibit 1009;

Schreiner3: Károly Bósa and Wolfgang Schreiner, *Taks Logging, Rescheduling and Peer Checking in Distributed Maple* (2002), filed as Exhibit 1010;

Maple Guide: K. M. Heal et al., *Maple V Learning Guide* (J. S. Devitt ed., 1998), filed as Exhibit 1011;

Dist.Maple5: "Source code for parallel versions of Maple functions in Distributed Maple from the 'distsoft' directory" (Pet. xii), filed as Exhibit 1012;

CASA Function Source Code: "Source code for parallel versions of Maple functions in Distributed Maple from the 'distsoft' directory" (Pet. xii), filed as Exhibit 1013;

Maple Function Source Code: "Source code for parallel versions of CASA functions in Distributed Maple from the 'distsoft' directory" (Pet. xii), filed as Exhibit 1014;

Install1 File: "'Install' file for Distributed Maple" (Pet. xii), filed as Exhibit 1015;

ReadMe1 File: "'ReadMe' file for Distributed Maple" (Pet. xii), filed as Exhibit 1016;

Install2 File: "'Install' file for source code in 'distsoft' directory" (Pet. xii), filed as Exhibit 1017;

ReadMe2 File: "'ReadMe' file for source code in 'distsoft' directory" (Pet. xii), filed as Exhibit 1018;

Howard: US 2003/0195938 A1, published Oct. 16, 2003, filed as Exhibit 1019; and

Maple Reference: Michael Kofler, *Maple An Introduction and Reference* (1997), filed as Exhibit 1031.

Petitioner refers to Exhibits 1008–1010 and 1012–1018 collectively as "Distributed Maple Publications." Pet. 7–8. Petitioner refers to Exhibits 1012–1018 collectively as "Distributed Maple Code." *Id.* at 8.

Petitioner asserts the following grounds of unpatentability:

| Claim(s) Challenged | 35 U.S.C. § | References |
|---|---|---|
| 1, 4–6, 8, 10, 11, 13, 16–19, 21–23, 27, 29–32 | 103(a)[2] | Schreiner1, Schreiner2, Schreiner3, Maple Guide, Distributed Maple Code |
| 14 | 103(a) | Schreiner1, Schreiner2, Schreiner3, Maple Guide, Distributed Maple Code, Maple Reference, Howard |

Pet. 10. Petitioner submits declarations of Henry Tufo, Ph.D. (Ex. 1005, "Tufo Declaration") and Wolfgang Schreiner, Ph.D. (Ex. 1006, "Schreiner Declaration") in support of its contentions. Patent Owner submits declarations of Jaswinder Pal Singh, Ph.D. (Ex. 2001), Dean Dauger, Ph.D.

[2] The application resulting in the '289 patent was filed prior to the date when the Leahy-Smith America Invents Act ("AIA"), Pub. L. No. 112–29, 125 Stat. 284 (2011), took effect. Thus, we refer to the pre-AIA version of sections 103 and 112 herein.

(Ex. 2006, "Dauger Declaration"), Vineer Bhansali, Ph.D. (Ex. 2007), and John Bancroft (Ex. 2008) in support of its preliminary responses.

## II. ANALYSIS

### A. Principles of Law

Petitioner bears the burden of persuasion to prove unpatentability, by a preponderance of the evidence, of the claims challenged in the Petition. 35 U.S.C. § 316(e). This burden never shifts to Patent Owner. *Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015). The Board may authorize an *inter partes* review if we determine that the information presented in the Petition and Patent Owner's Preliminary Response shows that there is a reasonable likelihood that Petitioner would prevail with respect to at least one of the claims challenged in the Petition. 35 U.S.C. § 314(a).

A patent claim is unpatentable under 35 U.S.C. § 103(a) 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 the 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, any objective evidence of nonobviousness. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

B. Level of Ordinary Skill in the Art

The level of ordinary skill in the art is "a prism or lens" through which we view the prior art and the claimed invention. *Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001). The person of ordinary skill in the art is a hypothetical person presumed to have known the relevant art at the time of the invention. *In re GPAC Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995). In determining the level of ordinary skill in the art, we may consider certain factors, including the "type of problems encountered in the art; prior art solutions to those problems; rapidity with which innovations are made; sophistication of the technology; and educational level of active workers in the field." *Id.* (internal quotation marks and citation omitted).

Dr. Tufo testifies that a person having ordinary skill in the art at the time of the invention ("POSITA") would have had "a Bachelor's degree in computer science, electrical engineering, or an equivalent field, and two years of academic or industry experience in parallel and distributed computing." Ex. 1005 ¶ 40; *see* Pet. 13 (citing Ex. 1005 ¶¶ 38–41).

Patent Owner does not proffer a definition for the level of ordinary skill in the art or refute that proposed by Petitioner. *See generally* Prelim. Resp.

For purposes of this Decision on Institution, we adopt Petitioner's proposed level of ordinary skill in the art, which comports with the teachings of the '289 patent and the asserted prior art.

C. Claim Construction

In an *inter partes* review, claims are construed using the same claim construction standard that would be used to construe the claims in a civil

action under 35 U.S.C. § 282(b), including construing the claims in accordance with the ordinary and customary meaning of such claims as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent. 37 C.F.R. § 42.100(b) (2020). Thus, we apply the claim construction standard as set forth in *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc). In addition to the specification and prosecution history, we also consider use of the terms in other claims and extrinsic evidence including expert and inventor testimony, dictionaries, and learned treatises, although extrinsic evidence is less significant than the intrinsic record. *Phillips*, 415 F.3d at 1312–17. Usually, the specification is dispositive, and it is the single best guide to the meaning of a disputed term. *Id.* at 1315.

The specification may reveal a special definition given to a claim term by the patentee, or the specification may reveal an intentional disclaimer or disavowal of claim scope by the inventor. *Phillips*, 415 F.3d at 1316. If an inventor acts as his or her own lexicographer, the definition must be set forth in the specification with reasonable clarity, deliberateness, and precision. *Renishaw PLC v. Marposs Societa' per Azioni*, 158 F.3d 1243, 1249 (Fed. Cir. 1998).

Disavowal of a claim term "can be effectuated by language in the specification or the prosecution history." *Poly-America, L.P. v. API Indus., Inc.*, 839 F.3d 1131, 1136 (Fed. Cir. 2016). "In either case, the standard for disavowal is exacting, requiring clear and unequivocal evidence that the claimed invention includes or does not include a particular feature." *Id.* (citing *Openwave Sys., Inc. v. Apple Inc.*, 808 F.3d 509, 513–14 (Fed. Cir. 2015); *Omega Eng'g, Inc. v. Raytek Corp.*, 334 F.3d 1314, 1323–26 (Fed.

Cir. 2003)). "Ambiguous language cannot support disavowal." *Id.* (citing *Omega*, 334 F.3d at 1324).

Although disavowal must be clear and unequivocal, it need not be explicit. *Trs. of Columbia Univ. v. Symantec Corp*., 811 F.3d 1359, 1363−64 (Fed. Cir. 2016). For example, an inventor may disavow claim scope lacking a particular feature when the specification describes "the present invention" as having that feature. *See, e.g.*, *Luminara Worldwide, LLC v. Liown Elecs. Co.*, 814 F.3d 1343, 1353 (Fed. Cir. 2016). Similarly, an inventor may disavow claim scope lacking a particular feature when the specification distinguishes or disparages prior art based on the absence of that feature. *See Openwave*, 808 F.3d at 513−14; *SightSound Techs., LLC v. Apple Inc.*, 809 F.3d 1307, 1317 (Fed. Cir. 2015).

Only those terms that are in controversy need be construed, and only to the extent necessary to resolve the controversy. *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (citing *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc*., 200 F.3d 795, 803 (Fed. Cir. 1999)).

Petitioner argues that "no express construction of any term is needed to resolve the challenges" in the Petition. Pet. 13.

Patent Owner presents two separate requirements and constructions for the "cluster node module" as recited in each of the challenged claims. First, Patent Owner argues that "[e]very challenged claim of the '289 patent includes one or more limitations related to the relative order in which commands or instructions are processed by the user interface, cluster node modules, and kernels." Prelim. Resp. 9. Patent Owner argues that "first cluster node module configured to send commands to the first kernel and

receives commands from a user interface" as recited in claim 1 should be interpreted

> as establishing the following relative order in which commands are processed by the user interface, first cluster node module, and first kernel: (1) first, commands start at the user interface, (2) second, commands are "receive[d] from" the user interface by the first cluster node module, and, (3) third, commands are "sen[t] . . . to" the first kernel by the first cluster node module.

*Id.* at 12 (alterations in original). According to Patent Owner, "[t]his excludes the first kernel receiving commands from the user interface and forwarding commands to the first cluster node module." *Id.* (citing Ex. 2001 ¶ 45). Patent Owner argues that similar recitations in independent claims 17 and 29 should be interpreted in the same manner. *Id.* at 17, 20–21 (citing Ex. 2001 ¶¶ 52, 56).

Second, Patent Owner contends,

> the Board should construe "cluster node module" to mean "a module that cooperates with other cluster node modules to establish intercommunication among nodes in a computer cluster and to exchange messages such that 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*."

Prelim. Resp. 22 (emphasis added) (quoting Ex. 2001 ¶ 58).

Regarding the first requirement, Patent Owner argues claim 1 "excludes the first kernel receiving commands from the user interface and forwarding commands to the first cluster node module." Prelim. Resp. 12 (citing Ex. 2001 ¶ 45). Patent Owner sets forth its argument in the following diagram:

| | |
|---|---|
| **Correct order:** | User Interface → Cluster Node Module → Kernel |
| **Incorrect order:** | User Interface → Kernel → Cluster Node Module |

The diagram above represents Patent Owner's claim construction, wherein construing claim 1 to allow a kernel to pass an instruction from a user interface to a cluster node module is labeled "incorrect." *See id.* at 1–2 (citing Ex. 2001 ¶ 37).

Contrary to Patent Owner's arguments, the plain language of claim 1 does not exclude instructions passing through an intervening kernel and does not require any of the negative limitations argued. Rather, claim 1 recites "said first cluster node module configured to send commands to the first kernel and receives commands from a user interface." Ex. 1001, 29:5–7. This language requires "said first cluster node module . . . to send commands to the first kernel" without specifying the first kernel's position relative to a user interface and cluster node module, and also without specifying anything about a central server or master mode. The language also requires "said first cluster node module . . . to . . . receive[] commands from a user interface," which does not prevent the instructions from passing through a kernel, central server, or master node situated between the user interface and the first cluster node module.

Contrary to Patent Owner's other arguments, the specification of the '289 patent does not limit the claims in the manner argued. *See* Prelim. Resp. 10–12 (citing Ex. 1001, 22:60–62, Fig. 2). Patent Owner relies on Figure 2 and other selected passages to incorporate limitations into claim 1 (*see id.*), but the specification specifically states that "[t]he drawings and the associated descriptions are provided to illustrate embodiments and *not to*

*limit the scope of the disclosure*." Ex. 1001, 3:61–63 (emphasis added). In addition, "[w]hile we read claims in view of the specification, of which they are a part, we do not read limitations from the embodiments in the specification into the claims." *Hill-Rom Servs., Inc. v. Stryker Corp.*, 755 F.3d 1367, 1371 (Fed. Cir. 2014) (citing *Liebel–Flarsheim Co. v. Medrad, Inc.*, 358 F.3d 898, 904 (Fed. Cir. 2004)).

Similarly, the specification describes several embodiments under a "SUMMARY" of the invention section in general terms "[w]ithout limiting the scope of the invention." *See* Ex. 1001, 2:5–7. One passage mimics the broad language of claim 1, which plainly does not provide the negative limitations argued by Patent Owner: "The first cluster node module is configured to send commands to the first kernel and receives commands from a user interface." *Id.* at 2:41–43. This generic passage allows the first cluster node module to "receive[] commands from a user interface" without requiring it to accept them *directly* from the user interface. The passage says nothing about precluding passage of a message through a master node, central server, or kernel.

Patent Owner also relies on Figure 2 as "show[ing] that the user interface module 202 is connected to the cluster node module 204a ***only*** and the kernel module 206a is connected to the cluster node module 204a ***only***." Prelim. Resp. 11. Patent Owner similarly contends that "[t]here is no connection between the user interface module 202 and the kernel module 206a or any of the other kernel modules." *Id.*

The specification contradicts Patent Owner on this preliminary record. For example, it states: "A kernel module 206 typically includes program code for interpreting high-level code, commands, and/or instructions

*supplied by a user* or a script into low-level code, such as, for example, machine language or assembly language." Ex. 1001, 23:2–5 (emphasis added). In other words, contrary to Patent Owner's arguments, on this preliminary record, the specification supports connecting a user interface directly to any kernel.

In line with the above teachings, the specification describes user interface module 202 communicating with kernel module 202 for "some embodiments" as follows:

> In *some embodiments*, computer cluster 100 includes a user interface module 202, such as, for example a Mathematica Front End or a command line interface, *that includes program code for a kernel module 206 to provide graphical output, accept graphical input, and provide other methods of user communication that a graphical user interface or a command-line interface provides. To support a user interface module 202, the behavior of a cluster node module 204a is altered in some embodiments*. Rather than sending output to and accepting input from the user directly, the user interface module 202 activates the cluster node module 204a to which it is connected and specifies parameters to form a connection, such as a MathLink connection, between the cluster node module 204a and the user interface module 202. The user interface module's activation of the cluster node module 204a can initiate the execution of instructions to activate the remaining cluster node modules 204b-e on the cluster and to complete the sequence to start all kernel modules 206a-e on the cluster. *Packets from the user interface module 202, normally intended for a kernel module 206a, are accepted by the cluster node module 204a as a user command*. Output from the kernel module 206a associated with the cluster node module 204a can be forwarded back to the user interface module 202 for display to a user. Any of the cluster node modules 204a-e can be configured to communicate with a user interface module 202.

Ex. 1001, 22:42–67 (emphases added).

Patent Owner argues that portions of this passage support its construction. Prelim. Resp. 10 (citing Ex. 1001, 22:60–62). However, in context, the passage, read in its entirety, does not support Patent Owner's limited claim construction on this preliminary record. Rather, the first emphasized portion as quoted above explicitly describes communication between user interface module 202 and kernel module 206. It also describes "alter[ing]" "the *behavior* of . . . cluster node module 204a . . . *in some embodiments*" so that the cluster node module "can initiate the execution of instructions to activate the remaining cluster node modules 204b–e on the cluster and to complete the sequence to start all kernel modules 206a–e on the cluster" (emphases added). To the extent this alteration of "behavior" somehow limits normal behavior, it only occurs for "some embodiments"—i.e., a subset of "some embodiments" introduced at the beginning of the passage.

The passage verifies that packets *normally* pass from user interface module 202 to kernel module 206a. *See* Ex. 1001, 22:42–67. Therefore, it is only in a subset of the embodiments that packet messages pass from user interface module 202 first, then through cluster node module 204, and finally to kernel module 206a. *See id.* Accordingly, nothing in the passage limits the claims to a direct connection between a user interface and a cluster node module by precluding an intervening kernel, master node, or server. And Patent Owner's claim construction attempts to allow some forms of indirect communication between cluster nodes, by only attempting to preclude an intervening "*central* server" or "*master* node," leaving the claim construction open to interpretation without requisite support from the specification. Similarly, Patent Owner explicitly states that its claim

construction does not require a direct connection between a user interface and a cluster node module because it allows for intervening "devices" or "components." *See* Prelim. Resp. 21 n.4 ("To be clear, this construction does ***not*** require a command to be transmitted directly from the user interface to a cluster node module without passing through other devices, such as routers, switches, or other components.").

In addition, cluster node module 204a acts as a "master node" or "central server" when it is connected to the user interface module, because messages from other kernels (nodes) must pass through cluster node module 204a on their way to the kernel associated with cluster node module 204a and/or to the user interface node.[3] *See, e.g.*, Ex. 1001, Fig. 2, 6:15–19 ("Results of evaluations performed by kernel modules 206a-e are communicated back to the first cluster node module 204a via the cluster node modules 204a-e, which communicates them to the user interface module 208."), 11:29–32 ("In one embodiment, the cluster node modules 204a-e provide a way for many kernel modules 206a-e such as, for example, Mathematica kernels, running on a computer cluster 100 to communicate with one another."), 24:15–17 ("The cluster node module creates an illusion that a kernel module is communicating directly with the other kernel modules."). Cluster node module 204a also acts as a "central server" because it instigates connections to the remaining cluster node modules, according to the column 22 passage discussed and reproduced

[3] According to the specification, "[t]he term 'node' refers to a processing unit or subunit that is capable of single-threaded execution of code." Ex. 1001, 4:42–44. The specification also describes "computers, microprocessors, and/or processor cores ('nodes')." *Id.* at 1:22–25.

above. It also controls the other cluster node modules in a "procedure to shut down the system." *See id.* at 25:34–50.

The specification also indicates that a load balancing embodiment includes a "root processor" that assigns tasks to each of the cluster nodes. *See* Ex. 1001, 21:20–30. On this preliminary record, this further shows that the claims do not require a cluster node module "to exchange messages such that 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*" as asserted by Patent Owner.

The prosecution history also does not support the negative limitations argued by Patent Owner. The Examiner of the application resulting in the '289 patent issued a single Office Action provisionally rejecting the claims under statutory and non-statutory double patenting. Ex. 1002, 105–06. The Applicant responded by requesting the provisional rejections be withdrawn (*id.* at 118–27), and the Examiner responded by issuing a Notice of Allowance (*id.* at 155–59). Notably, the Applicant expressly stated that no disavowals were made:

> Applicants reserve the right to pursue at a later date any previously pending or other broader or narrower claims that capture any subject matter supported by the present disclosure, including subject matter found to be specifically disclaimed herein or by any prior prosecution. *Accordingly, reviewers of this or any parent, child or related prosecution history shall not reasonably infer that Applicants have made any disclaimers or disavowals of any subject matter supported by the present application.*

*Id.* at 126 (emphasis added).

Based on the foregoing discussion, requisite disclaimer, disavowal, or lexicography does not appear to exist on this preliminary record to import

Patent Owner's proposed negative limitations into the plain language of the challenged claims. *See Omega Eng'g*, 334 F.3d at 1323–26. On this limited record, based on the arguments presented, the parties appear to agree that relatively generic structural implementations of the "kernel module" and "cluster node module" implement the functions recited in the challenged claims without any specific algorithmic structure that the specification may or may not disclose limiting the generic structure.[4]

No other terms require an express construction. Only those terms that are in controversy need be construed, and only to the extent necessary to resolve the controversy. *Nidec*, 868 F.3d at 1017.

D. Overview of the Asserted Prior Art

*1. Schreiner1 – Ex. 1008*

Schreiner1 is titled "Distributed Maple: parallel computer algebra in networked environments" and bears a copyright date of 2003. Ex. 1008, 3. Schreiner1 is a journal article authored by Dr. Schreiner, Christian

[4] The term "'module' is a well-known nonce word that can operate as a substitute for 'means' in the context of § 112, para. 6." *Williamson v. Citrix Online, LLC*, 792 F.3d 1339, 1349–50 (Fed. Cir. 2015) (en banc) ("[U]se of the word 'means' creates a presumption that [35 U.S.C.] § 112, ¶ 6 applies."; "'Module' is a well-known nonce word that can operate as a substitute for 'means' in the context of § 112, para. 6."); *see also* 35 U.S.C. § 112, ¶ 6 ("An element in a claim for a combination may be expressed as a means . . . for performing a specified function without the recital of structure, material, or acts in support thereof, and such claim shall be construed to cover the corresponding structure, material, or acts described in the specification and equivalents thereof."). Nevertheless, at this stage of the proceeding, neither party argues that that the nonce word "module" and any surrounding language falls under § 112, ¶ 6. Accordingly, we do not reach this issue for institution purposes.

Mittermaier, and Karoly Bosa. *Id.* Schreiner1 "gives a comprehensive overview on the design and the use of 'Distributed Maple', an environment for parallel computer algebra on multiprocessors and heterogeneous computer clusters." *Id.* Schreiner1 explains that Distributed Maple was developed on the basis of the computer algebra system Maple (*id.*) and that Distributed Maple is built on top of the Maple kernel and does not require any kernel extensions (*id.* at 4). According to Schreiner1, Distributed Maple is "so portable that applications can be executed in many different environments" and "so general that it can be applied to schedule tasks of other computer algebra systems (e.g., Mathematica)." *Id.* Schreiner1 describes Distributed Maple as providing "a programming model which is based on functional/logic/dataflow parallelism" that "allows the creation of a large number of implicitly scheduled tasks with automatic resolution of data dependencies and of globally shared data structures with implicit synchronization." *Id.* The authors describe using Distributed Maple "to develop the first parallel versions for a number of non-trivial applications from algebraic geometry (parallel curve and surface plotting and parallel neighbourhood analysis)." *Id.* at 5. Schreiner1 discloses that "[t]he user interacts with Distributed Maple via a conventional Maple frontend (text or graphical)." *Id.* at 7. Schreiner1 explains that "[t]he core of Distributed Maple is a scheduler program which is completely independent and even *unaware* of Maple" and Distributed Maple "can in fact embed and schedule tasks from any kind of computation kernels that implement a specific communication protocol." *Id.* at 8.

Schreiner1 discloses that a Distributed Maple session comprises two components: a scheduler and a Maple interface. Ex. 1008, 8. Figure 1 of

Schreiner1, reproduced below, depicts a software architecture for a Distributed Maple session:

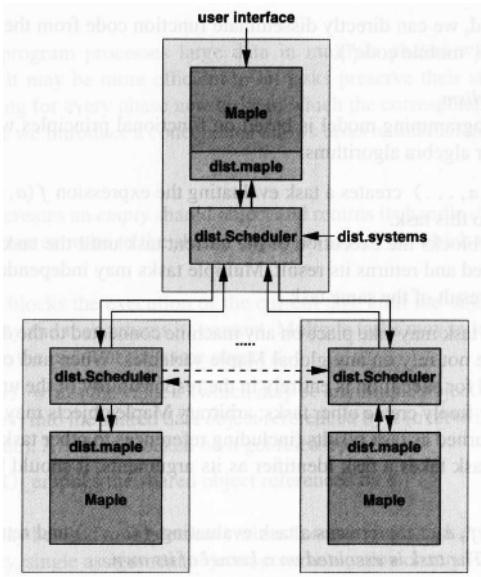

Fig. 1. Software architecture.

Figure 1 of Schreiner1 illustrates a software architecture for a Distributed Maple session. *Id.* at 9. As shown in Figure 1, a Distributed Maple session "comprises a set of *nodes* each of which holds a pair of processes: a *kernel* and a *scheduler*." *Id.* at 17. "Initially, a single task runs on the *root* kernel; this task may subsequently create new tasks which are distributed via the schedulers to other kernels and may in turn create new tasks." *Id.* With reference to Figure 1, Schreiner1 explains that "every scheduler instance accepts tasks from the attached computation kernel and schedules these tasks among all machines connected to the session." *Id.* at 9. Schreiner1 further explains that "[t]he Maple kernel is a single-threaded process which communicates by a simple communication protocol with the schedule on the same node" and "[a]ll capabilities for parallel and distributed program execution are embedded in this scheduler." *Id.* at 12.

*2. Schreiner2 – Ex. 1009*

Schreiner2 is titled "Distributed Maple – User and Reference Manual (V 1.1.12)," bears a publication date of July 6, 2001, and is authored by Dr. Schreiner. Ex. 1009, 1. Like Schreiner1, Schreiner2 describes the Distributed Maple system. More particularly, Schreiner2 "describes the use of a system for writing distributed Maple applications and sketches its implementation." *Id.* at 4.

*3. Schreiner3 – Ex. 1010*

Schreiner3 is titled "Task Logging, Rescheduling and Peer Checking in Distributed Maple," bears a publication date of March 18, 2002, and is authored by Dr. Schreiner and Karoly Bosa. Ex. 1010, 1. Schreiner3 describes extending the Distributed Maple system by adding "fault tolerance mechanisms such that the time spent in a long running computation is not . . . wasted by the eventual occurrence of session failure." *Id.* Schreiner3 describes a first fault tolerance mechanism as "the logging of task return values and of shared object values such that after a failure the newly started session can (transparently to the application program) reuse already computed result[s]." *Id.* A second fault tolerance mechanism is described as "the migration of tasks such that a session may tolerate the failure of individual nodes without overall failures." *Id.* A third fault tolerance mechanism is described as "the redirection of the messages such that a session may tolerate also the failure of the connections between nodes without overall failure." *Id.*

Figure 1 of Schreiner3 illustrates an Execution Model of the Distributed Maple system and is reproduced below:

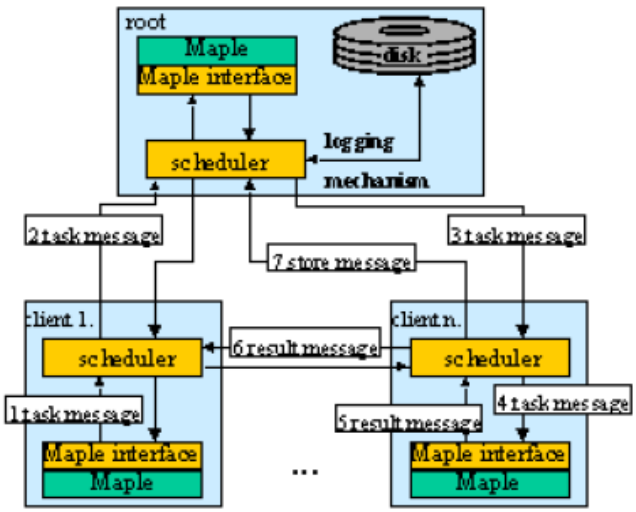


Figure 1: Execution Model

Figure 1 of Schreiner3 illustrates an Execution Model of the Distributed Maple system. Ex. 1010, 5. Figure 1 depicts the passing of messages between nodes in a Distributed Maple system, and a logging mechanism in the root node. *Id.* Schreiner3 explains that "[t]he logging mechanism in Distributed Maple is a fault tolerance mechanism for saving the results of intermediate tasks and the values of shared objects during the computation" and allows the system "to restore the results of computed tasks in a later session, if the current session crashes." *Id.* at 3.

*4. Maple Guide – Ex. 1011*

Maple Guide is titled "Maple V Learning Guide, Release 5" published by Waterloo Maple, Inc., and bears a copyright date of 1998. Ex. 1011, 5. Maple Guide explains that "Maple V is a *Symbolic Computation System* or *Computer Algebra System*" and that "[b]oth phrases refer to Maple V's ability to manipulate information in a symbolic or algebraic manner." *Id.* at 11.

*5. Distributed Maple Code – Exs. 1012–1018*

Distributed Maple Code is a collection of source code for difference components of the Distributed Maple system, the files including: the dist.maple5 file (Ex. 1012); source code for parallel versions of Maple functions in the distsoft directory (Ex. 1013);source code for parallel versions of CASA functions in the distsoft directory (Ex. 1014); an "install" file for Distributed Maple (Ex. 1015); a "readme" file for Distributed Maple (Ex. 1016); an "install" file for the source code in the distsoft directory (Ex. 1017); and a "readme" file for the source code in the distsoft directory (Ex. 1018).

*6. Maple Reference – Ex. 1031*

Maple Reference is titled "Maple: An Introduction and Reference" and bears a copyright date of 1997. Ex. 1031, 1, 6. Maple Reference is a book that provides an introduction to Maple, and describes the main commands for standard use of Maple and various special commands. *Id.* at 19.

*7. Howard – Ex. 1019*

Howard is titled "Parallel Processing Systems and Method" and discloses "[m]ethods and systems parallel computation of an algorithm using a plurality of nodes configured as a Howard Cascade." Ex. 1019, codes (54), (57). "A home node of a Howard Cascade receives a request from a host system to compute an algorithm identified in the request." *Id.* at code (57). The request is distributed to processing nodes of the Howard Cascade and then participating nodes perform the designated portion of the algorithm in parallel. *Id.* Partial results from each node are agglomerated

upstream to higher nodes of the structure and then returned to the host system. *Id.*

E. Asserted Obviousness Based on Schreiner1, Schreiner2, Schreiner3, Maple Guide, and Distributed Maple Code

Petitioner argues that claims 1, 4–6, 8, 10, 11, 13, 16–19, 21–23, 27, and 29–32 would have been obvious over the combination of Schreiner1, Schreiner2, Schreiner3, Maple Guide, and Distributed Maple Code. Pet. 14–77. In support of its showing, Petitioner relies upon the Tufo and Schreiner Declarations. *Id.* (citing Ex. 1005; Ex. 1006). We have reviewed Petitioner's assertions and supporting evidence. For the reasons discussed below, and based on the record before us, we determine that Petitioner demonstrates a reasonable likelihood of prevailing in showing that these claims would have been obvious over the combination of Schreiner1, Schreiner2, Schreiner3, Maple Guide, and Distributed Maple Code.

*1. Claim 1*

a. Analysis of Petitioner's Showing and Patent Owner's Responses

Petitioner relies on the combined teachings of Schreiner1, Schreiner2, Schreiner3, Maple Guide, and Distributed Maple Code, as supported by the testimony of Dr. Tufo, to allege obviousness of claim 1. Pet. 14–46. As motivation to combine the "Distributed Maple Publications" references, Petitioner contends that they share the same author, Dr. Schreiner, and all relate to the same software project, called "Distributed Maple." *Id.* at 14–15. Petitioner essentially contends that a person of ordinary skill would have consulted the references to learn details about the system,

including fault tolerances and capabilities, in order to combine desired features for running the software modules and system. *See id.* at 15.

Regarding the Maple Guide (not authored by Dr. Schreiner), Petitioner asserts that "Schreiner1 teaches that Distributed Maple includes Maple software modules and refers readers to www.maplesoft.com, a website operated by Waterloo Maple, the company that authored and sold the Maple software, for further details." Pet. 15–16 (citing Ex. 1008, 44;[5] Ex. 1006 ¶ 49).[6] Petitioner explains that

> Waterloo Maple published the Maple Guide, and a POSITA would have been motivated to read the Maple Guide to learn more about Maple. The teaching in the Distributed Maple Publications that Distributed Maple utilized Maple, including its kernel and libraries, provides a POSITA with a strong, express motivation to combine the features described in the Distributed Maple Publications with the features of Maple, as described in the Maple Guide.

*Id.* at 16 (citing Ex. 1005 ¶¶ 46–47).

Petitioner also contends that "the [Distributed Maple Publications] references . . . were publicly available on the same webpage – http://www.risc.uni-linz.ac.at/software/distmaple – which was cited by Schreiner1 and date-stamped and archived by the Internet Archive, and are submitted as Exhibits 1024 and 1025." Pet. 15 (citing Ex. 1008, 5–6; Ex. 1009, Abstract, 4; Ex. 1005 ¶ 46; Ex. 1006 ¶¶ 24–25; Ex. 1024;

[5] Although Petitioner's citations refer to the journal pagination, we convert the citations to the Exhibit pagination herein.

[6] Describing Distributed Maple as using "a conventional Maple frontend," Schreiner1 states that "Maple is a registered of Waterloo Maple Inc." Ex. 1008, 7. Schreiner1 also cites http://www.maplesoft.com under a listing of reference sources, listing "Maple, W., Maple 6, 2001" as one such reference source. *Id.* at 44.

Ex. 1025). Schreiner1 states that "[b]oth the Distributed Maple system itself and the library of parallel versions of . . . Maple algorithms are in stable versions freely available under the GNU Library General Public License at http://www.risc.uni-linz.ac.at/software/distmaple." Ex. 1008, 5.

Petitioner maintains that regardless of the above motivation, "Schreiner1 expressly teaches nearly all of the claim limitations by itself, and further motivations to combine for specific features are detailed below in connection with particular claim limitations." Pet. 16 (citing Ex. 1005 ¶ 48).

i. The Preamble

Claim 1 recites "[a] computer cluster." Ex. 1001, 28:61. Petitioner asserts that, "[t]o the extent the preamble is limiting, Schreiner1 discloses it." Pet. 22. Petitioner relies on Schreiner1's abstract to describe a computer cluster. *Id.* (citing Ex. 1008, Abstract). Petitioner also contends that Schreiner1's Figure 1 depicts a cluster and Schreiner1 otherwise describes "parallel operations on clusters." *Id.* (citing Ex. 1008, Fig. 1, 22–42; Ex. 1005 ¶ 61).

Patent Owner does not contest this aspect of the Petition. *See generally* Prelim. Resp.

Schreiner1 explains that it "describe[s] the design and use of Distributed Maple, an environment for executing parallel computer algebra programs on multiprocessors and heterogeneous clusters." Ex. 1008, Abstract. Schreiner1 further discloses using "a 24 processor heterogeneous computer cluster, an 18-processor Sun HPC 6500 system, and a Linux-based Beowulf cluster with 16 compute nodes linked by two 100 Mbit switched

Ethernets" and "a 128 processor SGI Origin 3800 distributed shared memory multiprocessor." *Id.* at 22–23, 25.

Accordingly, for the foregoing reasons and on this preliminary record, to the extent the preamble is limiting, Schreiner1 supports Petitioner's contentions.

ii. The Processor Recitations

Claim 1 recites "a first processor," "a second processor," and "a third processor." Ex. 1001, 28:62–64. Petitioner argues that "Schreiner1 discusses several implementations of its design, including a 128 processor SGI Origin 3800 distributed shared memory multiprocessor cluster, a 24-processor heterogeneous computer cluster, an 18-processor Sun HPC 6500 system, and a Linux-based Beowulf cluster with 16 compute nodes." Pet. 22 (emphasis omitted) (citing Ex. 1008, 22–23, 25). Petitioner argues that each of these examples includes three processors. *Id.* (citing Ex. 1005 ¶ 62).

Patent Owner does not contest this aspect of the Petition. *See generally* Prelim. Resp.

As noted above, Schreiner1 discloses using "a 24 processor heterogeneous computer cluster, an 18-processor Sun HPC 6500 system, and a Linux-based Beowulf cluster with 16 compute nodes linked by two 100 Mbit switched Ethernets" and "a 128 processor SGI Origin 3800 distributed shared memory multiprocessor." Ex. 1008, 22–23, 25. Dr. Tufo states that each of these systems includes three processors. Ex. 1005 ¶ 62.

Accordingly, for the foregoing reasons and on this preliminary record, Schreiner1 supports Petitioner's contentions.

iii. The Computer-Readable Medium Recitation

Claim 1 recites "at least one computer-readable medium in communication at least one of the first processor, the second processor, or the third processor." Ex. 1001, 28:65–67. Petitioner argues that "Maple is installed in storage and loaded in memory when the program is run by one or more processors." Pet. 23 (citing Ex. 1011, 15, 102).[7] Petitioner also contends that "[t]he Maple 'kernel consists of highly optimized C code.'" *Id.* (quoting Ex. 1011, 98). Petitioner also contends that Distributed Maple is a software program loaded into memory for execution by one or more processors. *Id.* (citing Ex. 1008, 3–5, 7–22; Ex. 1015; Ex. 1016; Ex. 1009, 9; Ex. 1005 ¶ 67). Petitioner also points to "shared memory" as disclosed in Schreiner1 as a computer-readable medium for running Maple and holding the Maple kernels and Distributed Maple code. *Id.* at 24 (citing Ex. 1008, 9, 12, 25; Ex. 1009, 9; Ex. 1005 ¶ 67).

Patent Owner does not contest this aspect of the Petition. *See generally* Prelim. Resp.

As noted above, Schreiner1 discloses using "a 24 processor heterogeneous computer cluster, an 18-processor Sun HPC 6500 system, and a Linux-based Beowulf cluster with 16 compute nodes linked by two 100 Mbit switched Ethernets" and "a 128 processor SGI Origin 3800 distributed shared memory multiprocessor." Ex. 1008, 22–23, 25. Dr. Tufo opines that "a POSITA would expect the dist.maple and scheduler libraries, as well as copies of the Maple kernel files, to be located in a globally connected storage medium from which they can be loaded to the cluster nodes."

[7] Although Petitioner's citations refer to the book pagination, we convert the citations to the Exhibit pagination herein.

Ex. 1005 ¶ 68. Schreiner1 supports this assertion, for example by explaining that "[t]he file dist.maple [is] read by every Maple kernel [and] implements the interface between kernel and scheduler." Ex. 1008, 8.

Accordingly, for the foregoing reasons and on this preliminary record, Schreiner1 supports Petitioner's contentions.

iv. The First Kernel Recitation

Claim 1 recites "a first kernel residing in the at least one computer-readable medium, said first kernel configured to translate commands into code for execution on the first processor." Ex. 1001, 29:1–3. To address these limitations, Petitioner annotates Schreiner1's Figure 1 as follows (Pet. 26):

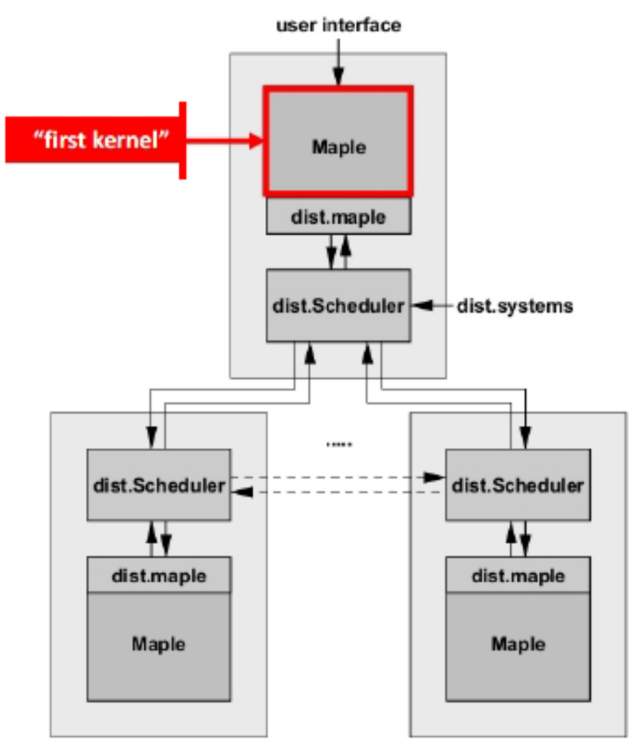


Fig. 1. Software architecture.

Figure 1 of Schreiner1 illustrates a software architecture for a Distributed Maple session. Ex. 1008, 9. Petitioner has modified this figure above to identify the Maple kernel of the upper node as the recited "first kernel." Petitioner argues that Distributed Maple connects external computation kernels on various machines and schedules concurrent tasks for execution thereon. Pet. 25 (citing Ex. 1008, 4). Petitioner argues that "Distributed Maple 'embeds kernels of the computer algebra system Maple as computational engines' and employs 'a comparatively high-level programming model.'" *Id.* at 26–27 (quoting Ex. 1008, Abstract).

To support its showing, Petitioner quotes the Maple Guide:

> The kernel is the base of Maple's system. It contains fundamental and primitive commands: ***the Maple language interpreter (which converts the commands you type into machine instructions your computer processor can understand)***, algorithms for numerical calculation, and routines to display results and perform other input and output operations.... The Maple kernel implements the most frequently used routines for integer and rational arithmetic and simple polynomial calculations.

Pet. 27 (quoting Ex. 1011, 98; citing Ex. 1005 ¶ 73). Petitioner also explains that "Schreiner2 teaches that high-level commands are translated by the kernel into lower-level code for execution by the processors." *Id.* (citing Ex. 1009, 7, 15, 30).

Patent Owner does not contest this aspect of the Petition. *See generally* Prelim. Resp.

Schreiner1 explains that Distributed Maple "embeds kernels of the computer algebra system Maple as computational engines into a networked coordination layer implemented in the programming language Java" and "is built on top of . . . the Maple kernel and does not require any kernel

extensions." Ex. 1008, Abstract, 4. The Maple Guide explains that the Maple kernel "contains fundamental and primitive commands" including "the Maple language interpreter (which converts the commands you type into machine instructions your computer processor can understand)." Ex. 1011, 98.

According, for the foregoing reasons and on this preliminary record, the asserted references support Petitioner's contentions. We further determine that, based on this preliminary record, Petitioner has set forth articulated reasoning with rational underpinning explaining why a person of ordinary skill would have combined the teachings of the asserted references. *See* Pet. 14–16 (contending that a person of ordinary skill would have consulted the references to learn details about the Distributed Maple system, including fault tolerances and capabilities, in order to combine desired features for running the software modules and system).

v. The First Cluster Node Module Recitation

Claim 1 recites "a first cluster node module residing in the at least one computer-readable medium, said first cluster node module configured to send commands to the first kernel and receives commands from a user interface." Ex. 1001, 29:4–7. To address these limitations, Petitioner annotates Schreiner1's Figure 1 as follows (Pet. 29):

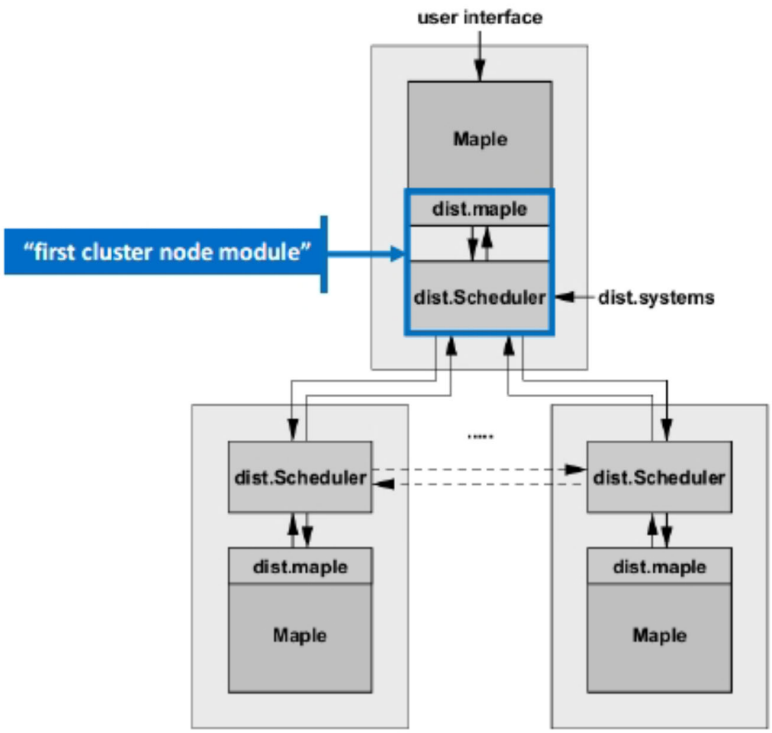


Fig. 1. Software architecture.

Figure 1 of Schreiner1 illustrates a software architecture for a Distributed Maple session. Ex. 1008, 9. Petitioner has modified this figure above to identify the dist.Scheduler Java program and the dist.maple file of the upper node as the recited "first cluster node module." Petitioner argues that "[t]he dist.Scheduler and dist.maple modules work together to provide communication capabilities: dist.Scheduler 'coordinates node interaction,' and dist.maple 'implements the interface between the kernel and the scheduler.'" Pet. 29–30 (quoting Ex. 1008, 8). Petitioner argues that it would have been obvious for these software modules to reside in the same computer-readable medium because they are accessible by the same processors. *Id.* at 31 (citing Ex. 1005 ¶ 83); *see also id.* at 24 (arguing that Schreiner1 describes an example installation having a "shared memory" that

"is a computer-readable medium holding the Maple kernels and Distributed Maple code and in communication with the first, second, and third processors"); Ex. 1005 ¶ 83 ("As software, dist.maple, dist.Scheduler and the other components of the Distributed Maple cluster node module are accessible by the same processors and reside in the same computer-readable medium, such as shared memory or a shared storage disk, as the corresponding Maple kernel."). We find, on this preliminary record, that the cited portions of the asserted references and Dr. Tufo's testimony support Petitioner's assertions that dist.Scheduler and dist.maple reside in the same computer-readable medium as the first Maple kernel.

Regarding the recitation that the first cluster node module be configured to send commands to the first kernel, Petitioner argues that "[t]he dist.Scheduler component provides '[a]ll capabilities for parallel and distributed program execution,' including sending commands to its 'attached computation kernel.'" Pet. 31 (second alteration in original) (citing Ex. 1008, 9, 12). Petitioner argues that "[t]he dist.maple component 'implements the interface between kernel and scheduler,' providing the final link in sending commands to the kernels." *Id.* (quoting Ex. 1008, 8; citing Ex. 1005 ¶ 84). We find, on this preliminary record, that the cited portions of Schreiner1 support Petitioner's assertions that dist.Scheduler is configured to send commands to the first Maple kernel.

Regarding the recitation that the first cluster node module receives commands from a user interface, Petitioner argues that Schreiner1 explains that "[t]he user interacts with Distributed Maple via a conventional Maple frontend (text or graphical), i.e. she operates within the familiar Maple environment for writing and executing parallel programs." Pet. 33 (quoting

Ex. 1008, 7) (citing Ex. 1005 ¶ 89; Ex. 1008, 7–8). We find, on this preliminary record, that the cited portions of Schreiner1 support Petitioner's assertions that dist.Scheduler and dist.maple receive commands from a user interface.

Patent Owner argues that the Petition fails to explain adequately how the asserted references disclose that the first cluster node module receives commands from the user interface. Prelim. Resp. 31–35. Patent Owner argues that claim 1 requires the first cluster node module to receive commands directly from the user interface without the commands first passing through the first kernel. *Id.* at 31–33. Continuing, Patent Owner argues that the Petition fails to explain adequately how the asserted references disclose cluster node modules. *Id.* at 35–37. Patent Owner reiterates its interpretation of "cluster node module" and asserts that, in the architecture disclosed by Schreiner1, messages are exchanged among the schedulers by the schedulers sending the messages to a root node scheduler that distributes the messages among the machines. *Id.* at 35–36. Patent Owner equates Schreiner1's root node scheduler to a master node. *Id.* at 36.

Patent Owner's arguments are premised on its proposed claim construction that effectively requires a direct connection between the user interface and the first cluster node module. As set forth above, the preliminary record does not support Patent Owner's narrow claim construction. *See* § II.C above.

Accordingly, for the foregoing reasons and on this preliminary record, the asserted references and Dr. Tufo's testimony support Petitioner's contentions. We further determine that, based on this preliminary record, Petitioner has set forth articulated reasoning with rational underpinning

explaining why a person of ordinary skill would have combined the teachings of the asserted references. *See* Pet. 14–16.

vi. The Second and Third Kernel Recitations

Claim 1 recites "a second kernel residing in the at least one computer-readable medium, said second kernel configured to translate commands into code for execution on the second processor" and "a third kernel residing in the at least one computer-readable medium, said third kernel configured to translate commands into code for execution on the third processor." Ex. 1001, 29:8–11, 29:17–20. Referring to Schreiner1's Figure 1, Petitioner maps the Maple kernel of the lower left node to the recited "second kernel" and the Maple kernel of the lower right node to the recited "third kernel." Pet. 34–35, 39–40. Petitioner relies on its showing made with respect to the first kernel and argues that the second and third kernels reside on the computer-readable medium and translate commands into code for execution on the second and third processors, respectively. *Id.* at 28, 35, 40.

Patent Owner argues that the Petition fails to explain adequately how the asserted references disclose second and third kernels being configured to translate commands into code. Prelim. Resp. 37–40. Patent Owner argues that the Petition relies solely on the testimony of Petitioner's declarants, with Dr. Tufo's testimony being conclusory and Dr. Schreiner's testimony being based on public use of Distributed Maple rather than a printed publication. *Id.*; *see also* PO Sur-reply 10.

Petitioner argues that "[Dr.] Schreiner's declaration is based on 'a series of papers,' not a public use." Pet. Reply 9.

We agree with Patent Owner's assertion that the Petition relies on the testimony of Dr. Tufo and Dr. Schreiner in asserting that, like the first

kernel, the second and third kernels are configured to translate commands into code for execution on the respective processors. *See* Pet. 28 (citing Ex. 1005 ¶ 76; Ex. 1006 ¶ 40), 35 (citing Ex. 1005 ¶¶ 93–94), 40 (citing Ex. 1005 ¶¶ 70–72, 102).

Dr. Schreiner discusses how, for "each of the examples discussed in Exhibit 1008, a Distributed Maple cluster was set up" by taking specified actions (Ex. 1006 ¶ 40), which appears to be a discussion of how he used the Distributed Maple cluster. For purposes of institution, we do not consider this and similar portions of the Schreiner Declaration.

Regarding the Tufo Declaration, although Patent Owner only cites to paragraph 76 (*see* Prelim. Resp. 37–38), in which Dr. Tufo states that "[t]hese teachings apply to each kernel in Distributed Maple, with each kernel translating commands into code for execution on its respective processor," the prior paragraphs of Dr. Tufo's testimony elucidate the referenced "teachings." For example, Dr. Tufo relies on Schreiner1, Schreiner2, and the Maple Guide to support his conclusion that "high-level commands," which "are translated by the kernel into lower-level code for execution by the processors," are "sent to each of the nodes and then translated by the individual kernels into code causing the *ifactors* library to be loaded into the computer-readable medium." Ex. 1005 ¶ 74 (citing Ex. 1008, 3; Ex. 1009, 7, 15; Ex. 1011, 98).

On this record, the asserted references support Dr. Tufo's assertions. For example, the Maple Guide explains that,

> When you start Maple, it loads only the *kernel*. The kernel is the base of Maple's system. It contains fundamental and primitive commands: the Maple language interpreter (which converts the commands you type into machine

> instructions your computer processor can understand), algorithms for numerical calculation, and routines to display results and perform other input and output operations.

Ex. 1011, 98. Schreiner2 explains that Distributed Maple creates a kernel on each processor in the cluster. Ex. 1009, 7 (discussing "the simple strategy of *data parallelism* where each element of a central input data structure is processed in parallel and the task results are joined to form the desired output structure"), 15 (explaining that the dist[all] command "executes [a command] on *every [Maple] kernel connected to the distributed session*" (emphasis added)). Additionally, Schreiner1 explains that the dist[initialize] command creates Maple kernels on all processors in the cluster. *See* Ex. 1008, 8.

Accordingly, for the foregoing reasons and on this preliminary record, the asserted references and Dr. Tufo's testimony support Petitioner's contentions. We further determine that, based on this preliminary record, Petitioner has set forth articulated reasoning with rational underpinning explaining why a person of ordinary skill would have combined the teachings of the asserted references. *See* Pet. 14–16.

vii. The Second and Third Cluster Node Module Recitations

Claim 1 recites "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" and "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." Ex. 1001, 29:12–16, 29:21–25. Referring to Schreiner1's Figure 1, Petitioner maps the dist.Scheduler Java program and the dist.maple file of the lower left node to the recited "second cluster node module" and the dist.Scheduler Java program and the dist.maple file of the lower right node to the recited "third cluster node module." Pet. 35–36, 40–42. Petitioner relies on its showing made with respect to the first cluster node module and argues that the second and third cluster node modules reside on the computer-readable medium and are configured to send commands to the second and third kernels, respectively. *Id.* Regarding the recitations that the second cluster node module communicates with the first cluster node module and the third cluster node module communicates with the first and second cluster node modules, Petitioner relies on Schreiner1 to disclose that each node within the Distributed Maple cluster can communicate with each of the other nodes. *Id.* at 37 (citing Ex. 1008, 13, 17; Ex. 1005 ¶ 98), 42 (citing Ex. 1008, 13).

Patent Owner does not contest this aspect of the Petition apart from the arguments discussed above with respect to the first cluster node module. *See generally* Prelim. Resp.

Schreiner1 explains that each node connected to a Distributed Maple session includes the dist.Scheduler Java program and the dist.maple file. Ex. 1008, 8–9. Dr. Tufo opines that "a POSITA would expect that the Distributed Maple cluster node module libraries and Maple kernel files would be stored in a global directory on disk or in memory, from which they could be installed on the various cluster nodes." Ex. 1005 ¶ 96. Schreiner1 explains that each "Maple kernel is a single-threaded process which communicates by a simple communication protocol with the scheduler on

the same node." Ex. 1008, 12. Additionally, "all nodes know of each other" and, "[w]hen a node needs to send a message to one of its peers, it can thus establish a direct connection for message transfers." *Id.* at 13. The dist.Scheduler Java program coordinates this node interaction. *Id.* at 8.

Accordingly, for the foregoing reasons and on this preliminary record, the asserted references and Dr. Tufo's testimony support Petitioner's contentions. We further determine that, based on this preliminary record, Petitioner has set forth articulated reasoning with rational underpinning explaining why a person of ordinary skill would have combined the teachings of the asserted references. *See* Pet. 14–16.

viii. The Wherein Recitation

Claim 1 recites "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, 29:26–28. Petitioner argues that the first cluster node module includes a data structure that acts as a buffer to collect messages received from the first and second cluster node modules. Pet. 44–45 (citing Ex. 1005 ¶¶ 108–109; Ex. 1008, 13, Fig. 2; Ex. 1009, 26).

Patent Owner does not contest this aspect of the Petition. *See generally* Prelim. Resp.

Schreiner1 explains that "all nodes know of each other, i.e. a node knows the address of a machine and the number of a port on which (a thread of) the remote scheduler is listening for connection requests." Ex. 1008, 13.

> The operation of the scheduler is implemented by a number of concurrent threads as shown in Fig. 2. Threads listening on all input channels put the received messages into a central buffer from where a server thread takes them, processes

> them, and creates new messages that are placed in some of the output buffers.

*Id.* Similarly, Schreiner2 explains that "[a] central server thread sequentially processes messages that were received from any input channel[] and put into a central buffer by a thread listening on that channel." Ex. 1009, 26.

Accordingly, for the foregoing reasons and on this preliminary record, the asserted references and Dr. Tufo's testimony support Petitioner's contentions. We further determine that, based on this preliminary record, Petitioner has set forth articulated reasoning with rational underpinning explaining why a person of ordinary skill would have combined the teachings of the asserted references. *See* Pet. 14–16; *see also id.* at 45–46 (discussing message buffers).

b. Public Accessibility of the Distributed Maple Code

Patent Owner argues, with respect to all of the claim recitations, that Petitioner failed to show that the Distributed Maple Code references were publically accessible prior to the date of the invention. *See* Prelim. Resp. 28–31 (noting that Distributed Maple Code includes Exhibits 1012–1018). However, Petitioner relies on the Distributed Maple Code references, which describe the source code for the Distributed Maple Code referenced in Schreiner1, Schreiner2, Schreiner3, and the Maple Guide, only to support its showing based on the latter references. *See, e.g.*, Pet. 62 ("This understanding is further confirmed in the dist.maple source code files . . . ."). As noted above, Petitioner also expressly states that "Schreiner1 expressly teaches nearly all of the claim limitations by itself." *Id.* at 16 (citing Ex. 1005 ¶ 48).

Assuming that the other references do not support institution sufficiently without the source code, Patent Owner contends that Petitioner relies on the uncorroborated testimony of Dr. Schreiner that he posted the Distributed Maple Code (i.e., source code) "in 2003 on the public website of Research Institute for Symbolic Computation ('RISC'), where the references allegedly could be downloaded through the webpage shown in Exhibit 1024." Prelim. Resp. 29 (arguing "corroboration is required of a witness's testimony about his own allegedly invalidating activities" (citing *Finnigan Corp. v. ITC*, 180 F.3d 1354, 1366 (Fed. Cir. 1999))). But Petitioner also cites the website as published in Schreiner1, as Patent Owner acknowledges. *Id.* at 29–30; Ex. 1008, 5, 7. Nevertheless, Patent Owner contends that "[t]he most the evidence submitted by Petitioner shows is that [Dr.] Schreiner himself, or possibly others who helped create the Distributed Maple Code or already knew of its existence, may have been able to locate whatever version was posted at that time." Prelim. Resp. 31.

This line of argument downplays that Schreiner1, published in the Journal of Symbolic Computation in 2003, would have pointed interested artisans to the website listed therein in order to obtain the "Distributed Maple system itself," the main subject of Schreiner1 and described as "freely available." *See* Ex. 1008, 5. Also, the Internet Archive screenshot, Exhibit 1024, describes "Distributed Maple" and lists the same website as published in Schreiner1, and states "Maintained by: Wolfgang Schreiner," "Last Modification: July 14, 2003." *See also* Ex. 1006 ¶ 24 (Dr. Schreiner noting that the Internet Archive screenshot states "Last Modification: July 14, 2003" and testifying "[t]hat is consistent with my recollection of the time when I last modified this page" (citing Ex. 1024)); Ex. 1025 (similar

Internet Archive screenshot evidence). This evidence corroborates Dr. Schreiner's testimony as to the timeframe he uploaded the source code.

Dr. Schreiner also testifies that "[i]t has been my practice to check, from time to time, whether my software was accessible through Google search results, and I did this prior to 2005 for these particular web pages and confirm that my Distributed Maple papers and software were accessible through Google searches." Ex. 1006 ¶ 21. Patent Owner argues that "Petitioner relies entirely upon Schreiner's memory from more than seven years ago to suggest the version of Distributed Maple Code filed in this IPR was publicly accessible back then." Prelim. Resp. 29. However, as indicated above, Schreiner1, coauthored by Dr. Schreiner with two others, and the Internet Archive documents corroborate Dr. Schreiner's testimony about uploading the software on the RISC website.[8] During trial, Patent Owner will have the opportunity to cross-examine Dr. Schreiner, including regarding Google searches and his memory, assuming for the sake of argument that the ability to search the RISC website using Google is relevant to show public accessibility of the source code.

On this preliminary record, even if Petitioner's showing requires the source code to be publically available to support institution, sufficient evidence exists here to show that the Distributed Maple Code was publically available in 2003 and thereafter up to the date of the invention in 2006. *See* Ex. 1001, code (60) (listing the filing date of a provisional application as October 11, 2006). Moreover, no dispute exists over the fact that some form of the source code existed prior to the date of the invention. This further

[8] Two others coauthored Schreiner1 with Dr. Schreiner. *See* Ex. 1008, 3 (listing authors "Wolfgang Schreiner, Christian Mittermaier, Karoly Bosa").

corroborates that Dr. Schreiner published it on RISC's public website as Schreiner1 and Exhibit 1024 indicate. Also, to the extent the source code may have changed over the relevant time frame as Patent Owner argues (*see* Prelim. Resp. 29), the parties will have the opportunity to address the materiality of any such changes during trial.

Even if the source code was not publically available at the relevant time, Petitioner's reliance on it as extrinsic evidence solely to support its showing of how the Distributed Maple system operated at the time of the invention would be proper. *See In re Baxter Travenol Labs.*, 952 F.2d 388, 390 (Fed. Cir. 1991) (explaining that extrinsic evidence may be used to explain what a reference discloses); *Hospira v. Fresenius Kabi USA*, 946 F.3d 1322, 1329 (Fed. Cir. 2020) ("Extrinsic evidence can be used to demonstrate what is 'necessarily present' in a prior art embodiment even if the extrinsic evidence is not itself prior art."). And even if Petitioner must show the public accessibility of such supporting references to rely on such support, on this preliminary record, Petitioner sufficiently shows that Schreiner1, Schreiner2, Schreiner3, and the Maple Guide teach the claim elements without reliance on the supporting source code as disclosed in the Distributed Maple Code.

c. Alleged Objective Evidence of Nonobviousness

Notwithstanding what the teachings of the prior art would have suggested to one skilled in the art, objective evidence of nonobviousness (so called "secondary considerations") may lead to a conclusion that the challenged claims would not have been obvious. *In re Piasecki*, 745 F.2d 1468, 1471–72 (Fed. Cir. 1984). Objective evidence of nonobviousness "may often be the most probative and cogent evidence in the record" and

"may often establish that an invention appearing to have been obvious in light of the prior art was not." *Transocean Offshore Deepwater Drilling, Inc. v. Maersk Drilling USA, Inc.*, 699 F.3d 1340, 1349 (Fed. Cir. 2012) (citing *Stratoflex, Inc. v. Aeroquip Corp.*, 713 F.2d 1530, 1538 (Fed. Cir. 1983)).

Patent Owner argues that objective evidence regarding its SEM and SET products supports the nonobviousness of the challenged claims. Prelim. Resp. 44–58. Patent Owner puts forth evidence of long-felt and unresolved need, failure by others, praise by others, skepticism of others, and copying. *Id.*

i. Nexus

"In order to accord substantial weight to secondary considerations in an obviousness analysis, 'the evidence of secondary considerations must have a "nexus" to the claims, i.e., there must be "a legally and factually sufficient connection" between the evidence and the patented invention.'" *Fox Factory, Inc. v. SRAM, LLC*, 944 F.3d 1366, 1373 (Fed. Cir. 2019) (citing *Henny Penny Corp. v. Frymaster LLC*, 938 F.3d 1324, 1332 (Fed. Cir. 2019)). "The patentee bears the burden of showing that a nexus exists . . . ." *WMS Gaming Inc. v. Int'l Game Tech.*, 184 F.3d 1339, 1359 (Fed. Cir. 1999). Nexus is a legally and factually sufficient connection between the objective evidence and the claimed invention, such that the objective evidence should be considered in determining nonobviousness. *Demaco Corp. v. F. Von Langsdorff Licensing Ltd.*, 851 F.2d 1387, 1392 (Fed. Cir. 1988). A nexus is presumed when "the patentee shows that the asserted objective evidence is tied to a specific product and that product 'embodies the claimed features, and is coextensive with them.'" *Fox*

*Factory*, 944 F.3d at 1373 (quoting *Polaris Indus., Inc. v. Arctic Cat, Inc.*, 882 F.3d 1056, 1072 (Fed. Cir. 2018)).

Patent Owner argues that "[t]here is sufficient nexus between the objective evidence related to SEM™ and SET™ and the challenged claims" because the "SEM™ and SET™ products practice at least the challenged independent claims." Prelim. Resp. 52. Patent Owner argues that "[e]ach of the objective indicia of non-obviousness results from the SEM™ and SET™ architecture embodied by the challenged claims." *Id.* at 55. Patent Owner argues that "[o]ther parallel-computing architectures failed to meet the long-felt, unmet need precisely because they lacked SEM™ and SET™'s claimed architecture." *Id.* at 56 (citing Ex. 2006 ¶ 37). Patent Owner argues the "claimed architecture" is also responsible for the other asserted objective indicia of nonobviousness. *Id.* (citing Ex. 2006 ¶¶ 39–42, 46–47).

Thus, Patent Owner's arguments are premised on its proposed construction for "cluster node module." *See, e.g.*, Ex. 2006 ¶ 24 ("SEM interposes a communication layer between the front end user interface (view) and the back end Mathematica kernels (model) on each node, and that communication layer manages the peer-to-peer behavior of the nodes."), 26 ("SET's architecture interposes a layer in between the front end user interface (view) and a back end kernel (model) that manages the peer-to-peer behavior of the nodes."), *cited at* Prelim. Resp. 56. However, even if these products fall within the scope of claim 1, for the reasons similar to those explained in § II.C above, the claims do not require the architecture of SEM and SET. In other words, the claims are not architecture-specific. *See MeadWestVaco Corp. v. Rexam Beauty & Closures, Inc.*, 731 F.3d 1258, 1264–65 (Fed. Circ. 2013) (citing *Asyst Techs., Inc. v. Emtrak, Inc.*, 544

F.3d 1310, 1316 (Fed. Cir. 2008)) (explaining that it was error to consider "secondary considerations of nonobviousness [that] involved only fragrance-specific uses" when "the claims now at issue are not fragrance-specific"). The court in *MeadWestVaco* held that the district court erred because it "credited evidence advanced to show long-felt need and commercial success specific to the perfume industry," and the claims were not limited to fragrance-specific dispensers. *See id.* (reasoning that "objective evidence of non-obviousness must be commensurate in scope with the claims which the evidence is offered to support" (quoting *Asyst Techs.*, 544 F.3d at 1316)).

For the foregoing reasons and on this preliminary record, Patent Owner fails to meet its burden of establishing a nexus between the objective evidence regarding its SEM and SET products and the claims of the '289 patent. We, therefore, do not accord substantial weight to such evidence. *Fox Factory*, 944 F.3d at 1373. For the sake of completeness, we nonetheless address below Patent Owner's allegations relating to objective indicia of nonobviousness.

ii. Long-Felt Need and Failure of Others

"The existence of a long-felt but unsolved need that is met by the claimed invention is . . . objective evidence of non-obviousness." *Millennium Pharms., Inc. v. Sandoz Inc.*, 862 F.3d 1356, 1369 (Fed. Cir. 2017) (citing *In re Cyclobenzaprine Hydrochloride Extended-Release Capsule Patent Litig.*, 676 F.3d 1063, 1081–83 (Fed. Cir. 2012)). "Long[-]felt need is closely related to the failure of others. Evidence is particularly probative of obviousness when it demonstrates both that a demand existed for the patented invention, and that others tried but failed to satisfy that demand." *Cyclobenzaprine*, 676 F.3d at 1082.

Patent Owner argues "there was a long-felt but unmet need for a way to unlock the performance advantages of cluster computing without requiring specialized expertise or excessive time, effort, and cost." Prelim. Resp. 46. Patent Owner argues that its SEM and SET products met this need. *Id.* at 46–48 (citing Ex. 2001 ¶¶ 83–88; Ex. 2006 ¶¶ 20–30; Ex. 2007 ¶¶ 10, 12; Ex. 2008 ¶¶ 25–28).

Petitioner argues that "[Dr.] Dauger provides no evidence or explanation for why interposing the communications software between the user interface and the kernel, as compared to connecting the communications software in some other way, would make any difference at all to the user." Pet. Reply 6. Petitioner argues that Dr. Dauger's testimony is also unpersuasive because it is based on an incorrect claim interpretation requiring the cluster node modules to accept instructions from the user interface without the instructions first passing through any kernel. *Id.* at 6–8.

Patent Owner argues that Petitioner's arguments regarding claim construction are outside the scope of our Order authorizing Petitioner to file its Reply. PO Sur-reply 6–9. To the contrary, as discussed in considering nexus above (§ II.E.1.c.i), the scope of the claims is relevant to objective indicia of nonobviousness.

Regarding the failure of others, Patent Owner acknowledges that others developed automatic parallelizers and universal compilers that converted serial code to parallel code, but argues that none achieved performance comparable to traditional parallel-computing architectures. Prelim. Resp. 50; *see also* PO Sur-reply 3.

Petitioner argues that "P[atent] O[wner]'s argument is irrelevant because the claims neither recite 'automatic' or 'universal' parallelization nor require a specific level of optimization or advantageousness." Pet. Reply 2 (citing *ABT Sys., LLC v. Emerson Elec. Co.*, 797 F.3d 1350, 1362 (Fed. Cir. 2015)).

Patent Owner's arguments that a long-felt need existed are based on the testimony of Dr. Dauger, Dr. Bhansali, and Mr. Bancroft. *See* Prelim. Resp. 44–48. However, none of these declarants establishes that others unsuccessfully attempted to solve the problem. Dr. Dauger states that "[n]umerous others had tried to implement automatic parallelizers or universal compilers that would take serial object code as input and output object parallel code," but "[n]one of these efforts succeeded to produce accurate parallel code that was sufficiently optimized or advantageous enough to catch on." Ex. 2006 ¶ 37. These conclusory and uncorroborated statements fail to establish that others actually tried to solve the asserted problem. The testimony of the other declarants fares no better. Dr. Bhansali merely states that he was not aware of any other products like the SEM product. Ex. 2007 ¶ 11. Mr. Bancroft states that he "had heard rumours of people trying to develop a universal parallelizer that could be used to automatically parallelize serial code." Ex. 2008 ¶ 30. None of this testimony persuasively establishes that others actually tried and failed to solve the problem asserted by Patent Owner.

Accordingly, for the foregoing reasons and on this preliminary record, we find Patent Owner's evidence of long-felt need and failure of others to be weak.

iii. Unexpected Results

"If a patent challenger makes a prima facie showing of obviousness, the owner may rebut based on 'unexpected results' by demonstrating 'that the claimed invention exhibits some superior property or advantage that a person of ordinary skill in the relevant art would have found surprising or unexpected.'" *Procter & Gamble Co. v. Teva Pharms. USA, Inc.*, 566 F.3d 989, 994 (Fed. Cir. 2009) (quoting *In re Soni*, 54 F.3d 746, 750 (Fed. Cir. 1995)). "To be particularly probative, evidence of unexpected results must establish that there is a difference between the results obtained and those of the closest prior art, and that the difference would not have been expected by one of ordinary skill in the art at the time of the invention." *Bristol-Myers Squibb Co. v. Teva Pharms. USA, Inc.*, 752 F.3d 967, 977 (Fed. Cir. 2014); *see also Kao Corp. v. Unilever U.S., Inc.*, 441 F.3d 963, 970 (Fed. Cir. 2006) ("'[W]hen unexpected results are used as evidence of nonobviousness, the results must be shown to be unexpected compared with the closest prior art.'") (quoting *Baxter Travenol Labs.*, 952 F.2d at 392).

Patent Owner argues that the performance and ease of use of its SEM and SET products was unexpected. Prelim. Resp. 48–50 (citing Ex. 2006 ¶¶ 38–41). Patent Owner argues that its SEM product outperformed gridMathematica. *Id.* at 48–49. Patent Owner argues that it was able to parallelize Wolfram Research's Mathematica, Apple's HD QuickTime Exporter, and Equalis's Scilab using its SET product in a much shorter time period than expected. *Id.* at 49.

Petitioner argues that Patent Owner's reliance on the testimony of Dr. Dauger is unpersuasive because Dr. Dauger is a listed inventor of the '289 patent. Pet. Reply 1. Petitioner also argues that Dr. Dauger's

"testimony is also irrelevant because it compares the claimed invention against gridMathematica, not the 'closest prior art.'" *Id.* (citing *In re Harris*, 409 F.3d 1339, 1344 (Fed. Cir. 2005); *Trs. of Columbia Univ. v. Illumina, Inc.*, 620 F. App'x 916, 932 (Fed. Cir. 2015)).

Patent Owner replies that "Dr. Dauger's testimony was submitted under oath and penalty of perjury" and the other evidence cited in its Preliminary Response support its contention that the SEM and SET products exhibited surprising results. PO Sur-reply 1–2. Patent Owner also argues that it "chose the closest prior art by comparing SEM™ with gridMathematica and SET™ with the conventional method of parallelizing applications." *Id.* at 2 (citing Ex. 2006 ¶ 40).

Patent Owner relies almost exclusively on the testimony of Dr. Dauger in asserting the surprising results of the SEM and SET products. *See* Prelim. Resp. 48–50 (citing Ex. 2006 ¶¶ 38–41). Dr. Dauger testifies the he was surprised that the SEM product performed better than gridMathematica and that Patent Owner was able to parallelize Mathematica "in one man-month." Ex. 2006 ¶¶ 38–41. Dr. Dauger is an inventor of the '289 patent, was Patent Owner's CTO, and is currently a consultant employed by Patent Owner. Ex. 1001, code (75); Ex. 2006 ¶ 1; Ex. 2015, 2; Ex. 2018, 2. On this record, we find Dr. Dauger's testimony about his personal surprise at the SEM and SET products that he helped create unpersuasive to establish unexpected results of these products. *See In re Cree*, 818 F.3d 694, 702 (Fed. Cir. 2016) (citing *Power-One v. Artesyn Techs., Inc.*, 599 F.3d 1343, 1352 (Fed. Cir. 2010)) (concluding that "self-serving statements from researchers about their own work" do not have the same credibility as statements made by disinterested parties). Notably,

Patent Owner provides no evidence to corroborate Dr. Dauger's assertions of unexpected results.

Additionally, Patent Owner provides no comparative testing against any prior art configuration, be it the closest or otherwise. Although Dr. Dauger testifies that some testing was performed (*see* Ex. 2006 ¶ 39), no documentation or data are provided from that testing to substantiate his assertions. This is the type of conclusory evidence that has been found insufficient. *See, e.g.*, *In re Lindner*, 457 F.2d 506, 508 (CCPA 1972) ("This court has said previously that mere lawyers' arguments unsupported by factual evidence are insufficient to establish unexpected results. . . . Likewise, mere conclusory statements in the specification and affidavits are entitled to little weight when the Patent Office questions the efficacy of those statements.").

Furthermore, Patent Owner does not persuasively argue that gridMathematica is the closest prior art. As noted by Petitioner, Patent Owner does not compare its products to the asserted references or the Distributed Maple system disclosed therein.

Accordingly, for the foregoing reasons and on this preliminary record, we find Patent Owner's evidence of unexpected results to be weak.

iv. Industry Praise

"Evidence that the industry praised a claimed invention or a product that embodies the patent claims weighs against an assertion that the same claimed invention would have been obvious. Industry participants, especially competitors, are not likely to praise an obvious advance over the known art." *Apple Inc. v. Samsung Elecs. Co.*, 839 F.3d 1034, 1053 (Fed. Cir. 2016) (en banc).

Relying on the asserted statements of Dr. Bhansali and Yuko Matsuda, Patent Owner argues that industry praise supports patentability of the '289 patent claims. Prelim. Resp. 50–51. According to Patent Owner, Dr. Bhansali found the SEM product to be efficient for load balancing issues and Mr. Matsuda endorsed the SEM product. *Id.*

Petitioner argues that "[Dr.] Bhansali focuses on 'load balancing,'" which "has no nexus because the patents do not assert that load balancing was novel or non-obvious." Pet. Reply 3–4 (citing *Kennametal, Inc. v. Ingersoll Cutting Tool Co.*, 780 F.3d 1376, 1385 (Fed. Cir. 2015)). Petitioner argues that Patent Owner's proposed construction of "cluster node module" excludes the only method of load balancing disclosed in the '289 patent. *Id.* at 4–5. Petitioner also argues that the references asserted in the Petition teach load balancing. *Id.* at 4.

Patent Owner argues that Petitioner's arguments regarding claim construction are outside the scope of our Order authorizing Petitioner to file its Reply. PO Sur-reply 1, 4–6. To the contrary, as discussed in considering nexus above (§ II.E.1.c.i), the scope of the claims is relevant to objective indicia of nonobviousness.

In order for evidence of industry praise to be probative of nonobviousness, the evidence must be specifically related to features of the claimed invention. *See Apple*, 839 F.3d at 1053–55 (discussing "substantial evidence of praise in the industry that specifically related to features of the claimed invention"). As argued by Patent Owner, Dr. Bhansali testifies that he found the SEM product to be efficient for load balancing issues, by which he means "*the distribution of different parts of an algorithm or application across different nodes* and the overall process of parallelizing the algorithm

or application." Ex. 2007 ¶ 12 (emphasis added). The '289 patent refers to load balancing in a similar manner. *See* Ex. 1001, 21:8–55. As correctly noted by Petitioner, the challenged claims do not recite load balancing or otherwise require commands to be distributed among the nodes in a particular manner. Thus, on this record, Dr. Bhansali's testimony appears not to be directed to features of the claimed invention and, therefore, is not probative of nonobviousness.

Regarding the asserted statements made by Mr. Matsuda, Patent Owner cites to the Dauger Declaration rather than any submission endorsed by Mr. Matsuda. Prelim. Resp. 51 (citing Ex. 2006 ¶¶ 44–45). Dr. Dauber cites to a slide deck which he appears to have prepared and the substance of which consists only of two quotations. Ex. 2006 ¶ 44 (citing Ex. 2018, 4); *see also* Ex. 2018, 2 (listing Dean E. Dauger, Ph.D. as the author). On this record, we find the uncorroborated statements of Dr. Dauber, alone, unpersuasive to evidence the asserted statement of Mr. Matsuda.

Dr. Dauger also cites to Exhibit 2023, referring to it as a "white paper" written by Mr. Matsuda. Ex. 2006 ¶ 45 (citing Ex. 2023, 2). Initially, it is not clear what significance a "white paper" carries. Moreover, in the sentence cited by Patent Owner, Mr. Matsuda merely states that the SEM product "stands in an advantageous position" compared with an undefined "Parallel Computing Toolkit" when used with Mathematica. Ex. 2023, 2. This is not the type of competitor praise that courts have found to be indicative of non-obviousness. *See, e.g.*, *Apple*, 839 F.3d at 1053–54 (discussing "numerous internal Samsung documents that both praised Apple's slide to unlock feature and indicated that Samsung should modify its own phones to incorporate Apple's slide to unlock feature").

Accordingly, for the foregoing reasons and on this preliminary record, we find Patent Owner's evidence of the industry praise to be weak.

v. Skepticism

Evidence of industry skepticism weighs in favor of nonobviousness. *See United States v. Adams*, 383 U.S. 39, 52 (1966). "If industry participants or skilled artisans are skeptical about whether or how a problem could be solved or the workability of the claimed solution, it favors nonobviousness." *WBIP, LLC v. Kohler Co.*, 829 F.3d 1317, 1335 (Fed. Cir. 2016).

Patent Owner argues that experts expressed skepticism that the SEM and SET products would work. Prelim. Resp. 51–52. Regarding the SEM product, Patent Owner relies solely on the testimony of Dr. Bhansali and Mr. Bancroft. *Id.* at 51 (citing Ex. 2007 ¶ 8; Ex. 2008 ¶ 32). Regarding the SET product, Patent Owner relies on the opinion of one unidentified Department of Energy ("DOE") "reviewer." *Id.* at 52 (citing Ex. 2006 ¶ 52); *see also* PO Sur-reply 3–4.

Petitioner argues that rather than expressing skepticism that Patent Owner's products would work, the DOE reviewers in Patent Owner's exhibits "expressed skepticism over the bold performance claims made by P[atent] O[wner]." Pet. Reply 2–3.

Regarding the SEM product, Patent Owner relies solely on statements of Dr. Bhansali and Mr. Bancroft regarding their personal experience with the SEM product. Prelim. Resp. 51 (citing Ex. 2007 ¶ 8; Ex. 2008 ¶ 32). Dr. Bhansali states that, "[w]hen I first learned about SEM, I was uncertain whether the product would perform as promised." Ex. 2007 ¶ 8. Dr. Bhansali states that he "graduated from Cal. Tech. with a dual B.S.-M.S.

in physics, and engineering and applied science" and "received [a] Ph.D. in theoretical physics from Harvard University." *Id.* ¶¶ 3–4. Neither Patent Owner nor Dr. Bhansali provide any detail about his course of study or industrial experience. Notably, no CV for Dr. Bhansali has been made of record. Accordingly, Patent Owner fails to establish adequately that Dr. Bhansali is a skilled artisan with respect to parallel or distributed computing. Accordingly, we accord Dr. Bhansali's opinion testimony little weight.

Although Mr. Bancroft states that he provided the SEM product to "many experienced parallel programmers" (Ex. 2008 ¶ 32), no information about or statements made by these asserted experts have been provided. Additionally, neither Patent Owner nor Mr. Bancroft provide his CV, making it difficult to assess his credibility to provide technical testimony. *See* Ex. 2008. We note that Mr. Bancroft's experience appears to be directed to business development matters rather than technical engineering or computer science research and development. *See id.* ¶¶ 4–14. Moreover, Mr. Bancroft is on Patent Owner's Business Advisory Board. *Id.* ¶ 33. Thus, it appears that Mr. Bancroft is not a disinterested party and may have economic or other interest in Patent Owner's success in this proceeding. Accordingly, we accord Mr. Bancroft's opinion testimony little weight.

Regarding the SET product, we agree that the DOE reviewers appear to indicate that the submissions they reviewed lacked sufficient detail for them to evaluate the performance assertions made in the submissions. Patent Owner relies on the comments of "Reviewer 2" of Exhibit 2019. Prelim. Resp. 52 (citing "Ex. 2006 ¶ 52 (Ex. 2019 at 2)"). This reviewer states, "The proposal . . . provides no quantitative or qualitative evidence of

(efficient or not) use of compute[r] resou[r]ces by SET." Ex. 2019, 2. This reviewer also states, "The applicants have not demonstrated quantitatively that their technology provides real results. . . . SET may prove to be the great success the applicants suggest, but there is no proof that it works on real CAD/CAM/CAE applications." *Id.* at 3. Continuing, this reviewer states, "The applicants haven't clearly defined the nature of the plasma code, nor the effort in porting it to SET." *Id.* Thus, the statements of Reviewer 2 appear to stem from a lack of detail to assess the credibility of the assertions in the submissions.[9] Other reviewers similarly identify a lack of detail in the submissions. *See id.* at 4 ("[T]he main concepts of this proposal have not been presented in any substantial detail."; "There is no sound plan to showing that this SET-based approach can be commercially viable."); Ex. 2021, 1 ("[T]here is no plan to compare the performance of the applications compared to their theoretical performance."), 2 ("The auto parallelization tools have not provided high performance as they usually have too many generalizations to take advantage of a particular computing architecture. I do not have evidence that the SET tool is any different."), 4 ("The applicant has provided a general outline of the comparison test approach, but further details in the work plan are needed."; "While there is an overall projection of technical relevance, the lack of specificity in the proposed test situation presents a high level of uncertainty in achieving the more ambitious goals of this proposal."); Ex. 2022, 3 ("The performance of SET in Linux and Mac OS operating environments, the type of efficiency increases achieved, and the strength and limitations of the SET approach are

[9] The submissions made to the DOE are not of record in this case.

not adequately described."), 4 ("The applicant has provided a general description of the technical problem and work plan, but specific details of the technical challenges to be encountered with the SET technology should be described in greater detail."). Thus, to the extent one reviewer expressed skepticism that the SET product would perform as claimed, this evidence is undercut by the overwhelming expression of a lack of detail provided in the submitted proposals that were reviewed.

Accordingly, for the foregoing reasons and on this preliminary record, we find Patent Owner's evidence of skepticism of others to be weak.

vi. Copying

"Copying may indeed be another form of flattering praise for inventive features." *Crocs, Inc. v. ITC*, 598 F.3d 1294, 1311 (Fed. Cir. 2010). Copying "requires evidence of efforts to replicate a specific product." *Wyers v. Master Lock Co.*, 616 F.3d 1231, 1246 (Fed. Cir. 2010). "This may be demonstrated either through internal documents; direct evidence such as disassembling a patented prototype, photographing its features, and using the photograph as a blueprint to build a virtually identical replica; or access to, and substantial similarity to, the patented product (as opposed to the patent)." *Iron Grip Barbell Co. v. USA Sports, Inc.*, 392 F.3d 1317, 1325 (Fed. Cir. 2004) (internal citations omitted). "We note, however, that a showing of copying is only equivocal evidence of nonobviousness in the absence of more compelling objective indicia of other secondary considerations." *Ecolochem, Inc. v. S. Cal. Edison Co.*, 227 F.3d 1361, 1380 (Fed. Cir. 2000); *see also In re GPAC*, 57 F.3d at 1580 ("[M]ore than the mere fact of copying by an accused infringer is needed to make that action

significant to a determination of the obviousness issue." (quoting *Cable Elec. Prods. v. Genmark, Inc.*, 770 F.2d 1015, 1028 (Fed. Cir. 1985))).

Patent Owner asserts that it provided information to Petitioner regarding its SET product during a November 2012 meeting and in a subsequent "email attaching a specially tailored data sheet." Prelim. Resp. 56 (citing Ex. 2006 ¶ 56). Patent Owner argues that "Petitioner then copied the claimed invention by incorporating the claimed architecture into Petitioner's GPGPUs in the manner described by the datasheet" and "named its GPU interconnect architecture, which uses the claimed structure, NVLink™."[10] *Id.* at 57 (citing Ex. 2006 ¶ 59); *see also* PO Sur-reply 9–10.

Petitioner traverses Patent Owner's assertions of copying, calling it "a gross misrepresentation to the PTAB." Pet. Reply 8–9. Petitioner asserts that the inventors of the '289 patent sent an unsolicited email to one of its employees attaching a public SET datasheet that "did not have any suggestion of 'provid[ing] a communications infrastructure for direct all-to-all communications between each GPU.'" *Id.* at 8 (alteration in original) (citing Prelim. Resp. 56).

Patent Owner provides no evidence to support its assertion. Patent Owner does not provide any description of the NVLink product or compare this product to the claims of the '289 patent. On this record, Patent Owner's conclusory assertions are inadequate to establish any copying of the claimed invention by Petitioner.

[10] Dr. Dauger refers to NVIDIA's "general-purpose GPU ('GPGPU') supercomputing" and describes "NVIDIA'S Tesla GPGPUs as hardware black boxes on which the back end executes." Ex. 2006 ¶¶ 56–57 (citing Ex. 2020, 4, Fig 3).

Accordingly, for the foregoing reasons and on this preliminary record, we find Patent Owner's evidence of copying to be weak.

d. Conclusion

As set forth above, we have considered the scope and content of the prior art (§ II.D above), the differences between the claimed subject matter and the prior art (§ **Error! Reference source not found.**), the level of skill in the art (§ II.B above), and the objective evidence of nonobviousness (§ II.E.1.c above). Based on our findings, at this stage of the proceeding, we determine that Petitioner has established a reasonable likelihood of prevailing on its assertion that claim 1 would have been obvious over the combination of Schreiner1, Schreiner2, Schreiner3, Maple Guide, and Distributed Maple Code.

*2. Claims 4–6, 8, 10, 11, 13, and 16*

Each of claims 4–6, 8, 10, 11, 13, and 16 depends, directly or indirectly, from claim 1. The Petition maps the additional limitations of these challenged dependent claims to Schreiner1, Schreiner2, and Schreiner3. Pet. 46–55. Patent Owner does not challenge separately the arguments and evidence presented for the dependent claims. *See generally* Prelim. Resp. Based on our review of the current record before us, we determine that the information presented in the Petition establishes that there is a reasonable likelihood that Petitioner would prevail in challenging claims 4–6, 8, 10, 11, 13, and 16 as being unpatentable over the combination of Schreiner1, Schreiner2, Schreiner3, Maple Guide, and Distributed Maple Code.

*3. Claim 17*

Independent claim 17 recites a computer cluster that is similar to that recited in claim 1. Ex. 1001, 30:23–39. Petitioner relies on the asserted references in a similar manner as advanced for claim 1 and relies on the same rationale for their combination. Pet. 14–16, 56–66.

a. The Preamble

Claim 17 recites "[a] computer cluster." Ex. 1001, 30:23. Petitioner relies on its showing regarding the preamble of claim 1. Pet. 56. Patent Owner does not contest this aspect of the Petition. *See generally* Prelim. Resp. For the reasons set forth above and on this preliminary record, to the extent the preamble is limiting, the asserted references support Petitioner's contentions.

b. The Nodes Recitation

Claim 17 recites "plurality of nodes, wherein each node is configured to access a computer-readable medium comprising program code for a user interface and program code for a single-node kernel module configured to interpret user instructions." Ex. 1001, 30:24–28. Petitioner relies on its showing regarding the Computer-Readable Medium and the First Kernel Recitations of claim 1. Pet. 56–57. Petitioner additionally argues that Schreiner1 "teaches that Maple was installed on each node of the Distributed Maple cluster." *Id.* at 57 (citing Ex. 1008, 8–9).

Patent Owner challenges Petitioner's showings with substantially the same arguments advanced for claim 1. Prelim. Resp. 42. These arguments fail to persuade us to deny institution for the reasons set forth above.

For the reasons set forth above and on this preliminary record, the asserted references support Petitioner's contentions.

c. The Cluster Node Modules Recitation

Claim 17 recites,

> a plurality of cluster node modules, wherein each cluster node module is configured to communicate with a single-node kernel and with one or more other cluster node modules, to accept instructions from the user interface, and to interpret at least some of the user instructions such that the plurality of cluster node modules communicate with one another in order to act as a cluster.

Ex. 1001, 30:29–36. Petitioner relies on its showing regarding the First, Second, and Third Cluster Node Module Recitations of claim 1. Pet. 57–59. In addition, Petitioner annotates Schreiner1's Figure 1 as follows (*id.* at 60):

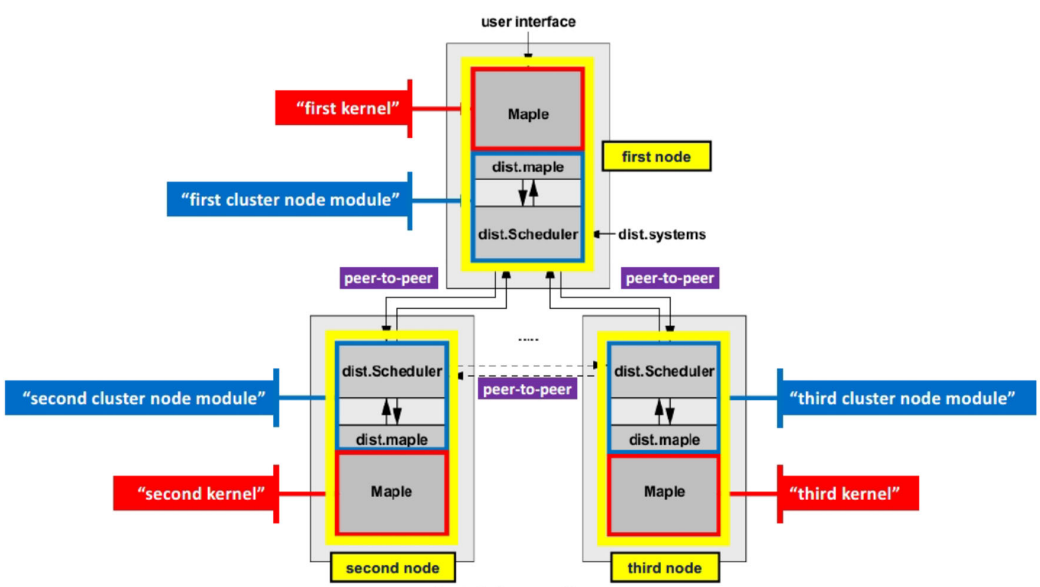

Fig. 1. Software architecture.

Figure 1 of Schreiner1 illustrates a software architecture for a Distributed Maple session. Ex. 1008, 9. Petitioner has modified this figure above to identify the recited kernels and cluster node modules as set forth with

claim 1 and to illustrate communication among the nodes with arrows. Pet. 60; *see also id.* at 58 (stating, with respect to a similarly annotated version of Schreiner1's Figure 1, "cluster node module to kernel communications shown by bidirectional arrows between Maple kernels and their respective scheduler processes, and cluster module-to-module communications shown by arrows between nodes"). Petitioner argues that Schreiner1 discloses a root cluster node module (the labeled "first node") having a root kernel (the labeled "first kernel") that receives commands from the user interface and passes them to the first cluster node module (the dist.Maple and dist.Scheduler of the labeled "first node"). *Id.* at 60 (citing Ex. 1008, 3–4, 7–8; Ex. 1005 ¶ 142). Petitioner argues that the commands are then communicated by the root scheduler (the dist.Scheduler of the labeled "first node") to the other nodes. *Id.* at 61 (citing Ex. 1008, 8–9, 13).

Regarding the recitation that the cluster node modules are configured to interpret at least some of the user instructions, Petitioner argues that "the cluster node modules interpret the dist[all] command such that the nodes communicate to evaluate a Maple statement in parallel." Pet. 61–62 (citing Ex. 1005 ¶ 144). Petitioner also argues that the cluster node modules interpret other commands, such as dist[start] and ssiPilot, to act as a cluster and evaluate expressions in parallel. *Id.* at 63 (citing Ex. 1008, 4, 5, 8, 10–12; Ex. 1005 ¶¶ 146–148).

Patent Owner challenges Petitioner's showings with substantially the same arguments advanced for claim 1. Prelim. Resp. 40–41. These arguments fail to undermine Petitioner's sufficient showing for purposes of institution for the reasons set forth above.

As noted in § II.E.1.a.v above, on this preliminary record Petitioner has persuasively explained how Schreiner1 discloses cluster node modules that accept instructions from a user interface. Schreiner1 further explains that "dist[all] (*command*) lets the Maple statement *command* be executed on every Maple kernel connected to the distributed session" and dist[start] creates tasks that are scheduled on a number of Maple kernels.
Ex. 1008, 9–10.

According, for the foregoing reasons and on this preliminary record, Schreiner1 supports Petitioner's contentions.

d. The Communication Network Recitation

Claim 17 recites "a communications network to connect the nodes." Ex. 1001, 30:37. Petitioner notes that Schreiner1 is titled "Distributed Maple: parallel computer algebra in **networked environments**" and argues that Schreiner1 "describes numerous examples of communications networks connecting the nodes." Pet. 46–47 (citing Ex. 1008, 3, 16–17, 23, 25, 35); *see also id.* at 64 (citing *id.* at 46–47). Patent Owner does not contest this aspect of the Petition. *See generally* Prelim. Resp. We find, on this preliminary record, that the cited portions of Schreiner1 support Petitioner's assertions that the nodes are connected by a communication network.

e. The Wherein Recitation

Claim 17 recites "wherein one of the plurality of cluster node modules returns a result to the user interface." Ex. 1001, 30:38–39. Petitioner argues that "Schreiner1 teaches that the cluster node modules return results to the user interface via the root node" using the dist[start] and dist[wait] commands. Pet. 64–65 (citing Ex. 1008, 8, 10, 14). Petitioner reproduces

examples of textual and graphical results sent to the user interface. *Id.* at 65 (citing Ex. 1008, 8, 28).

Patent Owner does not contest this aspect of the Petition. *See generally* Prelim. Resp.

Schreiner1 supports Petitioner's contentions. For example, Schreiner1 explains that, "After the distributed session has been successfully established, two calls of dist[start] create two tasks evaluating the Maple expressions int (x^n, x) and int (x^n, n), respectively. The two dist[wait] calls block the current execution until the corresponding tasks have terminated and then return their results." Ex. 1008, 8. As noted by Petitioner, the results can be returned to the user graphically as a plot. *See id.* at 28.

f. Conclusion

As set forth above, we have considered the scope and content of the prior art (§ II.D above), the differences between the claimed subject matter and the prior art (§§ II.E.3.a–e above), the level of skill in the art (§ II.B above), and the objective evidence of nonobviousness (§ II.E.1.c above). Based on our findings, at this stage of the proceeding, we determine that Petitioner has established a reasonable likelihood of prevailing on its assertion that claim 17 would have been obvious over the combination of Schreiner1, Schreiner2, Schreiner3, Maple Guide, and Distributed Maple Code.

*4. Claims 18, 19, 21–23, and 27*

Each of claims 18, 19, 21–23, and 27 depends, directly or indirectly, from claim 17. The Petition maps the additional limitations of these

challenged dependent claims to Schreiner1 and Schreiner3. Pet. 66–72. Patent Owner does not challenge separately the arguments and evidence presented for the dependent claims. *See generally* Prelim. Resp. Based on our review of the current record before us, we determine that the information presented in the Petition establishes that there is a reasonable likelihood that Petitioner would prevail in challenging claims 18, 19, 21–23, and 27 as being unpatentable over the combination of Schreiner1, Schreiner2, Schreiner3, Maple Guide, and Distributed Maple Code.

*5. Claim 29*

Independent claim 29 recites a method of evaluating a command on a computer cluster having recitations that are similar to those of claims 1 and 17. Ex. 1001, 31:17–31. Petitioner relies on the asserted references in a similar manner as advanced for claims 1 and 17 and relies on the same rationale for their combination. Pet. 14–16, 72–75.

a. The Preamble

Claim 29 recites "[a] method of evaluating a command on a computer cluster." Ex. 1001, 31:17–18. Petitioner relies on its showing regarding the preamble, First Kernel, and First Cluster Node Recitations of claim 1. Pet. 72. Patent Owner does not contest this aspect of the Petition. *See generally* Prelim. Resp. For the reasons set forth above and on this preliminary record, to the extent the preamble is limiting, the asserted references supports Petitioner's contentions.

b. The Command Communicating Recitation

Claim 29 recites "communicating a command from at least one of a user interface or a script to one or more cluster node modules within the

computer cluster." Ex. 1001, 31:19–21. Petitioner relies on its showing regarding the First, Second, and Third Cluster Node Module Recitations of claim 1. Pet. 72.

Patent Owner challenges Petitioner's showings with substantially the same arguments advanced for claims 1 and 17. Prelim. Resp. 42–44. These arguments fail to persuade us to deny institution for the reasons set forth above.

For the reasons set forth above and on this preliminary record, the asserted references support Petitioner's contentions.

c. The Message Communicating Recitation

Claim 29 recites "for each of the one or more cluster node modules, communicating a message based on the command to a respective kernel module associated with the cluster node module." Ex. 1001, 31:22–25. Petitioner relies on its showing regarding the First, Second, and Third Cluster Node Module Recitations of claim 1. Pet. 73.

Patent Owner challenges Petitioner's showings with substantially the same arguments advanced for claims 1 and 17. Prelim. Resp. 42–44. These arguments fail to persuade us to deny institution for the reasons set forth above.

For the reasons set forth above and on this preliminary record, the asserted references supports Petitioner's contentions.

d. The Receiving Recitation

Claim 29 recites "for each of the one or more cluster node modules, receiving a result from the respective kernel module associated with the cluster node module." Ex. 1001, 31:26–28. Petitioner relies on its showing

regarding the Wherein Recitation of claim 1. Pet. 73. Patent Owner does not contest this aspect of the Petition. *See generally* Prelim. Resp. For the reasons set forth above and on this preliminary record, the asserted references supports Petitioner's contentions.

e. The Responding Recitation

Claim 29 recites "for at least one of the one or more cluster node modules, responding to messages from other cluster node modules." Ex. 1001, 31:29–31. Petitioner argues that Schreiner1 discloses this recitation. Pet. 73–75. For example, Petitioner argues that Schreiner1 discloses

> an example where node n sends a task message to node n' for execution, node n'' asks node n for the result of that task, node n' responds with the result of the task to node n (which is one instance of the claimed "responding"), and node n then sends a reply to node n'' containing the result (another instance of the claimed "responding").

*Id.* at 73–74 (citing Ex. 1008, 18, Fig. 5; Ex. 1005 ¶ 73). Patent Owner does not contest this aspect of the Petition. *See generally* Prelim. Resp. We find, on this preliminary record, that the cited portions of Schreiner1 support Petitioner's assertions that the nodes respond to messages from other cluster node modules.

f. Conclusion

As set forth above, we have considered the scope and content of the prior art (§ II.D above), the differences between the claimed subject matter and the prior art (§§ II.E.5.a–e above), the level of skill in the art (§ II.B above), and the objective evidence of nonobviousness (§ II.E.1.c above). Based on our findings, at this stage of the proceeding, we determine that

Petitioner has established a reasonable likelihood of prevailing on its assertion that claim 29 would have been obvious over the combination of Schreiner1, Schreiner2, Schreiner3, Maple Guide, and Distributed Maple Code.

*6. Claims 30–32*

Each of claims 30–32 depends directly from claim 29. The Petition maps the additional limitations of these challenged dependent claims to Schreiner1, Schreiner2, and Schreiner3. Pet. 75–77. Patent Owner does not challenge separately the arguments and evidence presented for the dependent claims. *See generally* Prelim. Resp. Based on our review of the current record before us, we determine that the information presented in the Petition establishes that there is a reasonable likelihood that Petitioner would prevail in challenging claims 30–32 as being unpatentable over the combination of Schreiner1, Schreiner2, Schreiner3, Maple Guide, and Distributed Maple Code.

F. Asserted Obviousness Based on Schreiner1, Schreiner2, Schreiner3, Maple Guide, Distributed Maple Code, Maple Reference, and Howard

Petitioner argues that claim 14 would have been obvious the combination of Schreiner1, Schreiner2, Schreiner3, Maple Guide, Distributed Maple Code, Maple Reference, and Howard. Pet. 77–82. In support of its showing, Petitioner relies upon the Tufo Declaration. *Id.* (citing Ex. 1005). We have reviewed Petitioner's assertions and supporting evidence. For the reasons discussed below, and based on the record before us, we determine that Petitioner demonstrates a reasonable likelihood of prevailing in showing that this claim would have been obvious over the

combination of Schreiner1, Schreiner2, Schreiner3, Maple Guide, Distributed Maple Code, Maple Reference, and Howard.

Claim 14 depends indirectly from claim 1 through claim 13 and further recites "wherein the advanced functions module comprises a call that calculates a Fourier transform across the computer cluster in parallel." Ex. 1001, 30:13–15. Petitioner argues that, because Schreiner1 discloses "a toolkit of advanced parallelized functions," it would have been obvious to include "calculating a Fourier transform across the computer cluster in parallel," as taught by Howard, in Distributed Maple. Pet. 78 (citing Ex. 1019 ¶¶ 141–152, 437–447, Figs. 66–69; Ex. 1005 ¶ 198). Petitioner argues that including Fourier transforms in the library of Distributed Maple functions would have been obvious because, during prosecution of an descendant patent of the '289 patent, the Examiner rejected a claim reciting the parallelized performance of Fourier transforms by finding that Howard taught the Fourier transform limitations. *Id.* at 79 (citing Ex. 1021, 384–85). Thus, according to Petitioner, "the USPTO already has issued a finding combining the same teachings of Howard used in this Petition—and that finding was not refuted by the applicant during prosecution." *Id.* (citing Ex. 1021, 428–29; Ex. 1005 ¶ 205). Petitioner additionally argues that it would have been obvious to perform Fourier transforms using Distributed Maple because Fourier transforms are a standard tool in many fields with well-known practical importance. *Id.* at 80–82.

Patent Owner does not challenge separately the arguments and evidence presented for the dependent claims. *See generally* Prelim. Resp.

Howard supports Petitioner's assertions. For example, Howard discloses that a two-dimensional fast Fourier transform ("FFT") is computed

on a data set consisting of an array having m rows and n columns (such as a bitmap image) by performing a one-dimensional FFT on each dimension. Ex. 1019 ¶ 142. Then, the m rows and n columns are distributed over the parallel processing nodes (*id.* ¶¶ 143–145), which compute the one-dimensional FFTs (*id.* ¶ 148). The results are accumulated in a home node to produce the final result. *Id.* We further determine that, based on this preliminary record, Petitioner has set forth articulated reasoning with rational underpinning explaining why a person of ordinary skill would have included Fourier transforms in the library of Distributed Maple functions.

According, based on our findings and on this preliminary record, we determine that Petitioner has established a reasonable likelihood of prevailing on its assertion that claim 14 would have been obvious over the combination of Schreiner1, Schreiner2, Schreiner3, Maple Guide, Distributed Maple Code, Maple Reference, and Howard.

G. Patent Owner's Additional Arguments

Patent Owner presents a number of additional arguments asserting that we should deny institution. Prelim. Resp. 58–66. First, Patent Owner argues that "[t]he Petition violates the requirement to construe the claims because it does not construe *any* claim terms, even though construction is necessary to resolve the Petition." *Id.* at 58. Patent Owner argues that we should deny institution because Petitioner failed to address, in its claim construction section, "cluster node module" and how the cluster node modules receive commands from the user interface. *Id.* at 59–61.

We are not persuaded that we should exercise our discretion to deny institution based on Petitioner's alleged failure to set forth adequate claim

constructions. We understand Petitioner's statement that "[t]he Challenged Claims are interpreted using the same standard used in federal district court" (Pet. 13 (citing 37 C.F.R. § 42.100(b))) to assert that the claims terms should be construed according to their ordinary and customary meaning. Thus, for purposes of this Decision, Petitioner has complied with our rule that the Petition must identify how the challenged claims are to be construed. *See* 37 C.F.R. § 42.104(b)(3).

Next, Patent Owner reiterates its argument that the Petition relies on assertions of public use made by Dr. Schreiner to fill in gaps in the asserted references. Prelim. Resp. 61–65. Patent Owner argues that we must deny institution if the Petition relies on public use in its challenges to the '289 patent. *Id.* at 62. Patent Owner also argues that even if we were to determine that the Petition does not rely improperly on asserted public use, we should exercise our discretion to deny institution "to avoid the injustice of allowing Petitioner to have two bites at the apple" because it is uncertain whether a district court "would apply estoppel to bar Petitioner from re-litigating essentially the same invalidity challenge in the form of a public use challenge." *Id.* at 63.

We are not persuaded that we should exercise our discretion to deny institution. As explained above, to the extent that Petitioner relies on Dr. Schreiner's assertions of public use, we do not consider such testimony for purposes of this Decision. As also explained above, we conclude that Petitioner maps the challenged claims to the asserted references adequately to satisfy its burden to establish a reasonable likelihood that Petitioner would prevail with respect to at least one of the claims challenged in the Petition.

Nor are Patent Owner's assertions that instituting *inter partes* review would improperly allow Petitioner "two bites at the apple." *See* Prelim. Resp. 63. First, as explained above, to the extent Petitioner makes arguments based on asserted public use, we do not consider such arguments. Moreover, Patent Owner's arguments amount to mere speculation about future events in a separate proceeding before a different tribunal. Such speculation does not persuade us that we should deny institution.

Finally, Patent Owner argues that "the Petition used tricks to undercount words," such as omitting spaces in abbreviations in citations to the papers and exhibits and copying text as images. Prelim. Resp. 66. According to Patent Owner, "[t]hese instances add up to about 1,000 excess words." *Id.* Patent Owner argues "[t]he Board has rejected briefs that used similar tricks." *Id.* (citing *Starbucks Corp. v. Ameranth, Inc.*, CBM2015-00091, Paper 16 at 2–3 (PTAB Jan. 29, 2016)).

Patent Owner does not seek a specific remedy. Rather, Patent Owner generally seeks a denial of institution at the end of its Preliminary Response "[f]or [all of] the foregoing reasons." *See* Prelim. Resp. 66 (citing *Starbucks*, Paper 16 (Board order directing patent owner to re-file its brief, which Patent Owner characterizes as a "rejected brief")). In any event, we are not persuaded that Petitioner's omission of spaces from its citation abbreviations amounts to "tricks" or gamesmanship warranting the re-filing of the Petition at this late stage or denial of institution. We agree with Patent Owner that the Petition incorporates text as images in three instances. *See* Prelim. Resp. 66 (citing Pet. 21, 54, 65). Although Patent Owner does not identify the number of "excess words" resulting from these images, it appears that there are approximately 280 words contained in these images.

We are not persuaded that the improper inclusion of this number of words as images or Petitioner's omission of these words from the word count warrants the re-filing of the Petition at this late stage or the draconian remedy of denying institution, especially where Patent Owner does not seek a specific remedy.

## III. CONCLUSION

For the foregoing reasons, we determine that the information presented establishes a reasonable likelihood that Petitioner would prevail in showing that at least one of claims 1, 4–6, 8, 10, 11, 13, 14, 16–19, 21–23, 27, and 29–32 of the '289 patent is unpatentable.

Our determination in this Decision is not a final determination on either the patentability of any challenged claim or the construction of any claim term and, thus, leaves undecided any remaining fact issues necessary to determine whether sufficient evidence supports Petitioner's contentions by a preponderance of the evidence in the final written decision. *See TriVascular, Inc. v. Samuels*, 812 F.3d 1056, 1068 (Fed. Cir. 2016) (noting that "there is a significant difference between a petitioner's burden to establish a 'reasonable likelihood of success' at institution, and actually proving invalidity by a preponderance of the evidence at trial").

## IV. ORDER

Accordingly, it is:

ORDERED that pursuant to 35 U.S.C. § 314(a), an *inter partes* review of claims 1, 4–6, 8, 10, 11, 13, 14, 16–19, 21–23, 27, and 29–32 of

the ’289 patent is instituted with respect to all grounds set forth in the Petition; and

FURTHER ORDERED that, pursuant to 35 U.S.C. § 314(c) and 37 C.F.R. § 42.4, notice is hereby given of the institution of a trial, which commences on the entry date of this decision.

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