

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

GOOGLE LLC,
Petitioner,

v.

VALTRUS INNOVATIONS LIMITED,
Patent Owner.

IPR2022-01406
Patent 7,748,005 B2

Before NORMAN H. BEAMER, KEVIN C. TROCK,
and SHARON FENICK, *Administrative Patent Judges*.

BEAMER, *Administrative Patent Judge*.

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

I. INTRODUCTION

On August 17, 2022, Google LLC (“Petitioner”) filed a Petition (“Pet.”) pursuant to 35 U.S.C. §§ 311–319 to institute an *inter partes* review of claims 1–20 of U.S. Patent No. 7,748,005 B2 (Ex. 1001, “the ’005 patent”). Paper 2. On April 10, 2023, we instituted *Inter Partes* Review. Paper 13. Subsequently, Patent Owner filed a Response (“PO Resp.”), Petitioner filed a Reply (“Reply”), and Patent Owner filed a Sur-Reply (“Sur-Reply”). Papers 22, 26, 31. An oral hearing was held on January 18, 2024, and a copy of the transcript was entered into the record.¹ Paper 39 (“Tr.”).

We have jurisdiction under 35 U.S.C. § 6. This Decision is a Final Written Decision under 35 U.S.C. § 318(a). Based on the complete record, we find that Petitioner has shown, by a preponderance of the evidence, that claims 1–20 of the ’005 patent are unpatentable.

II. BACKGROUND

A. The ’005 Patent

The ’005 patent, titled “System And Method For Allocating A Plurality Of Resources Between A Plurality Of Computing Domains,” was filed on September 10, 2004, and issued on June 29, 2010. Ex. 1001, codes (54), (22), (45). The ’005 patent is a continuation-in-part of application No. 10/206,594, filed on July 26, 2002, published February 20, 2003 as

¹ Patent Owner objected to Petitioner’s demonstratives presented at the hearing on the ground that they contain impermissible “new arguments” and evidence not “previously presented and discussed in the papers.” Paper 37, 1. This Decision does not rely on the demonstratives and therefore Patent Owner’s objections are overruled as moot.

publication US 2003/0037092 A1 (hereafter, the “McCarthy application” or “McCarthy”), now U.S. Patent No. 7,140,020, which in turn is a continuation-in-part of application No. 09/493,753, filed on January 28, 2000, now U.S. Patent No. 7,228,546. Ex. 1001, code (63); Ex. 1005; Ex. 1006; Ex. 1013, codes (10), (21), (43).

The ’005 patent is directed to allocating resources to computing domains. Ex. 1001, 1:19–21. The ’005 patent specifically describes two types of resource allocations to computing domains: “allocating physical resources between partitions,” and allocating “virtual resources as software constructs” to “virtual machines.” *Id.* at 13:37–47. In both cases, resource allocation is performed dynamically by the system, in response to changes in workload characteristics in the system, based on performance goals with different priorities defined by an administrator. *Id.* at 3:6–7, 3:14–20, 4:36–40.

For the physical partition embodiment, the ’005 patent explains that computer systems, which can be “a single small computer . . . a single large computer . . . or a network of larger and/or small computers,” can be divided into “protection domains or partitions.” Ex. 1001, 3:7–14. “Each partition may have one or more processors and other systems resources, e.g. storage devices, I/O devices, etc.” *Id.* at 4:61–63. “Each partition is preferably running its own operating system . . . which provides segregation and survivability between the partitions.” *Id.* at 4:63–66.

For the virtual machine embodiment, the ’005 patent explains that:

[V]irtualization refers to the creation of virtual machines that coexist on one or several physical servers. Virtualization software typically executes in connection with a host operating system of the physical server. The virtualization software

creates virtual resources as software constructs. The virtual resources are then assigned to virtual machines used for respective servers. Specifically, the virtual resources are used to execute “guest” operating systems that execute on top of the host operating system. The guest operating systems are then used to execute applications. Furthermore, each guest operating system operates independently. A software fault associated with any particular guest operating system and its application(s) may be contained within a given virtual machine.

Ex. 1001, 13:42–55; *see also id.* at 1:37–48.

Figure 1, reproduced below, illustrates the physical partition embodiment of the '005 patent subject matter.

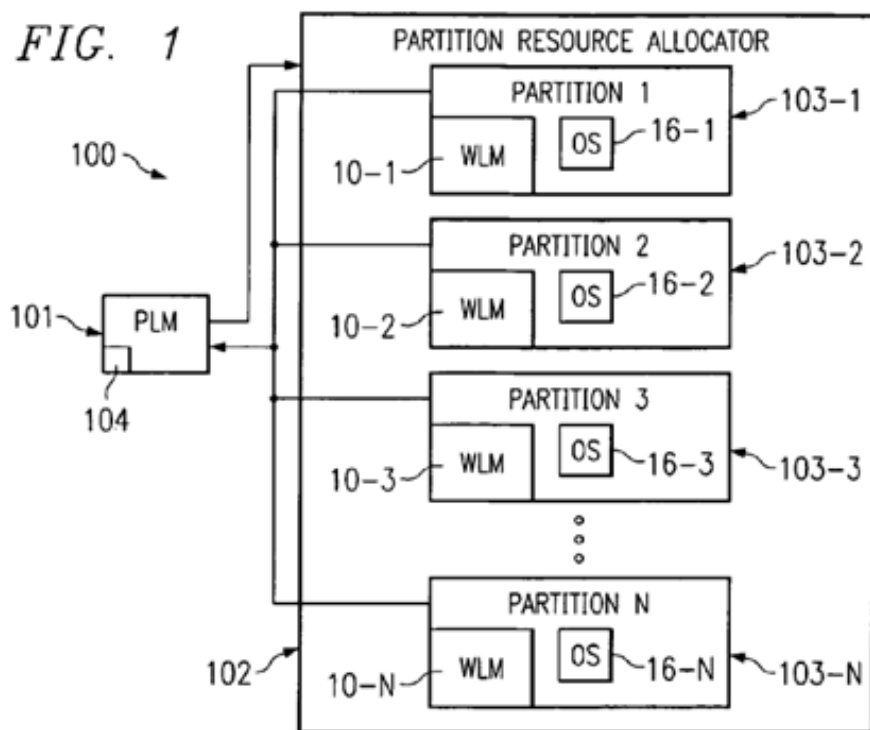


Figure 1 depicts partition load manager (PLM) 101 operating with a plurality of partitions 103-1 through 103-N, with each partition including workload manager (WLM) 10 and operating system (OS) 16. Ex. 1001, 2:52–54,

4:59–66. Although not shown in Figure 1, each partition also includes, *inter alia*, one or more CPUs (processors), applications, a performance monitor, and a goals configuration file containing application goals and priorities. *Id.* at Fig. 2, 4:61–63, 6:6–12, 6:30–44. WLMs 10 allocate a partition's resources to applications within a partition. *Id.* at 6:54–59. PLM 101 receives resource requests from the partitions, compares the requests with available resources, and allocates resources between partitions based on performance goals and priorities. *Id.* at 3:25–31, 3:38–44, 4:21–29, 5:14–16. Although Figure 1 depicts the PLM as separate from the partitions, it may reside in one partition and have access to the other partitions, or reside in each partition, and cooperatively allocate resources amongst themselves. *Id.* at 4:14–19.

Each WLM receives goal and priority information from the goals configuration file (provided by a user or administrator), and receives performance information from the performance monitor, which monitors the performance of the applications and devices within the partition. Ex. 1001, 3:58–59, 6:30–38. The WLM maintains a list of prioritized application goals with an indication of the quantity of each required resource. *Id.* at 4:24–27. The WLM compares the monitored information with the goals and priorities, and based on the comparison sends resource requests to the PLM. *Id.* at 3:65–4:9, 5:23–25, 6:30–38. The PLM receives the requests, and allocates the resources between the different partitions, based on the priorities of the partitions and the resource requests. *Id.* at 4:21–23, 7:13–17. This includes reassigning processors from one partition to another. *Id.* at 3:29–30, 4:61–63. WLM, after receiving information from PLM about its

partition resources, then allocates its allotted resources among the applications on its partition. *Id.* at 4:11–13.

Figure 7, reproduced below, illustrates the virtual machine embodiment of the '005 patent subject matter.

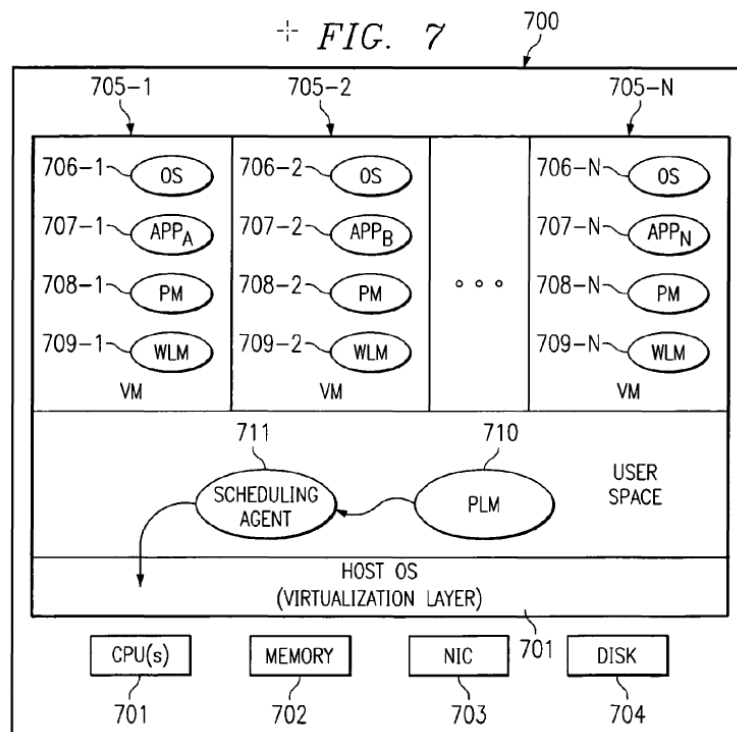


Figure 7 depicts a system that allocates virtual resources, based on underlying physical resources including CPUs 701, memory 702, network interface card (NIC) 703, and disk storage 704, and a host operating system that enables low level access to the physical resources. Ex. 1001, 13:62–67. The host operating system includes a virtualization software layer that virtualizes the physical resources as software constructs, creating virtual machines 705-1 through 705-N. *Id.* at 13:45–48, 13:65–14:5. The virtual machines “appear to software processes executing within the virtual machines to be physical server platforms,” and “provide partition and isolation functionality” such that a “software fault within any particular

virtual machine 705 may only affect the respective virtual machine 705, while software processes associated with the other virtual machines 705 may continue operations in an ordinary manner.” *Id.* at 14:5–13.

Each virtual machine includes guest operating system (OS) 706, applications (APP) 707, performance monitor (PM) 708, and workload manager (WLM) 709. Ex. 1001, 14:13–23. Partition load manager (PLM) 710 and scheduling agent 711 are software processes that operate in the user space associated with the host operating system. *Id.* at 14:27–37. The functional interaction between WLMs and PLM is similar to that described above for the physical partition embodiment: WLM receives performance data related to applications from the performance monitor and compares that to goals and priorities (also referred to as “SLOs,” or service level objectives), and when an application is not achieving its goals, WLM requests additional resources from PLM, which reallocates resources as appropriate. *Id.* at 14:21–34. PLM communicates with scheduling agent 711 which, for example, reassigns time slices of processors between virtual machines. *Id.* at 14:37–40.

B. Illustrative Claim

Independent claim 8 is reproduced below (with Petitioner’s identifiers of limitations in brackets).

8. A method, comprising:

[8.a] creating a plurality of computing domains;

[8.b] allocating a plurality of resources between said plurality of computing domains by a first manager process;

[8.c] executing at least one application, a second manager process, and a performance monitor process in each of said plurality of computing domains,

[8.d] wherein said second manager process maintains a list comprising a plurality of application priority levels for said at least one application and an indication of a quantity of said plurality of resources needed to meet said at least one level of said application priority levels and

[8.e] wherein said performance monitor process generates performance data related to said at least one application and

[8.f] said second manager process requests additional resources from the first manager process in response to analysis of said performance data in view of at least one service level parameter; and

[8.g] dynamically reallocating said plurality of resources between said plurality of computing domains by the first manager process in response to received requests for additional resources according to service level parameters.

Ex. 1001, 15:46–16:3; Pet. 77.

C. Asserted Challenges to Patentability and Evidence of Record

Petitioner challenges the patentability of claims 1–20 of the '005 patent based on the following references:

Claims Challenged	35 U.S.C. §	Reference(s)/Basis
1–20	103 ²	McCarthy, ³ Gien ⁴
1, 6, 8	102/103	McCarthy

Pet. 4. In support of its patentability challenge, Petitioner relies on, *inter alia*, the Declaration of Vijay K. Madisetti, Ph.D. In Support Of Petition For *Inter Partes* Review Of U.S. Patent No. 7,748,005, and the Declaration Of Vijay K. Madisetti, Ph.D. In Support Of Reply To Patent Owner Response. Ex. 1003 (“Madisetti Decl.”); Ex. 1060 (“Madisetti Reply Decl.”).

² The Leahy-Smith America Invents Act, Pub. L. No. 112-29, 125 Stat. 284 (2011) (“AIA”), included revisions to 35 U.S.C. § 103 that became effective as of March 16, 2013. The application for the '005 patent was filed before March 16, 2013, and therefore we apply the pre-AIA version of 35 U.S.C. § 103.

³ McCarthy, et al., US 2003/0037092 A1, published February 20, 2003 (“McCarthy,” Ex. 1013).

⁴ Michel Gien & Lori Grob, “Micro-kernel Based Operating Systems: Moving UNIX onto Modern System Architectures,” Proceedings of the UniForum '92 Conference, pp. 45–55 (1992). (“Gien,” Ex. 1014, Ex. A).

D. Real Parties in Interest

Petitioner identifies itself as a real party in interest. Pet. xiii. Patent Owner states:

Valtrus Innovations Limited (“Valtrus”) is the owner of U.S. Patent No. 7,748,005 (“the ’005 patent”). Valtrus Innovations Limited is a subsidiary of Key Patent Innovations Limited. Both Key Patent Innovations Limited and Valinvest LLC are financially interested in the outcome of the litigation between Valtrus and Google.

Paper 4, 1.

E. Related Proceedings

The parties identify the following related proceedings: *Valtrus Innovations Ltd. v. Google LLC*, Case No. 3:22-cv-00066 (N.D. Tex.) (“the Texas case”); *Valtrus Innovations Ltd. v. Google LLC*, Case No. 4:22-cv-00020 (N.D. Tex.); *Google LLC v. Valtrus Innovations Limited*, IPR2022-01408 (“IPR1408”); *Unified Patents, LLC v. Valtrus Innovations Limited*, IPR2022-01399 (“IPR1399”).⁵ Pet. xvi–xvii; Paper 4, 1–2.

III. ANALYSIS OF PETITIONER’S CHALLENGE

A. Legal Standards

To prevail in its challenge, Petitioner must demonstrate by a preponderance of the evidence that the claims are unpatentable. 35 U.S.C. § 316(e); 37 C.F.R. § 42.1(d). “In an IPR, the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable.” *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed.

⁵ IPR1408 and IPR1399 have been denied institution. Papers 13, 10, respectively.

Cir. 2016) (citing 35 U.S.C. § 312(a)(3) (2012) (requiring *inter partes* review petitions to identify “with particularity . . . the evidence that supports the grounds for the challenge to each claim”). This burden of persuasion never shifts to the patent owner. See *Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015) (discussing the burden of proof in *inter partes* review).

“A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference.” *Verdegaal Bros., Inc. v. Union Oil Co. of Cal.*, 814 F.2d 628, 631 (Fed. Cir. 1987). “The identical invention must be shown in as complete detail as is contained in the . . . claim.” *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236 (Fed. Cir. 1989). “These elements must be arranged as in the claim under review, but this is not an ‘ipsissimis verbis’ test.” *In re Bond*, 910 F.2d 831, 832 (Fed. Cir. 1990) (citations omitted).

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 said subject matter pertains. *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and (4) when in evidence, objective indicia of non-obviousness (also called secondary considerations), such as

commercial success, long-felt but unsolved needs, and failure of others.⁶ *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). We analyze grounds based on obviousness in accordance with the above-stated principles.

B. Level of Ordinary Skill in the Art

In determining whether an invention would have been obvious at the time it was made, 35 U.S.C. § 103(a) requires us to resolve the level of ordinary skill in the pertinent art at the time of the invention. *Graham*, 383 U.S. at 17. The person of ordinary skill in the art is a hypothetical person who is 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). Factors that may be considered in determining the level of ordinary skill in the art include, but are not limited to, the types of problems encountered in the art, the sophistication of the technology, and educational level of active workers in the field. *Id.* In a given case, one or more factors may predominate. *Id.*

Petitioner asserts that a person of ordinary skill in the art as of the September 10, 2004 filing date of the '005 patent:

would have had at least a Bachelor's degree in Computer Science, Computer Engineering, or related field, with three years of experience in the area of virtualization and distributed computer systems, including performance and/or resource optimizations A higher level of education may substitute for less experience A POSA's level of skill would not differ materially between the '005 patent's earliest possible priority date (in 2000) and its filing date (in 2004)

⁶ No evidence of secondary considerations appears in the record for us to consider.

Pet. 8 (citing Madisetti Decl. ¶ 61). Patent Owner does not specifically address the level of ordinary skill in the pertinent art at the time of the invention. *See generally* PO Resp.

Petitioner’s proposal is consistent with the level of ordinary skill in the art reflected by the asserted prior art. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001); *GPAC*, 57 F.3d at 1579. On this record, the level of ordinary skill is neither in dispute nor dispositive of any challenge. For this Decision, we apply Petitioner’s articulation.

C. Claim Construction

The Petition was accorded a filing date of August 17, 2022. Paper 6, 1. In an *inter partes* review for a petition filed on or after November 13, 2018, a claim “shall be construed using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. 282(b).” 37 C.F.R. § 42.100(b). We apply the claim construction standard from *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–13 (Fed. Cir. 2005) (en banc). Claim terms need only be construed to the extent necessary to resolve the controversy. *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co. Matal*, 868 F.3d 1013, 1017 (Fed. Cir. 2017).

The meaning of the claim term, “virtual machine,” is at issue — pertinent to determining whether the McCarthy application is prior art to the ’005 patent, which in turn hinges on whether McCarthy provides written description support for the “virtual machine” claim requirement (and related requirements), as discussed in Section III.D below. The term “virtual machine” appears in claims 2, 9, 12, 16 and in claims 3–5, 10–14, 17, and 18

by virtue of their dependency from claims 2, 9, 12, 16. Ex. 1001, 15:26–39, 16:4–24, 16:47–57.

Petitioner argues in the Petition that a person of ordinary skill in the art “would have understood ‘virtual machines’ in the ’005 patent as meaning software that mimics or emulates a complete computer system.” Pet. 12 (citing Ex. 1011, 471; Ex. 1012, 966; Ex. 1015, 1256 & 1054; Ex. 1017, 2:18–25; Madisetti Decl. ¶¶ 101–102). However, for the issue of whether the McCarthy application is prior art, Petitioner also argues that “[n]o exact outer boundary interpretation [of virtual machine] is needed, because under *any* reasonable interpretation no parent application to the ’005 patent supports the full scope of any Challenged Claim and the prior art meets the Challenged Claims.” *Id.* at 9.

Patent Owner proposes a construction it previously proposed in a joint claim construction chart submitted in the Texas case, that a virtual machine is “[a] set of virtual resources created as software constructs.” PO Resp. 46–50 (citing Ex. 2009, 32). In support of its proposed trial court definition, Patent Owner argues that the ’005 Patent “states that ‘virtualization refers to the creation of virtual machines’ and that ‘virtualization software creates virtual resources as software constructs.’” *Id.* at 46–47 (citing Ex. 1001, 13:40–48).

Patent Owner’s definition of “virtual machine” as “virtual resources created as software constructs” is problematic, given that it relies on “virtual” as part of the construction. It is also overbroad. For example, virtual memory is a virtual resource created as a software construct, but virtual memory is not itself a virtual machine. *See* Ex. 1019, 289. The statement in the ’005 patent that “virtualization refers to the creation of

virtual machines” is not a definition of the term, but rather describes how a virtual machine is created. The sentence following the reference to creating virtual resources as “software constructs,” on which Patent Owner relies, states, “[t]he virtual resources are *then* assigned to virtual machines used for respective servers.” Ex. 1001, 13:46–48 (emphasis added). Thus “virtualization” refers to creating virtual machines by assigning virtual resources as software constructs, but the nature and scope of what constitutes a “virtual machine” is unresolved by Patent Owner’s proposed construction. *See* Reply 5. In any event, like Petitioner, Patent Owner ultimately argues that it is unnecessary to pin down the outer bounds of the construction of “virtual machine,” because, according to Patent Owner, McCarthy discloses virtual machines under any of the constructions that have been considered here. Sur-Reply 17–20.

In regard to Petitioner’s proposed construction, while an emulated or mimicked complete computer system is certainly a category of virtual machine, “virtual machines” are not so limited. For example, so-called “system” virtual machines “provide[] a complete system environment,” but “process” virtual machines do not. Ex. 2034, Figs. 1.6, 1.7, 10–12; Edwards Decl. ¶¶ 70–72.⁷ As Patent Owner observes, “[v]irtual machines are a “diverse group” with “different goals,” “depending on the abstraction level where virtualization occurs.” PO Resp. 51 (citing Ex. 2027, 32–36, Fig. 3; Ex. 2034, 9–10, Figs. 1.4–1.5).

The record provides numerous examples defining or describing “virtual machine.” Given that the issue of whether or not the McCarthy

⁷ “Edwards Decl.” refers to the Declaration Of Dr. Stephen A. Edwards submitted by Patent Owner as Exhibit 2026.

application is prior art to the '005 patent hinges on the construction of “virtual machine” as understood as of the July 26, 2002 filing date of the application, we focus on examples dated prior to that date:

[S]imulated machines are called virtual machines (VMs), and the simulator software is called the virtual machine monitor (VMM). . . . The heart of a VM [virtual machine] system is the virtual machine monitor (VMM) software which transforms the single machine interface into the illusion of many. Each of these interfaces (virtual machines) is an efficient replica of the original computer system, complete with all of the processor instructions . . . and system resources (i.e., memory and I/O devices). Ex. 1008, 35–36 (1974).

virtual machine *n.* Software that mimics the performance of a hardware device, such as a program that allows applications written for an Intel processor to be run on a Motorola chip. Ex. 1011, 471 (1999).

Virtual Machine VM. Software that mimics the performance of a hardware device. Ex. 1012, 966 (2000).

virtual machine (software) A functional simulation of a computer and its associated devices. Ex. 1015, 1256 (2000).

The VM operating system for IBM systems is the best example of the virtual-machine concept, because IBM pioneered the work in this area. . . . By using CPU scheduling (Chapter 5) and virtual-memory techniques (Chapter 9), an operating system can create the illusion of multiple processes, each executing on its own processor with its own (virtual) memory. Ex. 1019, 74 (1998).

Virtual machine monitors (VMMs) implement in software a virtual machine identical to the underlying hardware. Ex. 1030, 2:36–67 (2000).

See also Madisetti Decl. ¶¶ 101–112.

These portions of the record inform our understanding of “virtual machine.” However, we note that these descriptions of “virtual machines”

hinge on such terms as “illusion,” “simulation,” “mimic,” and “replica” that are subjective, anthropomorphic, and very much dependent on the beholder. As the record discussed below reveals, the concept of what constitutes a virtual machine has evolved over the years, which, as discussed below, throws into question the legitimacy of relying on post-filing date references. Mindful that claim terms need only be construed to the extent necessary to resolve the controversy, *Nidec Motor Corp.*, *supra*, and given that the parties state that we do not need to define the full scope of “virtual machine” in general to resolve any controversy before us, we do not define that full scope as one of ordinary skill would have understood it as of the filing date of the McCarthy application. Rather, we base our analysis on the attributes that the pre-July, 2002 dictionaries and textbooks associated with virtual machines, such as virtualization of hardware, creating the illusion of multiple processes, use of CPU scheduling and virtual-memory techniques, functional simulation of a computer, and mimicking the performance of a hardware device. Considering these attributes, this Decision focuses on the dispositive issue of whether the evidence supports a determination that the McCarthy application’s disclosed physical partition embodiment would have disclosed a “virtual machine” to one of ordinary skill, and in any event whether it supports the full scope of “virtual machine” as that term is used in the ’005 patent.⁸ As discussed in the next Section, we find that it does not.

⁸ In the Decision to Institute, we stated, “[a]lthough we do not need to define the full scope of ‘virtual machine’ for purposes of this Decision, we interpret ‘virtual machine’ as encompassing software that mimics or emulates at least the basic functionality of a computer processor, but that merely virtualizing a resource such as memory or I/O devices, without more, does not create a virtual machine.” Paper 13, 14. This Decision is in accord with that

D. Prior Art Status of McCarthy

1. Petitioner's Arguments

As stated in Section II.A above, the '005 patent is a continuation-in-part of the McCarthy application. McCarthy was filed on July 26, 2002 and published February 20, 2003. Ex. 1013, codes (22), (43). Petitioner argues that none of the claims issued from the '005 application, filed on September 10, 2004, more than a year after the publication of the McCarthy application, are entitled to priority based on McCarthy, because McCarthy does not include written description support for the '005 claims. Pet. 1–4, 6–8, 10–17, 24, 58–65. Therefore, argues Petitioner, McCarthy is effective prior art to the '005 patent under pre-AIA 35 U.S.C. § 102(b). *Id.*

Petitioner relies on the fact that, although McCarthy includes all of the figures and accompanying description of the physical partition embodiment of the '005 patent, it does not mention virtual machines and does not include Figure 7 or any of the other portions of the '005 patent pertaining to the virtual machine embodiment. Pet. 10; *see* Ex. 1010 (“redline” comparison of written disclosure in '005 and U.S. Patent No. 7,140,020).⁹ Therefore, argues Petitioner, there is no written description support for the dependent '005 claims that explicitly require “virtual machines” (claims 2–5, 9–14 and 16–18 — the “VM claims”), “virtualization software layer” or “software virtualization layer” (claims 9–14 and 17 — the “VSL claims”), or “host

statement, in that there is ample evidence that processor emulation is an example of a “virtual machine.” Reply 5–8. However, as Patent Owner points out, the concept of “virtual machine” is not limited to processor emulation. PO Resp. 5, 54–56.

⁹ The McCarthy application issued as U.S. Patent No. 7,140,020 B2. Ex. 1005, code (45).

operating system” (claims 3–5, 10–14 and 18 — the “Host OS claims”).
Pet. 1–2, 6–7, 10–17.

Moreover, argues Petitioner, independent claims 1, 8, and 15, and dependent claims 6, 7, 19, and 20 (hereafter, the “computing domains claims”), while not limited to virtual machines, virtualization software layers, or host operating systems, nevertheless cover those virtual machine embodiments based on the “computing domains” requirement of these claims, because “computing domains” encompass virtual machines, virtualization software layers, and host operating systems, given that the pertinent dependent claims require that the computing domains include those components. Pet. 2, 7, 58–59.

Thus, Petitioner argues that McCarthy does not even support priority for the computing domains claims, because its written description does not support their full scope, which includes virtual machines, virtualization software layers, and host operating systems as well as physical partitions. *See D Three Enterprises v. SunModo Corp.*, 890 F.3d 1042, 1048–50 (Fed. Cir. 2018); *Rivera v. Int’l Trade Comm’n*, 857 F.3d 1315, 1319–21 (Fed. Cir. 2017). *Id.* at 59–65. On the other hand, because the computing domains claims also cover physical partitions, and because McCarthy indisputably discloses the physical partition embodiment, Petitioner relies on McCarthy as pertinent prior art to those claims. *Id.* at 2–3, 65–67. *See Chester v. Miller*, 906 F.2d 1574, 1577 (Fed. Cir. 1990) (“no impermissible anomaly or logical inconsistency” in treating parent application as prior art that invalidates “broader claims” it did not adequately describe).

Relying on the testimony of its declarant, Dr. Madisetti, Petitioner argues that McCarthy’s disclosure is limited to the physical partition

embodiment also described in the '005 patent. Pet. 13–17, 60 (citing Madisetti Decl. ¶¶ 113–132, 310).¹⁰ Dr. Madisetti submits that a partition is “a collection of hardware.” Madisetti Decl. ¶ 116; *see also id.* ¶¶ 113–115, 117–121. Dr. Madisetti cites to McCarthy:

Large computer systems, e.g. those with multiple processors, multiple I/O resources, multiple storage resources, etc., can be separated into partitions or protected domains. ***These partitions are hardware separations*** that place resources into separate functional blocks.

Madisetti Decl. ¶ 117 (citing Ex. 1005, 2:19–27 (emphasis added), corresponding to Ex. 1013 ¶ 8). The partitions of McCarthy contain one or more physical processors and McCarthy has the capability of reassigning a physical processor from one partition to another. Ex. 1013 ¶¶ 18, 25. As stated by Petitioner, “[p]artitions are ‘hardware separations that place resources into separate functional blocks,’ . . . which can be ‘resize[d]’ [t]hese are protected domains because ‘[r]esources in one block do not have direct access to resources in another block.’” Pet. 14 (citing Ex. 1005, 2:23–25, 3:10–11, 3:27–29, 5:44–47; Madisetti ¶¶ 117–119).

Relying on Petitioner’s proposed construction of “virtual machine” (“software that mimics or emulates a complete computer system”),

¹⁰ Patent Owner argues that Dr. Madisetti’s testimony should be given no weight, asserting that he ignored pertinent facts and refused to answer questions at his deposition. PO Resp. 39–42. Petitioner replies that Dr. Madisetti’s answers at his deposition were appropriate. Reply 20–21. We have reviewed Dr. Madisetti’s deposition transcript and do not discern that this issues raised would cause us to disregard his testimony. Ex. 2026, Ex. 2049 (Errata). With respect to the asserted issues with the testimony, when raised in arguments relating to the issues being discussed we take the answers into account when exercising our broad discretion to assign weight to be accorded to expert testimony.

Dr. Madisetti testifies that one of ordinary skill “would have understood [McCarthy’s] partitions cannot be a VM because the partition can include physical resources, while a VM is software (*i.e.*, not a physical resource) that emulates a computer system.” Madisetti Decl. ¶ 122; *see also id.* ¶¶ 123–132. Petitioner further argues, relying on the testimony of Dr. Madisetti, that McCarthy does not provide written description support of the claimed “virtualization software layer” or “software virtualization layer” that creates the guest operating systems of virtual machines, because nothing in McCarthy creates virtual resources as software construct, but rather assigns physical processor resources to partitions. Pet. 19–20 (citing Madisetti Decl. ¶¶ 141–148). Likewise, Petitioner argues that McCarthy does not provide written description support for the “host operating system” that includes the virtualization layers. *Id.* at 22–23 (citing Madisetti Decl. ¶¶ 153–155).

Petitioner acknowledges that McCarthy is titled “Dynamic Management Of *Virtual* Partition Computer Workloads Through Service Level Optimization.” Ex. 1005, code (54) (emphasis supplied); Pet. 14. But Petitioner argues that this only refers to the sole occurrence of the word “virtual” in the McCarthy specification: “the partitions may be *virtual*, as the multiple partitions may reside in one or more physical computers.” Pet. 14 (citing Ex. 1005, 4:62–63, corresponding to Ex. 1013, ¶ 24) (emphasis added). Petitioner relies on Dr. Madisetti, who testifies that this passage does not describe or suggest that partitions can be virtual machines, but rather simply states that partition hardware can be located in more than one computer. *Id.* at 14–15 (citing Madisetti Decl. ¶¶ 123–124, *see also id.* ¶¶ 127, 146–147).

Regarding its arguments concerning lack of support for a computing domains genus, Petitioner notes that, to provide written description support for claims requiring “computing domains” as a genus encompassing at least a species of “partition” embodiments and a species of “virtual machine” embodiments, McCarthy must disclose either (1) “structural features common to the members” of the genus (computing domains) or (2) “a representative number of species falling within the scope” of the genus so that a person of ordinary skill “can visualize or recognize the members of the” computing domain. *Ariad v. Eli Lilly*, 598 F.3d 1336, 1350 (Fed. Cir. 2010) (en banc). Pet. 59–60.

Petitioner argues that nothing in McCarthy provides a basis for finding that it discloses a genus of systems allocating resources to computing domains that would encompass virtual machines as one species of the genus. Pet. 60–65 (citing Madisetti Decl. ¶¶ 117–119, 310–314). Petitioner also argues that McCarthy makes no mention of “computing domains” and never describes using its resource allocation methods in anything other than partitions, does not provide “structural features common to the members” of a “computing domains” genus that expressly includes virtual machines, and does not describe a representative number of species falling within the scope of “computing domains.” *Id.*

2. *Patent Owner’s Response*

Patent Owner argues that McCarthy is not prior art to claims 1, 2, 6–9, 15–17, 19, and 20, which are the claims that do not require a “host operating

system.” PO Resp. 3.¹¹ Patent Owner first argues that McCarthy supports the “virtual machine” claim requirement that appears in claims 2, 9, 16 and 17. PO Resp. 4–42. Next, Patent Owner addresses the additional “virtualization software layer” or “software virtualization layer” requirement appearing in claims 9 and 17. PO Resp. 42–44. Finally, Patent Owner argues that McCarthy supports the full scope of the computing domains claims 1, 6–8, 15, 19, and 20. PO Resp. 44–45. There is no dispute that the other requirements of claims 1–2, 6–9, 15–17, 19 and 20 are disclosed in McCarthy. *See* PO Resp. 56–58.

a) Virtual Machine Claims 2, 9, 16 and 17

Patent Owner asserts that “McCarthy ‘reasonably conveys to those skilled in the art that the inventor had possession of’ virtual machines through its disclosure of ‘virtual’ partitions that allow for the ***dynamic allocation of processing resources*** by a software manager.”

PO Resp. 4–5 (citing *Hologic, Inc. v. Smith & Nephew, Inc.*, 884 F.3d 1357, 1361 (Fed. Cir. 2018)). Patent Owner argues that written description does not require the use of the exact terms (*in haec verba*) or listing “every conceivable” permutation of an invention. *Id.* at 4 (citing *Cordis Corp. v. Medtronic AVE, Inc.*, 339 F.3d 1352, 1364–65 (Fed. Cir. 2003)). Patent Owner asserts that “the industry often does not use the term virtual machine to refer to what are, in fact, virtual machines.” *Id.*

¹¹ Patent Owner does not concede that McCarthy fails to support the host operating system claims 3–5, 10–14 and 18, but for purposes of this Proceeding does not assert that there is support for those claims. Tr. 25:16–21. Instead, Patent Owner propounds other arguments opposing Petitioner’s challenge, discussed in Section III.F.4 below.

In arguing that the partition embodiment of McCarthy falls under the scope of the VM claims, Patent Owner and its declarant, Dr. Edwards, primarily rely on references dated *after* the McCarthy filing date to list various asserted attributes of virtual machines. PO Resp. 4, 10–11, 15–16; Edwards Decl. ¶¶ 70–72, 79–80. These include:

Virtual machines “add a software layer to a real machine to support the desired architecture” to “circumvent real machine compatibility and hardware resource constraints.” “A virtual machine can support individual processes or a complete system depending on the abstraction level where virtualization occurs.” Ex. 2027, 32–33 (2005).

Dynamic allocation of portions of processing capacity is known as CPU scheduling, and it is the basic tool that creates the VM illusion. Ex. 2032, 729 (2008); Ex. 2007, 64 (2005).

The concept of time sharing was developed to improve resource utilization by allowing multiple users to access a single computer system simultaneously, with each user being given the illusion of having access to a full set of system resources. In order to create this illusion, a multiprogramming operating system essentially implements a process virtual machine for each application-level program and switches resources among the programs on a time-shared basis. Ex. 2034, 369 (2005).

VMs are, at their core, time-sharing systems that multiplex resources like processors from around a system. . . . Sharing the real processor among virtual machines is a scheduling problem that’s not much different from the scheduling used by a normal OS to multiplex the processor among its threads. Ex. 2008, 144–145, 149 (2011).

When a system (or subsystem), e.g., a processor, memory, or I/O device, is virtualized, its interface and all resources visible through the interface are mapped onto the interface and resources of a real system actually implementing it [T]he real system is transformed so that it appears to be

a different, virtual system or even a set of multiple virtual systems. Ex. 2034, 3 (2005).

VM “creat[es] the illusion that each separate execution environment is running its own private computer.” Ex. 2007, 64 (2005).

See also, PO Resp. 16 (citing Ex. 2027, 36 (2005); Ex. 2034, Fig. 9.1, 374, 446, 458 (2005); Ex. 2007, 64 (2005); Edwards Decl. ¶ 95). In addition to the above post-McCarthy references, Patent Owner also relies on a 1974 article and a 1998 text book describing the virtual machine concept (PO Resp. 10, 16):

The VM operating system for IBM systems is the best example of the virtual-machine concept. . . .

By using CPU scheduling . . . and virtual-memory techniques . . . an operating system can create the illusion of multiple processes, each executing on its own processor with its own (virtual) memory. . . .

The resources of the physical computer are shared to create the virtual machines.

Ex. 1019, 74 (1998).

Considerations of [speed] have led to the development of much more efficient simulators for multiple copies of a machine on itself. In these systems, much of the software for the simulated machine executes directly on the hardware without software interpretation. Systems of this kind are called *virtual machine systems*, the simulated machines are called *virtual machines* (VMs), and the simulator software is called the *virtual machine monitor* (VMM).

. . . .

The heart of a VM system is the virtual machine monitor (VMM) software which transforms the single machine interface into the illusion of many. Each of these interfaces (virtual machines) is an efficient replica of the original computer system, complete with all of the processor instructions (i.e.,

both privileged and nonprivileged instructions) and system resources (i.e., memory and I/O devices).

Ex. 1008, 35–36 (1974).

Relying on these excerpts, and on its declarant Dr. Edwards, Patent Owner argues that the physical partition embodiment disclosed in McCarthy would have been regarded by persons of ordinary skill in the art, as of the July 26, 2002 filing date, as disclosing virtual machines. PO Resp. 4–21. Patent Owner argues “McCarthy necessarily describes emulating the functionality of a computer processor because it discloses dynamic allocation of fractions of processors and other resources among its partitions using software.” *Id.* at 5 (citing Edwards Decl. 39–51, 73–88). Patent Owner argues that an application running within a partition “appears to be running on real processor capacity, but which in fact is virtualized access to processing capacity that is not part of the partition.” *Id.* at 6. Patent Owner asserts that “[p]artitions’ and ‘domains are well-known terms referring to VMs with a virtual machine monitor (‘VMM’) (or hypervisor).” *Id.* (citing Ex. 2032 (dated 2008), 722–723).

Patent Owner additionally argues that the McCarthy partition embodiment is a virtual machine because resources, such as CPU time, are allocated between different partitions dynamically by adjusting the allocation based on resource availability and priority. PO Resp. 7–9 (citing Ex. 1013 ¶¶ 8, 18, 21, 24, 26–27, 34, 37–38, 42, 52). In particular, Patent Owner asserts that the McCarthy partition embodiment has the capability of assigning processor resources to partitions as percentages or as fractional values on a dynamic basis. *Id.* Patent Owner argues, “[b]ecause the PLM [partition load manager] is able to dynamically allocate resources, the PLM

creates the classic VM illusion to applications and the operating system that these newly allocated, fractions of resources are available within the partition.” *Id.* at 9 (citing Edwards Decl. ¶¶ 73–77). Thus, argues Patent Owner:

A skilled artisan would necessarily understand that dynamic allocation of fractional divisions of processors and other resources among separate partitions could only be done by using software . . . to emulate the functionality of a processor (and other resources) as present within the partition.

Id. at 10 (citing Edwards Decl. ¶¶ 79–80). Patent Owner further argues that this dynamic allocation of processing capacity is known as “CPU scheduling,” which is “the basic tool that creates the VM illusion.” *Id.* (citing Ex. 2032 (dated 2008), 729; Ex. 2007 (dated 2005), 64; Ex. 1019 (dated 1998), 74). Patent Owner cites, as virtual machine-like characteristics of the McCarthy partition embodiment, “simultaneous time sharing of processing resources,” multiplexing processor resources, and employing time-slicing of processor time. *Id.* at 10–12 (citing Ex. 2034 (dated 2005), 369; Ex. 2008 (dated 2011), 144–145, 149; Edwards Decl. ¶¶ 81–88).

Patent Owner challenges Petitioner’s assertion that the ’005 patent distinguishes partitions and virtual machines as if the two were mutually exclusive. PO Resp. 12. Patent Owner argues that, instead, the ’005 patent distinguishes between, on the one hand, prior art static partition systems with pre-assigned resources, and on the other hand, virtual machine technology encompassing both partitions with dynamic allocation of resources and the other virtual machine example described in Figure 7. *Id.* at 13–19 (citing Ex. 1001, 1:37–39, 13:37–41, 14:7–9, 14:57–62; Edwards Decl. ¶¶ 55, 89–93). Patent Owner argues that Petitioner’s argument that McCarthy is

limited to hardware partitions, based on the statement in McCarthy that “partitions are hardware separations,” only applies to the prior art static petitions described in the background section of McCarthy, not to the dynamic partitioning embodiment that is properly regarded as describing virtual machines. *Id.* at 17–18 (citing Ex. 1013 ¶¶ 8, 25; Edwards Decl. ¶¶ 94–104).

Patent Owner argues that McCarthy, for its partition embodiment, and the '005 patent, for both its partition and Figure 7 embodiments, each use a workload manager and partition load manager to dynamically allocate fractional processor time to domains running their own operating systems for segregation, fault protection, and survivability, and both McCarthy and the '005 patent state the partitions may be virtual. *Id.* at 36–39 (citing Edwards Decl. ¶¶ 51–58). Patent Owner argues that this confirms that the dynamic partition embodiments are virtual machines just like the Figure 7 embodiment. *Id.*

In addition, Patent Owner points out that McCarthy states that the “present invention” may be “implemented in software,” which Patent Owner argues refutes Petitioner’s characterization of partitions as limited to hardware embodiments. PO Resp. 18–19 (citing Ex. 1013 ¶ 57; Edwards Decl. ¶¶ 103–104).

Patent Owner addresses the import of the statement in McCarthy that “partitions may be virtual, as the multiple partitions may reside in one or more physical computers.” PO Resp. 14–17, 19–37. In contrast to Petitioner’s characterization, Patent Owner argues that this statement is confirmation that the partition embodiment is a virtual machine because the partitions are not constrained by physical boundaries given the emulation of

resources not within the partition. *Id.* at 14–16 (citing Ex. 1013, Title, ¶ 25; Ex. 2034, Fig. 9.1, 3, 374, 446, 458; Ex. 1016 ¶ 23; Ex. 1008, 36; Ex. 2027, 36; Ex. 2007, 64; Edwards Decl. ¶¶ 82, 94–95). As further confirmation, Patent Owner argues, McCarthy contemplates multiple different operating systems running within its partitions. *Id.* at 16–17 (citing Ex. 1013, ¶¶ 18, 24–25; Edwards Decl. ¶¶ 88, 81, 88, 99–102). Also, Patent Owner relies on a 2005 textbook that describes “Logical Partitioning” as virtual machines because such systems assign processing power on the fly to different partitions and “the logical partition only has the illusion of owning the resources that are allocated for its use.” *Id.* at 19–20 (citing Ex. 2034, 5, 373, 445–497; Edwards Decl. ¶ 106). Patent Owner describes such logical partition systems as making use of virtual machine monitors (VMMs), also called “hypervisors,” which are characteristic of virtual machines, and which logically divide resources among partitions. *Id.* at 20–22 (citing Ex. 2034, Figs. 9.1, 9.5, 24, 374, 445–447, 452–454, 458–475; Ex. 2027, 36; Ex. 1008, 36; Ex. 2027, 36; Ex. 2034, Fig. 9.1, 374, 446, 458; Edwards Decl. ¶¶ 87, 95, 99, 107–111, 130, 152).

In further support of its position that the reference in McCarthy to virtual partitions would suggest to one of ordinary skill the use of virtual machines, Patent Owner relies on three systems, allegedly contemporaneous with the filing of the McCarthy application, that it asserts use a similar virtual partition approach: Disco, HP’s vPars, and IBM’s LPARs. PO Resp. 22–35. Patent Owner alleges that each “provide isolated, virtual computing domains with independent operating systems and applications on a single computer . . . , a virtualization software layer . . . on top of virtualized hardware like CPU resources. . . ,” and thus each present the illusion to the

operating system that it is running on a separate machine. *Id.* at 22–23 (citing Ex. 2031, Fig. 2-4; Ex. 1030, Fig. 1; Ex. 2020, Fig. 1a; Ex. 1008, 36; Ex. 2027, 36; Ex. 2024, Fig. 9.1, 374, 446, 458; Edwards Decl. ¶¶ 87, 95, 99, 108, 112–113, 130, 152). Patent Owner argues that, like McCarthy, these systems allow for the dynamic allocation of resources. *Id.* at 23–24.

Patent Owner’s reliance on the Disco system includes a 1999 paper by Govil, that was cited during the prosecution of McCarthy, a 1997 article by Bugnion, et al., and a patent issued in 2000 to Bugnion, et al. PO Resp. 24–25 (citing Ex. 1005, 1; Ex. 2010, 74, 162; Ex. 1007; Ex. 1030; Ex. 2042). Govil describes the “Cellular Disco System” developed at Stanford University, which was derived from an earlier system called Disco described in Bugnion. Ex. 2034, 477. Patent Owner, citing these references, describes Disco (and Cellular Disco) as a virtual machine monitor that virtualizes processors and other hardware, by scheduling the hardware to create multiple virtual machines running independent operating systems and applications. PO Resp. 25–27 (citing Ex. 1007, 412, 415, 433; Ex. 1030, Fig. 1, 2:36–67, 4:6–16, 4:28–38, 4:52–55, 4:58–60, 6:17–20, 7:53–58, 8:56–65, 9:24–35, 11:8–10; Ex. 2042, 1, 155–157; Edwards Decl. ¶¶ 119–122). Patent Owner argues that Disco, like McCarthy, discloses the same dynamic allocation of resources to its virtual machine partitions, including fractional CPU resources. *Id.* at 26–27 (citing Ex. 1030, 4:58–60, 6:17–20, 11:8–10; Ex. 2042, 155–157; Edwards Decl. ¶¶ 121–122). Patent Owner describes the Disco systems as “logical partition systems,” and asserts that “[a] skilled artisan would [have] immediately thought of Disco as a ‘virtual partition’ in McCarthy.” *Id.* at 24–25 (citing Edwards Decl. ¶¶ 117–122).

Patent Owner's reliance on IBM LPARs includes a 2003 patent to Eilert, et al., which was discussed by the Examiner during the McCarthy prosecution, and a 2001 European application and a 2001 IBM white paper, both submitted during the prosecution. PO Resp. 27 (citing Ex. 2020; Ex. 2029; Ex. 2030; Ex. 2010, 58–65, 74–95, 123–131). Patent Owner, citing these references, describes IBM LPARs as including an LP Manager that acts as a “type 0 hypervisor,” a type of virtual machine monitor, that virtualizes processors and other hardware, by scheduling the hardware to create multiple virtual machines running independent operating systems and applications. *Id.* at 28–32 (citing Ex. 2029, Figs. 1A, 1B, ¶¶ 2, 20, 21, 24, 26, 35, 75–76; Ex. 2020, Figs. 1A, 1B, 1:48–51, 4:12–28, 4:50–56, 6:47–55, 17:44–47, 17:54–56; Ex. 2030, 2–3; Edwards Decl. ¶¶ 123–128). Patent Owner relies on a 2005 textbook to assert that “[i]n an IBM LPAR, ‘partitioning is “logical,” in the sense that a partition has no distinct, time-invariant physical boundaries.’” *Id.* at 28 (citing Ex. 2034, 458). Patent Owner argues that IBM LPARs, like McCarthy, discloses the same dynamic allocation of resources to its logical partitions, including fractional CPU resources. *Id.* at 32 (citing Ex. 2020, Abstract, 2:27–31; Ex. 2030, 2–3; Ex. 2034, Fig. 9.6, 473–474; Edwards Decl. ¶¶ 127–128).

Patent Owner's reliance on HP vPars includes a 2003 User's Guide, a 2002 textbook, a 2002 manual, and a 2002 white paper. PO Resp. 32–33 (citing Ex. 1039; Ex. 2028; Ex. 2031; Ex. 2035). Patent Owner argues that the mention of “virtual partitions” in McCarthy refers to HP vPars, given that McCarthy was assigned to HP and that McCarthy was characterized as using “vPars” during prosecution. *Id.* at 32 (citing Ex. 1013; Ex. 2010, 134, 130). Patent Owner, citing these references, describes HP vPars as turning a

server “into many ‘virtual’ computers,” each “running their own instance of HP-UX and associated applications,” in which a vPars monitor manages “the assignment of hardware resources to virtual partitions, boots virtual partitions and their kernels, and emulates certain firmware calls.” *Id.* at 33–35 (citing Ex. 2035, cover, xix; Ex. 2028, Fig. 6, 9, 20; Ex. 2031, 37).

Patent Owner argues that the vPars monitor’s emulation of firmware calls “creates the illusion to each HP-UX instance that it is running on a standalone server, consisting of the hardware that has been assigned to it.” *Id.* at 34 (citing Ex. 2031, Fig. 2-4, 37). Patent Owner argues that a skilled artisan would have understood this “illusion” of a standalone server created through emulating calls and dynamic resource assignment to be a “virtual machine”, and that HP vPars, like McCarthy, uses a dynamic allocation of processing resources to its virtual partitions controlled by its vPars monitor. *Id.* at 35 (citing Ex. 2028, 9, 10, 19–20, 34, 37, 41; Edwards Decl. ¶¶ 130–131).

As further evidence that McCarthy describes virtual machines, in addition to the references to Disco; HP’s vPars; and IBM’s LPARs in the McCarthy prosecution history, Patent Owner also submits that during the prosecution of McCarthy the examiner searched for prior art with terms that included “virtual machine” and classified McCarthy under “Virtual Machine Task or Process Management or Task Management/Control” PO Resp. 36 (citing Ex. 2010, 116–119; Ex. 1005; Ex. 2014). Patent Owner also argues that, after McCarthy issued, “the Office has repeatedly described McCarthy as related to ‘virtual machine[s]’ and ‘virtual environment[s].’” *Id.* (citing Ex. 2039, 5, 8, 18, 22, 33, 37; Ex. 2040, 3–4, 5–7; Ex. 2041, 12).

b) Virtualization Layer Claims 9 and 17

Noting that the virtualization layer claim requirements are satisfied by software that creates virtual resources as software constructs, Patent Owner argues that McCarthy at least inherently provides resources as software constructs for the same reasons it discloses “virtual machines.” PO Resp. 42 (citing Edwards Decl. ¶¶ 133–134). In addition, Patent Owner argues that the Partition Load Manager (PLM) of McCarthy is a virtualization software layer because it “manages and allocates resources to McCarthy’s virtual partitions.” *Id.* at 43–44 (citing Edwards Decl. ¶ 135).

c) Computing Domains Claims 1, 6–8, 15, 19, and 20

Patent Owner argues that McCarthy supports the computing domains genus claims because the virtual partition species disclosure is sufficient for written description, given that other members of the computing domains genus were well known in the art. PO Resp. 44 (citing *Hologic*, 884 F.3d at 1361). In addition to McCarthy’s explicit disclosure of virtual partitions, Patent Owner relies on the references to Disco, HP’s vPars, and IBM’s LPARs during the prosecution of McCarthy, the searches for virtual machine art during the prosecution, and the above-summarized record allegedly linking partitions to virtual machines, as sufficient to fulfill disclosure of the computing domains genus. *Id.* Patent Owner also relies on post filing date documents describing the ESX virtual machine marketed by VMware to “show the close link between logical partitions and virtual machines.” *Id.* at 44–45 (citing Ex. 1022, 1, 2 (dated Nov. 2002); Ex. 1023 (dated 2003), Fig. 1, 4, 6; Ex. 1024 ¶¶ 2, 20 (dated 2004); Edwards Decl. ¶¶ 114–116, 137, 140).

Patent Owner distinguishes the authorities finding insufficient written description support for a genus where a single species is disclosed, given that Petitioner does not allege that the field of invention is unpredictable or that the specific Figure 7 embodiment of the '005 patent was critical to the invention. PO Resp. 45 (citing *Ariad*, 598 F.3d at 1354, 1358; *In re Global IP Holdings LLC*, 927 F.3d 1373, 1376 (Fed. Cir. 2019)). Instead, argues Patent Owner, “a skilled artisan would have immediately thought of virtual partition systems, like Disco, IBM LPARs, and HP vPars, that share identical traits and structures as virtual machines: emulation, independent operating systems, software isolation, application portability with structural and functional similarities between the '005 Patent’s example virtual machine and virtual partitions.” *Id.* (citing Edwards Decl. ¶¶ 138–140).

3. *Petitioner’s Reply*

As a threshold matter, Petitioner argues that Patent Owner fails to meet its burden of production to identify support in McCarthy. Reply 1 (citing *Dynamic Drinkware*, 800 F.3d at 1379–1380; *Parus v. Google*, 70 F.4th 1365, 1371 (Fed. Cir. 2023)). Petitioner argues that the claim chart submitted by Patent Owner, based on Petitioner’s invalidity averments comparing McCarthy to the claims, is insufficient to demonstrate that McCarthy supports the full scope of the claims. *Id.* at 2. In particular, Petitioner argues that Patent Owner’s claim chart does not demonstrate that McCarthy provide full support for the “computing domains” claim requirement. *Id.* Petitioner emphasizes that the full scope of this requirement includes, not just the physical partition embodiment of the '005 patent, but also the “VMs [virtual machines], virtualization software, host OS, guest OS, ‘virtual resources as software constructs,’ and dynamically

reallocating resources between VMs using new components (scheduling agent 711, virtualization layer) and processes (message communication, system calls).” *Id.* at 3 (citing Pet. 6–7, 15; Ex. 1010; Ex. 1001, Fig. 7, 3:31–37, 13:37–15:2).

Also, Petitioner argues that Patent Owner’s “block-citations” to a forty-plus page range of its Response is impermissibly vague. Reply 2. Moreover, Petitioner criticizes Patent Owner’s reliance on references that post-date the McCarthy filing date. *Id.* (citing *Ariad*, 598 F.3d at 1355).

a) Virtual Machine Claims 2, 9, 16 and 17

Petitioner challenges Patent Owner’s argument that the virtual partitions mentioned in McCarthy are a type of virtual machine. Reply 3–16. In particular, Petitioner maintains that the ’005 patent explicitly distinguishes virtual partitions from virtual machines: after describing the virtual partition embodiment that allocates physical resources between partitions, which is also described in the same words in McCarthy, the ’005 patent separately adds completely new matter which is introduced with the statement, “[a]nother suitable computing domain is a virtual machine.” *Id.* at 4 (citing Ex. 1001, 13:40–41; Madisetti Decl. ¶¶ 305–306). Petitioner argues that, insofar as the ’005 patent is concerned, virtual machines refer to something different from partitions. *Id.*

Petitioner also challenges Patent Owner’s characterization of the McCarthy partition embodiment as having the capability of allocating fractional CPU shares to partitions — an ability that Patent Owner attributes to virtual machines. Reply 8–9. Petitioner explains that the McCarthy embodiment allocates fractional CPU shares to applications — but not partitions. *Id.* (citing Ex. 1013 ¶¶ 4, 33–34; Ex. 1058, 182:12–184:12;

Madisetti Reply Decl. ¶¶ 41–45). Petitioner also argues that the allocation of processor resources to partitions involves an accounting process that determines how many resources a partition needs by assigning “percentages” of processors, but this value is then rounded to a full processor when the allocator actually allocates it to a partition. *Id.* at 9 (citing Ex. 1013, Figs. 4A, 5A–5B, ¶¶ 42, 53–54; Madisetti Reply Decl. ¶ 51).

In any event, Petitioner argues, software that merely allocates fractions of physical processors does not emulate a processor’s functionality. Reply 9 (citing Ex. 1030, 7:32–35 (distinguishing “virtualiz[ing] resources” from “multiplexing them”); Ex. 1058, 98:8–17, 99:5–23, 100:19–102:2, 103:6–104:5; 196:17–197:3; Madisetti Reply Decl. ¶¶ 53–58).

Regarding Patent Owner’s reliance on Disco, HP’s vPars, and IBM’s LPARs, Petitioner argues that this extrinsic evidence cannot cure the lack of disclosure of virtual machines in the four corners of the McCarthy application. Reply 10. For HP’s vPars, Petitioner argues that the product only allocates processors to partitions, but does not create virtual machines. *Id.* at 10–12 (citing Ex. 2031, 37; Ex. 2035, Fig. 1-1, xxi, 2; Madisetti Reply Decl. ¶¶ 76–85). For IBM’s LPARs, Petitioner argues that McCarthy specifically excludes LPARs by virtue of its incorporation by reference of a patent to Bouchier that states “systems which are not multiple partition computers are: . . . based on IBM’s Logical Partitions (LPARs).” *Id.* at 12 (citing Ex. 1013 ¶ 28; Ex. 1018, 13:23–28; Madisetti Reply Decl. ¶¶ 114–117). Petitioner argues that the fact that the Examiner rejected claims during the McCarthy prosecution based on LPARs relates to an obviousness inquiry, and does not indicate written description support. *Id.* at 12–13. Moreover, Petitioner argues that the IBM LPARs are not virtual machines,

but rather “could be substituted” for virtual machines. *Id.* at 13 (citing Ex. 1024 ¶ 39; Madisetti Reply Decl. ¶¶ 96). In regard to Disco, Petitioner argues that Disco does not relate to logical, or virtual, partitioning of hardware, but rather, at most, relates to the prior art virtual machines that are first introduced in the ’005 patent but are absent from the McCarthy disclosure. *Id.* at 13–14 (citing Ex. 1024 ¶ 39; Madisetti Reply Decl. ¶¶ 92–93, 99–106).

Petitioner also argues that Patent Owner’s reliance on references that characterize partitions as “type 0 hypervisors” is not pertinent because such systems provide hardware partitions rather than virtual machines, and in any event such systems are not what is described in McCarthy. Reply 15 (citing Ex. 2032, 723; EX. 2034, 4 Fig. 9.3, 53). Also, Petitioner argues that Patent Owner’s reliance on references dated after the McCarthy filing date are not relevant. *Id.*

b) Virtualization Layer Claims 9 and 17

Petitioner argues that Patent Owner’s reliance on the partition load manager (PLM) of McCarthy as satisfying the claim requirement of a virtualization layer is without merit, because that component calculates resource entitlements, but does not assign resources to partitions. Reply 19 (citing Ex. 1001, 13:43–48; Madisetti Reply Decl. ¶¶ 118–119). In addition, the only example of a virtualization software layer in the ’005 patent is an entirely separate component from the PLM. *Id.* (citing Ex. 1001, Fig. 7).

c) Computing Domains Claim Requirement

Petitioner argues that, even if the physical partition embodiment of McCarthy is considered to be a species of virtual machine, which in turn is a

species of computing domains, that would not support the full scope of the genus of virtual machines because McCarthy fails to disclose the structural features common to the genus, nor does it disclose a representative number of species of the genus. Reply 15 (citing *Ariad*). Petitioner challenges Patent Owner’s reliance on *Hologic* for the principle that written description of a genus is satisfied by a single species disclosure when the other members of the genus are well known in the art. *Id.* at 16. Rather, argues Petitioner, in the present case the partition disclosure of McCarthy is not representative of a genus including the technology introduced in the ’005 patent and nowhere described in McCarthy. *Id.* (citing Madisetti Reply Decl. ¶¶ 112–113).

In particular, argues Petitioner, the ’005 patent claims all require dynamically reallocating resources between the plurality of computing domains, but McCarthy only discloses an allocator that resizes hardware partitions, whereas the ’005 patent includes reallocating resources between virtual machines by “[s]cheduling agent 711 . . . making a system call to the virtualization layer of host operating system 701.” *Id.* at 17–19 (citing Ex. 1001, Fig. 7, 14:32–36; Ex. 1010, 30; Madisetti Reply Decl. ¶¶ 129–130). Petitioner points out that Patent Owner does not allege that McCarthy discloses a host operating system involved in a reallocation process, despite that fact that dependent claims 3–5, 10–14, and 18 require a host operating system. *Id.* at 18 (citing *Alcon v. Apotex*, 687 F.3d 1362, 1367 (Fed. Cir. 2012) (each independent claim encompasses the scope of its dependents)).

4. Patent Owner’s Sur-Reply

In its Sur-Reply Brief, Patent Owner argues that Petitioner raises new arguments and improperly incorporates by reference a lengthy additional

declaration of Dr. Madiseti.¹² *E.g.*, Sur-Reply 1, 20; *see also* Papers 27, 37. Patent Owner presses its argument that McCarthy describes an emulated CPU by dynamically allocating fractions of processors among partitions. Sur-Reply 1. Patent Owner disputes Petitioner’s argument that McCarthy only discloses fractional allocation to applications, rather than partitions, citing portions of McCarthy that it argues assign fractional resources to partitions. *Id.* at 2 (citing Ex. 1013 ¶¶ 42, 52–53, 55). Patent Owner also disputes Petitioner’s argument that fractional CPU allocation involves multiplexing but not emulation, arguing that multiplexing resources is the way that virtual machine monitors create the virtual machine illusion. *Id.* (citing Ex. 2008, 144–145, 147, 149; Ex. 2032, 729; Ex. 2007, 64; Ex. 1019, 74; Ex. 2027, 36). Patent Owner argues that, for both McCarthy and the ’005 patent, fractional resources are “‘automatically’ and ‘dynamic[ally]’” assigned to its “‘virtual’ partitions,” which, argues Patent Owner, is an indication that the “shared resources must be virtualized (i.e., emulated) to maintain that illusion as allocations are adjusted.” *Id.* at 3 (citing Ex. 1001, 2:21–47, 3:31–37, 9:12–23, 14:57–15:2; Ex. 1013 ¶¶ 18, 25–25; Ex. 2026 ¶¶ 81, 88, 99–102; Ex. 2034, 3; Ex. 2036, 34:3–20).

Patent Owner also asserts that Petitioner has not disputed that skilled artisans use “partitions” and “domains” to describe virtual machines. Sur-

¹² Petitioner’s Reply appropriately responded to Patent Owner’s arguments that McCarthy provides written description support for the ’005 patent claims, consistent with the requirements that a “reply may only respond to arguments raised in the . . . patent owner response” (37 C.F.R. § 42.23(b)), and Patent Owner was given an opportunity in its Sur-Reply to respond to Petitioner’s arguments. *Parkervision, Inc. v. Vidal*, 88 F.4th 969, 979 (Fed. Cir. 2023).

Reply 4. Patent Owner argues that the reference in McCarthy to “virtual” partitions in “one or more physical computers” describes “multiple partitions (1) ‘in a single computer’ or (2) ‘across multiple computers,’” and asserts “[b]oth . . . require software virtualization’ to hide the ‘hardware boundaries’ and ‘to create the illusion of standalone systems.’” *Id.* (citing Edwards Decl. ¶¶ 98–99). Patent Owner asserts that the logical partitions of McCarthy are properly classified as “type 0 hypervisors” that are widely recognized virtual machine monitors. *Id.* (citing Ex. 2008, Fig. 4.18, 154; Ex. 2032, 724–725). Patent Owner argues that Petitioner’s conflation of hardware-supported logical partitioning with “just ‘hardware,’” is improper because logical partitions have the “illusion of owning the resources that are allocated for its use.” *Id.* at 5 (citing Ex. 2027, 36; Ex. 2034, 445, 454, 458, 497).

In regard to HP vPars, Patent Owner argues that the virtual partitions of McCarthy “align[] with the design of HP vPars, which are described as ‘virtual computers’ with emulated CPUs using a ‘vPar monitor’ that ‘emulates . . . firmware calls’ and ‘creates the illusion’ to the OS ‘that it is running on a standalone server’ made up of the assigned hardware.” Sur-Reply 6 (citing Ex. 2028, 9; Ex. 2031, 37, 177). For IBM LPARs, Patent Owner argues that multiple textbooks classify them as virtual machines, and disputes Petitioner’s argument that McCarthy specifically excludes LPARs by virtue of its incorporation by reference of a patent to Bouchier, which Patent Owner argues is only an example of an allocator and which in any case is suitable for virtual environments. *Id.* at 7 (citing Ex. 2032, 712; Ex. 2034, 458, 460–462; Ex. 2020, 1:57–67; Ex. 2029 ¶ 3; Ex. 2043, Abstract; Ex. 2044, 1:35–43; Ex. 2045, Abstract, 1:18–32, cl. 1). For Disco,

Patent Owner argues that it is relevant because it is classified in references as an example of partitioning, and argues that, even though not part of the intrinsic record, Disco is evidence of that logical partitions of the type expressly disclosed in McCarthy were recognized as of the priority date as virtual machines. *Id.* at 8 (citing Ex. 2034, Chapter 9, 475–477, 485; Ex. 2042 at 167).

In regard to the requirement of claims 9 and 17 of a virtualization software layer, Patent Owner argues that McCarthy inherently requires that feature, because it requires a virtual machine monitor, which is a form of virtualization software layer, given that McCarthy’s PLM (partition load manager) manages and assigns virtual resources. Sur-Reply 11 (citing Ex. 1013, Title, ¶¶ 19, 21–22, 27–28, 41–43, 49–51).

In response to Petitioner’s argument that McCarthy does not support the full scope of the claims, Patent Owner argues that written description does not require disclosure of what is well-known, and that for predictable art, such as is present here, a single species is enough to support the genus. Sur-Reply 12–13 (citing *Capon v. Eshhar*, 418 F.3d 1349, 1357–59 (Fed. Cir. 2005); *Hologic*, 884 F.3d at 1361; *Bilstad v. Wakalopulos*, 386 F.3d 1116, 1124–26 (Fed. Cir. 2004)).

Patent Owner argues that the pertinent genus here is “computing domains,” that virtual machines are at most a species of that genus, and that virtual partition systems share common traits with other virtual machines, which traits include emulation, independent operating systems, software isolation, and application portability. Sur-Reply 13–14. Patent Owner refers to annotated figures from the ’005 patent, Disco, HP vPars and IBM LPARs, arguing that they show common features of providing isolated, virtual

computing domains with independent operating systems and applications on a single computer, using a virtualization software layer on top of virtualized hardware such as CPU resources. *Id.* at 13–15. Patent Owner then refers to annotated figures in McCarthy and the '005 patent, arguing that McCarthy depicts fractional dynamic allocation of resources across isolated, fault-protected, and survivable partitions with essentially the same structural components as the '005 Patent's Figure 7 embodiment. *Id.* at 15–16.

Patent Owner argues that the new matter added to the '005 patent is merely an additional example of a virtual machine, which includes features not required by the independent claims. Sur-Reply 16–17. In regard to Petitioner's argument that McCarthy lacks written description support for the claimed dynamic reallocation of computing resources, Patent Owner argues that this argument is untimely made, and is based on the incorrect premise that such support requires description support for a host processor, which, argues Patent Owner, is only required for certain dependent claims. *Id.* at 20–21 (citing *Lucent Techs., Inc. v. Gateway, Inc.*, 543 F.3d 710, 718 (Fed. Cir. 2008)). Patent Owner argues that Petitioner confined its Petition to arguments that McCarthy did not describe a virtual machine and virtualization software layer, and therefore Patent Owner satisfied its burden of production in response by addressing that argument, and was not obligated to address the belated argument that McCarthy did not disclose dynamic reallocation by a host operating system. *Id.* at 21–22 (citing *Lupin Ltd. v. Pozen, Inc.*, IPR2015-01775, Paper 15 at 10–11 (PTAB Mar. 1, 2016)).

5. Analysis

To establish priority based on McCarthy, that application must provide written description support for the '005 claims. *Dynamic Drinkware*, 800 F.3d at 1379–80; *Lockwood v. Am. Airlines Inc.*, 107 F.3d 1565, 1571 (Fed. Cir. 1997). To satisfy the written description requirement, McCarthy must describe the claimed '005 invention in sufficient detail that one skilled in the art can reasonably conclude that the inventor had possession of the claimed invention at the time of filing. *Reiffin v. Microsoft Corp.*, 214 F.3d 1342, 1345 (Fed. Cir. 2000). This determination is based on “objective inquiry into the four corners of the [priority document] specification[s].” *Ariad*, 598 F.3d at 1351. It is irrelevant to the written description analysis whether a person of ordinary skill in the art would have found the '005 claimed subject matter obvious in light of McCarthy. *Lockwood*, 107 F.3d at 1571–72. However, written description does not require the use of the exact terms (*in haec verba*) or listing “every conceivable” permutation of an invention. *Cordis*, 339 F.3d at 1364–65.

Although Petitioner bears the ultimate burden of persuasion on invalidity, which never shifts to Patent Owner, given that Patent Owner here argues that the '005 patent is entitled to claim priority to the application date of McCarthy, Patent Owner bears the burden of production of evidence establishing that fact. *Dynamic Drinkware*, 800 F.3d at 1378–79; *In re Magnum Oil Tools Int'l, Ltd.*, 829 F.3d 1364, 1376 (Fed. Cir. 2016) (“[A] patentee bears the burden of establishing that its claimed invention is entitled to an earlier priority date than an asserted prior art reference”). The burden of production cannot be met without some combination of citing the relevant

record evidence with specificity and explaining the significance of the produced material in briefs. *Parus*, 70 F.4th at 1372.

As an initial matter, Patent Owner provides no evidence that McCarthy provides written description support for the '005 claims that require a “host operating system.” PO Resp. 1, 3; Tr. 25:16–21. Indeed, there is no mention of the use of a host operating system in McCarthy. Accordingly, we determine that McCarthy is prior art to claims 3–5, 10–14 and 18. For the remaining claims 1, 2, 6–9, 15–17, 19, and 20, Patent Owner argues that McCarthy provides written description support for the “virtual machine” and “virtualization software layer” (or “software virtualization layer”) claim requirements, and for the full scope of the “computing domains” requirement (the only requirements in those claims that are at issue). PO Resp. 3–58. In the sections below, we consider whether McCarthy provides written description support for these disputed claim requirements.

a) McCarthy Does Not Provide Written Description Support For “Virtual Machines”

We determine that Patent Owner has not met its burden of producing sufficient evidence that persons of ordinary skill in the art, as of the July 26, 2002, filing date of the McCarthy application, would have understood that the McCarthy inventors regarded the partitions disclosed in McCarthy, whether “virtual partitions” or otherwise, as “virtual machines” as ultimately claimed in the '005 patent. McCarthy makes no mention of virtual machines and there is nothing in McCarthy that would suggest to one of ordinary skill in the art that the applicants had in mind the use of virtual machines as an embodiment of their invention. McCarthy narrowly describes physical

partitions, which do not share the characteristics of virtual machines as defined and described in the pre-2002 record summarized in Section III.C above.¹³

First considering the most pertinent evidence to the written description determination — the “four corners” of the McCarthy application itself (*Ariad*, 598 F.3d at 1351) — we find no support for the proposition that persons of ordinary skill, reading the application, would have understood the detailed physical partition embodiment of McCarthy as disclosing virtual machines. The “Background Of The Invention” section of McCarthy describes prior art involving “multiple partition systems” with multiple processors and other resources that can be separated into partitions, which are “hardware separations that place resources into separate functional blocks.” Ex. 1013 ¶ 8. McCarthy states that this prior art approach has a disadvantage:

However, the partitions, once defined, are static in nature, and cannot be readily changed without operator intervention. Thus, resources cannot be readily moved from one partition to another to satisfy workload balancing.

Ex. 1013 ¶ 8.

McCarthy goes on to describe its asserted inventive contribution, which, like the physical partition embodiment of the ’005 patent, described in Section II.A above, involves dynamic allocation of resources to partitions using a two-part combination of a workload manager and partition load

¹³ As stated in Section III.C, our analysis does not require determining the outer bounds of what constitutes a “virtual machine,” or resolving the parties’ different proposed definitions. The pre-2002 record simply does not support classifying the physical partition embodiment of McCarthy as disclosing virtual machines.

manager. *E.g.*, Ex. 1013 ¶¶ 9, 18–21. Like the prior art static approach, each partition consists of one or more CPUs, but instead of the CPU allocations being statically assigned, the system can reassign a CPU from one partition to another depending on application priorities and workloads:

For multiple partition computer systems . . . the resources may be manipulated between partitions, e.g. reassigning a processor from one partition to other (effectively resizing the partitions)

Ex. 1013 ¶ 18. The allocation of one or more CPUs to a partition is depicted in Figure 2B of McCarthy, reproduced below.

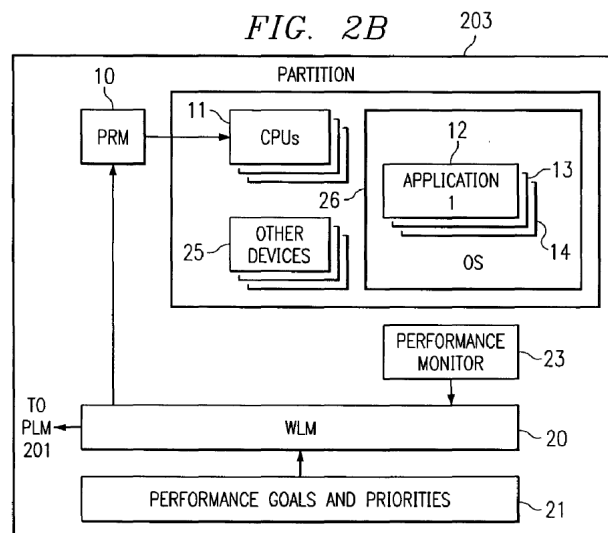


Figure 2B depicts a partition, including several CPUs 11. Ex. 1013 ¶¶ 13, 30–31, claim 2. Like the prior art static approach, the partitions are still hardware separations that place resources, including processors, into separate functional blocks.

Patent Owner argues that the portion of McCarthy describing its asserted invention, unlike the prior art description in the McCarthy “Background” section, is not limited to partitions that are hardware separations. PO Resp. 17–18. Not so — the difference between the described prior art and the McCarthy embodiment is that for the former,

resources, including CPUs, are statically preassigned, and for the latter, the resources can be dynamically reallocated among physical partitions. But both are hardware partitions with hardware resources.

We agree with Petitioner that this physical partition embodiment of McCarthy would not have suggested to one of ordinary skill that the McCarthy inventors contemplated a virtual machine embodiment. Pet. 13–17, 60. Our determination is not altered by the fact that, although McCarthy contains no mention of “virtual machine,” it is titled “Dynamic Management Of Virtual Partition Computer Workloads Through Service Level Optimization.” Ex. 1013, Title. This in turn refers to the isolated statement in McCarthy: “partitions may be virtual, as the multiple partitions may reside in one or more physical computers.” *Id.* ¶ 25. In a related statement McCarthy notes that references to “computers” encompass a “network of larger and/or small computers,” and “that the resources may be located on one physical computer and are allocated to an application or partition located on another physical computer.” *Id.* ¶ 18. The logical import of the statement “partitions may be virtual” is that some partitions are “virtual” and some are not, but McCarthy does not shed light on when a partition or group of partitions, whether on “one” computer or “more” computers, is virtual. The possibility of more than one partition residing in a single computer, or a single partition being located on more than one computer, or some other variation of “multiple partitions [residing] in one or more physical computers,” is not inconsistent with the fact that the partitions are hardware separations that place resources, such as CPUs, into separate functional blocks. Ex. 1013, Figs. 1A, 1B, ¶¶ 4, 8. Patent Owner argues that this reference to virtual partitions means that the partitions “are not constrained

by the physical boundaries.” PO Resp. 14–15 (citing Edwards ¶¶ 94–95). We do not see that this characterization is supported by the McCarthy disclosure. These statements describing the allocation of physical partitions to physical computers would not have suggested to one of ordinary skill that the inventors had in mind the use of “virtual machines” in the McCarthy system.

Patent Owner also relies (at PO Resp. 18–19) on the statement in paragraph 57 of McCarthy, that the “present invention” may be “implemented in software.” This does not suggest that the physical partition embodiment of McCarthy can be a virtual machine. That statement merely refers to the fact that such components as the PLM, WLM, and performance monitor are software modules running on physical processors. Nor does the fact that the Patent Office searched virtual machine prior art during the McCarthy prosecution (*see* PO Resp. 36; Sur-Reply 8) evidence written description support. Rather, it reflects the Examiner’s search for evidence of obviousness in light of virtual machine art. As stated above, art that supports an obviousness analysis is not proof of written description support. *Lockwood*, 107 F.3d at 1571–72.

Beyond the McCarthy application disclosure itself, consideration of that application in light of the extrinsic evidence in the record that existed as of the July 26, 2002 McCarthy filing date does not alter our determination that the physical partition approach of McCarthy would not have been considered a disclosure of a virtual machine. There is no question that virtual machines “had been well-known since at least the 1970s,” and so persons of ordinary skill in the art would have been well aware of virtual machines as of the McCarthy filing date. Pet. 1. As discussed in Section

III.F.4 below, the virtual machine embodiment of the '005 patent would have been obvious as of the patent's February 20, 2003 filing date. But despite that background knowledge, one of ordinary skill, looking at McCarthy's description of its physical partition embodiment, which describes assignment of one or more physical CPUs to physical partitions, would not have connected that with the attributes that the pre-2002 dictionaries and textbooks associate with virtual machines, such as virtualization of hardware, creating the illusion of multiple processes, use of CPU scheduling and virtual-memory techniques, functional simulation of a computer, and mimicking the performance of a hardware device. Unlike the virtual machine embodiment of the '005 patent, the physical partition embodiment of McCarthy (and of the '005 patent) does not "implement in software a virtual machine identical to the underlying hardware" (Ex. 1030, 2:36–67) — it *is* the underlying hardware.

In asserting that McCarthy supports the virtual machine claim requirement, Patent Owner offers, and its declarant Dr. Edward relies on, a number of textbooks and other references that *postdate* the 2002 critical date. *See, e.g.*, PO Resp. 15–16, 45–56 (citing Exs. 1016 (dated 2009), 1017 (dated 2006), 1034 (dated 2004), 2007 (dated 2005), 2008 (dated 2011), 2027 (dated 2005), 2032 (dated 2008), and 2034 (dated 2005)). Although we have reviewed and considered these references, we accord them little weight towards meeting Patent Owner's burden, given that satisfying the written description requirement is a determination made as of the application date. *Ariad*, 598 F.3d at 1355.

In particular, in reliance on the principle that written description support does not require the use of the exact terms (*in haec verba*) (*Cordis*,

339 F.3d 1364–65), Patent Owner asserts that “[s]killed artisans use ‘partitions’ and ‘domains’ to describe virtual machines.” Sur-Reply 3–4. However, Patent Owner only relies on post-2002 references in an attempt to establish that persons of ordinary skill regarded partitions as virtual machines — and, as discussed, nothing in the pre-2002 record supports Patent Owner’s assertion.

For example, Patent Owner quotes a “leading VM textbook” from 2005 as stating that there is a “practice to use some other term than virtual machine to describe what is in reality a form of virtual machine.” PO Resp. 4 (citing Ex. 2034, 13). Also, Patent Owner cites a 2008 reference that refers to virtual machines as “partitions” and “domains.” *Id.* at 4, 6 (citing Ex. 2032, 722–723). Patent Owner goes so far as to use post-2002 textbooks to assert that classic timesharing computer systems and multithreading operating systems could be thought of as virtual machines. *Id.* at 10–12 (citing Ex. 2034, 369 (dated 2005); Ex. 2008, 144–145 (dated 2011)). To like effect, Patent Owner cites post-filing date references pertaining to the ESX virtual machine that describe virtual machines as providing partitioning resources. *Id.* at 24 (citing Ex. 1024 ¶¶ 2, 20 (dated 2004); Ex. 1023, Fig. 1, 4, 6 (dated 2003); Ex. 1022, 1, 2 (dated Nov. 2002)). *See also* PO Resp. 15–16. Patent Owner provides nothing prior to 2002 that corroborates these characterizations — the pre-2002 references in the record do not address the issue of whether partitions, including virtual partitions, would have been regarded as virtual machines. Patent Owner asserts that the “Board need only agree with the leading textbook on VMs that any of the example logical partitions are a type of partitioned VM to find McCarthy is

not prior art” (Sur-Reply 5) — but we don’t agree, because the textbook in question is dated 2005. Ex. 2034.

Patent Owner argues that this reliance on post-2002 references is “perfectly permissible.” Sur-Reply 21 (citing *Plant Genetic Sys. NV v. DeKalb Genetics Corp.*, 315 F.3d 1335, 1343–44 (Fed. Cir. 2003); *POSCO v. ArcelorMittal*, IPR2019-01275, Paper 7 at 14–15 (PTAB Jan. 8, 2020)). That may be true in exceptional circumstances, but such are not present here. In *Plant Genetic*, the court relied on post-critical-date evidence that established that the first successful test of a critical feature occurred after the critical date, thus confirming that the subject patent was inoperative under Section 112 before the critical date. And in *POSCO*, a more legible post-critical-date document was relied on instead of a pre-critical-date copy of the same, but less legible, document.¹⁴

In part relying on post-critical-date evidence, Patent Owner attributes the capability of McCarthy to dynamically allocate CPUs and other resources to partitions, in response to monitoring workload and based on priorities, as evidence that the partitions are virtual machines. PO Resp. 7–9, 36–39. Patent Owner asserts, “[b]ecause the PLM is able to dynamically

¹⁴ To the extent Patent Owner relies on portions of post-2002 references that are merely cumulative of pre-2002 references cited above in Section III.C, that generally define or describe “virtual machines,” that is arguably consistent with *Plant Genetic*, *POSCO*, and other authorities. See *Application of Hogan*, 559 F.2d 595, 605 (C.C.P.A. 1977) (distinguishing between “permissible application of later knowledge about art-related facts existing on the filing date and the impermissible application of later knowledge about later art-related facts . . . which did not exist on the filing date”). However, as discussed above, none of these general descriptions of virtual machines, whether dated before or after McCarthy’s filing date, support the assertion that McCarthy discloses virtual machines.

allocate resources, the PLM creates the classic VM illusion to applications and the operating system that these newly allocated, fractions of resources are available within the partition.” *Id.* at 9 (citing Edwards ¶¶ 73–77). It is true that, as Patent Owner argues, the ’005 patent describes both the physical partition embodiment and the virtual machine embodiment of Figure 7 as having that capability. *Id.* at 9–10, 36–39. Patent Owner cites a 2005 textbook for the proposition that “simultaneous time sharing of processing resources is a classical virtual machine.” *Id.* at 10–12 (citing Ex. 2034, 369; also citing Ex. 2008, 144–145 (dated 2011)). However, none of the pre-filing date definitions of virtual machines (*see* Section III.C above) suggest that this capability is a unique dispositive attribute of virtual machines. Insofar as the pre-filing date evidence is concerned, the ability to dynamically allocate resources is a separate, independent, aspect of McCarthy, and also of both the physical partition and virtual machine embodiments of the ’005 patent. Significantly, the ’005 patent explicitly disavows the notion that dynamic allocation of resources is a necessary property of virtual machines, stating:

A subset of virtual machines 705 may have a fixed allocation of resources if appropriate for the software processes associated with those virtual machines 705. Accordingly, PM 708 and WLM 709 may also be omitted from a subset of virtual machines 705 depending upon application characteristics.

Ex. 1001, 14:51–56. Therefore, the fact that McCarthy discloses dynamic resource allocation among partitions is not evidence of written description support of virtual machines.

Also relying on post-critical-date evidence, Patent Owner places great weight on the premise that McCarthy discloses virtual machines because it

discloses allocation of *fractions* of processors and other resources among its partitions using software. PO Resp. 5–6 (citing Edwards Decl. ¶¶ 39–51, 73–88). Contrary to Patent Owner’s characterization, although McCarthy describes the ability within partitions to allocate fractional CPU resources to applications, it does not disclose that portions of CPU time can be split between partitions. Figure 1B depicts the prior art ability of a Process Resource Manager (PRM) to allocate percentages of CPU time to applications. Ex. 1013, Fig. 1B, ¶ 4. McCarthy goes on to extend that capability to the asserted invention, but only insofar as a Process Resource Manager within a partition can allocate percentages of CPU time to applications running *within* a partition. *Id.* at Fig. 2B, ¶¶ 18 (“resources may be manipulated within a partition, e.g. processor time being allocated among applications”), 33 (describing PRM allocating percentages of CPU time to applications), 34 (same).

But when allocating CPU resources *among* partitions, only whole, non-fractional processors are reassigned from one partition to another. Ex. 1013 ¶¶ 18, 34 (“The partition may have multiple numbers of resources, e.g. multiple CPUs”). Patent Owner points to the detailed description of the Partition Load Manager in the McCarthy disclosure, which allocates resources between partitions, and in doing so calculates processor requirements as “percentages, shares, or as normalized values,” and notes that “some computer systems may be able to use fractional values, with resources being split between partitions.” PO Resp. 7–8 (citing Ex. 1013 ¶¶ 34, 42, 52). In general, this allocation calculation allows for fractional assignment, such as “each partition receiving 1.5 resources.” Ex. 1013 ¶ 52. But this does not apply to processors. McCarthy explains that, as part of the

allocation determination, if a fractional processor allocation is calculated, the allocation is rounded up or down so that only whole processors are allocated:

[I]f resource values are used that are not representative of whole resource units and the system cannot handle fractionalize units, *e.g. one processor*, then rounding errors may occur Some systems may only operate with allocated values that are integer, thus fractional values of resources will need to be rounded up or down This is also true when allocating incremental resources *such as processors*, hard drives, etc., in resizing partitions where whole resources need to be allocated.

Id. ¶ 53 (emphasis added). Setting aside hindsight filling-in-the-blanks, there is simply no clear disclosure within “the four corners” of McCarthy of fractional allocation of CPUs to partitions.

As part of its attempt to meet its burden of production of evidence that McCarthy supports the “virtual machine” claim requirement, Patent Owner relies on references describing two systems that existed prior to McCarthy’s filing date: Disco and IBM PARs, and another system, HP vPars, that the record at most indicates was introduced at about the same time as the filing of McCarthy. None support the premise that McCarthy’s partitions, logical or otherwise, would have been regarded as virtual machines. Disco is indeed an example of a prior art virtual machine, including a virtual machine monitor. Ex. 1030, 2:36–67. But none of the pre-2002 Disco references relied on (Ex. 1007; Ex. 1030; Ex. 2042) use the term logical partition or virtual partition to characterize Disco, let alone establish that McCarthy’s partition disclosure suggests virtual machines. The Disco references actually distinguish Disco from the “hard-partitioning approach” — *i.e.*, the approach of McCarthy. Ex. 1007, 443; Ex. 2042, 154. In an attempt to

accord relevance to Disco, Patent Owner again resorts to a post-2002 textbook on virtual machines, which Patent owner asserts shows that Disco “is a well-known logical partition system.” PO Resp. 22, 24–25 (citing Ex. 2034, xiv, 26, 454, 475–485, 616, 620 (dated 2005)). However, as stated above, such evidence is not effective to meet Patent Owner’s burden.

Patent Owner asserts “IBM LPARs are indisputably listed as VMs in multiple textbooks.” Sur-Reply 7. The textbooks referred to are all dated after the McCarthy filing date. Ex. 2032 (dated 2008); Ex. 2034 (dated 2005). None of the pre-filing-date LPAR references relied on by Patent Owner (Ex. 2029; Ex. 2030) describe LPARs as virtual machines. Significantly, McCarthy incorporates by reference of a patent to Bouchier that states “systems which are not multiple partition computers are: . . . based on IBM’s Logical Partitions (LPARs).” Ex. 1013 ¶ 28; Ex. 1018, 13:23–28.¹⁵

Patent Owner argues that “McCarthy’s virtual partitions indisputably describe at least HP vPars, which are logical partitions.” Sur-Reply 6; *see also* PO Resp. 32. Of the references that Patent Owner relies on to describe vPars, only one unambiguously purports to precede the McCarthy filing date. *Cf.* Ex. 2028 (dated June 2002), *with* Ex. 1039 (dated 2003); Ex. 2031 (dated Nov. 2002); Ex. 2035 (dated 2002, month not of record). Patent

¹⁵ Patent Owner argues that this statement in Bouchier is not relevant because it is not a disclaimer of claim scope, and that the allocator of Bouchier is only provided as an example limited to “hardware partitions,” PO Resp. 30–31, n. 6. Nonetheless, in contrast to the extrinsic evidence that Patent Owner relies on, this statement, contained within the McCarthy disclosure by incorporation, explicitly informs one of ordinary skill that logical partitions are outside the scope of McCarthy’s partitions.

Owner would bootstrap this alleged association of HP vPars with McCarthy as evidence that the virtual partitions of McCarthy are virtual machines, by citing to a statement in a book titled “hp-ux virtual partitions,” stating “[w]ith Virtual Partitions (vPars) you can take almost any HP 9000 server and turn it into many ‘virtual’ computers.” *Id.* at 33 (citing Ex. 2035, xix). Although this book has a copyright date of 2002, there is no evidence that it would have been available to persons of skill in the art prior to the July 2002 filing date of McCarthy. Patent Owner also relies on a post-McCarthy-filing-date statement that vPars “creates the illusion to each [operating system] that it is running on a standalone server.” *Id.* at 34 (citing Ex. 2031, 37 (dated Nov. 2002)). But there is nothing established to be in the pre-filing-date record that states that vPars are “virtual computers,” let alone “virtual machines,” or which describe vPars as creating the illusion of physical servers.

Patent Owner also turns to the '005 patent itself (also post-McCarthy-filing-date evidence), arguing that it demonstrates the both the physical partition embodiment (common to both McCarthy and the patent), and the Figure 7 embodiment, are virtual machines. PO Resp. 13, 36–39. However, the '005 patent unequivocally distinguishes virtual machines from physical partitions. In its description of “Related Art,” after describing physical partitioning approaches, it states, “[v]irtual machine technology (such as the ESX server product available from VMware) is *another example* of partitioning functionality.”¹⁶ Ex. 1001, 1:37–39 (emphasis added). Then, in

¹⁶ Patent Owner argues that this statement that virtual machines have partitioning functionality is evidence that the physical petition embodiment of McCarthy is also a virtual machine. PO Resp. 37. On its face, this

the “Detailed Description” of the invention, after first describing “one embodiment” in which the computer system is “divided into protection domains or partitions” and resources such as CPUs are “reassign[ed] . . . from one partition to another,” the description then introduces “[i]n **another embodiment**, resources may be allocated between virtual machines . . . as discussed in regard to FIG. 7.” *Id.* at 3:11–36 (emphasis added). Further confirming this distinction, after describing in detail the physical partition embodiment that is also fully disclosed in McCarthy, the ’005 patent goes on to introduce a separate virtual machine embodiment:

Although some representative embodiments have been described in terms of allocating physical resources between partitions, representative embodiments may allocate resources between any suitable computing domain. ***Another suitable computing domain is a virtual machine.***

Ex. 1001, 13:37–41 (emphasis added). The ’005 patent then describes in detail the virtual machine embodiment, shown in Figure 7, which description is totally absent in McCarthy.

Patent Owner argues that the only distinction that the ’005 patent is making is, on the one hand, prior art static partitions with pre-allocated resources, versus the patented embodiments that dynamically allocate resources. PO Resp. 13. However, the above quoted portions from the ’005 patent establish that the distinction being made is between the physical partition embodiment that is also described in McCarthy and the Figure 7 virtual machine embodiment that is not described in McCarthy. Patent

statement say nothing more than that virtual machines are one way to provide partitioning functionality, but it does not follow that all partitioning methods — let alone the physical partition embodiment of McCarthy — are virtual machines.

Owner argues that the Figure 7 embodiment of the '005 patent is merely an additional example of a virtual machine, with the physical partition embodiment being another example of a virtual machine. PO Resp. 37–39. Patent Owner argues that both embodiments have the same structural components — *viz.*, operating systems, applications, a performance monitor, and a workload manager (WLM) interacting with a partition load manager (PLM). *Id.* However, like the dynamic resource allocation capability of both embodiments, the disclosed arrangement of separate WLMs interacting with a PLM is an asserted inventive aspect of the patent, independent of whether or not implemented in a virtual machine. Ex. 2010, 135–137.

In sum, we determine that Patent Owner has not met its burden of producing sufficient evidence that McCarthy provides written description support for the “virtual machine” requirement of the '005 claims. In regard to Patent Owner’s reliance on post-McCarthy-filing-date references, the most that can be said is that some authors, looking back on the historical developments in the field, described certain approaches as similar to virtual machines. But that is not persuasive proof of what a person of ordinary skill would have thought years before.

Accordingly, McCarthy is prior art to at least claims 2, 9, 16 and 17 (in addition to claims 3–5, 10–14 and 18, already dealt with because of the “host operating system” requirement), which explicitly require a virtual machine.

*b) McCarthy Does Not Provide Written Description Support For
“Virtualization Software Layer”*

Patent Owner argues that McCarthy inherently supports the virtualization software layer claim requirement, and in particular argues that

the Partition Load Manager (PLM) of McCarthy is a virtualization software layer. PO Resp. 42–44. Patent Owner’s argument that this requirement is inherently disclosed in McCarthy hinges on the assertion that McCarthy discloses virtual computers. *Id.* Because we have determined otherwise, this argument is without merit. Patent Owner also relies on a post-McCarthy-filing-date textbook to argue that virtual partitions, or logical partitions, have a virtualization software layer. *Id.* at 43 (citing Ex. 2034 (dated 2005)). As discussed, we do not accord such post-filing evidence persuasive weight. Also without merit is the argument that the PLM of McCarthy is a virtualization software layer — however, Figure 7, illustrating the virtual computer embodiment of the ’005 patent, specifically includes a “virtualization layer” as an entirely separate component from the PLM in that figure. Ex. 1001, Fig. 7. Nowhere in the ’005 patent is there any suggestion that the PLM, whether in the context of the virtual machine embodiment or the physical partition embodiment of the patent, can take on the virtualization software layer function. Therefore, the PLM of McCarthy would not have been regarded by one of ordinary skill as of the filing date of McCarthy as a virtualization software layer.

Thus Patent Owner has not met its burden of producing evidence that McCarthy provides written description support for the “virtualization software layer”/“software virtualization layer” requirement of the ’005 claims. Accordingly, for this separate reason (in addition to the above “virtual machine” analysis), McCarthy is prior art to claims 9 and 17 (and also claims 10–14, already dealt with re “host operating system”).

c) McCarthy Does Not Provide Written Description Support For A Computing Domains Genus

The remaining '005 claims not discussed above — claims 1, 6–8, 15, 19, and 20 — do not explicitly require a virtual machine, a virtualization software layer (or software virtualization layer), or a host operating system. But they do include the “computing domains” requirement, and Petitioner argues that McCarthy does not provide written description support for the full scope of the computing domains genus, since it only discloses the narrow species of physical partitions, but fails to support species including virtual machines, a virtualization software layer (or software virtualization layer), or a host operating system. Pet. 58–65.

Patent Owner does not challenge that “computing domains” as claimed make up a genus that includes the virtual partition and virtual machine embodiments of the '005 patent, but rather argues that McCarthy’s disclosure of the virtual partition embodiment alone is sufficient to support the full breadth of that genus. PO Resp. 44–45.

A sufficient written description of a genus requires the disclosure of either a representative number of species falling within the scope of the genus or structural features common to the members of the genus so that one of skill in the art can “visualize or recognize” the members of the genus. *Ariad*, 598 F.3d at 1350; *D Three Enterprises*, 890 F.3d at 1048–50; *Idenix v. Gilead Sciences*, 941 F.3d 1149, 1164 (Fed. Cir. 2019); *ICU Medical v. Alaris*, 558 F.3d 1368, 1377 (Fed. Cir. 2009); *Rivera*, 857 F.3d at 1319–21; *LizardTech v. Earth Res. Mapping*, 424 F.3d 1336, 1346 (Fed. Cir. 2005); *Smith & Nephew v. Arthrex*, IPR2017-00275, Paper 36, 27–28 (May 2, 2018).

Because we have determined that the physical partition embodiment of McCarthy is not a disclosure of virtual machines, a virtualization software layer (or software virtualization layer), or a host operating system, McCarthy does not support the computing domains genus of the '005 claims. Even if we were to agree that the disclosure in McCarthy of virtual partitions were a disclosure of a type of virtual machine (we do not), we would nevertheless determine that the full scope of the computing domains requirement was not met. The virtual machine embodiment claimed in the '005 patent describes the distinctive features of the virtual machine embodiment, not present in the physical partition embodiment:

Virtualization software typically executes in connection with a host operating system of the physical server. The virtualization software creates virtual resources as software constructs. The virtual resources are then assigned to virtual machines. Specifically, the virtual resources are used to execute “guest” operating systems that execute on top of the host operating system.

. . . .

[V]irtualization refers to the creation of virtual machines that coexist on one or several physical servers. Virtualization software typically executes in connection with a host operating system of the physical server. The virtualization software creates virtual resources as software constructs. The virtual resources are then assigned to virtual machines used for respective servers. Specifically, the virtual resources are used to execute “guest” operating systems that execute on top of the host operating system. The guest operating systems are then used to execute applications.

Ex. 1001, 1:39–45, 13:43–51. This arrangement of “guest” operating systems operating “on top of the host operating system” using “virtualization software” is not present in the physical partition embodiment of the '005

patent or McCarthy.¹⁷ Therefore, McCarthy neither discloses a representative number of species falling within the scope of the computing domains genus, nor structural features common to the members of the computing domains genus so that one of skill in the art can “visualize or recognize” the members of the genus.

d) Summary

Accordingly, having considered the entire record and weighed the entirety of the evidence, we determine that Petitioner has proved by a preponderance of the evidence that McCarthy is prior art to the '005 patent claims.¹⁸

E. Alleged Anticipation of Claims 1, 6, and 8 by McCarthy

Petitioner challenges claims 1, 6, and 8 as anticipated by McCarthy. Pet. 4, 36–45, 49–52, 65–68.¹⁹

¹⁷ We are not persuaded by Patent Owner’s argument that the full scope of the independent claims, required for written description support, does not include the host operating system requirement of the dependent claims. Sur-Reply 20–21 (citing *Lucent Techs.*, 543 F.3d at 718). *Lucent Techs* involved invention date issues related to a licensing dispute, and we do not consider that it conflicts with or supersedes the authorities cited above requiring written description support of genus claims.

¹⁸ Given that the '005 patent does not benefit from McCarthy’s filing date, it follows that it does not benefit from the Jan. 28, 2000 filing date of its earlier continuation-in-part application No. 09/493,753. MPEP 211.05(1)(B) (“If there is a continuous chain of co-pending nonprovisional applications, each co-pending application must disclose the claimed invention of the later-filed application in the manner provided by 35 U.S.C. 112(a) in order for the later-filed application to be entitled to the benefit of the earliest filing date”).

¹⁹ The cited pages include arguments supporting Petitioner’s anticipation challenges interspersed with its obviousness challenges.

Following Petitioner’s approach, we first consider claim 8, and for economy of presentation refer to the bracketed identifiers applied to the claim limitations by Petitioner (*see* Section II.B above). Pet. 36–45.

For the method preamble of claim 8, Petitioner generally relies on McCarthy’s method for managing computer resource allocations. Pet. 36 (citing Ex. 1013, Abstr., Fig. 3, ¶ 9, claims 9–18; Madisetti Decl. ¶¶ 196–199).²⁰

For requirement 8.a of claim 8 regarding creation of computing domains, Petitioner relies on the description in McCarthy of the use of partitions, which McCarthy describes as “protected domains.” Pet. 37 (citing Ex. 1013 ¶ 8; Madisetti Decl. ¶¶ 117–119, 202–204).

For requirement 8.b of claim 8 regarding allocating resources between computing domains by a first manager process, Petitioner relies on the disclosure in McCarthy of the PLM. Pet. 38 (citing Ex. 1013, ¶¶ 19, 21, 26, 41; Madisetti Decl. ¶¶ 207–208).

For requirement 8.c of claim 8 regarding executing applications, a second manager process, and a performance monitor in each domain, Petitioner relies on the disclosure that each partition in McCarthy includes execution of applications, a WLM (the second manager process) and a performance monitor. Pet. 38–39 (citing Ex. 1013, Fig. 2B, ¶¶ 20, 31–32; Madisetti Decl. ¶¶ 211–212).

For requirement 8.d of claim 8 regarding the second manager process maintaining a list of priority levels and needed resources, Petitioner relies on the disclosure in McCarthy that “[a] partition, preferably through its WLM,

²⁰ We make no determination whether or not the preamble of claim 8 (or of claim 1) is limiting.

maintains a list of prioritized application goals with an indication of the quantity of each required resource. . . .” Pet. 39 (citing Ex. 1013 ¶ 23; Madisetti Decl. ¶ 215) (emphasis omitted).

For requirement 8.e of claim 8 regarding performance monitoring, Petitioner relies on the disclosure in McCarthy of performance monitoring in each partition. Pet. 41 (citing Ex. 1013, Fig. 2B, ¶ 32; Madisetti Decl. ¶ 221).

For requirement 8.f of claim 8 regarding the second manager process requesting additional resources, Petitioner relies on the disclosure in McCarthy that WLM receives “goal information and priority information from a user or administrator” and “performance information from performance monitors,” “compares the [performance] information with the goals,” and “[b]ased on the comparison, the WLM may increase, decrease, or leave unchanged, an application’s entitlement.” Pet. 42–43 (citing Ex. 1013, Fig. 2B, ¶ 20; Madisetti Decl. ¶¶ 230–231).

For requirement 8.g of claim 8 regarding dynamic reallocation of resources by the first manager process, Petitioner relies on the disclosure in McCarthy of PLM dynamically reallocating resources as claimed. Pet. 43–44 (citing Ex. 1013, Fig. 3, ¶¶ 24, 27, 28, 35; Madisetti Decl. ¶¶ 236–237).

Independent claim 1 is a computing system counterpart to method claim 8, and includes requirements substantially the same as those of claim 8. Ex. 1001, 15:4–25. Petitioner essentially repeats its arguments made for claim 8, and also cites disclosure in McCarthy to the effect that the disclosed system can be implemented via “program or code segments” on a “processor readable medium.” Pet. 49–52 (citing Madisetti Decl. ¶¶ 266–277).

Claim 6 adds to claim 1 the requirement that the “plurality of resources comprise at least one processor.” Ex. 1001, 15:40–41. Petitioner relies on the disclosure in McCarthy that the allocation of resources by PLM includes allocation of processors. Pet. 68 (citing Ex. 1013, claim 2, ¶ 41; Madisetti Decl. ¶¶ 207–208, 318–319, 331–333).

Other than disputing the prior art status of McCarthy, which argument as discussed above we do not find persuasive, Patent Owner does not specifically respond to any other of Petitioner’s arguments regarding the requirements of claims 1, 6, and 8. Nonetheless, the burden remains on Petitioner to demonstrate unpatentability. *See Dynamic Drinkware*, 800 F.3d at 1378. Accordingly, having considered both the evidence of obviousness and Patent Owner’s submitted evidence of nonobviousness, and weighed the entirety of the evidence, we determine that Petitioner has proved by a preponderance of the evidence that claims 1, 6 and 8 are anticipated by McCarthy.

F. Alleged Obviousness of Claims 1–20 over McCarthy and Gien

Petitioner challenges claims 1–20 as obvious in light of the combination of McCarthy and Gien. Pet. 4, 10–67.

1. Gien

Gien, titled “Micro-Kernel Based Operating Systems: Moving UNIX onto Modern System Architectures,” is a paper presented at the “UniForum 1992 Conference Proceedings” in January, 1992. Ex. 1014, Ex. A. Petitioner presents evidence and argument directed to the public availability of Gien as pre-AIA 35 U.S.C. § 102(b) prior art to the ’005 patent. Pet. 24–25 (citing Ex. 1014, Statutory Declaration of Anthony William Corsini &

Ex. A). In addition, the Declaration of James L. Mullins supports a finding of public accessibility of Gien. Ex. 1029. Therefore, we accord Gien prior art status.

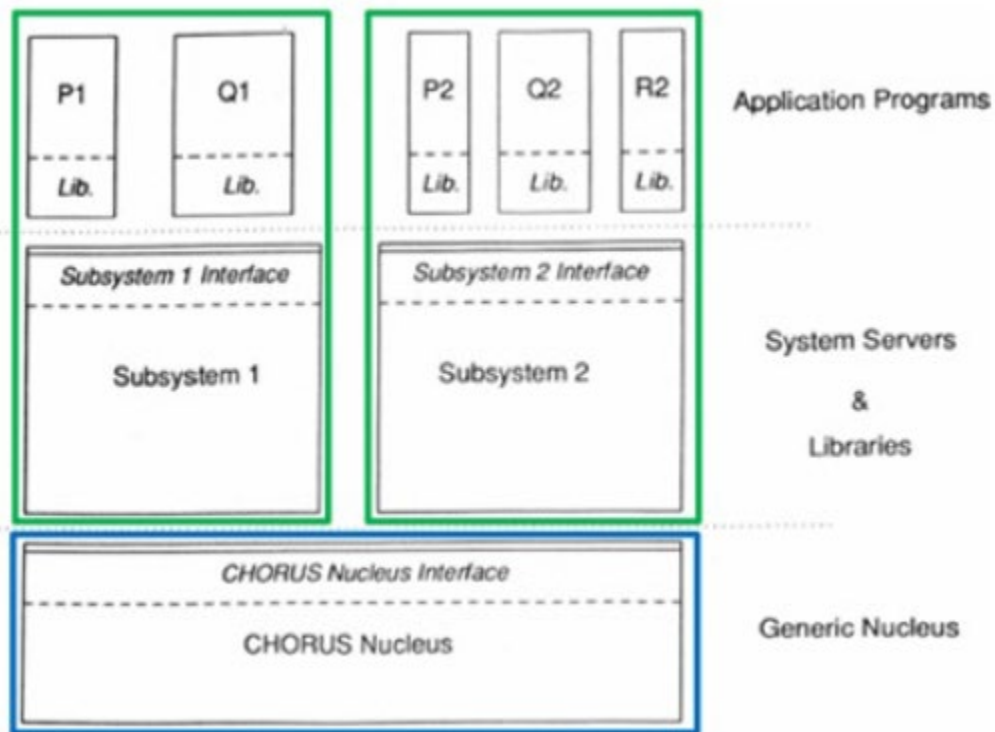
Gien describes a “CHORUS operating system” as “[o]ne approach to modern operating system design,” in which:

[The approach] is to build the distributed operating system as a set of independent system servers using the primitive, generic services of a micro-kernel. The micro-kernel provides a virtual machine for processor use, memory allocation and communication between operating system components.

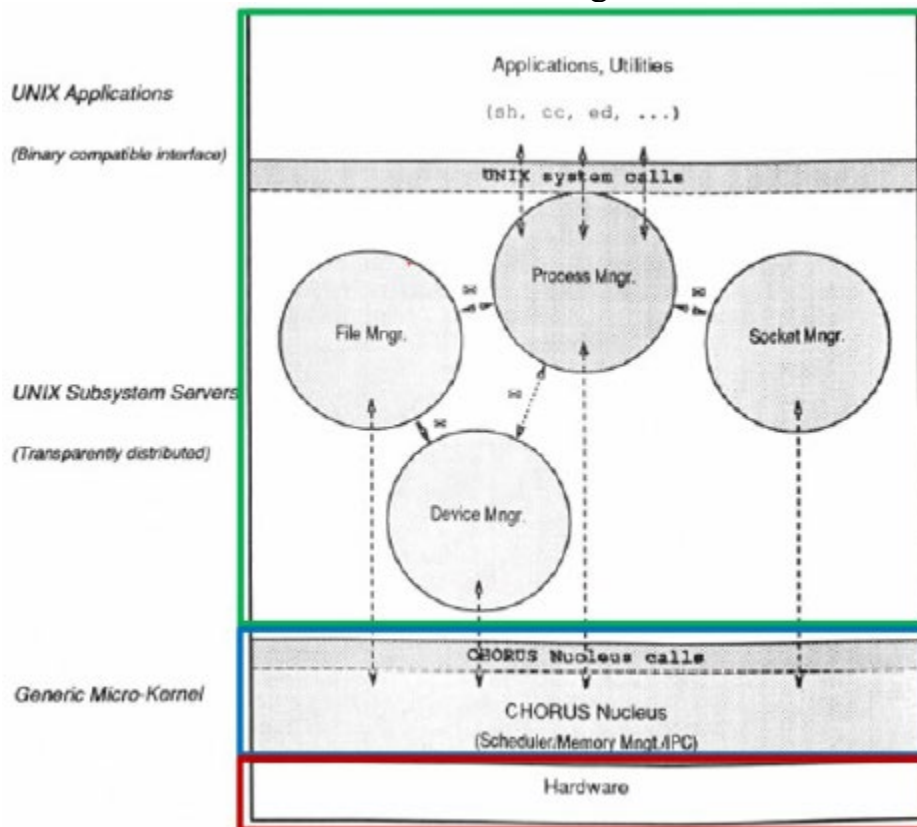
Ex. 1014 at 47. The CHORUS micro-kernel, called a “nucleus,” provides “core operating system services,” and “distributed computing built into [the] virtual machine layer.” *Id.* at 47–48. The nucleus “provides generic tools — thread scheduling, real time event handling, network-transparent inter-process communications (IPC) and virtual memory management — to sets of independent servers called *subsystems*, which coexist on top of the Nucleus.” *Id.* at 48. “Subsystems separate the functions of the operating system into sets of services provided by autonomous servers, and provide operating system interfaces to application programs.” *Id.* Gien further describes the subsystems:

Subsystems in CHORUS architecture are sets of system servers that use the generic services of the Nucleus to provide higher-level services. More simply, a subsystem is an operating system built on top of the CHORUS Nucleus.

Id. at 49. Gien Figures 2 and 3 are reproduced below, with annotations applied by Petitioner’s declarant Dr. Madisetti.



Annotated Gien Fig. 2



Annotated Gien Fig. 3

Madisetti Decl. 167. Dr. Madisetti testifies that the “green boxes mark VMs, blue boxes mark the host OS, and red boxes mark server hardware.” *Id.* Dr. Madisetti further testifies that “Gien’s CHORUS Nucleus is a host OS,” that the CHORUS micro-kernel “‘virtual machine layer’ is a virtualization software layer that provides VMs,” and that one of ordinary skill would have recognized that the “application programs on top of a subsystem, represent multiple VMs,” and that the “‘subsystem servers’ are guest OSs instantiated on single server hardware.” *Id.* ¶¶ 165–166, 168.

2. *The Combination of McCarthy and Gien*

Petitioner argues that a person of ordinary skill would have been motivated to replace the physical partitions of McCarthy with virtual machines using Gien’s host OS, allowing McCarthy’s WLM and performance monitor processes to execute with applications and a PLM process in the application layer in each virtual machine. Pet. 29 (citing Madisetti Decl. ¶¶ 171–173). Petitioner argues that the use of virtual machines “facilitates server consolidation, provides faster application deployment and better resource utilization, simplifies management, improves flexibility and scalability, and provides more efficient development environments, compared to using physical hardware partitions.” Pet. 29 (citing Ex. 1023, 6; Ex. 1034, 2; Madisetti Decl. ¶¶ 173–176). Petitioner provides detailed testimony from its declarant, Dr. Madisetti to this effect. Pet. 30–32 (citing Madisetti Decl. ¶¶ 177–183). Petitioner offers evidence that there would have been a reasonable

expectation of success in making the combination. Pet. 32–35 (citing Madisetti Decl. ¶¶ 184–192).

Patent Owner argues that there was no motivation to modify McCarthy with the teachings of Gien, because the virtual partitions of McCarthy already provided the advantages that Petitioner attributes to Gien. PO Resp. 66. However, as discussed above, Patent Owner’s attempt to attribute virtual machine-like capabilities to the McCarthy physical partitions, whether described as “virtual” or otherwise, is a mischaracterization. *See supra* § III.D.5.a). Patent Owner relies on ’005 patent-application-date references, and references that describe the Disco, IBM LPARs, and HP vPars systems that, as discussed above, bears no established relationship to McCarthy, to argue that the McCarthy virtual partitions already had the ability to resize partitions in software instead of hardware, to improve scalability, to support server consolidation, and provide application portability. *Id.* at 67–71. We accord these arguments little weight.

We credit the testimony of Petitioner’s expert Dr. Madisetti, which provides adequate support for Petitioner’s asserted combination. Moreover, Petitioner’s obviousness analysis is supported by the undisputed fact that virtual machines and their advantages were well known at the time of the McCarthy application, and by the prosecution history of the ’005 patent, during which, as discussed above in Section III.D.2.a), the Examiner cited references disclosing virtual machines in finding the then-pending claims obvious. Ex. 1002, 47–59. Applicants overcame that rejection by amending the claims to add the requirement that the second manager process maintain a list of priority levels and quantity of needed resources (a requirement now satisfied by McCarthy). *Id.* at 113–115, 181–192. But the basic finding of

the Examiner that virtual machines were a well-known and obvious technique at the time of the '005 invention supports Petitioner's challenge.

Accordingly, we determine that Petitioner has provided sufficiently articulated reasoning with rational underpinnings for the proffered combination of McCarthy and Gien, and the preponderance of the evidence establishes that a person of ordinary skill would have been motivated to make that combination.

*3. Alleged Obviousness of the Computing Domains Claims
(Claims 1, 6–8, 15, 19, and 20)*

As discussed in Section III.D.1 above, independent claims 1, 8, and 15, and dependent claims 6, 7, 19, and 20, do not require a virtual machine, but encompass computing domains that are made up of virtual machines. Therefore, argues Petitioner, these “computing domains” claims are obvious over the combination of McCarthy and Gien. Pet. 58–67. In fact, although Petitioner characterizes its challenges to these claims as being obvious over the combination of McCarthy and Gien, Petitioner's arguments rely on McCarthy alone for each claim (satisfying the partition embodiments of “computing domains”), although in some cases Petitioner offers alternative arguments including Gien (satisfying the virtual machine embodiments). *See generally* Pet. 65–67. We do not need to consider the latter.

For this Decision, we also do not need to consider Petitioner's obviousness arguments directed against claims 1, 6, or 8 because, as set forth above in Section III.E, we have determined that the Petition demonstrates a reasonable likelihood that Petitioner will prevail in establishing that claims 1, 6, and 8 are anticipated by McCarthy.

Independent claim 15 is a computer readable storage medium counterpart to method claim 8, and includes requirements substantially the same as those of claim 8. Ex. 1001, 16:25–46. Petitioner essentially repeats its arguments made for claim 8, and also cites disclosure in McCarthy to the effect that the disclosed system can be implemented via “program or code segments” on a “processor readable medium.” Pet. 54–56, 66 (citing Madisetti Decl. ¶¶ 287–296, 321).

Claim 7 adds to claim 1 (via claim 6, discussed above) the requirement that the “first manager allocates time slices of said at least one processor between multiple computing domains of said plurality of computing domains,” and claim 20 adds a commensurate requirement to claim 15 (via claim 19, discussed below). Ex. 1001, 15:43–45; 16:60–63. Petitioner relies on the disclosure in McCarthy of allocating shares of CPU resources to applications in terms of fractions of a CPU operating second, which was known in the art as a “time slice.” Pet. 48–49, 66, 67 (citing Ex. 1013 ¶¶ 33–34, 42; Ex. 1024 ¶ 20; Madisetti Decl. ¶¶ 260–261, 320, 323).

Claim 19 adds to claim 15 the requirement that “said resources comprise processors.” Ex. 1001, 16:58–59. Petitioner refers to arguments directed to claim 6, discussed above, in which Petitioner relies on the disclosure in McCarthy that the allocation of resources by PLM includes allocation of processors. Pet. 66 (citing Madisetti Decl. ¶ 322).

Patent Owner does not specifically address Petitioner’s arguments challenging claims 1, 6–8, 15, 19, and 20 based on McCarthy alone, except for its argument that McCarthy is not prior art. PO Resp. 3. As discussed, we are not persuaded by that argument. Accordingly, having considered both the evidence of obviousness and Patent Owner’s submitted evidence of

nonobviousness, and weighed the entirety of the evidence, we determine that Petitioner has proved by a preponderance of the evidence that claims 6, 7, 15, 19, and 20 would have been rendered obvious to a person of ordinary skill in the art by the disclosures in McCarthy, and *ipso facto* by the combination of McCarthy and Gien.

4. *Alleged Obviousness of the Virtual Machine claims (claims 2–5, 9–14, and 16–18)*

Petitioner argues that the combination of McCarthy and Gien renders obvious claims 2–5, 9–14, and 16–18. Pet. 4, 10–57.

Claims 2 and 16 add to claims 1 and 15, respectively, the requirement that “said plurality of computing domains are virtual machines.” Ex. 1001, 15:26–27, 16:47–49. Claim 9 adds to claim 8 the requirement of “creating multiple virtual machines from a single server platform using a virtualization software layer.” *Id.* at 16:4–7. Petitioner relies on the disclosures in Gien of the use of virtual machines and using the CHORUS micro-kernel “virtual machine layer” to provide virtual machines. Pet. 45, 52, 56 (citing Ex. 1014, 47; Madisetti Decl. ¶¶ 243, 278, 297–298).

Claim 3 adds to claim 2 the requirement that “said first manager process operates on a host operating system of said computing system.” Ex. 1001, 15:28–30. Claim 10 adds to claim 9 the requirement that “said virtualization software layer is implemented within a host operating system of said single server platform.” *Id.* at 16:8–10. Claim 11 adds to claim 10 the requirement that “said dynamically reallocating is performed by a process executing on top of said host operating system.” *Id.* at 16:11–13. Petitioner relies on the disclosure in Gien of the CHORUS micro-kernel, which is a host OS, and which includes a “virtual machine layer,” and on the

combination of McCarthy and Gien in which the PLM of McCarthy executes within the virtual machine application layer of Gien. Pet. 45–46, 52 (citing Ex. 1014, Fig. 3, 47, 51; Madisetti Decl. ¶¶ 154, 165–166, 170, 245–246, 249–250, 280–281). Petitioner argues that one of ordinary skill would have understood that both “executing on top” of the host OS, and “operat[ing] on” the host OS, both mean the first manager process (PLM) uses host OS services (the CHORUS micro-kernel), which is met in the McCarthy/Gien combination. *Id.* at 52 (citing Madisetti Decl. ¶ 154).

Claim 4 adds to claim 3 the requirement that “a respective operating system executes on top of said host operating system for each of said plurality of computing domains.” Ex. 1001, 15:32–34. Claim 12 adds to claim 10 the requirement that “executing a respective guest operating system on top of said host operating system for each of said multiple virtual machines.” *Id.* at 16:14–17. Petitioner relies on the disclosure in Gien of the CHORUS nucleus, which Petitioner argues is the host OS, and on the UNIX Subsystem Servers, which Petitioner argues execute on top of the CHORUS nucleus. Pet. 46, 53 (citing Ex. 1014, 49; Madisetti Decl. ¶¶ 154, 252, 283).

Claim 5 adds to claim 3 the requirement:

[S]aid first manager process allocates said plurality of resources between said plurality of computing domains by assigning virtual resources to said plurality of computing domains through system calls to a kernel of said host operating system.

Ex. 1001, 15:35–39. Claim 13 adds to claim 10 the requirement “said dynamically reallocating comprises: performing system calls to said host operating system to reassign virtual resources.” *Id.* at 16:18–21. Claim 17 adds to claim 16 the requirement “said code for dynamically allocating

performs calls to a software virtualization layer to reassign resources between said plurality of computing domains.” *Id.* at 16:50–53. And claim 18 adds to claim 16 the requirement “said code for dynamically allocating performs system calls to a host operating system to reassign resources between said plurality of computing domains.” *Id.* at 16:54–57. For these claims, Petitioner relies on the combination of McCarthy and Gien in which the PLM of McCarthy executes within the virtual machine application layer of Gien and makes system calls to the Gien CHORUS nucleus to allocate virtual resources as claimed. Pet. 47–48, 53, 57 (citing Ex. 1014, 49; Madisetti Decl. ¶¶ 254–257, 285–286, 300, 302). Petitioner argues that “system call” was a well-known term of art which would have been understood to apply to the McCarthy/Gien combination in this context. Pet. 47–48 (citing Ex. 1014, Fig. 3, 51; Madisetti Decl. ¶¶ 254–255).

Claim 14 adds to claim 10 the requirement “said performing system calls reassigns time slices associated with at least one processor.” Ex. 1001, 16:22–24. Petitioner relies on the disclosure in McCarthy of allocating shares of CPU resources to applications in terms of fractions of a CPU operating second, which was known in the art as a “time slice.” Pet. 48–49, (citing Ex. 1013 ¶¶ 33–34, 42, 48; Ex. 1024 ¶ 20; Madisetti Decl. ¶¶ 260–264).

Patent Owner does not specifically address Petitioner’s arguments challenging claims 2, 9, 16, and 17, except for its argument that McCarthy is not prior art, and that the combination of McCarthy and Gien is not motivated. PO Resp. 3. As discussed above, we are not persuaded by those arguments. However, for VM claims 3–5, 10–14, and 18, Patent Owner argues that Gien’s micro-kernel (the “CHORUS nucleus”) is not a host

operating system, which is required by those claims. PO Resp. 58–65. Patent Owner argues that claim 5 differentiates between a host operating system and a kernel of an operating system based on its requirement of “system calls to a kernel of said host operating system,” and therefore “[t]o equate a ‘kernel’ to a ‘host operating system’ would impermissibly render this claim language superfluous and redundant.” *Id.* at 60. However, we agree with Petitioner that a host operating system as claimed can include an operating system made up just a kernel, and also a more inclusive operating system. Reply 25–26. Patent Owner argues that the micro-kernel of Gien is only part of the operating system, providing only basic services, with more complex services included in the separate “subsystems.” PO Rep. 60–63. However, Gien states that “[t]he micro-kernel provides a virtual machine for processor use, memory allocation and communication between operating system components,” Ex. 1014, 47; *see* Madisetti Decl. ¶¶ 165–168. We see no reason why the CHORUS nucleus of Gien would not teach or suggest the use of a host operating system, even though it only provides basic service.

We find that Gien at least would have taught the use of a host operating system to a person of ordinary skill in the art, as confirmed by the prosecution history of the ’005 application, during which the Examiner likewise found that these aspects of the ’005 claims were obvious in light of similar virtual machine references. “The test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference. . . . Rather, the test is what the combined teachings of those references would have suggested to those of ordinary skill in the art.” *In re Keller*, 642 F.2d at 425; *In re Mouttet*, 686 F.3d 1322, 1332 (Fed. Cir. 2012). “Combining the *teachings* of references does not involve

an ability to combine their specific structures.” *In re Nievelt*, 482 F.2d 965, 968 (CCPA 1973).

Accordingly having considered both the evidence of obviousness and Patent Owner’s submitted evidence of nonobviousness, and weighed the entirety of the evidence, we determine that Petitioner has proved by a preponderance of the evidence that claims 2–5, 9–14, and 16–18 would have been rendered obvious to a person of ordinary skill in the art by the combination of McCarthy and Gien.

IV. CONCLUSION²¹

For the foregoing reasons, we are persuaded that Petitioner establishes by a preponderance of the evidence that claims 1–20 of the ’005 patent are unpatentable.

In summary:

Claims	35 U.S.C. §	Reference(s)/Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
1–20	103	McCarthy, Gien	1–20	
1, 6, 8	102/103	McCarthy	1, 6, 8	
Overall Outcome			1–20	

²¹ Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner’s attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending ALA Trial Proceeding*. See 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. See 37 C.F.R. §§ 42.8(a)(3), (b)(2).

V. ORDER

In consideration of the foregoing, it is hereby

ORDERED that claims 1–20 of U.S. Patent No. 7,748,005 B2 have been shown to be unpatentable under 35 U.S.C. § 103(a); and

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

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