

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

AMERICAN AIRLINES, INC. and SOUTHWEST AIRLINES CO.,
Petitioner,

v.

INTELLECTUAL VENTURES II LLC,
Patent Owner.

IPR2025-00931
Patent 8,332,844 B2

Before KEN B. BARRETT, GEORGIANNA W. BRADEN, and
STEPHEN E. BELISLE, *Administrative Patent Judges*.

BRADEN, *Administrative Patent Judge*.

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

I. INTRODUCTION

American Airlines, Inc. and Southwest Airlines Co. (collectively, “Petitioner”) filed a Petition (Paper 1, “Pet.”) requesting an *inter partes* review of claims 1–27 (“Challenged Claims”) of U.S. Patent No. 8,332,844 B2 (Ex. 1001, “the ’844 patent”). Intellectual Ventures I LLC (“Patent Owner”) filed a Preliminary Response. Paper 9 (“Prelim. Resp.”).

We have authority to determine whether to institute an *inter partes* review. 35 U.S.C. § 314(b) (2024); 37 C.F.R. § 42.4(a) (2024). We may not institute an *inter partes* review “unless . . . there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition.” 35 U.S.C. § 314(a). The “reasonable likelihood” standard is “a higher standard than mere notice pleading” but “lower than the ‘preponderance’ standard to prevail in a final written decision.” *Hulu, LLC v. Sound View Innovations, LLC*, IPR2018-01039, Paper 29 at 13 (PTAB Dec. 20, 2019) (precedential). When instituting *inter partes* review, the Board will authorize the review to proceed on all of the challenged claims and on all grounds of unpatentability asserted for each claim. 37 C.F.R. § 42.108(a).

Applying those standards, and based on the record before us, we determine Petitioner has not demonstrated a reasonable likelihood of success in proving that any one of the Challenged Claims is unpatentable. *See* 35 U.S.C. § 314; 37 C.F.R. § 42.4(a). Accordingly, we deny institution of an *inter partes* review of the ’844 patent.

II. BACKGROUND

A. Real Parties in Interest

Petitioner identifies American Airlines, Inc.¹ and Southwest Airlines Co. as real parties in interest. Pet. 1. Patent Owner identifies itself as a real party in interest. Paper 5 (Patent Owner’s Updated Mandatory Notices), 2.

B. Related Matters

The parties state the ’844 patent has been asserted in the following district court actions: *Intellectual Ventures I LLC v. American Airlines, Inc.*, No. 4:24-cv-980 (E.D. Tex. filed November 2, 2024); and *Intellectual Ventures I LLC v. Southwest Airlines, Co.*, No. 7:24-cv-277 (W.D. Tex. filed November 2, 2024). Pet. 3; Paper 5, 2.

Patent Owner also states that the ’844 patent is or was involved in the following related matters: (1) *Intellectual Ventures I LLC et al., v. Liberty Mutual Holding Company Inc., et al.*, No. 23-cv-525 (E.D. Tex. Filed November 15, 2023); (2) *Intellectual Ventures I LLC et al., v. Comerica Incorporated*, No. 23-cv-524 (E.D. Tex. Filed November 15, 2023); (3) *Intellectual Ventures I LLC et al., v. JP Morgan Chase Bank, National Association et al.*, No. 23-cv-523 (E.D. Tex. Filed November 15, 2023); (4) *Intellectual Ventures I LLC et al., v. Nationwide Mutual Insurance Company*, No. 3:25-cv-632 (N.D. Tex. Filed March 15, 2025); and (5) *Intellectual Ventures I LLC et al., v. The Bank of New York Mellon*

¹ Petitioner states that American Airlines, Inc. is a wholly owned subsidiary of American Airlines Group, Inc., “which is not a real party in interest to this petition.” Pet. 1.

Corporation, No. 3:25-cv-631 (N.D. Tex. Filed March 15, 2025). Paper 5, 2.

C. The '844 Patent

The '844 patent is titled “Root Image Caching and Indexing for Block-Level Distributed Application Management,” and issued December 11, 2012, from U.S. Patent Application No. 11/709,477, filed February 21, 2007. Ex. 1001, codes (10), (21), (22), (45), (54).

The '844 patent claims priority to Continuation-In-Part Application Nos. 11/395,816, filed March 13, 2006, 11/026,622, filed December 30, 2004. *Id.* at code (60).

1. Written Description

The '844 patent generally relates to “clustered computing” involving multiple compute nodes with Operating System (“OS”) software image management, where nodes are activated by diskless booting protocols or remote software installation to local storage, and where a boot image is required for each node in the cluster – and states that storing a boot image for each server results in wasted storage, and copying the entire master image at boot results in long boot times. *Id.* at 1:31–67. The '844 patent discloses branching-store file systems where a read-only “root” image is accessible by all nodes, and changes made by a node to the root image are stored in a “leaf” image unique to that node—a filter merges the leaf images with the root image to provide a cohesive instance of the application environment. *Id.* at 2:13–24.

One system embodiment of the '844 patent, as shown in Figure 1 below, includes a general-purpose computing system environment with compute node 100. *Id.* at 4:27–36.

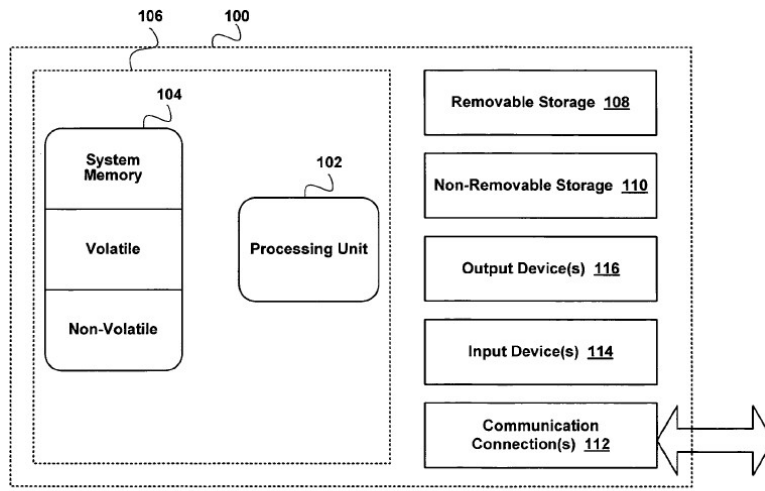


FIG. 1

According to the '844 patent, in its most basic configuration, compute node 100 shown in Figure 1 above, typically includes at least one processing unit 102 and memory 104. Ex.1001, 4:29–31. Another system embodiment of the '844 patent, shown in Figure 2 below, is implemented in a multi-computer system, such as an HPC cluster. *Id.* at 5:15–16.

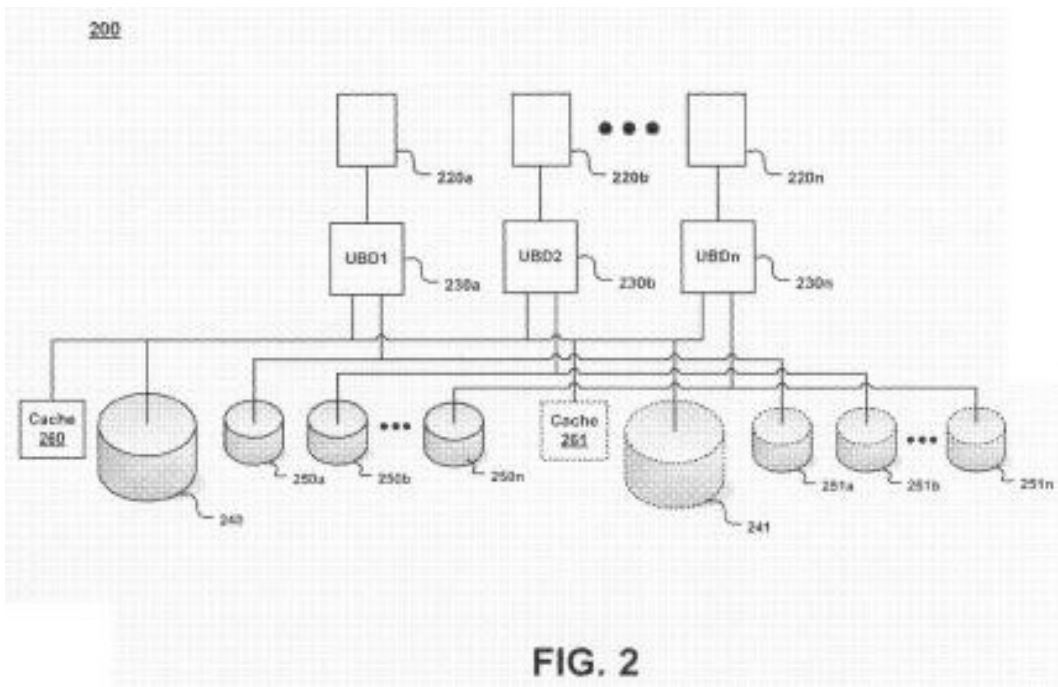


FIG. 2

The '844 patent discloses that system 200, shown in Figure 2 above, has multiple compute nodes 220a-n coupled to first storage unit 240 and corresponding second storage unit 250a-n through corresponding union block device (“UBD”) 230a-n. Ex.1001, 5:12–22. To the compute nodes 220a-n, it appears that they have access to their own version of the application environment. A separate boot image, however, is not created and stored for each node. *Id.* at 5:22–26.

Rather, according to the 844 patent, first storage unit 240 stores blocks of the root image. *Id.* at 5:27–32. The root image contains data initially common to compute nodes 220a-n, and is not changed by them. *Id.* Each compute node 220a-n also has access to second storage unit 250a-n for storing a leaf image, which includes “only additional data blocks not previously contained in said root image and changes made by respective compute nodes to the blocks of [said/the] root image.” *Id.* at 5:33–34, 10:61–65, 11:32–35, 12:4–8, 12:47–50. The '844 patent discloses that first storage unit 240 and second storage units 250a-n may each be contained on separate physical storage devices, on separate logical spaces on the same storage device, or any combination thereof. *Id.* at 5:34–38.

In one embodiment, the '844 patent discloses that compute node 220a-n boots up an application using its respective UBD 230a-n, which are “effectively low level drivers that operate as an interface between the first and second storage devices and the file system of each compute node 220a-n.” *Id.* at 5:59–64. According to the 844 patent, UBDs 230a-n determine what “leaf image” (from second storage unit 250) is needed for portions of the image that their respective compute nodes 220a-n have changed, and locate the portions of the image not changed by their

respective node (which may reside in the root image or intermediate images comprising versions of the root image, not depicted in Figure 2). Ex.1001, 6:4–13. UBDs 230a-n also create a new leaf image on second storage unit 250an when their respective compute nodes 220a-n make changes to their version of the image (and may also modify the leaf image in response to their respective compute node’s access to its instance of the image). *Id.* at 6:13–22.

The ’844 patent discloses that the blocks of the root image, leaf image, and cache are merged “on the fly” to create the node’s image. *Id.* at 8:13–15. From the node’s perspective, the created image appears as one cohesive image even though a separate and complete image is not actually stored for the node. *Id.* at 8:18–55. According to the ’844 Patent, this saves space without significantly impacting load times. *See id.* at 2:51–57.

The ’844 Patent teaches improving speed by caching portions of the root image in cache 260 (as several nodes in a cluster may often access the same root image data). *Id.* at 2:59–61, 6:38–43. Because cache capacity is typically limited, older data can be removed (as the amount approaches a threshold) to make way for new data by techniques “known in the art.” *Id.* at 7:1–16.

The ’844 Patent also teaches an “added benefit” by which one compute node can index the contents of the (shared) root image and provide the results to the other compute nodes (e.g., by storing results on a shared storage unit or providing the results directly). *Id.* at 7:23–31.

2. Illustrative Claim

The ’844 patent includes 27 claims, all of which are challenged. Claims 1, 7, 14, 19, and 23 are independent, and all other claims depend

from one of these independent claims. Claims 1 and 14 are illustrative of the claimed subject matter and are reproduced below.

1. A system for providing data to a plurality of compute nodes, the system comprising:
 - a first storage unit configured to store blocks of a root image of said compute nodes;
 - a plurality of second storage units configured to store leaf images of respective compute nodes, said leaf images including only additional data blocks not previously contained in said root image and changes made by respective compute nodes to the blocks of said root image, wherein said leaf images of respective compute nodes do not include blocks of said root image that are unchanged by respective compute nodes; and
 - a cache configured to cache blocks of said root image previously accessed by at least one of said compute nodes.

Ex. 1001, 10:56–11:3.

14. A system for indexing file systems for a plurality of compute nodes, the system comprising:
 - a first storage unit configured to store blocks of a root image of said compute nodes;
 - a plurality of second storage units configured to store leaf images of respective compute nodes, said leaf images comprising only additional data blocks not previously contained in said root image and changes made by respective compute nodes to the blocks of said root image, wherein said leaf images of respective compute nodes do not include blocks of said root image that are unchanged by respective compute nodes; and
 - a plurality of union block devices corresponding to said compute nodes, said union block devices configured to interface between said compute nodes and said first and second storage units to distribute said file systems to said compute nodes, wherein said union block devices are configured to create said file systems by merging the blocks

of said root image stored on the first storage unit with the blocks of respective leaf images stored on respective second storage units, and wherein further at least one of said compute nodes is configured to index said root image and provide the indexing results to another of said compute nodes.

Ex. 1001, 11:66–12:22.

D. Asserted Challenges to Patentability and Evidence of Record

Petitioner challenges the patentability of claims 1–27 of the '844 patent based on the following combination of references:

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1–6	102	Sapuntzakis, ² Holzmann ³
4, 6, 11, 16	103	Sapuntzakis, Federwisch ⁴
1–3, 6–16	102	Birse, ⁵ Holzmann
4, 5, 11, 12, 15, 16	103	Birse, Federwisch

Pet. 7. In support of its patentability challenges, Petitioner relies on, *inter alia*, the Declaration of Erez Zadok, Ph.D. (“Dr. Zadok”). Ex. 1003. In support of its opposition to Petitioner’s patentability challenges, Patent Owner relies on, *inter alia*, the Declaration of Richard Newman, Ph.D. (“Dr. Newman”). Ex. 2014.

² Sapuntzakis C. P., et al., *Optimizing the Migration of Virtual Computers*, Proceedings of the 5th Symposium on Operating Systems Designs and Implementation (2002) (Ex. 1005) (“Sapuntzakis”).

³ U.S. Patent Publication No. 2005/0283597 A1, filed June 22, 2004, published on December 22, 2005 (Ex. 1007) (“Holzmann”).

⁴ U.S. Patent Publication No. 2003/0182313 A1, filed March 19, 2002, published on September 25, 2003 (Ex. 1008) (“Federwisch”).

⁵ U.S. Patent No. 7,089,300 B1, issued on August 8, 2006 (Ex. 1006) (“Birse”).

III. PRELIMINARY MATTERS

A. Principles of Law Regarding Obviousness and Burdens of Proof

A claim is unpatentable under 35 U.S.C. § 103 if “the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) where in evidence, objective evidence of non-obviousness.⁶ *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). A patent claim “is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art.” *KSR*, 550 U.S. at 418.

An obviousness determination based on a combination of references requires finding “both ‘that a skilled artisan would have been motivated to combine the teachings of the prior art references to achieve the claimed invention, and that the skilled artisan would have had a reasonable expectation of success in doing so.’” *Intelligent Bio-Sys., Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1367–68 (Fed. Cir. 2016); *see KSR*, 550 U.S. at 418. Furthermore, an assertion of obviousness “cannot be sustained by mere conclusory statements; instead, there must be some articulated

⁶ At this stage of the proceeding, Patent Owner has not presented objective evidence of non-obviousness.

reasoning with some rational underpinning to support the legal conclusion of obviousness.” *KSR*, 550 U.S. at 418; *In re NuVasive, Inc.*, 842 F.3d 1376, 1383 (Fed. Cir. 2016) (a finding of a motivation to combine “must be supported by a ‘reasoned explanation’”).

“In an [*inter partes* review], the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable.” *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016) (citing 35 U.S.C. § 312(a)(3)); *see Intelligent Bio-Sys.*, 821 F.3d at 1369. This burden of persuasion never shifts to Patent Owner. *See Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015) (discussing the burden of proof in *inter partes* review).

The Supreme Court has made clear that we apply “an expansive and flexible approach” to the question of obviousness. *Id.* at 415. Whether a patent claiming a combination of prior art elements would have been obvious is determined by whether the improvement is more than the predictable use of prior art elements according to their established functions. *Id.* at 417. To reach this conclusion, however, requires more than a mere showing that the prior art includes separate references covering each separate limitation in a claim under examination. *Unigene Labs., Inc. v. Apotex, Inc.*, 655 F.3d 1352, 1360 (Fed. Cir. 2011).

Instead, obviousness requires the additional showing that a person of ordinary skill at the time of the invention would have selected and combined those prior art elements in the normal course of research and development to yield the claimed invention. *Id.* “To satisfy its burden of proving obviousness, a petitioner cannot employ mere conclusory statements. The petitioner must instead articulate specific reasoning, based on evidence of

record, to support the legal conclusion of obviousness.” *In re Magnum Oil Tools Int’l, Ltd.*, 829 F.3d 1364, 1380 (Fed. Cir. 2016). Therefore, to prevail in an *inter partes* review, Petitioner must explain how the proposed combination of prior art would have rendered the challenged claims unpatentable. At this preliminary stage, we determine whether the information presented in the Petition shows there is a reasonable likelihood that Petitioner would prevail in establishing that at least one of the challenged claims would have been obvious over the proposed combinations of prior art.

We analyze the challenges presented in the Petition in accordance with the above-stated principles.

B. Level of Ordinary Skill in the Art

In determining the level of ordinary skill in the art, various factors may be considered, including the “type of problems encountered in the art; prior art solutions to those problems; rapidity with which innovations are made; sophistication of the technology; and educational level of active workers in the field.” *In re GPAC, Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995) (quoting *Custom Accessories, Inc. v. Jeffrey-Allan Indus., Inc.*, 807 F.2d 955, 962, (Fed. Cir. 1986)). Furthermore, the prior art itself can reflect the appropriate level of ordinary skill in the art. *Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001).

Petitioner contends that a person of ordinary skill in the art, at the time of the invention of the ’844 patent:

would have had a bachelor’s degree in computer science, computer engineering, electrical engineering, or related field, and at least two years of experience in the fields of networked

data storage. Additional education could substitute for professional experience, and vice-versa.

Pet. 11 (citing Ex. 1003 ¶ 34). Petitioner's Declarant, Dr. Zadok, states:

my opinion, a POSITA would have had a bachelor's degree in computer science, computer engineering, or an equivalent degree. A POSITA would also have had approximately two years of experience working in the fields of networked data storage, file systems, and operating systems. Additional experience might substitute for less education and *vice versa*.

Patent Owner does not address the level of skill in the art at the critical time. *See generally* Prelim. Resp. Patent Owner's Declarant, Dr. Newman, states that for his analysis he uses the definition provided by Dr. Zadok. Ex. 2014 ¶ 13.

We discern no meaningful difference between the definitions proffered by Petitioner or its Declarant. Neither party argues that the outcome of this case would differ based on our adoption of any particular definition of the level of ordinary skill in the art. Considering the subject matter of the '844 patent, the background technical field, the prior art, and Dr. Zadok's unopposed definition of the ordinarily skilled artisan (Ex. 1003 ¶ 35), which is adopted by Dr. Newman (Ex. 2014 ¶ 13) and is consistent with the asserted prior art references, we apply the level of skill set forth by Dr. Zadok.

C. Claim Construction

We construe claims “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), including construing the claim in accordance with the ordinary and customary meaning of such claim as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent.” 37 C.F.R.

§ 42.100(b); *see also Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc).

In this context, claim terms “are generally given their ordinary and customary meaning” as understood by a person of ordinary skill in the art in question at the time of the invention. *Phillips*, 415 F.3d at 1312–13; *see CCS Fitness, Inc. v. Brunswick Corp.*, 288 F.3d 1359, 1366 (Fed. Cir. 2002) (noting “a ‘heavy presumption’ that a claim term carries its ordinary and customary meaning”). “In determining the meaning of the disputed claim limitation, we look principally to the intrinsic evidence of record, examining the claim language itself, the written description, and the prosecution history, if in evidence.” *DePuy Spine, Inc. v. Medtronic Sofamor Danek, Inc.*, 469 F.3d 1005, 1014 (Fed. Cir. 2006) (citing *Phillips*, 415 F.3d at 1312–17). Extrinsic evidence is “less significant than the intrinsic record in determining ‘the legally operative meaning of claim language.’” *Phillips*, 415 F.3d at 1317.

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

Petitioner contends “that the challenged claims are obvious under any reasonable interpretation under the *Phillips* standard, and thus Petitioners submit that the Board need not resolve any express constructions.” Pet. 11

Patent Owner asserts “the Board should resolve this IPR under the plain-and ordinary-meaning standard without adopting any special constructions beyond what is necessary to address a concrete dispute.” Prelim. Resp. 11.

Based on our review of the current record, we agree with parties that no express construction of any term is necessary to resolve this case.

IV. ANALYSIS

A. Summary of References

1. Overview of Sapuntzakis (Ex. 1005)

Sapuntzakis is a conference paper titled “Optimizing the Migration of Virtual Computer” and is directed to moving the state of a running computer across a network, including the state in its disks, memory, CPU registers, and I/O devices. Ex. 1005, 1. This “state” is called a capsule.” *Id.* The capsule includes the entire operating system as well as applications and running processes. *Id.* Sapuntzakis teaches that it can take a significant amount of time to store, manipulate, and migrate lots of capsules. *Id.* at 2. Sapuntzakis then proposes a number optimizations in order to reduce the time. *Id.* at 4.

Once such optimization is storing disks in the capsules in a hierarchy. *Id.* at 5. According to Sapuntzakis, each child capsule in the hierarchy would “inherit” states from the parent capsule and any differences between the parent and child would be captured in a separate copy-on-write (COW) virtual disk. *Id.* Sapuntzakis explains that “[a]t the root of the hierarchy is a root disk, which is a complete capsule disk” while “[a]ll other nodes represent a COW disk.” *Id.* Therefore, administrators can install and

maintain the same software set on multiple machines by creating one (inactive) capsule and distributing it to all machines. *Id.* at 6. Sapuntzakis further teaches that “once capsules have children, they become immutable; this property simplifies the caching of capsules.” *Id.* at 5.

Figure 1, reproduced below, shows one example of Sapuntzakis’s capsule hierarchy as set up in a university environment.

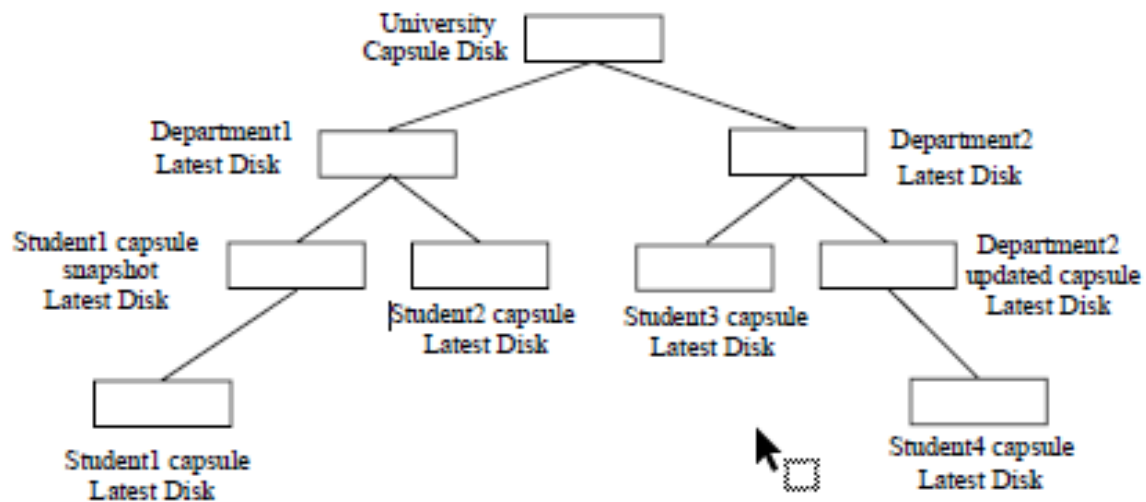


Figure 1: An example capsule hierarchy.

Figure 1, above, is a diagram illustrating Sapuntzakis’s root capsule. The root capsule is shown as the University Capsule Disk in Figure 1, and contains all the software available to all students. According to Sapuntzakis, “[e]ach time a user logs in, he looks up the latest department capsule and derives his own individual capsule” and “[t]he capsule migrates with the student as he commutes, and is destroyed when he logs out.” *Id.* at 5. Sapuntzakis discloses that if a capsule disk is updated, all the derived capsules containing custom installed software have to be ported to the updated capsule. *Id.*

Sapuntzakis teaches that each COW disk is made of a bitmap file and a sequence of extent files, which is a sequence of blocks of the COW disk.

Id. An example of this is shown in Figure 2, reproduced below.

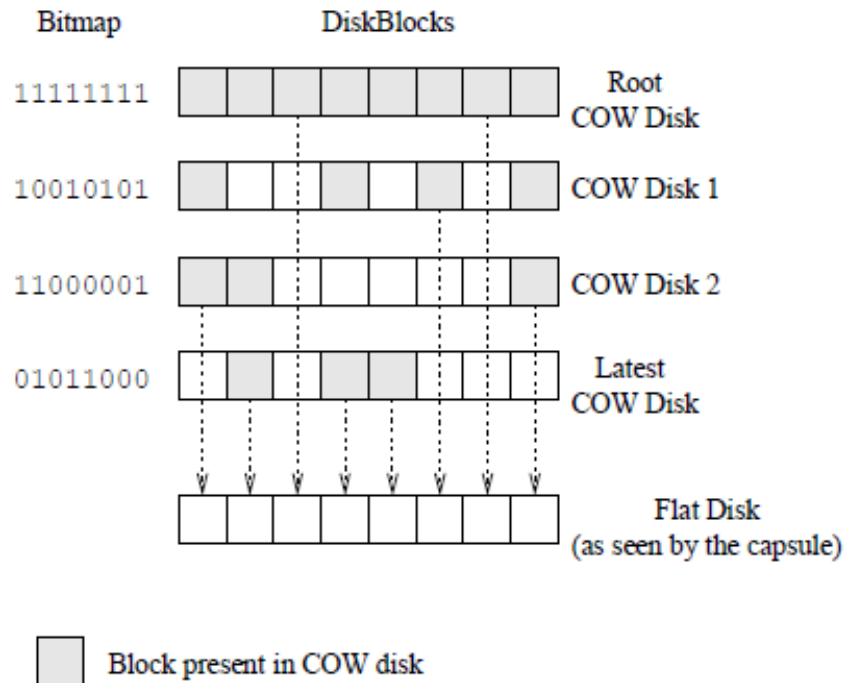


Figure 2: An example capsule disk.

Figure 2, above, is a diagram illustrating that Sapuntzakis's bitmap files, which contain one bit for each 16 KB block on the disk, indicating whether the block is present in the COW disk. *Id.* According to Sapuntzakis, “[w]rites to a capsule disk are performed by writing the data to the latest COW disk and updating its bitmap file,” while “[r]eads involve searching the latest COW disk and its ancestor disks in turn until the required block is found.” *Id.* at 5–6. Sapuntzakis explains “that the COW disk hierarchy is not visible to the VMM, or to the OS and applications inside the capsule; all of them see a normal flat disk as illustrated in the figure.” *Id.* at 6.

Another optimization technique taught by Sapuntzakis is that COW disks corresponding to a capsule disk are read page-by-page on demand,

rather than being pre-fetched. *Id.* According to Sapuntzakis, this reduces the start-up time of a capsule. *Id.* Sapuntzakis discloses that another technique to speed up data transfer over low-bandwidth links and decrease transfer time is to send a hash of data blocks instead of the data itself. *Id.* at 7. Sapuntzakis call this technique HCP, for Hashed Copy. *Id.* HCP uses a hash cache to map hashes to data and the cache is persistent. *Id.* The cache is implemented using a hash table whose size is fixed at creation. *Id.* And when the cache reads file data referenced by the table, it always checks that it matches the 20-byte SHA-1 hash provided. *Id.* According to Sapuntzakis, this maintains integrity and allows for a couple of performance improvements. *Id.*

2. Overview of Holzmann (Ex. 1007)

Holzmann is a U.S. Patent Application Publication titled “System and Method for Booting Multiple Servers from a Single Operating System Image” and is directed to storing an operating system (“OS”) image on a solid-state disk and using that single image to boot up multiple other servers or resources across a network. Ex. 1007, codes (12), (54), (57), ¶ 17. One embodiment of Holzmann is show in Figure 1, reproduced below.

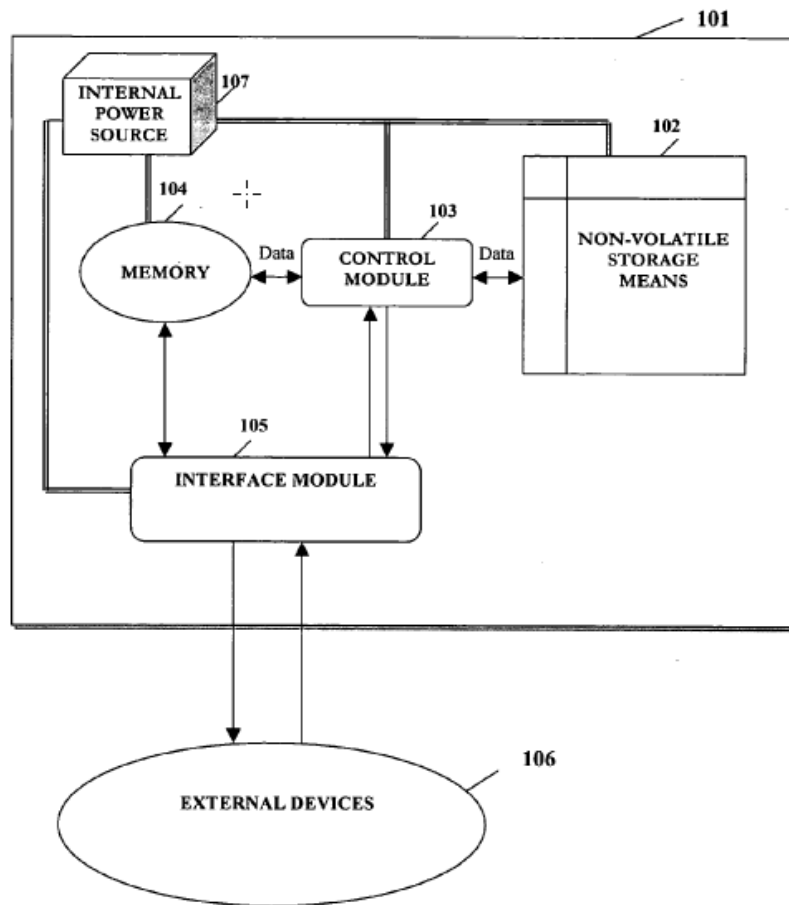


Fig. 1

Figure 1, above, is a functional block diagram illustrating solid state disk system 101 for storing data, including OS images disposed on memory module 104 where control module 103 automatically manipulates the copying and writing of data between the memory module and storage means 102. Ex.1007 ¶¶ 17–20. Holzmann discloses that control module 103 can allocate a sub-portion of the memory portion to be used as a cache for the OS. *Id.* ¶ 21. Holzmann further discloses if a second server or other external device sends a boot request to control module 103, the module allocates additional space in the cache for a second cache. *Id.* ¶ 33. Then if additional servers require boot operations, additional cache space

can be allocated for those servers. *Id.* According to Holzmman, by “allocating separate cache space for each server or other network resource, the inventive system prevents corruption of data, overwriting of data, and other harmful actions that would lead to resource malfunction.” *Id.*

In one embodiment of Holzmman control module 103 monitors requests for OS data, and determines whether a particular OS data block requested by external devices 106 has previously been loaded into OS cache. *Id.* ¶ 24. According to Holzmman, “[i]f the data block has been loaded into the cache, and that data block has not been overwritten subsequent to being loaded into the cache, the requested data block is provided from the cache in memory module 104 to interface module 105 for transmission to the appropriate external device 106.” *Id.* If, however, the requested data has not been loaded into cache, then a control module copies the data from the OS data stored in a memory portion of cache. *Id.*

3. *Overview of Federwisch (Ex. 1008)*

Federwisch is a U.S. Patent Application Publication titled “System and Method for Determining Changes in Two Snapshots and for Transmitting Changes to Destination Snapshot,” and is directed to mirroring changes between source and destination snapshots by comparing two snapshots and identifying differences in “the logical file block index of each snapshot.” Ex. 1008, codes (19), (54), (57). The system compares the indexes to file block numbers between two snapshots to identify changed data. *Id.* ¶ 14. Trees of blocks associated with the files are traversed, bypassing unchanged pointers between versions and walking down to identify the changes in the hierarchy of the tree. *Id.* These changes are transmitted to the destination mirror or replicated Snapshot. *Id.* This

technique allows regular files, directories, inodes and any other hierarchical Structure to be efficiently scanned to determine differences between versions. *Id.* The “scanner searches the index for changed base/incremental inode file snapshot blocks, comparing volume block numbers or another identifier . . . Hence, scanned blocks at the same index in both snapshots can be efficiently bypassed.” *Id.* at code (57), ¶¶ 71–72.

Each snapshot (the “leaf image”) has its own index of file blocks. *Id.* ¶ 109. Federwisch discloses that “[i]f the information is not in memory, the file system layer 450 indexes into the inode file using the inode number to access an appropriate entry and retrieve a volume block number.” *Id.* ¶ 53. According to Federwisch, the existence of a changed volume block number at a given offset in the index between the base snapshot inode file and incremental Snapshot inode file generally indicates that one or more of the underlying inodes and files to which the inodes point have been changed. *Id.* ¶ 71. A scanner searches the index for changed base/incremental inode file snapshot blocks, comparing volume block numbers or another identifier. *Id.* ¶ 72. If blocks are unchanged the files, they are scanned over without further processing. *Id.* “Hence, scanned blocks at the same index in both snapshots can be efficiently bypassed, reducing the scan time.” *Id.*

The system performs re-indexing when updating destination snapshots’ index maps. *Id.* ¶¶ 134, 137. It uses NVRAM and buffer caches for both snapshots and active file systems. *Id.* ¶¶ 48, 53, 58, 70. Data is shared (“exported” over a network), thus “allowing source and destination systems of different vendors to share the information.” *Id.* ¶¶ 15, 86, 120.

4. Overview of Birse (Ex. 1006)

Birse is a U.S. Patent titled “Method and Apparatus for Administering the Operating System of a Net-Booted Environment,” and directed to a network computer (“NC”) system that includes an NC servers and multiple NC clients that are all managed by a single NC client so that the any remaining NC clients that are booted later receive OS software that is configured differently than the one currently in effect. Ex. 1006, codes (12), (54), (57). According to Birse, this is accomplished by replacing one or more system volumes on the NC server containing the OS software with one or more different system volumes. *Id.* at code (57).

In one embodiment of Birse, a server in a NC system maintains a copy of the OS that cannot be corrupted by ordinary users of the NC system. Ex. 1006, 1:18–21. Additionally, the NC system may preserve user customizations (e.g., preferences) by maintaining individual, user, storage areas. When an NC client boots from the network and accesses a stored copy of the OS from an NC server, the user’s preferences are dynamically merged with the system environment provided to the NC client. *Id.* at 2:56–65. Advantageously, because of these features, a user may login to any NC client on the network and have the same user experience. *Id.* at 2:65–3:3.

One such embodiment of Birse is shown in Figure 1, reproduce below.

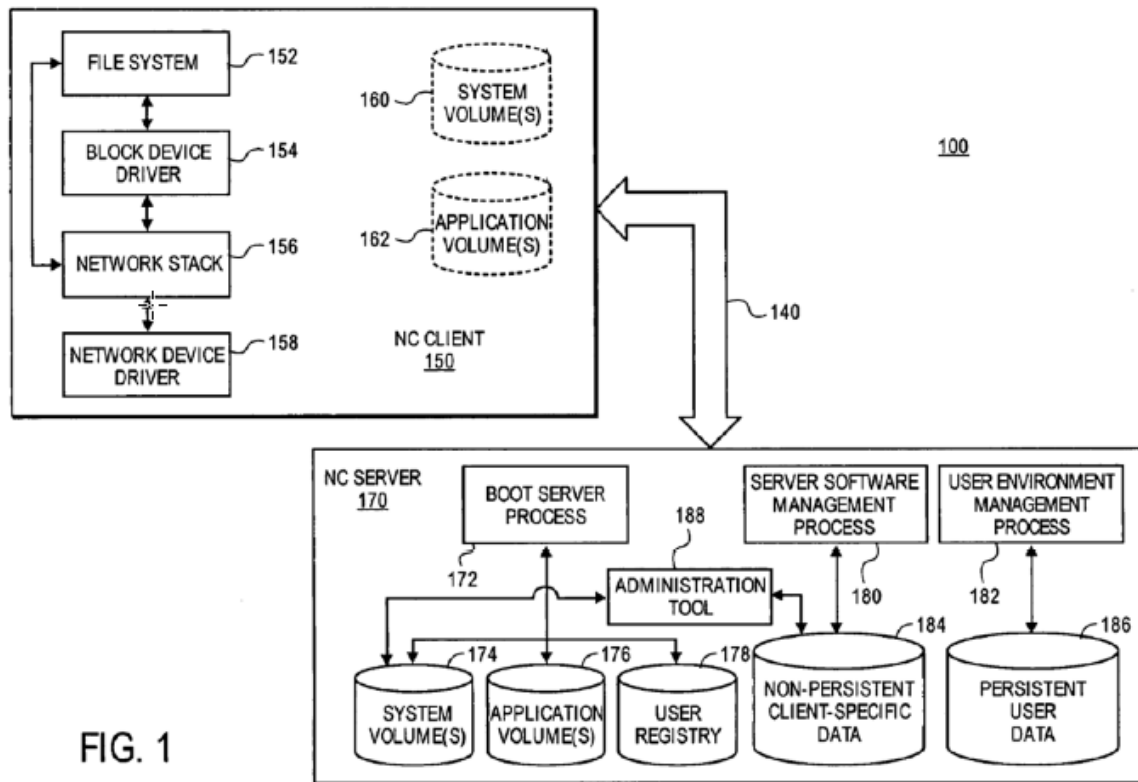


Figure 1, above, is a simplified block diagram illustrating NC system 100, which includes an NC client 150 (e.g., personal computer) coupled to an NC server 170 via data communication line 140. Ex. 1006, 2:8–10, 4:65–5:8. NC server 170 can include one or more system volumes 174 (including a protected, read-only, master copy of the OS software), one or more application volumes 176, user registry 178, non-persistent client-specific data 184 (temporary data storage), and persistent user data 186 (long-term storage for user information, e.g., preferences, browser bookmarks, other desktop environment customizations). *Id.* at 5:9–29, 6:43–48.

Birse teaches that NC server 170 also includes a boot server process 172 (managing access to the system volumes 174 and the application volumes 176), a server software process 180 (managing access to the non-

persistent client-specific data 184), and a user environment process 182 (maintaining the persistent user data 186). Ex. 1006, 5:46–6:34. Birse explains that NC client 150 also includes a file system 152 (logical structures and software routines to control access to and from local and remote storage media), a block device driver 154 (servicing file system read/write requests to the system volume 160 or shadow volumes, discussed below), a network stack 156 (used to access the data communication link 140), and a network device driver 158. *Id.* at 7:6–60.

According to Birse, when an NC client boots from the network and accesses the operating system from an NC server, the user’s preferences are dynamically merged with the system environment provided to the NC client. *Id.* at 2:62–65. In one embodiment, one or more shadow volumes is created from the NC client 150 and stored with the nonpersistent client-specific data 184 for the purpose of storing user preferences and/or changes to the operating system. *Id.* at 7:41–46.

B. Alleged Obviousness of Claims 1–13 over the Combination of Sapuntzakis and Holzmann

Petitioner contends claims 1–13 would have been unpatentable under 35 U.S.C. § 103 as obvious over the combination of Sapuntzakis (Ex. 1005) and Holzmann (Ex. 1007). Pet. 23–47 (citing Ex. 1003 ¶¶ 336–89). Patent Owner opposes Petitioner’s contentions. Prelim. Resp. 21–36. Based on our review of the record before us, we determine Petitioner has not established a reasonable likelihood that it would prevail in showing that independent claims 1 or 7 (and thus any Challenged Claim) would have been unpatentable as obvious over the combination of Sapuntzakis and Holzmann, as discussed below.

1. Analysis of Independent Claims 1 and 7

- a. “a cache configured to cache blocks of said root image previously accessed by at least one of said compute nodes” or “caching blocks of said root image that have been accessed by at least one of said compute nodes in a cache memory.”*

Claim 1 recites, in relevant part, “a cache configured to cache blocks of said root image previously accessed by at least one of said compute nodes.” Ex. 1001, 11:1–3. Claim 7 recites, in relevant part, “caching blocks of said root image that have been accessed by at least one of said compute nodes in a cache memory.” *Id.* at 11: 39–40. This is the only disputed limitation for these claims. The parties specifically dispute whether the combination of Sapuntzakis and Holzmann would have taught or suggested this limitation to the ordinarily skilled artisan at the critical time. *See* Pet. 30–33; Prelim. Resp. 32–34.

Petitioner argues that a person of ordinary skill in the art would have recognized that Holzmann’s memory module 104 is describing a cache memory “because RAM is often used as a fast volatile cache and (SSD) storage devices are used as relatively fast non-volatile caches.” Pet. 32 (citing Ex. 1003 ¶¶ 86–101, 329, 412). This statement, however, appears to be at odds with other testimony from Petitioner’s declarant, Dr. Zadok.

Dr. Zadok specifically testifies that a “memory cache stores the contents of frequently accessed RAM locations and the addresses where these data items are stored” and a “cache is useful when RAM accesses are slow compared with the microprocessor speed, because cache memory is always faster than main RAM memory.” Ex. 1003 ¶ 90 (citing Ex. 1011, 72). Dr. Zadok testifies that a “RAM cache” is “[c]ache memory that is used

by the system to store and retrieve data from the RAM.” *Id.* ¶ 93 (citing Ex. 1011, 395). Dr. Zadok explains in any cache hierarchy, “typically the cache (above) is faster and smaller than the backend location (below) from where the data was retrieved.” *Id.* ¶ 94. According to Dr. Zadok, if a data item is found in a cache it is called a “cache hit,” meaning that there was a “successful retrieval of data from a cache rather than from the slower hard disk or RAM.” *Id.* (citing Ex. 1011, 234–235).

Regardless of Dr. Zadok’s apparent inconsistent or ill-explained testimony, Holzmann does teach allocating a sub-portion of the memory to be used as a cache for the operating system. *See* Ex. 1007 ¶ 21. Holzmann also teaches that control module determines whether particular OS data blocks have been loaded into the OS cache. *Id.* ¶ 24. Yet, as argued persuasively by Patent Owner, Holzmann’s cache does not meet the claim limitation because it is an OS cache that contain a single OS image accessible by multiple servers to allow the multiple servers to boot up faster. *See id.* ¶¶ 9–10, 21, 36, Figs. 4–5; Prelim. Resp. 33–34.

Based on our reading of Holzmann, it does not disclose or teach per-node leaf images nor does it meet the claim’s negative limitation on leaf content. Rather, Holzmann is directed to avoiding maintaining separate OS images per server and instead relies on a single OS image with a centrally managed cache, and its cache arbitrates reads and writes to cached OS data at the line level with server-specific metadata. *See* Ex. 1007 ¶¶ 9–10; Figs. 4–5. Therefore, we are unpersuaded that Holzmann’s cache operations would have rendered the claim limitation obvious to an ordinarily skilled artisan.

b. Rationale to Combine the References

Petitioner contends that “[b]oth Sapuntzakis and Holzmann are concerned with the management of whole OS images being shared by users on a network, particularly efficient storage/transfer of such images” and “[b]oth disclose caching blocks of the root/boot disk images to improve efficiency.” Pet. 23. According to Petitioner, “a POSITA would have been motivated to modify Sapuntzakis with Holzmann’s caching techniques, including because, while Sapuntzakis discloses caching, a POSITA would have known there are many different caching techniques with associated benefits and drawbacks (several disclosed in Holzmann) – and Holzmann details how to cache data for each OS (e.g., Sapuntzakis’ virtual machine).” *Id.* at 23–24. Petitioner argues that “[m]odifying Sapuntzakis with Holzmann’s caching teachings would have been simple to a POSITA, and would not have required extensive experimentation or imposed undue burden – especially when both disclose caching.” *Id.* at 24. For the same reasons, Petitioner concludes that the combination would have yielded predictable results and there would have been a high expectation of success, because “Holzmann merely describes caching in greater detail than Sapuntzakis.” *Id.* (citing Ex.1003 ¶¶ 336–55).

Petitioner further addresses the cache memory issue, arguing that when the cache of Holzmann is used to cache blocks of the read-only shared OS image 660 of Sapuntzakis, there would be no need to create separate caches for each client because the read-only image is not subject to “corruption of data, overwriting of data, and other harmful actions that would lead to resource malfunction.” Pet. 33 (citing Ex.1007 ¶ 33). According to Petitioner, such “read-only data can be easily shared with

multiple users and they will all see the same consistent data.” *Id.* (citing Ex.1003 ¶ 333).

Patent Owner contests Petitioner’s position, arguing that Petitioner fails to provide an adequate rationale as to why a person of skill in the art would combine Holzmann’s centralized, multi-boot cache with Sapuntzakis’s “ephemeral capsule architecture,” especially in light of the opposing design philosophies of the references. Prelim. Resp. 22–24. Patent Owner specifically argues that Holzmann is designed expressly for persistent, cross-boot reuse coordinated through a centralized device memory and per-server metadata (Ex. 1007, Fig. 4), whereas “Sapuntzakis teaches exactly the opposite: capsules that are torn down at logout and rebuilt per session, relying on immutable remote COW media with per-host shadow caching and WAN-oriented migration techniques (Ex. 1005 § 4.2, Fig. 1; § 4.3, Fig. 3).” Prelim. Resp. 26.

Patent Owner further argues that an ordinarily skilled artisan would have been forced to “re-architected” Sapuntzakis’s per-host shadow-COW model to accommodate Holzmann’s centralized, cross-server boot cache in order to meet all the claim limitations as proffered by Petitioner. Prelim. Resp. 29. Yet, according to Patent Owner, such an ordinarily skilled artisan would not have done so “because Sapuntzakis already claims to solve the very reuse and bandwidth problems Petitioner invokes: at runtime via host-local shadow COW caches and across migrations via ballooning and hashed-copy (HCP) to avoid retransmitting blocks that exist at the destination (Ex. 1005 §§ 4.1, 4.3, 4.4; Figs. 3, 6, 8).” *Id.* That design leaves no “gap” that would have “directed a POSITA to import Holzmann’s central, multi-boot OS cache.” *Id.*

Patent Owner relies on the testimony of Dr. Newman to support its position. Dr. Newman testifies that the “fundamental lifecycle, placement/consistency, and problem-framing mismatches” between Sapuntzakis and Holzmann actually would have discouraged a person of ordinary skill and would require non-routine redesign rather than a predictable substitution. Ex. 2014 ¶ 99. Therefore, Patent Owner concludes that the references teach away from Petitioner’s theory, which is based on hindsight analysis and lacks any reasoned motivation to combine with a reasonable expectation of success. Prelim. Resp. 26.

We agree with Patent Owner that Petitioner fails to offer sufficient explanation as to why a person of ordinary skill in the art would have combined the teachings of Sapuntzakis and Holzmann. Rather, Petitioner appears to argue that, based on the advantages described by Holzmann (Ex. 1007 ¶ 33), and using well-known techniques with unspecified predictable results, a person of ordinary skill in the art would have had sufficient reason to combine these disparate elements taught in the prior art references to render the challenged claims obvious. Pet. 23–24, 33. Yet, other than Petitioner’s cursory assertion of advantageously incorporating the memory module from Holzmann to provide a caching mechanism (Pet. 33), which cites equally cursory and unsupported testimony by Dr. Zadok (Ex. 1003 ¶¶ 329, 333, 336–355), Petitioner fails to identify what particular advantages or efficiencies would have prompted a person of ordinary skill in the art to combine Holzmann’s memory module with Sapuntzakis’s system.

Although we agree with the Petitioner that a person of ordinary skill would have been *capable* of making the proposed combination, Patent Owner persuasively demonstrates that the Petitioner has not identified *why* a

person of ordinary skill would do so. As the Supreme Court has said, “a patent composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 418 (2007). [I]t can be important to identify a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does. This is so because inventions in most, if not all, instances rely upon building blocks long since uncovered, and claimed discoveries almost of necessity will be combinations of what, in some sense, is already known. *KSR*, 550 U.S. at 418-19. For example, the Federal Circuit has held that testimony “succumbed to hindsight bias” when it “primarily consisted of conclusory references to her belief that one of ordinary skill in the art *could* combine these references, not that they *would* have been motivated to do so.” *InTouch Techs., Inc. v. VGO Commc’ns, Inc.*, 751 F.3d 1327, 1352 (Fed. Cir. 2014). Such is the case here where Petitioner has found a person of ordinary skill *could* combine the references, but has not sufficiently explained whether a person of ordinary skill *would* do so.

Furthermore, Dr. Zadok’s testimony regarding predictable results and “obvious to try” are similarly lacking in elaboration and substantiation. *See* Ex. 1003 ¶¶ 329, 333, 336–355. Such conclusory statements and unspecific testimony without evidence on the record cannot satisfy the Petitioner’s burden of demonstrating obviousness. *In re Magnum Oil Tools Int’l, Ltd.*, 829 F.3d 1364, 1380 (Fed. Cir. 2016); *I/P Engine, Inc. v. AOL Inc.*, 576 Fed. Appx. 982, 999 (Fed. Cir. 2014) (“The testimony of the Defendants’ expert amounts to a ‘mere conclusory statement’ that may not serve as a basis for

finding the asserted claims obvious.”); *see InTouch Techs., Inc.*, 751 F.3d at 1352; *see also* 37 C.F.R. 42.65(a) (“Expert testimony that does not disclose the underlying facts or data on which the opinion is based is entitled to little or no weight.”).

We have considered Petitioner’s arguments and cited evidence concerning whether the combination of Sapuntzakis and Holzmann would have taught or suggested to the ordinarily skilled artisan the features of claims 1 and 7, and do not find them sufficiently persuasive on the record before us. Rather, we find Patent Owner’s arguments and cited evidence outlined above sufficiently persuasive to demonstrate Petitioner failed to meet its burden of proof in this case. Accordingly, for the reasons expressed above and based on the record before us, we determine that Petitioner has not established a reasonable likelihood that it would prevail in showing that independent claim 1 is unpatentable as obvious under 35 U.S.C. § 103(a) in view the combination of Sapuntzakis and Holzmann.

2. Dependent Claims 2–6, 8–13

Claims 2–6 and 8–13 depend, directly or indirectly, from independent claims 1 or 7. Ex. 1001, 11:4–26, 11:41–65. Based on the record before us, we determine that Petitioner’s analysis for claims 2–6 and 8–13 does not remedy the deficiencies identified above with respect to independent claims 1 and 7. *See* Pet. 33–46. Thus, for the same reasons discussed in connection with the challenge to independent claims 1 and 7, we determine that Petitioner has not established a reasonable likelihood that it would prevail in showing that any of claims 2–6 and 8–13 is unpatentable as obvious over the combination of Sapuntzakis and Holzmann.

C. Alleged Obviousness of Claims 14–27 over the Combination of Sapuntzakis and Federwisch

Petitioner contends claims 14–27 would have been unpatentable under 35 U.S.C. § 103 as obvious over the combination of Sapuntzakis (Ex. 1005) and Federwisch (Ex. 1008). Pet. 47–58. Patent Owner opposes Petitioner’s contentions. Prelim. Resp. 36–47. Based on our review of the record before us, we determine that Petitioner has not established a reasonable likelihood that it would prevail in showing that independent claims 14, 19, or 23 (and thus any Challenged Claim) would have been unpatentable as obvious over the combination of Sapuntzakis and Federwisch, as discussed below.

1. Analysis of Independent Claims 14, 19, 23

The parties dispute whether the combination of Sapuntzakis and Federwisch would have taught or suggested to the ordinarily skilled artisan the required union block devices or the cross-node root-image indexing limitations recited in claims 14, 19, or 23. *See* Pet. 49–52 (citing Pet. 36–39; Ex. 1003 ¶¶ 439, 479, 492); Prelim. Resp. 36–41.

a. Union Block Devices Limitation

Claims 14 recites a “plurality of union block devices corresponding to said compute nodes, said union block devices configured to interface between said compute nodes and said first and second storage units to distribute said file systems to said compute nodes, wherein said union block devices are configured to create said file systems by merging the blocks of said root image stored on the first storage unit with the blocks of respective leaf images stored on respective second storage units.” Ex. 1001, 12:11–19. Claim 19 recites “merging the blocks of said root image with the blocks of respective leaf images stored on respective second storage units to create

respective file systems for respective compute nodes.” *Id.* at 12:54–57.

Claim 23 recites “wherein said file system is the result of merging said root image portion and said leaf image portion together at the block-level.” *Id.* at 13:14–16.

Petitioner contends these “elements are substantially similar to elements recited in claims 4 and 11 regarding UBDs and merging” and that Sapuntzakis discloses these elements. Pet. 50. According to Petitioner, “none of the individual COW disks in [Sapuntzakis’s] hierarchy are visible to the client user; instead, a single cohesive (logical) storage image corresponding to the ’844 Patent’s merged root and leaf blocks presenting cohesive respective application environments.” Pet. 38 (citing Ex.1003 ¶¶ 390–96, 426–28). Therefore, Petitioner argues that Sapuntzakis must render union block devices obvious because an ordinarily skilled artisan “would have recognized that such a system component is necessary to provide features,” that “taken together, embody the union block device” recited in the claims. Pet. 38–39 (citing Ex. 1003 ¶¶ 426–28). Petitioner further notes that it was well-known for storage systems to use single storage appliances. *Id.* at 39.

Patent Owner persuasively responds (and we agree for the same reasons):

Neither Sapuntzakis nor Federwisch discloses or suggests this architecture. Sapuntzakis describes per-capsule copy-on-write (“COW”) disk hierarchies used to migrate a self-contained virtual machine “capsule.” In Sapuntzakis, reads are performed by searching the most-recent COW layer and then ancestors “until the required block is found,” and the OS inside the capsule “see[s] a normal flat disk.” EX1005 §4.2. That COW layering is internal to a single capsule image; it is not a union device

deployed across a plurality of independent compute nodes to create their file systems by merging a common root with respective leaves. Sapuntzakis's own usage model reinforces the point: a user logs in, derives an individual capsule, and that capsule "migrates ... and is destroyed when he logs out," which underscores a transient, per-capsule store—not a shared root image that is merged with respective leaf images for many different nodes via a "plurality of union block devices." EX1005 §4.2.

Prelim. Resp. 38.

Patent Owner further argues that Federwisch cannot teach union block devices because it addresses "remote asynchronous replication or mirroring of changes" between snapshots by scanning two versions of a source snapshot to identify changed blocks and transmitting those changes to build a new, replicated destination snapshot. *Id.* (citing Ex. 1008 ¶ 14). Patent Owner is again persuasive when it asserts that Federwisch using offline snapshot replication between a source and a destination filer, which is not a union block device that sits beneath each compute node's file system (functioning at the "block" layer) and merges a shared root image with respective leaf images to "create" a node's runtime file system. *Id.* at 39.

In addition to the persuasive argument provided by Patent Owner, we find that Petitioner's position is merely conclusory and insufficiently supported by the record. Specifically, Petitioner fails to explain sufficiently *how* or *why* Sapuntzakis's disclosure allegedly teaches or suggests the features of the union block devices within the context of the disputed claims as a whole. Thus, we are unpersuaded that Sapuntzakis's invisible hierarchy somehow would have rendered the claim limitation obvious to an ordinarily skilled artisan.

b. Cross-Node Root-Image Indexing Limitation

Each of claims 14, 19, and 23 require indexing a root image or root image portion and providing the indexing results to another of said compute nodes. Ex. 1001, 12:20–22, 12:58–61, 13:17–19.

Petitioner contends that the combination of Sapuntzakis with Federwisch discloses these elements. Pet. 50–51. Petitioner specifically argues that Sapuntzakis discloses that data is indexed and that an ordinarily skilled artisan “interested in building a system based on Sapuntzakis would have been motivated to seek out additional details on indexing storage systems, files, and caches thereof.” *Id.* at 51. According to Petitioner, “[t]his is particularly so because indexing of data items was a well known technique. A POSITA would have found Federwisch relevant, which discloses greater details of indexing.” *Id.* at 51–52. Petitioner further asserts that:

A person of ordinary skill in the art] would have understood that the scanner of Federwisch ***could*** be implemented on any of the compute nodes of Sapuntzakis, as part of the Union Block Device. As described, *supra* §§VI, VIII.A, a [person of ordinary skill in the art] would further have understood that such scanner ***could*** be used to index the root image and to provide the index results to other compute nodes, because such indexing and sharing of data over networks was well known. Ex.1003, ¶¶434-37,480-81,493-94.

Pet. 51 (emphasis added). Petitioner proffers these conclusory statements regarding what an ordinarily skilled artisan *could* do given the disclosures of Sapuntzakis and Federwisch, but does so without sufficiently explaining *why* such a skilled artisan *would* perform the features of the challenged limitation based on these disclosures.

Additionally, as argued persuasively by Patent Owner, Petitioner fails to show sufficiently how or when an index would be provided to another compute node. *See* Prelim. Resp. 41–45. Other than making generalized statement regarding indexing and Federwisch identifying changed and unchanged blocks (Pet. 51–52), Petitioner fails to make a showing of such indexing being sent to or provided to another node. Thus, we find Petitioner does not show sufficiently how the disclosures in Federwisch and Sapuntzakis teaches or suggests indexing a root image or root image portion and providing the indexing results to another of said compute nodes.

c. Combined Teachings and Summary

As for the *combined* teachings of Sapuntzakis and Federwisch, the full extent of Petitioner’s argument is that

a [person of ordinary skill in the art] would have been motivated to modify Sapuntzakis with Federwisch’s indexing – including because, while Sapuntzakis discloses that data is indexed, it does so only in connection with a hash table that indexes cached entries for faster access. A POSITA building a Sapuntzakis system, and knowing indexing of data items was a well-known technique, would have been motivated to seek additional details on indexing storage systems, files, and caches thereof (supplied by Federwisch). A [person of ordinary skill in the art] would also have known that indexing of data is an age-old technique long utilized in computer systems.

Modifying Sapuntzakis to include Federwisch’s indexing would have been simple to a POSITA, and would not have required extensive experimentation or imposed undue burden – including because Sapuntzakis already indexed data objects and a POSITA would not have expected Sapuntzakis to provide details of such a basic concept. For the same reasons, the combination would have yielded predictable results, as indexes are well understood to structure and locate data objects efficiently and a POSITA would have had a high expectation of

success, because indexing techniques were well understood for decades beforehand. Ex.1003, ¶¶449-471.

Pet. 47 (emphasis added). But Petitioner does not sufficiently explain what is missing in the combination of Sapuntzakis that Federwisch allegedly would add nor does Petitioner explain how details from Federwisch would be implemented in Sapuntzakis. Rather, Petitioner merely concludes that an ordinarily skill artisan could have done so and, therefore, would have do so.

Our reviewing courts have warned us that “[o]bviousness may not be established using hindsight or in view of the teachings or suggestions of the inventor.” *Para-Ordnance Mfg. v. SGS Importers Int’l*, 73 F.3d 1085, 1087 (Fed. Cir. 1995) (citing *W.L. Gore & Assocs., Inc. v. Garlock, Inc.*, 721 F.2d 1540, 1551, 1553 (Fed. Cir. 1983)). “The mere fact that the prior art may be modified in the manner suggested . . . does not make the modification obvious unless the prior art suggested the desirability of the modification.” *In re Fritch*, 972 F.2d 1260, 1266 (Fed. Cir. 1992) (citing *In re Gordon*, 733 F.2d 900, 902, 221 USPQ 1125, 1127 (Fed. Cir. 1984)). “It is impermissible to use the claimed invention as an instruction manual or 'template' to piece together the teachings of the prior art so that the claimed invention is rendered obvious.” *Fritch*, 972 F.2 at 1266 (citing *In re Gorman*, 933 F.2d 982, 987 (Fed. Cir. 1991)). Without the challenged claims as a guide, we are not persuaded an ordinarily skill artisan at the critical time would have combined the prior art as suggested by Petitioner.

We have considered Petitioner’s arguments and cited evidence concerning whether the combination of Sapuntzakis and Federwisch would have taught or suggested to the ordinarily skilled artisan the features of the disputed limitation, and do not find them sufficiently persuasive on the

record before us. Rather, we find Patent Owner's arguments and cited evidence outlined above sufficiently persuasive to demonstrate Petitioner failed to meet its burden of proof in this case. Accordingly, for the reasons expressed above and based on the record before us, we determine that Petitioner has not established a reasonable likelihood that it would prevail in showing that independent claims 14, 19, and 23 are unpatentable as obvious over the combination of Sapuntzakis and Federwisch.

2. Dependent Claims 15–18, 20–22, and 24–27

Based on the record before us, we determine that Petitioner's analysis for dependent claims 15–18, 20–22, and 24–27 does not remedy the deficiencies identified above with respect to independent claims 14, 19, and 23. *See* Pet. 52–58. Thus, for the same reasons discussed in connection with the challenge to independent claims 14, 19, and 23, we determine that Petitioner has not established a reasonable likelihood that it would prevail in showing that any of claims 15–18, 20–22, and 24–27 are unpatentable as obvious over the combination of Sapuntzakis and Federwisch.

D. Alleged Obviousness of Claims 14–27 over the Combination of Birse and Federwisch

Petitioner contends claims 1–13 would have been unpatentable under 35 U.S.C. § 103 as obvious over the combination of Birse (Ex. 1006) and Holzmann (Ex. 1007). Pet. 58–74 (citing Ex. 1003 ¶¶ 537–66). Patent Owner opposes Petitioner's contentions. Prelim. Resp. 21–36. Based on our review of the record before us, we determine Petitioner has not established a reasonable likelihood that it would prevail in showing that independent claims 1 or 7 (and thus any Challenged Claim) would have been

unpatentable as obvious over the combination of Birse and Holzmann, as discussed below.

1. Analysis of Independent Claims 1 and 7

- a. *“a cache configured to cache blocks of said root image previously accessed by at least one of said compute nodes” or “caching blocks of said root image that have been accessed by at least one of said compute nodes in a cache memory”*

The parties dispute whether the combination of Birse and Holzmann would have taught or suggested to the ordinarily skilled artisan the required “caching blocks” limitations recited in claims 1 or 7. *See* Pet. 67 (citing Pet. 21–22, 24–33; Ex. 1003 ¶¶ 534–36, 582); Prelim. Resp. 47–51.

Petitioner specifically relies on the disclosure in Holzmann to meet the “caching blocks” claim element. Pet. 67. Petitioner argues that it would have been obvious to an ordinarily skill artisan at the critical time to combine the cache system of Holzmann with the system of Birse to improve the performance of Birse. *Id.* (citing Ex. 1003 ¶¶ 534–36, 582).

Patent Owner contests Petitioner’s position, arguing that Petitioner fails to provide an adequate rationale as to why a person of skill in the art would combine Holzmann’s “single, centrally managed image with a shared cache” with Birse’s “per-client artifacts (including full copies in one embodiment) as the way to manage client changes,” especially in light of the opposing design philosophies of the references. Prelim. Resp. 52. Patent Owner specifically argues that Holzmann describes “an appliance-resident, per-server operating system cache tied to a single shared OS image, complete with line-level metadata and write-arbitration mechanisms, whereas Birse teaches a “SplitOS” model that “proliferates per-client

volumes, including full or sparse shadows, but never teaches caching of root image blocks for cross-node reuse.” Prelim. Resp. 47.

Patent Owner further argues that under Petitioner’s proffered combination, an ordinarily skilled artisan would have been forced to re-engineer the entire system. *Id.* at 48. According to Patent Owner, much of the re-engineer would be due to Birse lacking the claimed cache and claimed caching context. *Id.* at 49. Patent Owner’s position is supported by the testimony of Dr. Newman, who testifies that:

to meet the claim from Birse and Holzmann, a person of ordinary skill would have to: (i) introduce the patent’s root/leaf composition model in which unchanged root blocks never appear in the leaf and writes go only to the leaf; (ii) relocate and re scope Holzmann’s appliance cache so that it caches only blocks of the shared root image, not generic OS data, and so that it is consumed through a block level merge with each node’s leaf beneath the file system; and (iii) strip out Holzmann’s per line write semantics and server ownership locking — which exist precisely because Holzmann’s cache is used as a read and write appliance cache for a single OS image — to conform to the claim’s root read/leaf write division of responsibility.

Ex. 2014 ¶ 131.

As discussed previously, based on our reading of Holzmann, it does not disclose or teach per-node leaf images nor does it meet the claim’s negative limitation on leaf content. Rather, Holzmann is directed to avoiding maintaining separate OS images per server and instead relies on a single OS image with a centrally managed cache, and its cache arbitrates reads and writes to cached OS data at the line level with server-specific metadata. *See* Ex. 1007 ¶¶ 9–10; Figs. 4–5. Therefore, we are unpersuaded

that Holzmann's cache operations would have rendered the claim limitation obvious to an ordinarily skilled artisan.

b. Rationale to Combine the References

Petitioner contends that an ordinarily skill artisan at the critical time would have combine the teachings of Birse and Holzmann to arrive at the challenged claims. *See* Pet. 58–59 (citing Ex. 1003 ¶¶ 537–555). According to Petitioner, both Birse and Holzmann are concerned with efficient management of whole OS images and booting systems over a network, and Birse discloses caching as a feature on some embodiments of its system's server and client computers. *Id.* at 58. Yet, Birse it lacks detail on how caching may be applied to its boot images. Therefore, Petitioner asserts that a person of ordinary skill in the art would have looked to Holzmann for greater details of caches for each system/server being booted, as well as different cache configurations. *Id.* (citing Ex.1003 ¶¶ 537–555).

Petitioner further argues that an ordinarily skill artisan “would have been motivated to modify Birse with Holzmann's caching techniques, including because, while Birse discloses typical caching, Holzmann offers details of how to cache data for the OS distribution purpose (*e.g.*, Birse's boot images).” *Id.* Petitioner concludes that combining the teachings of these references would have been simple, inexpensive, and would have yielded predictable results for the ordinarily skill artisan. *Id.* at 59.

Patent Owner disputes Petitioner's position. Prelim. Resp. 51–54. Patent Owner contends the two references “pull a person of ordinary skill in opposite directions on the core design choice at issue.” *Id.* at 52. According to Patent Owner, “Holzmann tells the reader that keeping per-server images is undesirable and should be replaced by a single, centrally managed image

with a shared cache,” while Birse “embraces per-client artifacts (including full copies in one embodiment) as the way to manage client changes.” *Id.* Patent Owner further argues that “[i]mplementing claim 1 from these references would also change their principles of operation rather than yield a predictable variant.” *Id.* at 53. Patent Owner’s position is supported by the testimony of Dr. Newman, who testifies that a person of ordinary skill in the art:

starting from Holzmann’s model would have no record-based reason to re-introduce per-node, persistent image artifacts—precisely what claim 1 requires for the leaf images—because Holzmann’s stated objective is to avoid them. Conversely, a skilled artisan starting from Birse’s per-client shadow scheme would not be steered toward Holzmann’s single-image boot appliance with a centrally partitioned OS cache.

Ex. 2014 ¶ 132.

We agree with Patent Owner that Petitioner fails to offer sufficient explanation as to why a person of ordinary skill in the art would have combined the teachings of Birse and Holzmann. Rather, Petitioner appears to argue that, based on the advantages described by Holzmann, and using well-known techniques with unspecified predictable results, a person of ordinary skill in the art would have had sufficient reason to combine these specific elements taught in the prior art references in the specific manner recited in the challenged claim, thereby rendering such claims obvious. Pet. 58–59. Petitioner walks a narrow path in arguing that Birse’s disclosure of caching techniques is both sufficient enough to lead an ordinarily skilled artisan to want caching, but insufficient enough to require more detail.

Although we agree with the Petitioner that a person of ordinary skill would have been *capable* of making the proposed combination, Patent

Owner persuasively demonstrates that the Petitioner has not identified *why* a person of ordinary skill would use Holzmänn's caching details or its caching configurations when it is so different from Birse. As the Supreme Court has said, "a patent composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art." *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 418 (2007). [I]t can be important to identify a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does. This is so because inventions in most, if not all, instances rely upon building blocks long since uncovered, and claimed discoveries almost of necessity will be combinations of what, in some sense, is already known. *KSR*, 550 U.S. at 418-19. For example, the Federal Circuit has held that testimony "succumbed to hindsight bias" when it "primarily consisted of conclusory references to her belief that one of ordinary skill in the art *could* combine these references, not that they *would* have been motivated to do so." *InTouch Techs., Inc. v. VGO Commc'ns, Inc.*, 751 F.3d 1327, 1352 (Fed. Cir. 2014). Such is the case here where Petitioner has argued that a person of ordinary skill *could* combine the references, but has not sufficiently explained whether a person of ordinary skill *would* do so.

Furthermore, Dr. Zadok's testimony regarding predictable results and obviousness to try are similarly lacking in elaboration and substantiation. *See* Ex. 1003 ¶¶ 553–555. Such conclusory statements and unspecific testimony without evidence on the record cannot satisfy the Petitioner's burden of demonstrating obviousness. *In re Magnum Oil Tools Int'l, Ltd.*, 829 F.3d 1364, 1380 (Fed. Cir. 2016); *I/P Engine, Inc. v. AOL Inc.*, 576 Fed.

Appx. 982, 999 (Fed. Cir. 2014) (“The testimony of the Defendants’ expert amounts to a ‘mere conclusory statement’ that may not serve as a basis for finding the asserted claims obvious.”); *see InTouch Techs., Inc.*, 751 F.3d at 1352; *see also* 37 C.F.R. 42.65(a) (“Expert testimony that does not disclose the underlying facts or data on which the opinion is based is entitled to little or no weight.”).

We have considered Petitioner’s arguments and cited evidence concerning whether the combination of Birse and Holzmann would have taught or suggested to the ordinarily skilled artisan the features of claims 1 and 7, and do not find them sufficiently persuasive on the record before us. Rather, we find Patent Owner’s arguments and cited evidence outlined above sufficiently persuasive to demonstrate Petitioner failed to meet its burden of proof in this case. Accordingly, for the reasons expressed above and based on the record before us, we determine that Petitioner has not established a reasonable likelihood that it would prevail in showing that independent claim 1 is unpatentable as obvious under 35 U.S.C. § 103(a) in view the combination of Birse and Holzmann.

1. Dependent Claims 2–6, 8–13

Claims 2–6 and 8–13 depend, directly or indirectly, from independent claims 1 or 7. Ex. 1001, 11:4–26, 11:41–65. Based on the record before us, we determine that Petitioner’s analysis for claims 2–6 and 8–13 does not remedy the deficiencies identified above with respect to independent claims 1 and 7. *See* Pet. 33–46. Thus, for the same reasons discussed in connection with the challenge to independent claims 1 and 7, we determine that Petitioner has not established a reasonable likelihood that it would

prevail in showing that any of claims 2–6 and 8–13 is unpatentable as obvious over the combination of Birse and Holzmann.

E. Alleged Obviousness of Claims 14–27 over the Combination of Birse and Federwisch

Petitioner contends claims 14–27 would have been unpatentable under 35 U.S.C. § 103 as obvious over the combination of Birse (Ex. 1006) and Federwisch (Ex. 1008). Pet. 74–79. Patent Owner opposes Petitioner’s contentions. Prelim. Resp. 36–47. Based on our review of the record before us, we determine that Petitioner has not established a reasonable likelihood that it would prevail in showing that independent claims 14, 19, or 23 (and thus any Challenged Claim) would have been unpatentable as obvious over the combination of Birse and Federwisch, as discussed below.

1. Analysis of Independent Claims 14, 19, 23

a. cross-node root-image indexing limitations

The parties dispute whether the combination of Birse and Federwisch would have taught or suggested to the ordinarily skilled artisan the required the cross-node root-image indexing limitations recited in claims 14, 19, or 23. See Pet. 76–77 (citing Pet. 74–75; Ex. 1003 ¶¶ 639–40); Prelim. Resp. 57–59.

Petitioner relies on the disclosure in Federwisch for the disputed limitation. Pet. 76–77 (citing Pet. 74–75; Ex. 1003 ¶¶ 639–40). As explained previously, Petitioner proffers only conclusory statements regarding what an ordinarily skilled artisan *could* do given the disclosure of Federwisch, but does so without sufficiently explaining *why* such a skilled artisan *would* perform the features of the challenged limitation based on the disclosure.

Additionally, we also previously found that Petitioner fails to show sufficiently how or when an index in Federwisch would be provided to another compute node. Other than making generalized statement regarding indexing and Federwisch identifying changed and unchanged blocks (*see* Pet. 51–52), Petitioner fails to make a showing of such indexing being sent to or provided to another node. Thus, we find Petitioner does not show sufficiently how the disclosures in Federwisch and Birse teaches or suggests indexing a root image or root image portion and providing the indexing results to another of said compute nodes.

a. Combined Teachings and Summary

As for the *combined* teachings of Birse and Federwisch, the full extent of Petitioner’s argument is that

Both Birse and Federwisch operate at and recognize disk blocks at the block layer (while also recognizing that file systems interoperate and work atop the block layer), disclose/use CoW snapshots (a POSITA would have known CoW techniques enable snapshots), and disclose caching blocks of the root/boot disk images. Further, a POSITA would have been motivated to modify Birse with Federwisch’s indexing – including because, while Birse suggests that the boot images are indexed and organized through boot file selection and a registry, a POSITA building a Birse system, and knowing that indexing of data items was a well-known technique, would have been motivated to seek additional details on indexing storage systems, files, and caches thereof (supplied by Federwisch). A POSITA would also have known that indexing of data is an age-old technique long utilized in computer systems. Ex.1003, ¶¶617-638.

Modifying Birse to include Federwisch’s indexing would have been simple to a POSITA, and would not have required extensive experimentation or imposed undue burden – including because Birse likely already supported the use indexing tools and a POSITA would not have expected Birse to provide details of

such a basic concept. For the same reasons, the combination would have yielded predictable results, as indexes are well understood to structure and locate data objects efficiently and a POSITA would have had a high expectation of success, because indexing techniques were well understood for decades beforehand. Ex.1003, ¶¶639-40.

Pet. 74–75 (emphasis omitted). But Petitioner does not sufficiently explain how details from Federwisch would be implemented in Birse and to what extent. Rather, Petitioner merely concludes that an ordinarily skill artisan could have done so and, therefore, would have do so.

Our reviewing courts have warned us that “[o]bviousness may not be established using hindsight or in view of the teachings or suggestions of the inventor.” *Para-Ordnance Mfg. v. SGS Importers Int’l*, 73 F.3d 1085, 1087 (Fed. Cir. 1995) (citing *W.L. Gore & Assocs., Inc. v. Garlock, Inc.*, 721 F.2d 1540, 1551, 1553 (Fed. Cir. 1983)). “The mere fact that the prior art may be modified in the manner suggested . . . does not make the modification obvious unless the prior art suggested the desirability of the modification.” *In re Fritch*, 972 F.2d 1260, 1266 (Fed. Cir. 1992) (citing *In re Gordon*, 733 F.2d 900, 902, 221 USPQ 1125, 1127 (Fed. Cir. 1984)). “It is impermissible to use the claimed invention as an instruction manual or 'template' to piece together the teachings of the prior art so that the claimed invention is rendered obvious.” *Fritch*, 972 F.2 at 1266 (citing *In re Gorman*, 933 F.2d 982, 987 (Fed. Cir. 1991)). Without the challenged claims as a guide, we are not persuaded an ordinarily skill artisan at the critical time would have combined the prior art as suggested by Petitioner.

We have considered Petitioner’s arguments and cited evidence concerning whether the combination of Birse and Federwisch would have taught or suggested to the ordinarily skilled artisan the features of the

disputed limitation, and do not find them sufficiently persuasive on the record before us. Rather, we find Patent Owner's arguments and cited evidence outlined above sufficiently persuasive to demonstrate Petitioner failed to meet its burden of proof in this case. Accordingly, for the reasons expressed above and based on the record before us, we determine that Petitioner has not established a reasonable likelihood that it would prevail in showing that independent claims 14, 19, and 23 are unpatentable as obvious over the combination of Birse and Federwisch.

2. Dependent Claims 15–18, 20–22, and 24–27

Based on the record before us, we determine that Petitioner's analysis for dependent claims 15–18, 20–22, and 24–27 does not remedy the deficiencies identified above with respect to independent claims 14, 19, and 23. *See* Pet. 52–58. Thus, for the same reasons discussed in connection with the challenge to independent claims 14, 19, and 23, we determine that Petitioner has not established a reasonable likelihood that it would prevail in showing that any of claims 15–18, 20–22, and 24–27 are unpatentable as obvious over the combination of Birse and Federwisch.

V. CONCLUSION

Petitioner has not demonstrated a reasonable likelihood of prevailing with respect to any of claims 1–27 of the '844 patent under any of its proffered challenges.

VI. ORDER

For the reasons given, it is hereby
ORDERED that the Petition is *denied*, and an *inter partes* review of
U.S. Patent No. 8,332,844 B2 is not instituted.

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Patent 8,332,844 B2

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