IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Apple Inc.,
Petitioner

v.

California Institute of Technology,
Patent Owner

IPR2017-00728
Patent No. 7,421,032

PETITIONER'S NOTICE OF APPEAL

Director of the United States Patent and Trademark Office
c/o Office of the General Counsel
P.O. Box 1450
Alexandria, VA 22314-5793

Pursuant to 35 U.S.C. §§ 141-44 and 319, and 37 C.F.R. § 90.2-90.3, notice is hereby given that Petitioner Apple Inc. appeals to the United States Court of Appeals for the Federal Circuit from the Final Written Decision entered August 20, 2018 (Paper 63) in IPR2017-00728, and all prior and interlocutory rulings related thereto or subsumed therein.

In accordance with 37 C.F.R. § 90.2(a)(3)(ii), Petitioner further indicates that the issues on appeal include, but are not limited to, whether the Patent Trial and Appeal Board erred in determining that Petitioner had not established by a preponderance of the evidence that claims 18–23 of U.S. Patent No. 7,421,032 are unpatentable under 35 U.S.C. § 103 over the combination of Ping, MacKay, Divsalar, and Luby97; and any finding or determination supporting or related to those issues, as well as all other issues decided adversely to Petitioner in any orders, decisions, rulings, and opinions.

Pursuant to 37 C.F.R. § 90.3, this Notice of Appeal is timely, having been duly filed within 63 days after the date of the Final Written Decision.

A copy of this Notice of Appeal is being filed simultaneously with the Patent Trial and Appeal Board, the Clerk's Office for the United States Court of Appeals for the Federal Circuit, and the Director of the Patent and Trademark Office.

Respectfully submitted,

Date: September 20, 2018

/Michael Smith/

Michael H. Smith
Registration No. 71,190
Counsel for Petitioner

CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. §§ 90.2(a)(1) and 104.2(a), I hereby certify that, in addition to being filed electronically through the Patent Trial and Appeal Board's End to End (PTAB E2E), a true and correct original version of the foregoing PETITIONER'S NOTICE OF APPEAL is being filed by Express Mail (Express Mail Label EL 815615055 US) on this 20th day of September 2018, with the Director of the United States Patent and Trademark Office, at the following address:

Director of the United States Patent and Trademark Office
c/o Office of the General Counsel
United States Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450

Pursuant to 37 C.F.R. § 90.2(a)(2) and Federal Circuit Rule 15(a)(1), and Rule 52(a),(e), I hereby certify that a true and correct copy of the foregoing PETITIONER'S NOTICE OF APPEAL is being filed in the United States Court of Appeals for the Federal Circuit using the Court's CM/ECF filing system on this 20th day of September 2018, and the filing fee is being paid electronically using pay.gov.

I hereby certify that on September 20, 2018 I caused a true and correct copy of the PETITIONER'S NOTICE OF APPEAL to be served via e-mail on the following attorneys of record:

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EXHIBIT A

Trials@uspto.gov
571-272-7822

Paper: 63
Mailed August 20, 2018

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC.,
Petitioner,

v.

CALIFORNIA INSTITUTE OF TECHNOLOGY,
Patent Owner.

Case IPR2017-00728
Patent 7,421,032 B2

Before KEN B. BARRETT, TREVOR M. JEFFERSON, and JOHN A. HUDALLA, *Administrative Patent Judges*.

BARRETT, *Administrative Patent Judge.*

FINAL WRITTEN DECISION
Inter Partes Review
35 U.S.C. § 318(a) and 37 C.F.R. § 42.73

I. INTRODUCTION

A. Background and Summary

Apple Inc. ("Petitioner") filed a Petition requesting *inter partes* review of U.S. Patent No. 7,421,032 B2, issued September 2, 2008 ("the '032 patent," Ex. 1201). Paper 5 ("Pet."). The Petition challenges the patentability of claims 18–23 of the '032 patent on the ground of obviousness under 35 U.S.C. § 103. California Institute of Technology ("Patent Owner") filed a Preliminary Response to the Petition. Paper 13 ("Prelim. Resp."). We instituted *inter partes* review (Paper 14, "Inst. Dec.") of all the challenged claims based on Ping, MacKay, Divsalar, and Luby97.

Patent Owner filed a Response to the Petition (Paper 32, "PO Resp."), and Petitioner filed a Reply (Paper 45, "Pet. Reply"). Pursuant to our authorization (Paper 43), Patent Owner filed a Sur-Reply (Paper 55, "PO Sur-Reply").

An oral hearing was held on May 8, 2018, and a transcript of the hearing is included in the record. Paper 62 ("Tr.").

As authorized in our Order of February 10, 2018 (Paper 41), Patent Owner filed a motion for sanctions related to Petitioner's cross-examination of Patent Owner's witnesses, Dr. Mitzenmacher and Dr. Divsalar (Paper 42), and Petitioner filed an opposition (Paper 47).

Additionally, Patent Owner filed a Motion to Exclude evidence (Paper 52), to which Petitioner filed an Opposition (Paper 54), and Patent Owner filed a Reply (Paper 58).

We have jurisdiction under 35 U.S.C. § 6. This Final Written Decision is entered pursuant to 35 U.S.C. § 318(a). After consideration of the parties' arguments and evidence, and for the reasons discussed below, we determine that Petitioner has *not* shown by a preponderance of the evidence that claims 18–23 of the ’032 patent are unpatentable.

B. Related Proceedings

One or both parties identify, as matters involving or related to the ’032 patent, *Cal. Inst. of Tech. v. Broadcom Ltd.*, No. 2:16-cv-03714 (C.D. Cal. filed May 26, 2016) and *Cal. Inst. of Tech. v. Hughes Commc’ns, Inc.*, 2:13-cv-07245 (C.D. Cal. filed Oct. 1, 2013), and Patent Trial and Appeal Board cases IPR2015-00059, IPR2015-00060, IPR2015-00061, IPR2015-00067, IPR2015-00068, IPR2015-00081, IPR2017-00210, IPR2017-00211, IPR2017-00219, IPR2017-00297, IPR2017-00423, IPR2017-00700, and IPR2017-00701. Pet. 3, Paper 7.

C. The ’032 Patent

The ’032 patent is titled “Serial Concatenation of Interleaved Convolutional Codes Forming Turbo-Like Codes.” Ex. 1201, [54].
The ’032 patent explains some of the prior art with reference to its Figure 1, reproduced below.

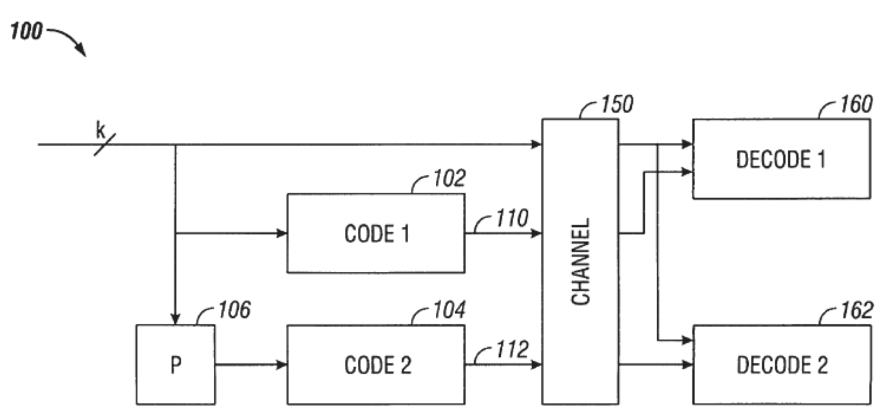

Figure 1 is a schematic diagram of a prior “turbo code” system. *Id.* at 2:16–17. The ’032 patent specification describes Figure 1 as follows:

> A block of k information bits is input directly to a first coder 102. A k bit interleaver 106 also receives the k bits and interleaves them prior to applying them to a second coder 104. The second coder produces an output that has more bits than its input, that is, it is a coder with rate that is less than 1. The coders 102, 104 are typically recursive convolutional coders.
>
> Three different items are sent over the channel 150: the original k bits, first encoded bits 110, and second encoded bits 112. At the decoding end, two decoders are used: a first constituent decoder 160 and a second constituent decoder 162. Each receives both the original k bits, and one of the encoded portions 110, 112. Each decoder sends likelihood estimates of the decoded bits to the other decoders. The estimates are used to decode the uncoded information bits as corrupted by the noisy channel.

Id. at 1:41–56.

A coder 200, according to a first embodiment of the invention, is described with reference to Figure 2, reproduced below.

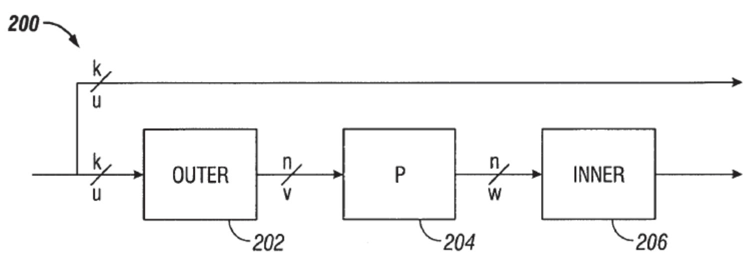

Figure 2 of the '032 patent is a schematic diagram of coder 200.

> The coder 200 may include an outer coder 202, an interleaver 204, and inner coder 206. . . . The outer coder 202 receives the uncoded data. The data may be partitioned into blocks of fixed size, say k bits. The outer coder may be an (n,k) binary linear block coder, where n>k. The coder accepts as input a block u of k data bits and produces an output block v of n data bits. The mathematical relationship between u and v is

> $v=T_0u$, where T_0 is an n×k matrix, and the rate[1] of the coder is k/n.
>
> The rate of the coder may be irregular, that is, the value of T_0 is not constant, and may differ for sub-blocks of bits in the data block. In an embodiment, the outer coder 202 is a repeater that repeats the k bits in a block a number of times q to produce a block with n bits, where n=qk. Since the repeater has an irregular output, different bits in the block may be repeated a different number of times. For example, a fraction of the bits in the block may be repeated two times, a fraction of bits may be repeated three times, and the remainder of bits may be repeated four times. These fractions define a degree sequence, or degree profile, of the code.
>
> The inner coder 206 may be a linear rate-1 coder, which means that the n-bit output block x can be written as $x=T_Iw$, where T_I is a nonsingular n×n matrix. The inner coder 210 can have a rate that is close to 1, e.g., within 50%, more preferably 10% and perhaps even more preferably within 1% of 1.

Id. at 2:36–65. In an embodiment, the second ("inner") coder 206 is an accumulator. *Id.* at 2:66–67. "The serial concatenation of the interleaved irregular repeat code and the accumulate code produces an irregular repeat and accumulate (IRA) code." *Id.* at 3:30–32.

Figure 4 of the '032 patent is reproduced below.

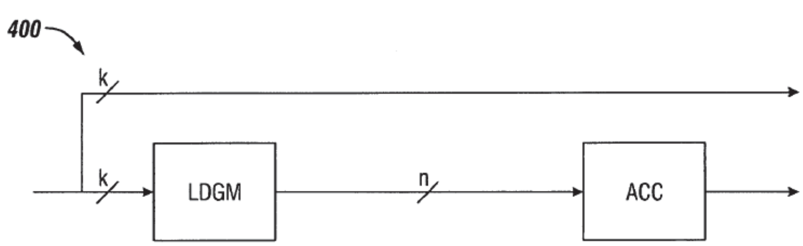

Figure 4 shows an alternative embodiment in which the outer encoder is a low-density generator matrix (LDGM). *Id.* at 3:56–59. LDGM codes have a

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[1] We understand that the "rate" of an encoder refers to the ratio of the number of input bits to the number of resulting encoded output bits related to those input bits.

"sparse" generator matrix. *Id.* at 3:59–60. The IRA code produced is a serial concatenation of the LDGM code and the accumulator code. *Id.* at 3:60–62. No interleaver (as in the Figure 2 embodiment) is required in the Figure 4 arrangement because the LDGM provides scrambling otherwise provided by the interleaver in the Figure 2 embodiment. *Id.* at 3:62–64.

"The set of parity checks may be represented in a bipartite graph, called the Tanner graph, of the code." *Id.* at 3:33–35. Figure 3, shown below, depicts such a Tanner graph.

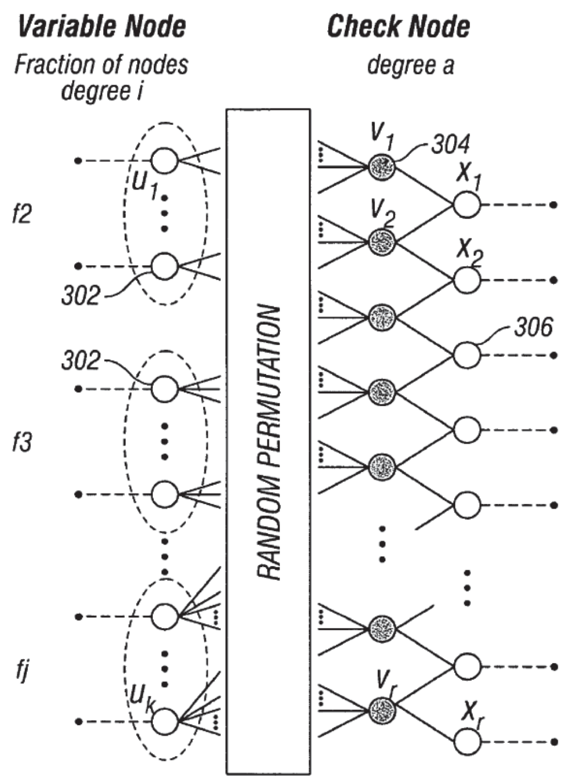


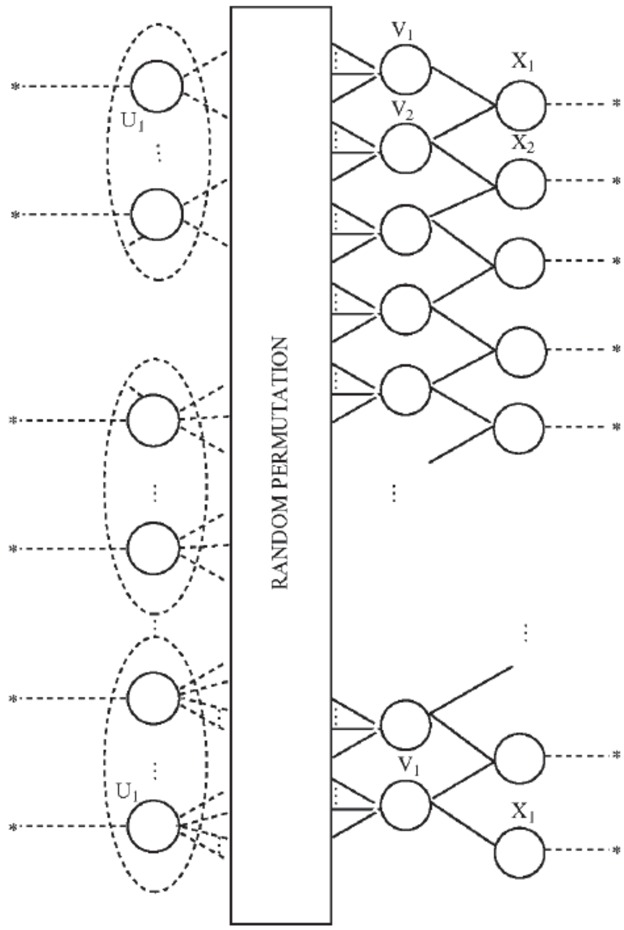
Figure 3 is described as "a Tanner graph for an irregular repeat and accumulate (IRA) coder." *Id.* at 2:20–21. The left-most column of nodes, information nodes 302 (the open circles), are variable nodes that receive information bits. The column of nodes (the filled circles) just to the right of the "RANDOM PERMUTATION" block are check nodes v indicated by reference numeral 304. An information bit node connected to two check nodes represents a repeat of 2. An information node connected to three check nodes represents a repeat of 3. The nodes (the open circles) in the right-most column are parity bit nodes x, referenced by 306. As shown by the edges[2] of the Tanner graph, each parity bit is a function of its previous parity bit and is also a function of information bits (edges connect through check nodes and random permutation to information bit nodes). *Id.* at 3:34–55; *see also* Ex. 1204 ¶ 110 (discussing the relationship between parity bits in the context of the claimed Tanner graph and the ’032 patent’s specification).

D. Illustrative Claim

Of the challenged claims of the ’032 patent, claim 18 is the only independent claim. The remaining challenged claims depend directly from claim 18. Claim 18, reproduced below as originally issued and before issuance of a Certificate of Correction dated February 17, 2009, and with paragraphing added, is illustrative:

> 18. A device comprising:
>
> a message passing decoder configured to decode a received data stream that includes a collection of parity bits,
>
> the message passing decoder comprising two or more check/variable nodes operating in parallel to receive messages from neighboring check/variable nodes and send updated messages to the neighboring variable/check nodes,
>
> wherein the message passing decoder is configured to decode the received data stream that has been encoded in accordance with the following Tanner graph:

[2] We understand that “edges” are the straight lines that connect one node to another node of a Tanner graph. *See* Ex. 1201, 3:53–54.



Ex. 1201, 9:57–10:42. A Certificate of Correction for the ’032 patent replaced the labels V_1, U_1, and X_1 from the lower portion of the Tanner graph in claim 18 with V_r, U_k, and X_r, respectively. *See id.* at Certificate of Correction (Feb. 17, 2009).

E. Evidence

Petitioner relies on the following art references:

Reference	Exhibit No.
D. J. C. MacKay et al., *Comparison of Constructions of Irregular Gallager Codes*, IEEE TRANSACTIONS ON COMMUNICATIONS, Vol. 47, No. 10, pp. 1449–54, October 1999 (“MacKay”)	Ex. 1202

Reference	**Exhibit No.**
L. Ping et al., *Low Density Parity Check Codes with Semi-Random Parity Check Matrix*, IEE ELECTRONICS LETTERS, Vol. 35, No. 1, pp. 38–39, Jan. 7, 1999 ("Ping")	Ex. 1203
M. Luby et al., *Practical Loss-Resilient Codes*, PROCEEDINGS OF THE TWENTY-NINTH ANNUAL ACM SYMPOSIUM ON THEORY OF COMPUTING, May 4–6, 1997, at 150–159 ("Luby97")	Ex. 1208
Dariush Divsalar, et al., *Coding Theorems for "Turbo-Like" Codes*, PROCEEDINGS OF THE THIRTY-SIXTH ANNUAL ALLERTON CONFERENCE ON COMMUNICATION, CONTROL, AND COMPUTING, Sept. 23–25, 1998, at 201–209 ("Divsalar")	Ex. 1217

Petitioner also relies on the Declaration of Dr. James A. Davis, dated January 19, 2017 (Ex. 1204), and the Declaration of Brendan Frey, Ph.D., dated February 21, 2018 (Ex. 1265) in support of its arguments. Patent Owner relies upon the Declaration of Dr. Michael Mitzenmacher, dated November 21, 2017 (Ex. 2004), and the Declaration of Dr. Dariush Divsalar, dated November 7, 2017 (Ex. 2031), in support of its arguments in the Patent Owner Response. The parties rely on other exhibits as discussed below.

F. The Asserted Ground of Unpatentability

The following ground of unpatentability remains at issue in this case (Pet. 41; Inst. Dec. 9, 22 (instituting a trial on all of the challenged claims and on the sole ground presented in the Petition)):

References	**Basis**	**Claim(s)**
Ping, MacKay, Divsalar, and Luby97	§ 103(a)	18–23

II. ANALYSIS

A. Principles of Law

Petitioner bears the burden of proving unpatentability of the claims challenged in the Petition, and that burden never shifts to Patent Owner. *Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015). To prevail, Petitioner must establish the facts supporting its challenge by a preponderance of the evidence. 35 U.S.C. § 316(e); 37 C.F.R. § 42.1(d).

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 skill in the art; and (4) any objective evidence of non-obviousness.[3] *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

B. The Level of Ordinary Skill in the Art

Petitioner's declarant, Dr. Davis, opines that:

> A person of ordinary skill in the art at the time of the alleged invention of the '032 patent would have had a Ph.D. in mathematics, electrical or computer engineering, or computer science with emphasis in signal processing, communications, or

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[3] Although Patent Owner puts forth evidence of objective indicia of non-obviousness (PO Resp. 55–66), we need not reach this evidence based on our disposition below.

> coding, or a master's degree in the above area with at least three years of work experience in this field at the time of the alleged invention.

Ex. 1204 ¶ 98; *see* Pet. 26 (citing the same). Patent Owner's declarant, Dr. Mitzenmacher, applies the same definition offered by Dr. Davis. Ex. 2004 ¶ 66.

We determine that the definition offered by Dr. Davis comports with the qualifications a person would have needed to understand and implement the teachings of the '032 patent and the prior art of record. Accordingly, we apply Dr. Davis's definition of the level of ordinary skill in the art.

C. Claim Construction

In an *inter partes* review, claim terms in an unexpired patent are given their broadest reasonable construction in light of the specification of the patent in which they appear. 37 C.F.R. § 42.100(b); *see also Cuozzo Speed Techs. LLC v. Lee*, 136 S. Ct. 2131, 2144–46 (2016). Under the broadest reasonable construction standard, claim terms are given their ordinary and customary meaning, as would be understood by one of ordinary skill in the art in the context of the entire patent disclosure. *In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007).

Tanner Graph

For purposes of our Institution Decision, we adopted the construction for "Tanner graph" set forth in a prior Board decision concerning the '032 patent and for which Petitioner supports the application of the same construction in the present case. Inst. Dec. 10–11 (quoting IPR2015-00060, Paper 18, 12–14; citing Pet. 28–29[4]). That construction is as follows:

> [1] a graph representing an [irregular[5] repeat accumulate] IRA code as a set of parity checks where every message bit is repeated, at least two different subsets of message bits are repeated a different number of times, and
>
> [2] check nodes, randomly connected to the repeated message bits, enforce constraints that determine the parity bits[, and] . . .
>
> [3] a parity bit is determined as a function of both information bits and other parity bits as shown by the configuration of nodes and edges of the Tanner graph.

Inst. Dec. 10.

Patent Owner does not express disagreement with the construction but contends that the term "Tanner graph" need not be construed because, *inter alia*, a person of ordinary skill in the art "would have readily understood

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[4] Petitioner contends that this construction is the broadest reasonable interpretation, yet is narrower than that adopted by the District Court in *Caltech v. Hughes Communications Inc.*, No. 2:13-cv-07245 (C.D. Cal.) because the court's construction did not include the constraint regarding parity bit determination (constraint [3]). Pet. 29 (citing Ex. 1213). Petitioner contends that the difference has no substantive effect on the issues before us. *See* Tr. 34:16–35:2.

[5] The Board, in the prior decision regarding the '032 patent, adopted a construction where, "[i]n the context of the '032 patent specification, . . . 'irregular' refers to the notion that different message bits or groups of message bits contribute to different numbers of parity bits." IPR2015-00060, Paper 18, 12 (Decision denying institution); *see also* Pet. 27–28 (advocating the adoption of that construction in this case); IPR2017-00700, Paper 32, 14 (Patent Owner, in a related case, citing Ex. 2004 ¶ 69 and asserting: "Caltech does not believe the term needs to be construed, as the plain and ordinary meaning of irregular repetition is clear. That message bits contribute in differing numbers to parity bits is made clear in the claim language.").

how to encode bits according to the Tanner graph in the claims and in view of the specification." PO Resp. 15; *see also* Ex. 2004 ¶ 73 (Dr. Mitzenmacher not disagreeing with any aspect of the construction but opining that: "[T]here is no need to 'construe' the graph. Any person of ordinary skill could readily comprehend what the graph requires in terms of an encoder or a decoder.").

Regardless as to whether the person of ordinary skill in the art—e.g., a person with a doctorate in mathematics—would understand the claim, we find a verbal description of the graph to be helpful. Accordingly, we again adopt that prior construction for purposes of analyzing Petitioner's challenges before us in this case.

On this record and for purposes of deciding the dispositive issues before us, we determine that no other claim terms require express construction.

D. The Alleged Obviousness over Ping, MacKay, Divsalar, and Luby97

Petitioner alleges that independent claim 18 and dependent claims 19–23 of the '032 patent would have been obvious over Ping, MacKay, Divsalar, and Luby97. *See* Pet. 41–64 (addressing independent claim 18).

Petitioner asserts that Ping discloses much of the subject matter of independent claim 18, but maintains that Ping's outer coder is regular. Pet. 41–42; *see also id.* at 58. Petitioner relies on MacKay for teaching irregularity, *id.* at 41, 43, relies on Divsalar for teaching repetition "if Ping standing alone is not understood to teach, or render obvious, repeating information bits," *id.* at 46, and relies on Luby97 for teaching receiving a source data stream, *id.* at 48. Additionally, Petitioner relies on Divsalar, MacKay, and Luby97 for teaching that message passing decoders were well-known in the art. *See* Pet. 20, 51–52. Patent Owner argues, *inter alia*, that the Petition presents a flawed reason to modify Ping in light of MacKay. PO Resp. 2–3.

1. Ping (Ex. 1203)

Ping is an article directed to "[a] semi-random approach to low density parity check [LDPC] code design." Ex. 1203, 38. In this approach, "only part of [parity check matrix] **H** is generated randomly, and the remaining part is deterministic," which "achieve[s] essentially the same performance as the standard LDPC encoding method with significantly reduced complexity." *Id.* The size of matrix **H** is $(n\text{–}k) \times n$ where k is the information length and n is the coded length. *Id.* A codeword c is decomposed "as $\mathbf{c} = [\mathbf{p}, \mathbf{d}]^t$, where **p** and **d** contain the parity and information bits, respectively." *Id.* Parity check matrix **H** can be decomposed into two parts corresponding to **p** and **d** as "$\mathbf{H} = [\mathbf{H^p}, \mathbf{H^d}]$." *Id.* $\mathbf{H^p}$ is defined as follows:

$$\mathbf{H^p} = \begin{pmatrix} 1 & & & 0 \\ 1 & 1 & & \\ & \ddots & \ddots & \\ 0 & & 1 & 1 \end{pmatrix}$$

Id. $\mathbf{H^d}$ is created such that it "has a column weight of t and a row weight of $kt/(n\text{–}k)$ (the weight of a vector is the number of 1s among its elements)," *id.*, such that

$$\mathbf{H^d} = \begin{bmatrix} h^d_{1,1} & h^d_{1,2} & h^d_{1,3} & \dots & h^d_{1,k} \\ h^d_{2,1} & h^d_{2,2} & h^d_{2,3} & \dots & h^d_{2,k} \\ h^d_{3,1} & h^d_{3,2} & h^d_{3,3} & \dots & h^d_{3,k} \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ h^d_{n-k,1} & h^d_{n-k,2} & h^d_{n-k,3} & \dots & h^d_{n-k,k} \end{bmatrix}$$

Ex. 1204 ¶ 74.[6] For each sub-block of $\mathbf{H^d}$, there is exactly "one element 1 per column and *kt/(n-k)* 1s per row." Ex. 1203, 38. This construction "increase[s] the recurrence distance of each bit in the encoding chain" and "reduces the correlation during the decoding process." *Id.*

Parity bits "$\mathbf{p} = \{p_i\}$ can easily be calculated from a given $\mathbf{d} = \{d_i\}$" using the following expressions:

$$p_1 = \sum_j h_{1j}^d d_j \quad \text{and} \quad p_i = p_{i-1} + \sum_j h_{ij}^d d_j \pmod 2$$

Ex. 1203, 38 (equation (4)).[7]

2. MacKay (Ex. 1202)

MacKay is a paper related to Gallager codes based on irregular graphs, which are "low-density parity check codes whose performance is closest to the Shannon limit." Ex. 1202, 1449. According to MacKay, "[t]he best known binary Gallager codes are *irregular* codes whose parity check matrices have *nonuniform* weight per column." *Id.* A parity check matrix that "can be viewed as defining a bipartite graph with 'bit' vertices corresponding to the columns and 'check' vertices corresponding to the rows" where "[e]ach nonzero entry in the matrix corresponds to an edge connecting a bit to a check." *Id.* at 1450. As an example of an irregular

[6] This particular representation of $\mathbf{H^d}$ is taken from Dr. Davis's testimony. Patent Owner's description of $\mathbf{H^d}$ is found at page 8 of its Response.

[7] The reference to "mod 2" refers to modulo-2 addition. Modulo-2 addition corresponds to the exclusive-OR (XOR or ⊕) logical operation, which is defined as follows: $0 \oplus 0 = 0$, $0 \oplus 1 = 1$, $1 \oplus 0 = 1$, and $1 \oplus 1 = 0$. *See* Ex. 1204 ¶ 185.

code in a parity check matrix, MacKay describes a matrix that "has columns of weight 9 and of weight 3 [and] all rows hav[ing] weight 7." *Id.* at 1451.

3. Divsalar (Ex. 1217)

Divsalar teaches "repeat and accumulate" codes, described as "a simple class of rate 1/*q* serially concatenated codes where the outer code is a *q*-fold repetition code and the inner code is a rate 1 convolutional code with transfer function 1/(1 + D)." Ex. 1204 ¶ 89 (quoting Ex. 1217, 1 (Abstr.)). Petitioner relies on Divsalar's Figure 3, reproduced below.

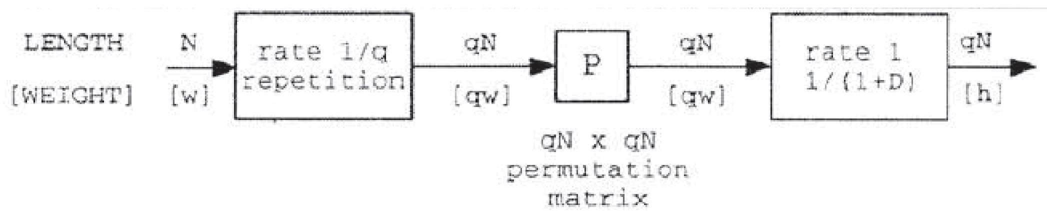

Figure 3 of Divsalar describes an encoder for a (*qN*, *N*) repeat and accumulate code. Ex. 1217, 5. The numbers above the input-output lines indicate the length of the corresponding block, and those below the lines indicate the weight of the block. *Id.*

4. Luby97 (Ex. 1208)

Luby97 describes "randomized constructions of linear-time encodable and decodable codes that can transmit over lossy channels at rates extremely close to capacity." Ex. 1208, 150 (Abstr.). Luby97 describes receiving data to be encoded in a stream of data symbols, such as bits, where the "*stream of data symbols* [] is partitioned and transmitted in logical units of blocks." *Id.* (emphasis added, footnote omitted).

5. The Alleged Obviousness of Claims 18–23

As discussed above in the context of claim construction, independent claim 18 contains a Tanner graph having at least three elements. Petitioner, in articulating its obviousness challenge of claim 18, relies on the testimony of Dr. Davis and maps the teachings of the prior art against those three elements as well as the express recitations of the claim. Pet. 50–64.

Claim 18 recites "a message passing decoder configured to decode a received data stream that includes a collection of parity bits." Petitioner maintains that Divsalar teaches an encoding device and teaches message passing decoding. *Id.* at 51. Petitioner maintains that MacKay and Luby97 also teach forms of message passing decoding. *Id.* at 51–52. Petitioner reasons that, in light of these teachings and "the fact that one of ordinary skill would understand message passing algorithms to be a standard technique for decoding linear error-correcting codes," it would have been obvious to use a message passing decoder to decode the codes of Ping. *Id.* at 52 (citing Ex. 1204 ¶ 194); *see also id.* at 20 (citing Ex. 1204 ¶ 62) (Petitioner asserting that a message passing decoder was a well-known type of decoder). Petitioner points to Luby97's teaching of receiving, in streams, data to be encoded and asserts that the sequence of blocks of symbols transmitted by the encoder of Luby97 constitutes a stream. *Id.* at 48–49. Petitioner asserts that it would have been obvious to use, for Ping's codes, a decoder that can receive encoded bits in a stream where the encoder that encoded those bits outputs them in a stream. *Id.* at 49–50, 52–53; *see* Ex. 1204 ¶¶ 195–200.

Claim 18 next recites "the message passing decoder comprising two or more check/variable nodes operating in parallel to receive messages from neighboring check/variable nodes and send updated messages to the neighboring variable/check nodes." Relying on, *inter alia*, the testimony of Dr. Davis, Petitioner contends that such a parallel operation would have been obvious because message passing decoding works by passing messages back and forth between variable nodes and check nodes according to a Tanner graph. Pet. 23–24, 53–54; Ex. 1204 ¶¶ 68, 201–203.

As for the Tanner graph of claim 18, Petitioner addresses the three elements of our construction in an order different than that listed above in the claim construction section. For the element "[3] a parity bit is determined as a function of both information bits and other parity bits as shown by the configuration of nodes and edges of the Tanner graph," Petitioner asserts that Ping teaches a two-stage, low-density parity-check (LDPC)-accumulate code where the value of one parity bit is used in the calculation of the next parity bit. Pet. at 30, 55–57; *see also id.* at 58 (maintaining that Ping's inner coder is an accumulator).

The next element of the Tanner graph addressed by Petitioner is "[1] a graph representing an [irregular repeat accumulate] IRA code as a set of parity checks where every message bit is repeated, at least two different subsets of message bits are repeated a different number of times." Pet. 57–61. Petitioner asserts that a particular code may be represented as matrices or as a Tanner graph, with those being two ways of describing the same thing, and contends that the proposed combination would have been understood by one of ordinary skill in the art to correspond to the claimed Tanner graph. *Id.* at 59–61.

Petitioner contends that, "[i]n Ping's $\mathbf{H^d}$ matrix, every column corresponds to an information bit (d_i) and every row corresponds to a summation ($\sum_j h_{ij}^d \, d_j$)" and that one of ordinary skill in the art would have understood that the summations are computed as the first stage of computing the parity bits in Ping. *Id.* at 34, 35. According to Petitioner, "Ping's outer LDPC code is regular because each column in Ping's generator matrix $\mathbf{H^d}$

contains the same number of 1s – exactly '*t*' 1s," and notes that "Ping thus states that matrix '$\mathbf{H^d}$ has a column weight of *t* . . . .'" *Id.* at 43 (quoting Ex. 1203, 38). Petitioner cites MacKay for teaching that "[t]he best known binary Gallager codes are *irregular* codes whose parity check matrices have *nonuniform* weight per column." *Id.* at 44 (quoting Ex. 1202, 1449) (emphasis in original); *see also* Pet. Reply 3 (citing Ex. 1265 (Frey Decl.) ¶¶ 20–24) ("MacKay also teaches that codes with such parity check matrices, *i.e.*, matrices with uneven column weights, can outperform their regular counterparts.").

Petitioner reasons that, "[b]ecause MacKay teaches that irregular codes perform better than regular codes, one of ordinary skill would have been motivated to incorporate irregularity into Ping." Pet. 43. Petitioner proposes modifying Ping's $\mathbf{H^d}$ matrix (or outer coder), which Petitioner characterizes as regular, and contends that one of ordinary skill in the art would have made this modification to improve the performance of Ping's code. Pet. 43; Pet. Reply 4. Petitioner maintains:

> It would have been straightforward for a person of ordinary skill to change Ping's generator $\mathbf{H^d}$ matrix such that not all columns had the same weight – *e.g.*, setting some columns to weight 9 and others to weight 3, as taught by MacKay. (Ex. 1202, p. 1451.) This change would result in some information bits contributing to more outer LDPC parity bits than others, and would have made Ping's outer LDPC code irregular. . . . Moreover, MacKay's teaching that the best performing LDPC codes are irregular would also have made this modification obvious (and desirable) to try. (Ex. 1202, pp. 1449, 1454, "The excellent performance of irregular Gallager codes is the motivation for this paper….") (Ex. 1204, ¶116.)

Pet. 44. According to Petitioner, a person of ordinary skill would not have been motivated to modify $\mathbf{H}^{\mathbf{p}}$ because "it has only a single form and because doing so would have complicated a simple encoder." Pet. Reply 8. Thus, Petitioner contends that the person of ordinary skill "who wanted to obtain the benefit of MacKay's irregularity in Ping would have had only one option—to incorporate MacKay's irregularity into $\mathbf{H}^{\mathbf{d}}$." *Id.*

Petitioner further contends that, "even if Ping standing alone is not understood to teach, or render obvious, repeating information bits, doing so would have been obvious in view of Divsalar's explicit teaching of repeating bits." Pet. 46. Petitioner also argues that "[o]ne of ordinary skill would have been further motivated to implement Ping using the repeater of Divsalar because this implementation would be both cost-effective and easy to build," and that the similarities between Ping and Divsalar provide additional motivation to combine the references' teachings. *Id.* at 47–48.

Thus, argues Petitioner, the combination of Ping, MacKay, and Divsalar teaches an irregular repeat accumulate code where message bits are repeated and at least two different subsets of message bits are repeated a different number of times. *Id.* at 59 (citing Ex. 1204 ¶ 139).

Lastly, Petitioner contends that Ping teaches the Tanner graph requirement of "[2] check nodes, randomly connected to the repeated message bits, [which] enforce constraints that determine the parity bits." *Id.* at 61–63. Petitioner points to Ping's Equation (4)

$$p_i = p_{i-1} + \sum_j h_{ij}^d \, d_j$$

as teaching check nodes constraining the relationship between information bits and parity bits. *Id.* at 61–63. Petitioner further maintains that Ping, using Divsalar's repetition, teaches that the check nodes are randomly connected to repeated message bits. *Id.* at 63–64.

Patent Owner disputes, *inter alia*, Petitioner's rationale for combining Ping and MacKay—which underlies the overall combination of Ping, MacKay, Divsalar, and Luby97—on a number of bases. *See* PO Resp. 15–16 (summarizing ten arguments regarding Petitioner's ground), 27–28. Patent Owner argues that Ping's parity check matrix **H** is already irregular as defined by MacKay. *See id.* at 28–33. According to Patent Owner, "Ping's parity-check matrix has three different column weights (t, 2, and 1), and two different row weights ($kt/(n\text{-}k)+1$ and $kt/(n\text{-}k)+2$)." *Id.* at 29 (citing Ex. 2033, 231:11–14); *see also* Ex. 2004 ¶ 92 (same). As such, Patent Owner argues "Ping's parity-check matrix is actually even more 'irregular' than MacKay's irregular codes," so ordinarily skilled artisans "would not have been motivated by MacKay's teachings that irregular codes are an improvement over regular codes." PO Resp. 30–31 (citing Ex. 2004 ¶¶ 94, 95, and 97–99).

Patent Owner also highlights that Petitioner's proposed modifications relate only to a portion of Ping's parity check matrix **H**, namely, sub-matrix $\mathbf{H^d}$. *See id.* at 31–32; *see also* Ex. 2004 ¶ 96. Patent Owner argues "MacKay does not even *consider* modifying submatrices, much less teach that there may be benefits to try." PO Resp. 33. According to Patent Owner, "MacKay teaches that irregular parity-check matrices <u>*as a whole*</u> may define better codes than regular parity-check matrices <u>*as a whole*</u>—it does not teach any improvement from making a submatrix within a parity-check matrix irregular, or from using any other type of irregular matrix (*e.g.*, irregular generator matrices)." *Id.* at 31. Patent Owner argues MacKay does not "suggest that *additional* irregularity should be applied to uniform portions when the overall parity-check matrix is already irregular." *Id.* at 32 (citing Ex. 2004 ¶¶ 96–99) (footnote omitted).

Patent Owner further argues that Petitioner has not established that an ordinarily skilled artisan would have reasonably expected success from the proposed modification of Ping in light of MacKay. *See* PO Resp. 46–51. Patent Owner argues "the petition does not even attempt to analyze a reasonable expectation of success, and for that reason, it is incurably deficient." *Id.* at 46. As further evidence of the lack of anticipated success, Patent Owner emphasizes that constructing error-correction codes "was a highly unpredictable endeavor" that was subject to "extensive trial-and-error and experimentation to determine whether new codes led to an improvement." *Id.* at 4 (citing Ex. 2004 ¶ 46); *see also id.* at 46 (citing Ex. 2004 ¶¶ 126–128; Ex. 2033, 256:21–257:12).

We are persuaded by Patent Owner's arguments. We agree with Patent Owner (*see* PO Resp. 31–32 & n.7) that, although Petitioner may explain how to modify Ping's $\mathbf{H^d}$ sub-matrix in light of MacKay, it does not address why such an ordinarily skilled artisan would have done this. Nor does Petitioner establish that such an artisan reasonably would have expected success from the modification. Based on the entire trial record, we determine that Petitioner has not established a persuasive rationale for modifying Ping in light of MacKay as asserted by Petitioner. Petitioner's additional reliance on Divsalar and Luby97 does not remedy this fundamental flaw in the articulated combination. *See* Pet. 46, 48–50 (relying on Divsalar for the teaching of repeating information bits and Luby97 for the teaching of receiving data to be encoded in a stream).

Petitioner's unpatentability contentions presuppose that an ordinarily skilled artisan would seek to modify a *sub-matrix* in Ping in light of MacKay. *See* Pet. Reply 7 ("Caltech's comparison of Ping's **H** matrix to MacKay's is improper. . . . The proper comparison is between Ping's $\mathbf{H}^{\mathbf{d}}$ matrix . . . and MacKay's matrix."). Yet even if MacKay touts improvements from irregularity in a parity check matrix (e.g., Ping's matrix **H**), MacKay does not suggest that these improvements would have been applicable to *portions* of a parity check matrix (e.g., Ping's sub-matrix $\mathbf{H}^{\mathbf{d}}$). To reach its proposed modification, Petitioner characterizes Ping's sub-matrix $\mathbf{H}^{\mathbf{d}}$ as a generator matrix (or "outer coder") and Ping's sub-matrix $\mathbf{H}^{\mathbf{p}}$ as merely an accumulator (or "inner coder"). Pet. 30, 44; Pet. Reply 10–13. We agree with Patent Owner (*see* PO Resp. 39), however, that Petitioner does not explain adequately why labeling sub-matrix $\mathbf{H}^{\mathbf{d}}$ as a generator matrix supports the proposed modification of $\mathbf{H}^{\mathbf{d}}$ based on MacKay. Indeed, this label does not explain why an ordinarily skilled artisan considering MacKay would have chosen to modify $\mathbf{H}^{\mathbf{d}}$ or any other portion of parity check matrix **H**.

Petitioner's further contentions also are not persuasive. Specifically, Petitioner contends $\mathbf{H}^{\mathbf{p}}$ is an accumulator with only a single, fixed form, so an ordinarily skilled artisan would not have been motivated to modify $\mathbf{H}^{\mathbf{p}}$ because "doing so would have complicated a simple encoder." Pet. Reply 7–8, 13. Yet this rationalization belies the fact that Ping also specifically defines a structure for sub-matrix $\mathbf{H}^{\mathbf{d}}$, which simplifies a portion of the parity check matrix. According to Dr. Mitzenmacher, "the constraints on $\mathbf{H}^{\mathbf{d}}$, including its regularity, were a deliberate design decision that contributes to the improved performance of Ping's code over fully random

LDPC codes—it is a fundamental part of its code." Ex. 2004 ¶ 104. Thus, choosing to modify *any* portion of Ping's matrix would have broken constraints in Ping that were intended to simplify encoding. *See* Ex. 1203, 38 (Ping describing the disclosed approach as a "new method [that] can achieve essentially the same performance as the standard LDPC encoding method with significantly reduced complexity"). This is a strong indication that an ordinarily skilled artisan would not have been motivated to reach within Ping's parity check matrix **H** and modify a sub-matrix.

We also agree with Patent Owner that Ping's parity check matrix **H** is already "irregular," which undermines Petitioner's stated motivation for modifying Ping in view of MacKay. *See* PO Resp. 28–33. Citing Dr. Mitzenmacher, Patent Owner establishes that Ping's matrix **H** has three different column weights (*t*, 2, and 1). *Id.* at 28–29; Ex. 2004 ¶¶ 91–92; *see also* Ex. 2033, 231:11–14 (Dr. Davis acknowledging that Ping's parity check matrix **H** has "different weights for the columns"). We accept this as evidence of "irregularity" based on Petitioner's own acknowledgment that "irregularity" is associated with "uneven column weights." *See* Pet. Reply 12–13. Petitioner does not contest that Ping's parity check matrix **H** is irregular; rather, Petitioner contends that the appropriate comparison is between MacKay's parity check matrix and Ping's sub-matrix $\mathbf{H^d}$. *Id.* at 7. But MacKay is silent on the concept of sub-matrices, so Petitioner's association of MacKay's teaching with sub-matrix $\mathbf{H^d}$ is not apt. Instead, we agree with Patent Owner that "MacKay's teachings are only applicable to full parity check matrices." PO Resp. 15–16. Thus, the record does not establish that an ordinarily skilled artisan would have sought to add irregularity to Ping's parity check matrix **H**—or additional irregularity to a sub-matrix of **H**, such as $\mathbf{H}^{\mathbf{d}}$—because **H** itself is already irregular.

Finally, we agree with Patent Owner that the Petition is silent on whether a person of ordinary skill in the art would have expected success in combining MacKay with Ping. Although Petitioner cites an alleged "straightforward modification of Ping's $\mathbf{H}^{\mathbf{d}}$ matrix" at page 44 of the Petition as supporting the expectation of success (Pet. Reply 13–14), the cited passage only describes the proposed modification, rather than addressing whether an ordinarily skilled artisan would have anticipated success from the modification. *See* Pet. 44. In addition, Petitioner's argument that an ordinarily skilled artisan "would have needed no more specificity to attempt to use MacKay's irregularity in Ping" (Pet. Reply 14) only underscores the lack of evidence in the Petition regarding anticipated success.

Perhaps sensing this deficiency in the Petition, Petitioner introduces new testimony and a new simulation from Dr. Frey with its Reply in which Dr. Frey allegedly "demonstrate[s] the ease with which a [person of ordinary skill in the art] could have added MacKay's irregularity to Ping." Ex. 1265 ¶ 42. According to Petitioner, the results of the simulation "outperform Ping's original code" and "confirm that a [person of ordinary skill in the art] would have been motivated to use MacKay's uneven column weights in Ping's $\mathbf{H}^{\mathbf{d}}$ matrix, and . . . would have had a reasonable expectation of success when doing so." Pet. Reply 15–16. Yet, even if we were to deem the testimony and simulation to be within the proper scope of a reply brief,[8]

[8] We need not reach this issue, because we do not rely on this evidence in a manner adverse to Patent Owner. *See also infra* § II.E. (dismissing Patent Owner's Motion to Exclude as moot on the same basis).

they do not support a reasonable expectation of success *at the time of the invention*. We agree with Patent Owner that "[i]t is irrelevant what Dr. Frey claims he could do in the year 2018 when armed with Caltech's disclosures, [the named-inventor's] original coding work, contemporary resources (*e.g.*, Matlab), and some 18 years of post-filing date knowledge." PO Sur-Reply 7. Because this evidence is not tied to the state of the art at the time of the invention, it is not probative of anticipated success. *See Millennium Pharm., Inc. v. Sandoz Inc.*, 862 F.3d 1356, 1367 (Fed. Cir. 2017) (quoting *Interconnect Planning Corp. v. Feil*, 774 F.2d 1132, 1138 (Fed. Cir. 1985)) ("Those charged with determining compliance with 35 U.S.C. § 103 are required to place themselves in the minds of those of ordinary skill in the relevant art *at the time the invention was made*, to determine whether that which is now plainly at hand would have been obvious at such earlier time." (emphasis added)).

Furthermore, as part of our obviousness analysis, we are charged to consider "the scope and content of the prior art." *See Graham*, 383 U.S. at 17–18. One important aspect of the art in this case is the relative unpredictability of developing error-correction codes. *See* PO Resp. 46 (citing Ex. 2004 ¶¶ 126–128; Ex. 2033, 256:21–257:12) ("New codes appeared from unexpected sources, and developing the precise parameters that could lead to incremental improvements often took a significant amount of time and experimentation."). In its Reply, Petitioner embraces the notion of unpredictability as supporting its combination; Petitioner contends that "rigorous mathematical analysis of codes is difficult, and, as a result, [persons of ordinary skill in the art] routinely develop codes by experimentation." Pet. Reply 14. Petitioner further contends that "running experimental tests on a version of Ping that incorporated MacKay's irregularity would have been routine[,] . . . [and] the modifications suggested by MacKay would have been straightforward and would have taken very little time to implement." *Id*.

Yet we do not agree with Petitioner that the need to run experiments in an unpredictable field, such as error-correction coding, indicates anything about whether such experiments ultimately would have been successful at the time of the invention. Importantly, "[u]npredictability of results equates more with nonobviousness rather than obviousness, whereas that which is predictable is more likely to be obvious." *Honeywell Int'l Inc. v. Mexichem Amanco Holding S.A.*, 865 F.3d 1348, 1356 (Fed. Cir. 2017). In the absence of any argument rooted in the Petition directing us to evidence that substantiates a reasonable expectation of success, Petitioner's reliance on a known need for experimentation is not sufficient to support its obviousness rationale.[9] *See Arctic Cat Inc. v. Bombardier Recreational Prod. Inc.*, 876 F.3d 1350, 1360–61 (Fed. Cir. 2017) ("[W]here a party argues a skilled artisan would have been motivated to combine references, it must show the artisan would have had a reasonable expectation of success from doing so." (internal quotation omitted)).

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[9] Notably, Petitioner does not contend that its proposed combination should be analyzed under obvious-to-try case law. Tr. 15:24–16:4 (Petitioner acknowledging that it was not putting forth an obvious-to-try argument). Nor could Petitioner, because Petitioner does not develop an obvious-to-try theory. Specifically, Petitioner does not establish that the prior art directs which parameters to try and/or guides an inventor toward a particular solution. *See Bayer Schering Pharma AG v. Barr Labs., Inc.*, 575 F.3d 1341, 1347 (Fed. Cir. 2009).

For these reasons, we are not persuaded that an ordinarily skilled artisan would have been motivated to combine the teachings of Ping and MacKay in the manner suggested by Petitioner. Petitioner's reliance on Divsalar's and Luby97's teachings in the proposed combination does not remedy this underlying flaw. Thus, we determine Petitioner has not shown by a preponderance of the evidence that claim 18 would have been obvious over the combination of Ping, MacKay, Divsalar, and Luby97.

Petitioner relies on the same deficient rationale for combining Ping and MacKay with respect to its analysis for dependent claims 19–23. *See* Pet. 64–73. Thus, we also determine Petitioner has not shown by a preponderance of the evidence that claims 19–23 would have been obvious over the combination of Ping, MacKay, Divsalar, and Luby97.

E. Patent Owner's Motion to Exclude

Patent Owner moves to exclude Exhibits 1206, 1218, 1219, 1224, 1229–1249, 1257–1261, 1265, 1267, 1268, 1271, 1272, and portions of Exhibits 2038 and 2039. Paper 52, 1. Patent Owner's motion is dismissed as moot with respect to these exhibits, as we do not rely on them in a manner adverse to Patent Owner.

F. Patent Owner's Motion for Sanctions

Patent Owner requests sanctions against Petitioner for allegedly failing to stay within the proper scope of cross-examination during the deposition of Dr. Mitzenmacher and Dr. Divsalar. Paper 42, 1.[10]

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[10] Although Patent Owner cites primarily to Exhibit 1064 as the transcript of Dr. Divsalar's deposition, the pertinent exhibit in this case is Exhibit 2039. *See* Paper 42, 4.

Specifically, Patent Owner details questioning of Dr. Mitzenmacher that allegedly "ventured into various topics beyond the scope of the witness' direct testimony." *Id.* at 7–9. For example, Patent Owner cites "extensive questioning regarding Tanner graphs and figures newly created by Petitioner's lawyers, but absent from any petition materials or the witness' direct testimony." *Id.* at 8. Similarly, Patent Owner asserts that Dr. Divsalar was questioned regarding subject matter not discussed in his declaration including the Allerton Conference, Tanner graphs, and certain references. *Id.* at 3–7. As sanctions, Patent Owner asks us to: (1) strike the out-of-scope testimony elicited by Petitioner; (2) hold the direct testimony of Dr. Mitzenmacher and Dr. Divsalar to be facts established in this proceeding; and (3) impose "reasonable compensatory expenses, including attorney fees, for costs reasonably related to excessive questioning and deposition time." *Id.* at 9–10.

Petitioner contends that "each question posed by Petitioner during Dr. Mitzenmacher's deposition pertained directly to topics and opinions in his declaration." Paper 47, 5. Regarding the Tanner graphs and figures, Petitioner contends these were properly served upon Petitioner at Dr. Mitzenmacher's deposition in accordance with 37 C.F.R. § 42.53(f)(3). *Id.* at 6. According to Petitioner, Patent Owner's proposed sanctions are unwarranted, particularly because Patent Owner suffered no harm. *Id.* at 7–8.

The "Board may impose a sanction against a party for misconduct." 37 C.F.R. § 42.12(a); *see also* 35 U.S.C. § 316(a)(6) (requiring regulations prescribing sanctions). As the moving party, Patent Owner has the burden to persuade the Board that sanctions are warranted. *See* 37 C.F.R. § 42.20(c).

In general, a motion for sanctions should address three factors: (i) whether a party has performed conduct that warrants sanctions; (ii) whether the moving party has suffered harm from that conduct; and (iii) whether the sanctions requested are proportionate to the harm suffered by the moving party. *See Square, Inc. v. Think Comput. Corp.*, Case CBM2014-00159, slip op. at 2 (PTAB Nov. 27, 2015) (Paper 48) (citing *Ecclesiastes 9:10-11-12, Inc. v. LMC Holding Co.*, 497 F.3d 1135, 1143 (10th Cir. 2007)).

Having reviewed the relevant portions of Dr. Mitzenmacher's deposition, we agree with Petitioner that sanctions are not warranted. Petitioner's attempts to elicit testimony regarding the Tanner graphs and figures, while inartful, did not rise to the level of sanctionable conduct because they were reasonably related to Dr. Mitzenmacher's direct testimony.

As to Dr. Divsalar, Patent Owner characterizes his direct testimony (Ex. 2031) as merely taking the form of "a short declaration addressing only a few discrete points relating specifically to the Divsalar reference." Paper 42, 3. Patent Owner contends Petitioner's questions about the Allerton Conference, Tanner Graphs, and certain other references went beyond the "limited scope of Dr. Divsalar's 16-page declaration." *Id.* at 3–7.

Petitioner cites certain direct testimony from Dr. Divsalar regarding the perspective of a person of ordinary skill in the art, Tanner graphs, and certain "contemporaneous literature" and contends that it was permissible to question Dr. Divsalar at the deposition about the foundation and validity of his opinions on these topics. Paper 47, 3–5 (quoting Ex. 2031 ¶ 10 and citing Ex. 2031 ¶¶ 9–11, 26, 28–30, and 33–36). Petitioner further contends that "in his declaration, Dr. Divsalar discussed having submitted a paper 'in connection with the Allerton conference in 1998' [and] Petitioner thus properly asked questions about what 'in connection with the Allerton conference' means." Paper 47, 3 (citing Ex. 2031 ¶ 19).

We again agree with Petitioner that sanctions concerning the deposition of Dr. Divsalar are not warranted. In fact, Patent Owner acknowledges that Dr. Divsalar offered opinion testimony going to the heart of the dispute in this case. Paper 42, 3. In that respect, Patent Owner states:

> Dr. Divsalar expressed his view that modifying an RA [repeat-accumulate] code to include irregular repetition of information bits would not make sense on the basis that it would add unnecessary difficulty and complexity at odds with the stated objective in the paper, with no expectation of a corresponding benefit. [Ex. 2031 (Divsalar Declaration)] at ¶¶ 33-36. Dr. Divsalar was also asked to address the hypothetical modification suggested by Petitioner, which he explained was nonsensical and at odds with a key conclusion in the Divsalar paper. *Id.* at ¶ 37.

Id.; *see also* Ex. 2031 ¶ 9 (Dr. Divsalar, under the heading "Summary of Opinions," testifying: "I do not believe it would have been trivial or obvious to modify RA codes by making them 'irregular' in order to arrive at IRA codes, nor would a person of ordinary skill in the art be motivated to make such a modification."). In light of this, we are persuaded by Petitioner that its questions were reasonably related to Dr. Divsalar's direct testimony—including the opinion testimony—and were not so far afield as to warrant sanctions.

Furthermore, we agree with Petitioner that Patent Owner suffered no harm with respect to the depositions of Dr. Mitzenmacher and Dr. Divsalar, particularly in light of our disposition of the challenged claims. For these reasons, we deny Patent Owner's motion for sanctions.

III. CONCLUSION

Petitioner has *not* demonstrated by a preponderance of the evidence that claims 18–23 of the '032 patent are unpatentable as obvious over Ping, MacKay, Divsalar, and Luby97.

IV. ORDER

For the foregoing reasons, it is

ORDERED that claims 18–23 of the '032 patent have *not* been proven to be unpatentable;

FURTHER ORDERED that Patent Owner's Motion to Exclude is *dismissed as moot*;

FURTHER ORDERED that Patent Owner's Motion for Sanctions is *denied*; and

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

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