Case No. IPR2017-00297
Docket No.: 1033300-00287US4

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

IPR2017-00297[1]
Patent No. 7,916,781

PETITIONER'S NOTICE OF APPEAL

[1] Case IPR2017-00423 has been consolidated with this proceeding.

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 June 29, 2018 (Paper 66) in IPR2017-00297, 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 13–15, 18, and 22 of U.S. Patent No. 7,916,781 are unpatentable under 35 U.S.C. § 103 over the combination of Ping and MacKay; claim 16 of U.S. Patent No. 7,916,781 is unpatentable under 35 U.S.C. § 103 over the combination of Ping, MacKay, and Coombes; 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: August 29, 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 749915533 US) on this 29th day of August 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 day, August 29th, 2018, and the filing fee is being paid electronically using pay.gov.

I hereby certify that on August 29th, 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

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Paper 66
Entered: June 29, 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 IPR2017-00297[1]
Patent 7,916,781 B2

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

HUDALLA, *Administrative Patent Judge*.

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

In Case IPR2017-00297 ("297 IPR"), Petitioner, Apple, Inc. ("Petitioner"), filed a Petition (Paper 5,[2] "297 Petition" or "297 Pet.") requesting an *inter partes* review of claims 3–12 and 19–21 of U.S. Patent

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[1] Case IPR2017-00423 has been consolidated with this proceeding.

[2] Unless otherwise indicated, citations to papers and exhibits are made to Case IPR2017-00297.

No. 7,916,781 B2 (Ex. 1001, "the '781 patent"). Patent Owner, California Institute of Technology ("Patent Owner"), filed a Preliminary Response to the 297 Petition. Paper 14 ("297 Preliminary Response" or "297 Prelim. Resp."). Taking into account the arguments presented in Patent Owner's 297 Preliminary Response, we determined that the information presented in the 297 Petition established that there was a reasonable likelihood that Petitioner would prevail in challenging claims 19–21 of the '781 patent under 35 U.S.C. § 102(b). Pursuant to 35 U.S.C. § 314, we instituted this proceeding on July 5, 2017, as to claims 19–21 of the '781 patent. Paper 16 ("297 Institution Decision" or "297 Dec. on Inst.").

In related Case IPR2017-00423 ("423 IPR"), Petitioner filed a second Petition (423 IPR, Paper 5, "423 Petition" or "423 Pet.") requesting an *inter partes* review of claims 13–22 of the '781 patent. Patent Owner filed a Preliminary Response to the 423 Petition. 423 IPR, Paper 14 ("423 Preliminary Response" or "423 Prelim. Resp."). Taking into account the arguments presented in Patent Owner's 423 Preliminary Response, we determined that the information presented in the 423 Petition established that there was a reasonable likelihood that Petitioner would prevail in challenging claims 13–16, 18, and 22 of the '781 patent under 35 U.S.C. § 103(a). Pursuant to 35 U.S.C. § 314, we instituted an *inter partes* review proceeding on July 5, 2017, as to claims 13–16, 18, and 22 of the '781 patent. Paper 18[3] ("423 Institution Decision" or "423 Dec. on Inst."). In the 423 Institution Decision, we ordered the consolidation of the 423 IPR with the 297 IPR for purposes of trial. *Id.* at 25.

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[3] The 423 Institution Decision is included in the 297 IPR as Paper 18 because it includes a consolidation order.

During the course of trial, Patent Owner filed a Patent Owner Response (Paper 31, "PO Resp."), and Petitioner filed a Reply to the Patent Owner Response (Paper 38, "Pet. Reply"). Patent Owner also filed a Sur-Reply (Paper 54, "PO Sur-Reply"), as was authorized by our Order of March 2, 2018 (Paper 47). An oral hearing was held on April 19, 2018, and a transcript of the hearing is included in the record. Paper 65 ("Tr.").

Petitioner filed Declarations of James A. Davis, Ph.D., with the 297 Petition (Ex. 1004) and the 423 Petition (Ex. 1024). Petitioner also filed a Declaration of Brendan Frey, Ph.D. (Ex. 1049) with its Reply. Patent Owner filed a Declaration of Michael Mitzenmacher, Ph.D., with its Response (Ex. 2004). The parties also filed transcripts of the depositions of Dr. Davis (Ex. 2033) and Dr. Mitzenmacher (Ex. 1045).

As authorized in our Order of February 10, 2018 (Paper 39), Patent Owner filed a motion for sanctions related to Petitioner's cross-examination of Patent Owner's witness, Dr. Mitzenmacher[4] (Paper 40), and Petitioner filed an opposition (Paper 44).

Patent Owner also filed a motion to exclude certain exhibits filed by Petitioner. Paper 49. Petitioner filed an opposition (Paper 53), and Patent Owner filed a reply (Paper 55).

In light of the U.S. Supreme Court's decision in *SAS Institute, Inc. v. Iancu*, 138 S. Ct. 1348 (2018), we modified the 297 Institution Decision and

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[4] Petitioner's motion also seeks sanctions related to Petitioner's cross-examination of Dariush Divsalar, Ph.D., in certain related cases. *See* Paper 40, 3–7. Nevertheless, Patent Owner did not file direct testimony from Dr. Divsalar in this consolidated case. Accordingly, we only address Patent Owner's motion for sanctions in this case to the extent it relates to Dr. Mitzenmacher's cross-examination.

the 423 Institution Decision to institute on all of the challenged claims and all of the grounds presented in the 297 Petition and the 423 Petition. Paper 61. Subsequently, the parties filed a joint motion to limit the Petitions to the claims and grounds that were originally instituted. Paper 63. We granted the motion. Paper 64. As a result, the remaining instituted grounds are the same as they had been at the time of the 297 Institution Decision and the 423 Institution Decision. *See id.* at 3.

We have jurisdiction under 35 U.S.C. § 6. This decision is a Final Written Decision under 35 U.S.C. § 318(a) as to the patentability of claims 13–16 and 18–22 of the ’781 patent. For the reasons discussed below, Petitioner has demonstrated by a preponderance of the evidence that claims 19–21 are unpatentable. Petitioner has not demonstrated by a preponderance of the evidence that claims 13–16, 18, and 22 are unpatentable.

I. BACKGROUND

A. Related Proceedings

The parties identify the following district court cases related to the ’781 patent (297 Pet. 1; 423 Pet. 1; Paper 7, 1):

Cal. Inst. of Tech. v. Broadcom Ltd., No. 2:16-cv-03714 (C.D. Cal. filed May 26, 2016);[5]

Cal. Inst. of Tech. v. Hughes Commc’ns, Inc., No. 2:15-cv-01108 (C.D. Cal. filed Feb. 17, 2015); and

[5] Petitioner is a defendant in this case. *See* 297 Pet. 1; 423 Pet. 1.

Cal. Inst. of Tech. v. Hughes Commc'ns, Inc., 2:13-cv-07245 (C.D. Cal. filed Oct. 1, 2013).

The '781 patent was previously subject to an *inter partes* review in Case IPR2015-00059 ("059 IPR"). 297 Pet. 1, 19; 423 Pet. 1, 19; Ex. 1011; Paper 7, 1. In the Final Written Decision from the 059 IPR, which Petitioner filed as Exhibit 1011 in this proceeding, the Board determined that claims 1 and 2 of the '781 patent are unpatentable as anticipated by a reference known as "Divsalar" that is no longer at issue in this consolidated proceeding. *See* Ex. 1011, 43.

Petitioner additionally states that patents in the priority chain of the '781 patent were challenged in Cases IPR2015-00068, IPR2015-00067, IPR2015-00060, IPR2015-00061, and IPR2015-00081. 297 Pet. 1; 423 Pet. 1. We additionally identify the following cases between the parties: Cases IPR2017-00210, IPR2017-00211, IPR2017-00219, IPR2017-00700, IPR2017-00701, IPR2017-00702, IPR2017-00703, and IPR2017-00728.

B. The '781 patent

The '781 patent describes the serial concatenation of interleaved convolutional codes forming turbo-like codes. Ex. 1001, Title. It explains some of the prior art with reference to its Figure 1, reproduced below.

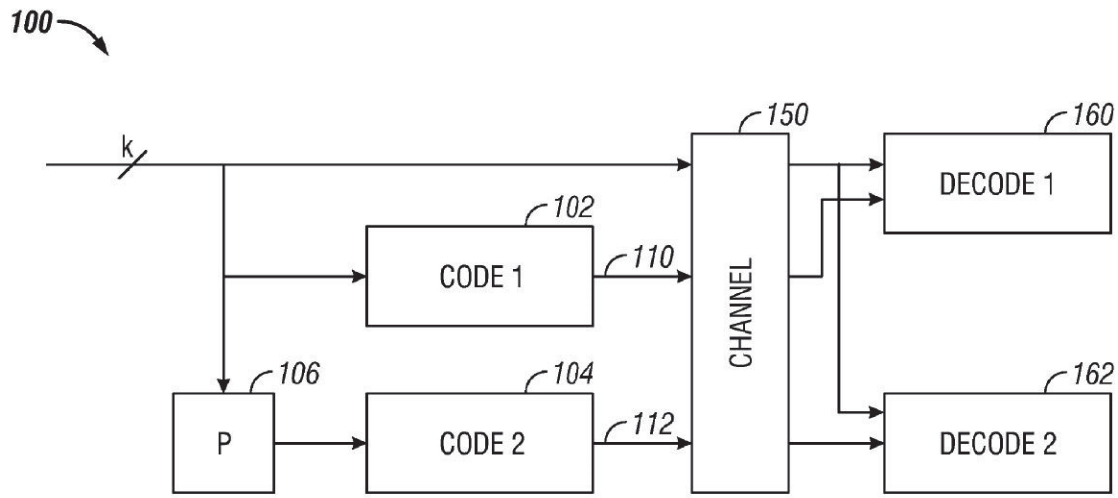

FIG. 1
(Prior Art)

Figure 1 is a schematic diagram of a prior "turbo code" system. *Id.* at 2:20–21. The '781 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 1:44–60.

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

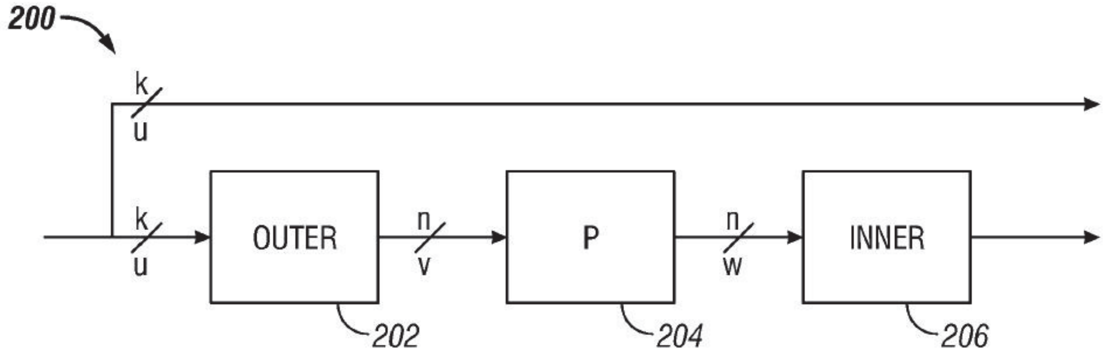

FIG. 2

Figure 2 of the ’781 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 [that] may be partitioned into blocks of fixed size, [e.g.] 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[6] 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

[6] 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.

> 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 2:40–3:2 (footnote added). Codes characterized by a regular repeat of message bits into a resulting codeword are referred to as "regular repeat," whereas codes characterized by irregular repeat of message bits into a resulting codeword are referred to as "irregular repeat." The second ("inner") encoder 206 performs an "accumulate" function. Thus, the two step encoding process illustrated in Figure 2, including a first encoding ("outer encoding") followed by a second encoding ("inner encoding"), results in either a "regular repeat accumulate" ("RRA") code or an "irregular repeat accumulate" ("IRA") code, depending upon whether the repetition in the first encoding is regular or irregular.

Figure 4 of the '781 patent is reproduced below.

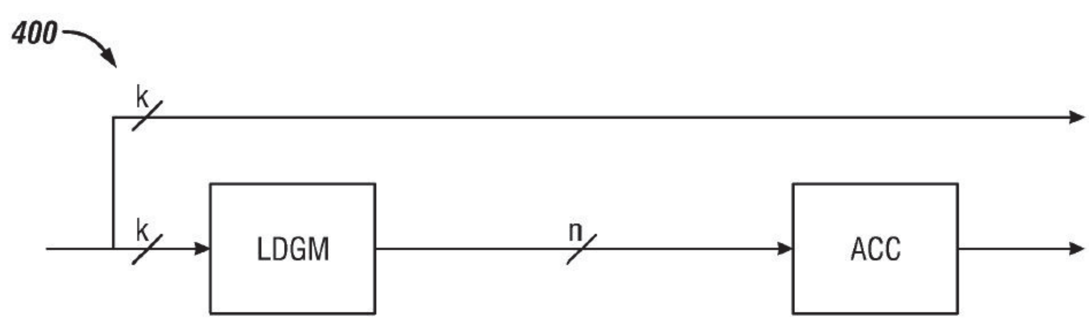

FIG. 4

Figure 4 shows an alternative embodiment in which the first encoding is carried out by a low density generator matrix. Low density generator matrix (LDGM)[7] codes are a special class of low density parity check codes that

[7] We understand that a "generator" matrix (typically referred to by "G") is used to create (generate) codewords. A parity check matrix (typically referred to by "H") is used to decode a received message.

allow for less encoding and decoding complexity. LDGM codes are systematic linear codes generated by a "sparse" generator matrix. 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.

Petitioner notes (297 Pet. 3; 423 Pet. 3) that the '781 patent claims priority to a provisional application filed on May 18, 2000. Ex. 1001, [60]. Patent Owner does not dispute that May 18, 2000, is the effective filing date for the challenged claims of the '781 patent.

C. Illustrative Claims

Claims 13 and 19–21 of the '781 patent are independent. Claims 14–16 and 18 depend directly or indirectly from claim 13, and claim 22 depends from claim 21. Claims 13 and 19 are illustrative of the challenged claims and recite:

> 13. A method of encoding a signal, comprising:
>
> receiving a block of data in the signal to be encoded, the block of data including information bits; and
>
> performing an encoding operation using the information bits as an input, the encoding operation including an accumulation of mod-2 or exclusive-OR sums of bits in subsets of the information bits, the encoding operation generating at least a portion of a codeword,
>
> wherein the information bits appear in a variable number of subsets.
>
> 19. A method of encoding a signal, comprising:
>
> receiving a block of data in the signal to be encoded, the block of data including information bits; and

> performing an encoding operation using the information bits as an input, the encoding operation including an accumulation of mod-2 or exclusive-OR sums of bits in subsets of the information bits, the encoding operation generating at least a portion of a codeword,
>
> wherein at least two of the information bits appear in three subsets of the information bits.

Id. at 8:7–17, 8:35–44.

D. The Prior Art

Petitioner relies on the following prior art:

> MacKay et al., "Comparison of Constructions of Irregular Gallager Codes," IEEE TRANSACTIONS ON COMMUNICATIONS, Vol. 47, No. 10, pp. 1449–54, October 1999 (Ex. 1002, "MacKay");
>
> 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 (Ex. 1003, "Ping"); and
>
> Coombes et al., U.S. Patent No. 4,271,520, filed June 25, 1979, issued June 2, 1981 (Ex. 1018, "Coombes").

E. Remaining Instituted Grounds

The following instituted grounds remain at issue in this consolidated proceeding (297 Dec. on Inst. 26; 423 Dec. on Inst. 24; Paper 64, 3):

Reference(s)	Basis	Claim(s) Challenged	Citation
Ping	35 U.S.C. § 102(b)	19–21	297 Pet. 57–60
Ping and MacKay	35 U.S.C. § 103(a)	13–15, 18, and 22	423 Pet. 31–43, 47–48
Ping, MacKay, and Coombes	35 U.S.C. § 103(a)	16	423 Pet. 48–50

F. Claim Interpretation

In an *inter partes* review, we construe claims by applying the broadest reasonable interpretation in light of the specification. 37 C.F.R. § 42.100(b); *see Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 2131, 2144–46 (2016). Under the broadest reasonable interpretation standard, and absent any special definitions, 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 disclosure. *See In re Translogic Tech. Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007). Any special definitions for claim terms or phrases must be set forth "with reasonable clarity, deliberateness, and precision." *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994).

We determine that no terms require explicit construction. *See Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999) ("[O]nly those terms need be construed that are in controversy, and only to the extent necessary to resolve the controversy").

G. Level of Ordinary Skill in the Art

Citing testimony from Dr. Davis, Petitioner contends a person of ordinary skill in the art was "a person with a Ph.D. in mathematics, electrical or computer engineering, or computer science with emphasis in signal processing, communications, or 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." 297 Pet. 21 (citing Ex. 1004 ¶ 84); 423 Pet. 22 (citing Ex. 1024 ¶ 77). Patent Owner takes no position on the level of ordinary skill in the art, but Dr. Mitzenmacher applies the same standard advanced by Petitioner. Ex. 2004 ¶ 64.

We determine that Petitioner's proposed definition comports with the qualifications a person would have needed to understand and implement the teachings of the '781 patent and the prior art of record. Accordingly, we apply Petitioner's definition of the level of ordinary skill in the art.

II. ANALYSIS

A. Anticipation Ground Based on Ping (297 IPR)

Petitioner contends that claims 19–21 are anticipated by Ping. 297 Pet. 57–59; Pet. Reply 1–2. Patent Owner disputes Petitioner's contention. PO Resp. 49–51; PO Sur-Reply 1.

1. Ping

Ping is an article directed to "[a] semi-random approach to low density parity check [LDPC] code design." Ex. 1003, 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 $(n–k) \times n$ where k is the information length and n is the coded length. *Id.* A codeword **c** is decomposed "as **c** = [**p**, **d**], 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 "$\mathbf{H} = [\mathbf{H}^{\mathbf{p}}, \mathbf{H}^{\mathbf{d}}]$." *Id.* $\mathbf{H}^{\mathbf{p}}$ 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 $kt/(n–k)$ (the weight of a vector is the number of 1s among its elements)" such that

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

Id.; Ex. 1004 ¶ 67.[8] For each sub-block of $\mathbf{H^d}$, there is exactly "one element 1 per column and *kt/(n-k)* 1s per row." Ex. 1003, 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. 1003, 38 (Equation (4)).[9]

Petitioner contends Ping "was published on January 7, 1999" and "is thus prior art to the '781 patent under 35 U.S.C. § 102(a) and (b)." 297 Pet. 24, 34–35; 423 Pet. 24. Ping appears to be included in a publication

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[8] 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 pages 8–9 of its Response.

[9] The reference to "mod 2" refers to modulo-2 addition. Modulo-2 addition corresponds to the exclusive-OR (XOR or $\oplus$) logical operation, which is defined as follows: $1\oplus1=0$, $1\oplus0=1$, $0\oplus1=1$, and $0\oplus0=0$. *See* 297 Pet. 11–12 & n.2; 423 Pet. 11–12 & n.2.

from the Institution of Electrical Engineers (IEE) bearing a "7th January 1999" date and a "JAN 25 1999" date stamp from "LINDA HALL LIBRARY." Ex. 1003. Patent Owner does not dispute the prior art status of Ping. The January 7, 1999, edition date and the January 25, 1999, date stamp provide some evidence of publication in a well-known IEE journal more than one year before the earliest possible effective filing date for the challenged claims of the '781 patent, which is May 18, 2000. *See* Ex. 1001, [60]; Ex. 1003. Thus, we determine that Ping qualifies as prior art under 35 U.S.C. § 102(b).

2. Claim 19

To anticipate a patent claim under 35 U.S.C. § 102, "a reference must describe, either expressly or inherently, each and every claim limitation and enable one of skill in the art to practice an embodiment of the claimed invention without undue experimentation." *Am. Calcar, Inc. v. Am. Honda Motor Co.*, 651 F.3d 1318, 1341 (Fed. Cir. 2011) (citing *In re Gleave*, 560 F.3d 1331, 1334 (Fed. Cir. 2009)). When evaluating a prior art reference in the context of anticipation, the reference must be "considered together with the knowledge of one of ordinary skill in the pertinent art." *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994) (citing *In re Samour*, 571 F.2d 559, 562 (CCPA 1978)). "[A] reference can anticipate a claim even if it 'd[oes] not expressly spell out' all the limitations arranged or combined as in the claim, if a person of skill in the art, reading the reference, would 'at once envisage' the claimed arrangement or combination." *Kennametal, Inc. v. Ingersoll Cutting Tool Co.*, 780 F.3d 1376, 1381 (Fed. Cir. 2015) (quoting *In re*

Petering, 49 CCPA 993, 301 F.2d 676, 681 (1962)). We analyze the instant ground with these principles in mind.

Petitioner's anticipation analysis for claim 19 references its analysis for an obviousness ground based on Ping and Divsalar that is no longer part of this consolidated proceeding. *See* 297 Pet. 57; Paper 64, 3. For "receiving a block of data in the signal to be encoded, the block of data including information bits," Petitioner contends "Ping teaches block codes" wherein "Ping denotes the block of information bits to be encoded using the vector variable **d**." 297 Pet. 40 (citing Ex. 1003, 38). According to Petitioner, "Ping receives the information bits **d** and computes from them a codeword **c**." *Id.* at 41 (citing Ex. 1004 ¶ 109), 57 (citing Ex. 1004 ¶ 160). Petitioner contends Ping "provides equations from which the parity bits '$\mathbf{p} = \{p_i\}$ can easily be calculated from a given $\mathbf{d} = \{d_i\}$.'" *Id.* at 40–41 (citing Ex. 1003, 38); Pet. Reply 1–2. Petitioner also states that "Ping's code is binary, meaning that all of its coding operations are performed using binary arithmetic." 297 Pet. 41 (citing Ex. 1003, 38; Ex. 1004 ¶ 110).

Regarding the recited "encoding operation," Petitioner cites Ping's Equation (4):

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

Id. at 41–42 (citing Ex. 1003, 38; Ex. 1004 ¶¶ 112–114), 57 (citing Ex. 1004 ¶ 161). For the recitation "the encoding operation including an accumulation of mod-2 or exclusive-OR sums of bits in subsets of the information bits," Petitioner cites the modulo-2 summation $\sum_j h_{ij}^d d_j$ and contends that these summations are sums of bits in a subset of the information bits, because each d_j is an information bit. *Id.* at 53 (citing

Ex. 1003, 38; Ex. 1004 ¶¶ 147–148), 57 (citing Ex. 1004 ¶ 161). Regarding the limitation "at least two of the information bits appear in three subsets of the information bits," Petitioner contends "[t]he number of subsets in which an information bit appears is given by the number of 1s in the column of $\mathbf{H}^{\mathbf{d}}$ corresponding to that information bit." *Id.* at 55, 57. Petitioner cites an example in Ping where $\mathbf{H}^{\mathbf{d}}$ has a column weight of four, meaning that every column of $\mathbf{H}^{\mathbf{d}}$ contains exactly four 1s. *See id.* at 55 (citing Ex. 1003, 39; Ex. 1004 ¶ 153). Accordingly, Petitioner contends every information bit "necessarily appears in at least 'three subsets of the information bits'" if it appears in four subsets. *Id.*

Patent Owner argues that Petitioner's analysis is flawed "because Ping is clear that **d** is a component of the codeword **c**, which is an *output* of the encoder, not its input." PO Resp. 50 (citing Ex. 1003, 38). Citing Dr. Mitzenmacher's testimony, Patent Owner further argues "Ping is silent as to whether data is received, generated internally for simulation purposes, or how [it is] received." *Id.* at 50 (citing Ex. 2004 ¶ 135).

Patent Owner's arguments would require us to overlook the context of Ping, namely, the known use of codewords and parity-check matrices to determine when there has been an error during transmission of information bits. *See* Ex. 1004 ¶¶ 46–47; Ex. 2004 ¶¶ 29, 32, 37. In particular, a codeword includes information bits and parity bits. *See* Ex. 1003, 38; Ex. 1004 ¶¶ 25–26; Ex. 2004 ¶ 29. A valid codeword, when multiplied with a parity check matrix, results in an output of 0. *See* Ex. 1003, 38 (equation 1); Ex. 1004 ¶ 47; Ex. 2004 ¶ 37. Consistent with this application, Ping's codeword **c** is described as including parity bits **p** and information bits **d**. *See* Ex. 1003, 38.

Petitioner identifies the information bits in vector **d** as the received block of data in the signal to be encoded. 297 Pet. 41 (citing Ex. 1004 ¶ 109). Although Patent Owner is correct that Ping details how the information bits in vector **d** of codeword **c** interact with parity check matrix **H** on the output side of the encoder (*see* PO Resp. 50), Ping also describes encoding. *See* Ex. 1003, 38 (referring to "LDPC encoding" and "the encoding process in eqn. 4," among other things). In particular, Ping describes how parity bits "can easily be calculated from a given **d**" in equation 4. 297 Pet. 40–41 (quoting Ex. 1004, 38). The "given **d**" referenced in Ping is a vector of information bits that is inputted into the encoding process. *See* Ex. 1004 ¶ 46 (describing the encoding process as "convert[ing] blocks of information bits into codewords" via "a linear transformation that maps *k*-dimensional [information] bit vectors to *n*-dimensional [codeword] bit vectors."); Ex. 2004 ¶ 33 ("[O]ne generates the codeword by multiplying the generator matrix by the input vector of bits.").

Thus, considering the cited teachings of Ping from the perspective of an ordinarily skilled artisan, we are satisfied that such an artisan would at once envisage that vector **d** is the "block of data in the signal to be encoded" with "the block of data including information bits." *See Kennametal*, 780 F.3d at 1381. The information bits in vector **d** are received insofar as Ping teaches how to compute from them codeword **c**. *See* 297 Pet. 41 (citing Ex. 1004 ¶ 109). Importantly, the Specification of the '781 patent does not describe any particular form of the input signal or particular process for receiving a block of data. Ping's references to encoding a "given **d**" are coextensive with the '781 patent's generic description of receiving data at the input side of the encoding process. As such, we determine that the cited disclosures from Ping describe the "receiving" step of claim 19.

Based on the entire trial record, we are satisfied that Ping describes each limitation of claim 19, combined in the same way as in claim 19. Thus, we determine Petitioner has shown by a preponderance of the evidence that claim 19 is anticipated by Ping.

3. Claim 20

Petitioner's analysis for claim 20 references much of the same analysis for claim 19. *See* 297 Pet. 58. Petitioner additionally maps the calculation of Ping's first parity bit p_1 according to the summation $\sum_j h_{1j}^d d_j$ for the "first sum" limitation. *Id.* at 53, 58. Regarding the "second sum" limitation, Petitioner maps the calculation of Ping's second parity bit p_2 according to the equation

$$p_2 = p_1 + \sum_j h_{2j}^d d_j$$

Id. at 53, 58–59.

Based on the evidence and analysis presented in the Petition, Petitioner has established that Ping describes each limitation of claim 20, combined in the same way as in claim 20. Patent Owner relies on the same arguments discussed above with respect to claim 19. Thus, we determine Petitioner has shown by a preponderance of the evidence that claim 20 is anticipated by Ping.

4. Claim 21

Claim 21 recites, *inter alia*, a "first parity bit" and "second parity bit" rather than a "first sum" and "second sum" as in claim 20. Petitioner's analysis for claim 21 is similar to that for claim 20. *See* 297 Pet. 59–60. In addition, for the "outputting a codeword" limitation, Petitioner contends Ping describes an encoding process that "outputs a 'codeword **c** as **c** = **[p, d]**, where **p** and **d** contain the parity and information bits, respectively.'" *Id.* at 60 (quoting Ex. 1003, 38). Petitioner contends Ping's codeword includes all parity bits, including the "first parity bit" and "second parity bit" recited in the claim. *Id.* (citing Ex. 1004 ¶ 175).

Based on the evidence and analysis presented in the Petition, Petitioner has established that Ping describes each limitation of claim 21, combined in the same way as in claim 21. Patent Owner relies on the same arguments discussed above with respect to claim 19. Thus, we determine Petitioner has shown by a preponderance of the evidence that claim 21 is anticipated by Ping.

B. Obviousness Ground Based on Ping and MacKay (423 IPR)

Apple contends claims 13–15, 18, and 22 would have been obvious over Ping and MacKay. 423 Pet. 31–48; Pet. Reply 2–21. Patent Owner disputes Petitioner's contention. PO Resp. 15–49, 51–62; PO Sur-Reply 1–8.

1. MacKay

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. 1002, 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 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.

2. Claims 13–15, 18, and 22

A 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. *See 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, so-called secondary considerations. *See Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). We also recognize that prior art references must be "considered together with the knowledge of one of ordinary skill in the pertinent art." *In re Paulsen*, 30 F.3d at 1480 (citing *In re Samour*, 571 F.2d 559, 562 (CCPA 1978)). We analyze Petitioner's obviousness grounds with the principles identified above in mind.

In its obviousness analysis for claim 13, Petitioner cites the information bits in Ping denoted by vector **d** for the step of "receiving a block of data in the signal to be encoded." 423 Pet. 38 (citing Ex. 1003, 38). Petitioner contends "Ping receives the information bits **d** and computes from them an encoded codeword **c**." *Id.* (citing Ex. 1024 ¶ 100). For the limitation "performing an encoding operation using the information bits as an input, the encoding operation including an accumulation of mod-2 or exclusive-OR sums of bits in subsets of the information bits," Petitioner cites the modulo-2 summation $\sum_j h_{ij}^d d_j$ and contends that these summations are sums of bits in a subset of the information bits, because each d_j is an information bit. *Id.* at 38–39 (citing Ex. 1003, 38; Ex. 1024 ¶ 102). Petitioner contends "Ping's encoding operation also generates a codeword, so it must generate 'at least a portion of a codeword' as claimed." *Id.* at 39 (citing Ex. 1003, 38; Ex. 1024 ¶ 103).

Regarding "the information bits appear[ing] in a variable number of subsets," Petitioner cites Ping in view of MacKay. *See id.* at 39–40. As background for its analysis of this limitation, Petitioner states the following regarding Ping:

> Ping's outer code is regular because, in Ping, each information bit contributes to the same number of summations $\sum_j h_{ij}^d d_j$. Those summations are the "parity bits," produced by Ping's outer coder (and are distinct from the "parity bits" subsequently produced by Ping's inner coder, the accumulator). The number of outer coder parity bits to which each information bit contributes is determined by Ping's generator matrix $\mathbf{H}^\mathbf{d}$ (which is, as explained above, also a portion of Ping's parity-check matrix **H**). (Ex. [1003], Equations (1), (3) and (4), p. 38.) Each column in matrix $\mathbf{H}^\mathbf{d}$ corresponds to a single information bit, and the number of 1s in a column determines the number of summations, or outer coder parity bits, to which the

> corresponding information bit contributes. (*Id.*) Ping refers to the number of 1s per column as the "column weight" of matrix $\mathbf{H^d}$, and uses the variable "t" to set this number for every column. (Ex. [1003], p. 38.) (Ex. [1024], ¶87.)

423 Pet. 32.

Petitioner contends "[e]ach column of Ping's matrix $\mathbf{H^d}$ corresponds to an information bit, and each row of the matrix $\mathbf{H^d}$ corresponds to a subset of information bits that are added together to form Ping's outer coder parity bits, the summations ($\sum_j h_{ij}^d \, d_j$)." *Id.* at 39 (citing Ex. 1024 ¶ 104). According to Petitioner, "[t]he number of subsets in which an information bit appears is given by the number of 1s in the column of $\mathbf{H^d}$ corresponding to that information bit," which Ping teaches is "exactly '*t*' 1s." *Id.* at 34, 39. Petitioner further 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 40 (quoting Ex. 1002, 1449) (emphasis in original).

Petitioner contends an ordinarily skilled artisan would have been motivated to incorporate the irregularity disclosed in MacKay into Ping's code based on MacKay's teaching that doing so would improve code performance. *Id.* at 33; Pet. Reply 7–8. Petitioner cites MacKay for the proposition that "irregular codes perform better than regular codes," so Petitioner proposes a modification to Ping's $\mathbf{H^d}$ matrix (or "outer coder"), which Petitioner characterizes as being regular, to improve the performance of Ping's code. 423 Pet. 32–36; Pet. Reply 3–4. In particular, Petitioner proposes "chang[ing] 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." 423 Pet. 36 (citing Ex. 1002, 1451).

According to Petitioner, an ordinarily skilled artisan would not have modified $\mathbf{H}^{\mathbf{p}}$ because "it has only a single form and because doing so would have complicated a simple encoder." Pet. Reply 7. Thus, Petitioner contends an artisan "want[ing] to obtain the benefit of MacKay's irregularity in Ping would have had only one option—to incorporate MacKay's uneven column weights into $\mathbf{H}^{\mathbf{d}}$." *Id.* at 7–8. Petitioner states that this would result in "some information bits . . . contribut[ing] to more summations ($\sum_j h_{ij}^{d} d_j$) than others, such that the information bits would appear in a variable number of subsets." 423 Pet. 40 (citing Ex. 1024 ¶ 105).

Patent Owner disputes Petitioner's rationale for combining Ping and MacKay on a number of bases. First, Patent Owner argues that Ping's parity check matrix **H** is already irregular. *See* PO Resp. 23–28. 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*-*k*) +1 and *kt*/(*n*-*k*) + 2)." *Id.* at 25; *see also* Ex. 2004 ¶ 84 (same). As such, Patent Owner argues "Ping's parity-check matrix is at least as irregular, if not more irregular, as MacKay's," so ordinarily skilled artisans "would not have been motivated by MacKay's teachings that irregular codes are an improvement over regular codes." PO Resp. 27 (citing Ex. 2004 ¶¶ 87, 89–91).

Second, Patent Owner highlights that Petitioner's proposed modifications relate only to a portion of Ping's parity check matrix **H**, namely, sub-matrix $\mathbf{H}^{\mathbf{d}}$. *Id.* at 27. Patent Owner argues "MacKay does not even consider, much less suggest, modifying only a sub-matrix within the larger parity-check matrix." *Id.* at 27–28. According to Patent Owner, "MacKay teaches that irregular parity-check matrices *as a whole* may define better codes than regular parity-check matrices *as a whole*—it does not teach anything about irregular sub-matrices are an improvement over regular sub-matrices, or other types of matrices (*e.g.*, irregular generator matrices)." *Id.* at 28. Patent Owner argues MacKay does not "suggest that *additional* irregularity should be applied to individual portions or submatrices when the overall parity-check matrix is already irregular." *Id.*

Third, Patent Owner argues that Petitioner has not established that an ordinarily skilled artisan would have reasonably expected success from the Ping-MacKay combination. *See* PO Resp. 44–49. Patent Owner argues "the petition does not even attempt to explain how its proposed modification to Ping would have a reasonable expectation of success, and for that reason, it must be rejected as being incurably deficient." *Id.* at 44. 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 5 (citing Ex. 2004 ¶ 46); *see also id.* at 44 (citing Ex. 2004 ¶¶ 118–120; Ex. 2033, 256:21–257:12) (same).

We are persuaded by Patent Owner's arguments. We agree with Patent Owner (*see* PO Resp. 27–29 & n.6) 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 suggested by Petitioner.

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 $\mathbf{H^d}$ 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 $\mathbf{H^d}$). To reach its proposed modification, Petitioner characterizes Ping's sub-matrix $\mathbf{H^d}$ as a generator matrix (or "outer coder") and Ping's sub-matrix $\mathbf{H^p}$ as merely an accumulator (or "inner coder"). 423 Pet. 24–25, 32, 34, 36; Pet. Reply 9–13. We agree with Patent Owner (*see* PO Resp. 36–37), however, that Petitioner does not explain why labeling sub-matrix $\mathbf{H^d}$ as a generator matrix supports the proposed modification of $\mathbf{H^d}$ based on MacKay, which does not discuss generator matrices. Indeed, this label does not explain why an ordinarily skilled artisan considering MacKay would have chosen to modify $\mathbf{H^d}$ or any other portion of parity check matrix **H**.

Petitioner's further contentions do not fare better. Specifically, Petitioner contends $\mathbf{H^p}$ is an accumulator with only a single, fixed form, so an ordinarily skilled artisan would not have been motivated to modify $\mathbf{H^p}$ because "doing so would have complicated a simple encoder." Pet. Reply 7, 9. Yet this rationalization belies that fact that Ping also specifically defines a structure for sub-matrix $\mathbf{H^d}$, which simplifies a portion of the parity check matrix. According to Dr. Mitzenmacher, "the constraints on $\mathbf{H^d}$, 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 ¶ 96. Thus, choosing to modify *any* portion of Ping's matrix would have broken constraints in Ping that were intended to simplify encoding. *See* Ex. 1003, 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. 23–27. Citing Dr. Mitzenmacher, Patent Owner establishes that Ping's matrix **H** has three different column weights (*t*, 2, and 1). *Id.* at 25; Ex. 2004 ¶ 84; *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. 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 $\mathbf{H^d}$. Pet. Reply 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. 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 423 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 36 of the Petition as supporting the expectation of success (Pet. Reply 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* 423 Pet. 36. 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[n ordinarily skilled artisan] could have added MacKay's irregularity to Ping." Ex. 1049 ¶ 41. According to Petitioner, the results of the simulation "outperform Ping's original code" and "confirm that a[n ordinarily skilled artisan] 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 14–15. Yet, even if we were to deem the testimony and simulation to be within the proper scope of a reply brief,[10] they do not

[10] 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.D. (dismissing Patent Owner's Motion to Exclude as moot on the same basis).

support a reasonable expectation of success *at the time of the invention*. We agree with Patent Owner that "[i]t is completely irrelevant what Dr. Frey claims he could do in the year 2018 when armed with Caltech's patent disclosures and publications, [the inventor's] original coding work, contemporary resources, and some 18 years of post-filing date knowledge." PO Sur-Reply 6. 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. 44 (citing Ex. 2004 ¶¶ 118–120; 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, [ordinarily skilled artisans] 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[,] . . . 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 evidence rooted in the Petition that substantiates a reasonable expectation of success, Petitioner's reliance on a known need for experimentation is not sufficient to support its obviousness rationale.[11] *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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[11] Notably, Petitioner does not contend that its proposed combination should be analyzed under obvious-to-try case law. *Cf.* Tr., 14:1–6 (Petitioner acknowledging, for a related case, 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. Thus, we determine Petitioner has not shown by a preponderance of the evidence that claim 13 would have been obvious over the combination of Ping and MacKay.

Petitioner relies on the same deficient rationale for combining Ping and MacKay with respect to its analysis for claims 14, 15, 18, and 22. Thus, we also determine Petitioner has not shown by a preponderance of the evidence that claims 14, 15, 18, and 22 would have been obvious over the combination of Ping and MacKay.

C. Obviousness Ground Based on Ping, MacKay, and Coombes (423 IPR)

Petitioner contends claim 16 would have been obvious over Ping, MacKay, and Coombes. 423 Pet. 48–50; Pet. Reply 17–21. Patent Owner disputes Petitioner's contention. PO Resp. 49, 51–62.

1. Coombes

Coombes is a U.S. patent directed to "resolving synchronization in an error correction encoded transmission." Ex. 1018, 1:7–10. Coombes teaches that N data bits are passed to conventional block code encoder 12. *Id.* at 3:1–2. Block code encoder 12 processes the N data bits and produces an output error correctable encoded bit stream comprised of the N data bits followed by K parity bits. *Id.* at 3:5–10.

2. Claim 16

Claim 16 depends from claim 13 via claims 14 and 15. Claim 16 recites "the parity bits follow the information bits in the codeword." According to Petitioner, "Coombes teaches that, in the output of an error-correcting encoder, the 'encoded bit stream . . . is comprised of the N data bits *followed by* K parity bits,' where the 'N data bits' are the information bits input into the encoder." 423 Pet. 50 (quoting Ex. 1018, 3:9–10) (emphasis added by Petitioner).

Building on its reasons for combining Ping and MacKay, Petitioner contends "it would have been obvious to use the output bit order taught by Coombes in the combination of Ping in view of MacKay." *Id.* at 48. Petitioner reasons "the information bits exist prior to creation of the parity bits and, accordingly, it is simple, and obvious to output the information bits from the encoder prior to the later created parity bits." *Id.* at 49 (citing Ex. 1003, 38; Ex. 1018, 3:5–10).

Because Petitioner's obviousness analysis for claim 16 relies on the same rationale for combining Ping and MacKay discussed above (*see id.* at 48), Petitioner's rationale for this ground incorporates the same deficiencies discussed above. For this reason, we determine Petitioner has not shown by a preponderance of the evidence that claim 16 would have been obvious over the combination of Ping, MacKay, and Coombes.

D. Patent Owner's Motion to Exclude

Patent Owner moves to exclude Exhibits 1027–1032, 1046, 1048, 1049, 1051, 1052, and portions of Exhibits 1045. Paper 49, 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.

E. 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. Paper 40, 1. 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. 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 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 44, 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. Furthermore, we agree with Petitioner that Patent Owner suffered no harm, particularly in light of our disposition of claims 13–16, 18, and 22 above. For these reasons, we deny Patent Owner's motion for sanctions.

III. CONCLUSION

Petitioner has demonstrated by a preponderance of the evidence that claims 19–21 of the '781 patent are anticipated by Ping. Petitioner has not demonstrated by a preponderance of the evidence that claims 13–15, 18, and 22 of the '781 patent would have been obvious over the combination of Ping and MacKay. Petitioner also has not demonstrated by a preponderance of the evidence that claim 16 of the ’781 patent would have been obvious over the combination of Ping, MacKay, and Coombes.

IV. ORDER

Accordingly, it is:

ORDERED that claims 19–21 of the ’781 patent are held 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 this proceeding seeking judicial review of our decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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