**No. 2020-2222**

# UNITED STATES COURT OF APPEALS FOR THE FEDERAL CIRCUIT

THE CALIFORNIA INSTITUTE OF TECHNOLOGY,

*Plaintiff-Appellee,*

*v.*

BROADCOM LIMITED, BROADCOM CORPORATION, AVAGO TECHNOLOGIES LIMITED, AND APPLE INC.,

*Defendants-Appellants.*

On Appeal from the United States District Court for the Central District of California in Case No. 2:16-cv-03714-GW-AGR, Judge George H. Wu

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## PATENT CLAIMS AT ISSUE

<u>Claim 20 of the ’710 patent</u>

> 15. A coder comprising:
>
> a first coder having an input configured to receive a stream of bits, said first coder operative to repeat said stream of bits irregularly and scramble the repeated bits; and
>
> a second coder operative to further encode bits output from the first coder at a rate within 10% of one.
>
> 20. The coder of claim 15, wherein the first coder comprises a low-density generator matrix coder.

Appx265(8:21-22).

<u>Claim 13 of the ’781 patent</u>

> 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.

Appx291(8:7-16).

## CERTIFICATE OF INTEREST

Counsel for Defendants-Appellants Broadcom Limited, Broadcom Corporation, Avago Technologies Limited, and Apple Inc. certifies the following:

**1. Represented Entities**. Fed. Cir. R. 47.4(a)(1). Provide the full names of all entities represented by undersigned counsel in this case.

Broadcom Corporation, Avago Technologies Limited (now Avago Technologies International Sales Pte. Limited), Broadcom Limited (dissolved in 2019), and Apple Inc.

**2. Real Party in Interest**. Fed. Cir. R. 47.4(a)(2). Provide the full names of all real parties in interest for the entities. Do not list the real parties if they are the same as the entities.

None.

**3. Parent Corporations and Stockholders**. Fed. Cir. R. 47.4(a)(3). Provide the full names of all parent corporations for the entities and all publicly held companies that own 10% or more stock in the entities.

Broadcom Inc. owns 10% or more stock in Broadcom Corporation and Avago Technologies Limited (now Avago Technologies International Sales Pte. Limited).

**4. Legal Representatives**. List all law firms, partners, and associates that (a) appeared for the entities in the originating court or agency or (b) are expected to appear in this court for the entities. Do not include those who have already entered an appearance in this court. Fed. Cir. R. 47.4(a)(4).

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**5. Related Cases**. Provide the case titles and numbers of any case known to be pending in this court or any other court or agency that will directly affect or be directly affected by this court's decision in the pending appeal. Do not include the originating case number(s) for this case. Fed. Cir. R. 47.4(a)(5). See also Fed. Cir. R. 47.5(b).

*California Institute of Technology v. HP Inc.*, No. 6:20-cv-01041 (W.D. Tex.)

*California Institute of Technology v. Dell Technologies Inc.*, No. 6:20-cv-01042 (W.D. Tex.).

**6. Organizational Victims and Bankruptcy Cases**. Provide any information required under Fed. R. App. P. 26.1(b) (organizational victims in criminal cases) and 26.1(c) (bankruptcy case debtors and trustees). Fed. Cir. R. 47.4(a)(6).

None.

Dated: December 14, 2020

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ADDENDUM

CERTIFICATE OF SERVICE

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## CONFIDENTIAL MATERIAL OMITTED

The material omitted from brief pages 4, 13, 19, 52-54, 56-60, and 65 contains confidential provisions from various contracts, including royalty rate, pricing, and other terms from settlement and license agreements with third parties, and confidential details of the relationship between Apple and Broadcom. The material omitted from Addendum pages Appx138-155, Appx194-240 and Appx241-251 likewise contains confidential provisions from various contracts, including royalty rate, pricing, and other terms from settlement and license agreements with third parties, confidential details of the relationship between Apple and Broadcom, in addition to descriptions of Broadcom's confidential source code, and information relating to Caltech's request for supplemental damages, ongoing royalties, and an injunction, which the district court filed under seal.

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## STATEMENT OF RELATED CASES

No appeal from this civil action was previously before this or any other appellate court. This Court previously decided two sets of consolidated appeals from inter partes review ("IPR") decisions for the three patents at issue in this appeal: U.S. Patent Nos. 7,116,710 ("the '710 patent"), 7,421,032 ("the '032 patent"), and 7,916,781 ("the '781 patent"). *Apple Inc. v. California Inst. of Tech.*, Nos. 19-1580, -1581, 796 F. App'x 743 (Fed. Cir. Mar. 5, 2020) (Wallach, Taranto, & Stoll, JJ.); *Apple Inc. v. California Inst. of Tech.*, Nos. 18-2332, -2369, -2410, -2411, -2412, 784 F. App'x 759 (Fed. Cir. Nov. 13, 2019) (Dyk, Taranto, & Stoll, JJ.).

The Court's decision in this appeal may directly affect or be directly affected by the following pending cases, in which Appellee California Institute of Technology ("Caltech") has asserted the '710, '032, and '781 patents: *California Inst. of Tech. v. HP Inc.*, No. 6:20-cv-01041 (W.D. Tex.), and *California Inst. of Tech. v. Dell Techs. Inc.*, No. 6:20-cv-01042 (W.D. Tex.). Counsel for Broadcom Limited, Broadcom Corporation, and Avago Technologies Limited (now Avago Technologies International Sales Pte. Limited) (collectively, "Broadcom") and Apple Inc. ("Apple") are unaware of any other case pending in this Court or any other court that will directly affect or be directly affected by the Court's decision in the pending appeal.[1]

[1] This brief refers to Broadcom and Apple collectively as "Appellants."

## JURISDICTIONAL STATEMENT

The district court had jurisdiction under 28 U.S.C. §§1331, 1338 and entered final judgment August 3, 2020. Appx252-254. Appellants timely appealed August 28, 2020. Appx10637-10640. This Court has jurisdiction under 28 U.S.C. §1295(a)(1).

## INTRODUCTION

Caltech sued Appellants for infringement of three patents relating to error-correction codes, alleging that specific circuits in Broadcom's Wi-Fi-compatible chips perform the claimed mathematical encoding functions. Although Caltech accused Broadcom and Apple of infringement based on the ***same*** circuits in the ***same*** Broadcom chips, which are incorporated into smartphones, tablets, and computers made by Apple and others, Caltech sought a royalty ***five times greater*** from Apple ($1.40/unit) than from Broadcom ($0.26/unit). The jury found infringement and awarded over ***$1.1 billion*** in damages. That award cannot stand, as this case was filled with error at every turn.

To begin, the infringement judgment hinges on multiple legal errors. After initially concluding that one claim term ("repeat") should have its plain meaning, the district court provided a new—and erroneous—construction of that term during trial. That new construction was unsupported by intrinsic evidence and squarely contradicted Judge Pfaelzer's construction of the same term in Caltech's prior assertion of the same patents against satellite-manufacturer Hughes Communications, Inc. ("Hughes"). The district court then refused to inform the jury of its claim construction for another term ("variable number of subsets"), even though the court relied on that construction in its earlier—and also erroneous—§101 ruling. But even under the district court's constructions, the infringement judgment must be reversed because no reasonable jury could find that the accused Broadcom chips satisfy two claim limitations ("repeat irregularly" and "sums of bits").

The district court also erroneously precluded Appellants from pursuing several key defenses following the PTAB's IPR decisions, which rejected Appellants' patentability challenges to the claims-in-suit. Because of the IPR decisions, the district court dismissed Appellants' invalidity and inequitable conduct claims and severely restricted Appellants' ability to introduce prior-art evidence at trial. The district court could make these rulings only by disregarding this Court's interpretation of statutory language, deciding a disputed factual issue on summary judgment, departing (again) from Judge Pfaelzer's decisions in *Hughes*, and failing to appreciate that prior-art evidence is relevant and important to trial issues beyond invalidity. These rulings unfairly prejudiced Appellants and greatly hampered their ability to rebut Caltech's repeated emphasis at trial on the supposed importance of the patents-in-suit, which led to an enormous—and unwarranted—damages award.

As for damages, the district court never should have allowed Caltech to present its exorbitant demand to the jury. Caltech's entire damages theory assumed that Broadcom and Apple would have engaged in two separate hypothetical negotiations with Caltech, and would have agreed to wildly different royalty rates—$0.26/unit for Broadcom and $1.40/unit for Apple—to license the ***same*** technology in the ***same*** Broadcom chips. That theory is not only contrary to this Court's precedent and common sense, it is also unsuited to the facts: in the real world, a Broadcom license would have covered Apple's downstream sales as well, and Broadcom was [redacted] Apple for any infringement arising from its accused chips. Not surprisingly, the district court expressed doubt concerning Caltech's damages model. *E.g.*, Appx10028 (stating "[t]here should be only one license price, not two"); Appx3879 (finding it "somewhat troubling" Apple "face[d] a much higher threatened … royalty" and asking "why shouldn't it be the same rate of damages that Broadcom … would have to pay?"). Yet it did nothing to ensure that only a legally correct, factually supported, and reliable damages theory was presented to the jury.

Even after failing to exclude Caltech's two-tier hypothetical negotiation approach, the district court still should have precluded Caltech's damages expert from presenting the two royalty rates themselves. Caltech's expert derived these rates from non-comparable settlement agreements, without apportionment, and applied upward adjustments based on excluded evidence and "black box" calculations. By contrast, and without any reasonable justification, the district court precluded Appellants' experts from presenting rebuttal damages opinions regarding apportionment and comparable licenses. Adding further reversible error, the district court also allowed the jury to award Caltech over $250 million in damages based on extraterritorial sales—contrary to the Patent Act and this Court's clear precedent.

The judgment should be reversed.

## STATEMENT OF ISSUES

1. Whether the infringement judgment should be reversed because the district court erroneously construed "repeat" and failed to inform the jury of its "variable number of subsets" construction, and Broadcom's chips do not satisfy the "irregularly repeat" and "sums of bits" limitations.

2. Whether claim 13 of the '781 patent is ineligible under §101 because it is directed to abstract mathematical operations.

3. Whether the district court erroneously treated the IPR decisions as precluding Appellants from pursuing ***any*** prior-art-based invalidity defenses, litigating inequitable conduct, and fully presenting prior-art evidence at trial for damages and other purposes.

4. Whether the damages judgment should be vacated because Caltech's damages model impermissibly applied two separate hypothetical negotiations for

Broadcom and Apple; Caltech's expert's royalty rates were derived from non-comparable settlements, without apportionment, and based on excluded evidence and "black box" calculations; the district court erroneously excluded Appellants' experts' opinions regarding comparable licenses and apportionment; and the jury compensated Caltech for extraterritorial sales.

## STATEMENT OF CASE

### A. The Asserted Patents

The technology in this case relates to error-correction codes, which have been used for decades to detect and correct errors in electronic transmissions. Error-correction codes take "information bits," which represent a message to be transmitted, and output codewords containing "parity bits." The codewords can be used to reconstruct the transmitted message on the receiving end if errors are introduced during transmission. Appx2708-2709.

#### 1. The specification

The asserted patents share a near-identical specification, which describes an error-correction code known as an ***irregular repeat-accumulate ("IRA")*** code. Figure 2 shows an encoder for generating an IRA code:

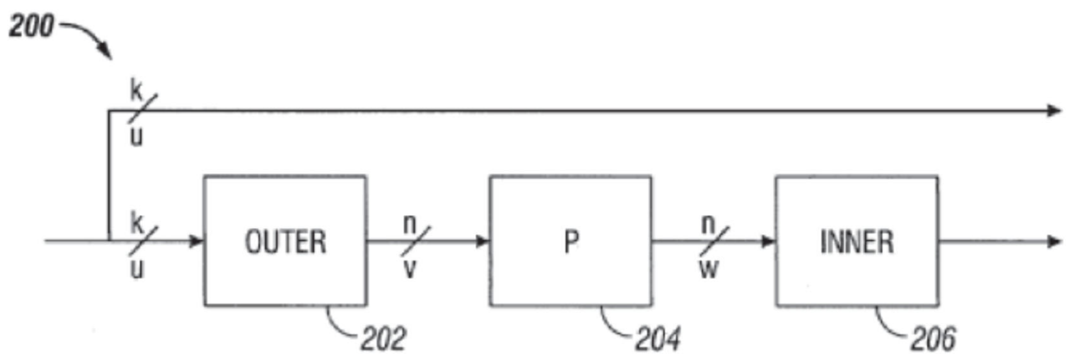


FIG. 2

Appx258(Fig.2); Appx262(2:33-40).

Outer coder 202 receives a block of information bits and ***repeats*** each bit some number of times, which produces a sequence of distinct, repeated bits at its output. Appx262(2:48-58). The outer coder repeats information bits ***irregularly***—that is, "bits in different sub-blocks are repeated a different number of times[.]" Appx262(1:61-64); *see* Appx255(Abstract); Appx262(2:52-54). For example, some information bits may be repeated two times, while others are repeated six times, etc.

The repeated bits are passed to interleaver 204, where they are rearranged or scrambled. Appx263(3:18-22). The scrambled bits are passed to inner coder 206, where they are accumulated to form parity bits. Appx262-263(2:65-3:12). Accumulation involves "perform[ing] recursive modulo two [mod-2] addition operations on the input bit stream." Appx262(2:1-5); *see* Appx262(2:65-67).

Together, "the interleaved irregular repeat code and the accumulate code produces an irregular repeat and accumulate (IRA) code." Appx263(3:23-25).

### 2. The asserted claims

Claims 20 and 22 of the ’710 patent claim encoding devices, where the incoming information bits are repeated irregularly and then those irregularly repeated bits are scrambled. Claim 20 is reproduced below:

> 15. A coder comprising:
>
> a first coder having an input configured to receive a stream of bits, said first coder operative ***to repeat said stream of bits irregularly*** and scramble the repeated bits; and
>
> a second coder operative to further encode bits output from the first coder at a rate within 10% of one.
>
> 20. The coder of claim 15, wherein the first coder comprises a low-density generator matrix coder.

Appx265(8:1-22).[2] During prosecution, Caltech emphasized that its claims were patentable over the prior art due to the “irregular” part of the claimed IRA encoding (Appx7270-7274)—even though the inventors knew of, but did not disclose, prior art teaching such irregularity. *Infra* pp. 42-43.

Claims 11 and 18 of the ’032 patent similarly claim devices for encoding and decoding signals. They include “Tanner graphs,” which depict irregularly repeating information bits in graphical form. Appx277-278(8:62-10:42); Appx17-18.

Claim 13 of the ’781 patent recites an encoding method focused on the mathematical operation of accumulating sums of information bits:

---

[2] Emphases are added unless indicated otherwise.

> 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***.

Appx291(8:7-17). Before trial, the district court held that the "variable number of subsets" limitation requires irregularly repeating information bits. Appx78.

### B. The Accused Products

The accused products are Broadcom chips supporting the 802.11n and/or 802.11ac Wi-Fi standards, and Apple products incorporating those Broadcom chips, including smartphones, tablets, and computers. Appx6259-6271; Appx2717-2719; Appx2727; Appx2976-2981. Each Broadcom chip incorporates dozens of different features and technologies, and some are "combo" chips with Bluetooth functionality in addition to Wi-Fi functionality. Appx3606-3609; Appx3815.

Caltech alleged infringement by two encoders—a Richardson-Urbanke ("RU") encoder and a low-area ("LA") encoder—and a corresponding decoder. Appx2717-2719; Appx2845; Appx2946-2947; Appx6259-6271; Appx6272-6304; Appx6305-6325. The accused circuitry exists entirely in the Broadcom chips, and encodes and decodes an error-correction code known as a low-density parity check ("LDPC") code. Appx2977-2978; Appx2673-2674.[3]

In the accused encoders, incoming information bits are provided to AND gates (in the RU encoder) or multiplexers (in the LA encoder). The AND gates and multiplexers do not "repeat" information bits; instead, they ***combine*** the information bits with bits from a parity-check matrix to output new bits reflecting that combination. Appx3687; Appx3692-3695; Appx3719; Appx3948-3951.[4] The AND gates and multiplexers also do not generate bits "irregularly," as they output the ***same*** number of bits for every information bit. Appx3956-3960; Appx3720.

After additional processing, each outputted bit arrives at an XOR gate, which is a logic gate that sums its inputs. Appx3721-3724; Appx3844; Appx3971-3980. The XOR gates never sum two "information bits"; rather, each sum always includes a reset bit and/or outputted bits generated by earlier processing. *Id.*; Appx9947-9948.

The accused decoder, in turn, decodes messages that have been encoded according to the process described above. Appx3703-3704.

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[3] LDPC codes were introduced in the 1960s and described in the prior art by Richardson and Urbanke, among others. Appx6804-6893; Appx8284-8318; Appx2484-2487.

[4] A "parity-check matrix" is an array of 0s and 1s describing the relationship between inputted information bits and outputted codewords. Appx2353-2356.

## C. District Court Proceedings

### 1. Summary judgment

***Section 101.*** Appellants moved for summary judgment that claim 13 of the ’781 patent is patent-ineligible because it is directed to abstract mathematical operations—namely, accumulating sums of information bits. Appx6683-6704. The district court disagreed, holding as a matter of law that claim 13 is directed to patent-eligible subject matter because it (purportedly) improves a computer’s functioning by allowing for more efficient data transmission. Appx86-100; Appx10119.

***IPR estoppel.*** After the PTAB issued IPR decisions finding Appellants had not proved the claims-in-suit unpatentable, the district court granted Caltech summary judgment of validity based on statutory estoppel. Appx36-63; Appx117-120; Appx136-137. In so doing, the court interpreted 35 U.S.C. §315(e)(2) as precluding Appellants from pursuing any invalidity ground they could have raised in their IPR ***petitions***, not just those grounds they could have raised ***during the instituted IPRs***. Appx41-50; Appx117. This ruling prevented Appellants from litigating any obviousness (or anticipation) defenses.

***Inequitable conduct.*** Although the Caltech inventors knew of prior art teaching “irregular repetition,” they failed to disclose it during prosecution and could not explain why. *Infra* pp. 42-43. In *Hughes*, Judge Pfaelzer found these facts “significant” in allowing the same inequitable conduct claim to survive summary judgment. *California Inst. of Tech. v. Hughes Commc'ns, Inc.*, 2015 WL 11089495, at *7 (C.D. Cal. May 5, 2015). Yet the district court here granted summary judgment of no inequitable conduct based on its own ***factual*** determination that the undisclosed references were not "but-for material" to patentability. Appx108-112. As relevant, the court found that the undisclosed Richardson99 reference—which describes the Richardson-Urbanke ("RU") method for irregular codes—was not material because the PTAB considered two ***other*** undisclosed references in the IPRs. *Id.*

### 2. *Daubert* motions

***Caltech's damages experts.*** Caltech's expert David Teece offered a "two-tier" damages theory in which Caltech would have engaged in ***separate*** hypothetical negotiations with Broadcom and Apple. In the Caltech-Broadcom negotiation, Broadcom would pay $0.26/unit for all Broadcom chips worldwide except that it would carve out Broadcom chips that go into the products of one of its largest customers, Apple, but only for Apple products sold in the United States. Appx8868(¶310); Appx8899-8900(¶¶452-453). In the separate Caltech-Apple negotiation, Apple would pay $1.40/unit for those carved-out Apple products sold in the United States. Appx8899(¶¶450-451). In other words, Dr. Teece opined that Apple would pay a rate ***five times greater*** than Broadcom to license the same technology in the same Broadcom chips, even though the lower $0.26/unit rate applied to ***the same Apple products*** when sold outside the United States and to Broadcom's other customers incorporating the same chips in the United States. Dr. Teece insisted on this two-tier approach notwithstanding that ***Broadcom was*** [redacted] ***both the $0.26/unit and $1.40/unit rates*** under its [redacted] to Apple. Appx8899-8900(¶¶450-453); Appx6058-6059(§§12.1,13.1).

Appellants moved to exclude Caltech's damages theory because it conflicts with precedent regarding hypothetical negotiations, exhaustion, and apportionment, and is not reasonably tied to the facts of this case. Appx8729-8735. Appellants also sought to exclude Dr. Teece's $1.40/unit and $0.26/unit royalty rates because he derived them from non-comparable settlement agreements, without apportionment, and made unsupported upward adjustments. Appx8735-8753; Appx10152-10154; Appx10275-10278. The district court initially stated "[t]here should be only one license price, not two" (Appx10028), but denied Appellants' motion because it believed these issues "are best addressed through vigorous cross examination and post-trial challenges[.]" Appx145-146. And while the court found Dr. Teece's rate calculations lacking support in certain respects, it allowed him to supplement those opinions. Appx145-150.

***Appellants' damages experts.*** By contrast, the district court excluded several damages opinions from Appellants' experts without allowing supplementation. For example, the court thought Appellants' technical expert Wayne Stark, whose analysis spanned dozens of pages, did "not provide sufficient opinions" showing the technological comparability of licensed patents, or comparing the accused technology to other features in Broadcom's chips. Appx142-143; *see* Appx8976-9043(¶¶1070-1262); Appx9082-9100(¶¶1369-1424). The court also excluded Appellants' damages expert Vincent Thomas's opinions regarding: (1) comparable licenses because he (supposedly) did not adequately account for economic differences and relied on Dr. Stark's technical analysis; and (2) standard-essential patents, including those concerning comparable licenses, royalty stacking, and patent pools. Appx144-145; *see* Appx8488(¶162); Appx8497-8504(¶184-199); Appx8519-8529(¶¶236-259); Appx8537(¶278).

**3. Trial**

Appellants were disadvantaged from the trial's start, as the district court gave Broadcom and Apple together only 45% of the total time, or four hours less than Caltech. Appx10146; Appx10266-10268.

***State-of-the-art evidence.*** After ruling that Appellants were estopped on invalidity, the district court limited their ability to introduce prior-art evidence—even though that evidence remained relevant to damages and other trial issues. For instance, the court ruled that Appellants could not refer to what had been their "main invalidity prior art references" and instead could introduce just a few references ***of Caltech's choosing***. Appx168; *see* Appx160-161; Appx10284-10285. Even after

Caltech's fact witnesses testified that the claimed inventions were significant advances over what was known, the court still refused to allow Appellants' counsel to fully cross-examine those witnesses with the prior art. *Infra* pp. 45-48.

***Claim construction.*** During *Markman*, the district court gave "repeat" its plain meaning. Appx9-14; *see* Appx10 (agreeing with Appellants "that 'repeated bits' are a construct distinct from the original bits from which they are created"). But during trial, the court decided to construe that term and instructed the jury—contrary to the plain meaning and Judge Pfaelzer's construction in *Hughes*—that "repeat" encompasses the mere "reuse" of bits, as opposed to requiring duplication to create a new, distinct bit. Appx171; Appx181.

Meanwhile, the district court refused Appellants' request to instruct the jury that the "irregular repeat" requirement applies to claim 13 of the '781 patent (Appx10360-10362; Appx10365; *see* Appx180-181)—even though the court's earlier §101 ruling held precisely that. Appx78; Appx86.

***Infringement.*** Caltech's technical expert Matthew Shoemake presented Caltech's infringement case. He pointed to the AND gates' outputs (in the RU encoder) and the multiplexers' outputs (in the LA encoder) as the "irregularly repeated" bits, and to the XOR gates as performing the '781 patent's "sums of bits." Appx2744-2751; Appx2772-2773; Appx3020; Appx3033-3038; Appx4144-4149.

Appellants called their technical expert Dr. Stark and Andrew Blanksby, a Broadcom engineer who developed the RU encoder and testified as a fact and expert witness. Drs. Blanksby and Stark explained that the AND gates' and multiplexers' outputs are not "repeated" information bits because they are formed by ***combining*** information bits with parity-check-matrix bits; nor are they "irregular" because the circuitry outputs the ***same*** number of bits for every information bit. Appx3717-3720; Appx3841-3844; Appx3933-3960. Drs. Blanksby and Stark also explained that the XOR gates never sum two "information bits," because each sum includes a reset bit or an outputted bit generated by earlier processing—neither of which is an information bit. Appx3721-3724; Appx3971-3980.

***Damages.*** Caltech's expert Dr. Teece, along with expert Catharine Lawton, presented Caltech's damages case according to the two-tier hypothetical negotiation theory discussed above. Appx3330-3345; Appx3396-3397; Appx3422-3442; Appx3473-3485; Appx3503-3506; Appx3514-3517; Appx3541-3570; *supra* pp. 12-13. Constrained by the court's *Daubert* rulings and trial-time restrictions, Appellants did not call any damages experts.

### 4. Verdict and judgment

The jury found that Appellants infringed all asserted claims (but not willfully), and awarded the full $1.1 billion in damages that Caltech sought. Appx191-193.

The district court denied Appellants' JMOL and new trial motions. Appx194-240. The court awarded ongoing royalties at the jury's rates, but deferred ruling on supplemental damages or determining the products to which ongoing royalties apply until after this appeal. Appx244-250. The court entered final judgment of $270,241,171 plus $18,004,985 in pre-judgment interest against Broadcom, and $837,801,178 plus $47,640,650 in pre-judgment interest against Apple, and post-judgment interest. Appx252-254.

## SUMMARY OF ARGUMENT

1. The infringement judgment should be reversed or vacated. The district court erroneously construed "repeat" during trial as encompassing the mere reuse of information bits, contrary to the claim language, specification, and Judge Pfaelzer's construction in *Hughes*. The court also erred in refusing to instruct the jury that the '781 patent's "variable number of subsets" limitation requires irregular repetition, as the court had ruled in its §101 decision. These claim construction errors require at least a new trial.

Even under the district court's constructions, no reasonable jury could find infringement because the accused products do not "repeat" information bits (instead, they ***combine*** information bits with parity-check-matrix bits through AND gates and multiplexers); nor do they repeat information bits "irregularly" (instead, they produce the ***same*** number of output bits for every information bit). And with only conclusory expert testimony, Caltech failed to present the particularized evidence needed to prove infringement by equivalents.

Additionally, substantial evidence does not support infringement for the ’781 patent’s “sums of bits” limitation. The accused circuits perform additions, but not on ***two information bits*** as this limitation requires.

2. Claim 13 of the ’781 patent is ineligible under §101 because it is directed to abstract mathematical operations—namely, accumulating sums of information bits. Nothing in the claim focuses on improving a computer’s functioning, or otherwise transforms the claim into anything more than a collection of abstractions.

3. The district court’s rulings precluding Appellants’ litigation defenses due to the PTAB’s IPR decisions should be reversed. In its estoppel ruling, the court misinterpreted §315(e)(2) as barring any invalidity grounds Appellants could have raised in their IPR ***petitions***, contrary to this Court’s interpretation of the statute’s plain language as applying only to grounds that could have been raised ***during the instituted IPRs***. In its inequitable conduct ruling, the court erroneously granted summary judgment by deciding a disputed ***factual*** issue regarding whether an undisclosed reference was material to patentability. And in its evidentiary rulings, the court improperly limited Appellants’ presentation of prior-art evidence, which

unfairly hampered their ability to rebut Caltech's evidence regarding the alleged inventions' significance and value.

4. The damages judgment should be reversed or vacated. Caltech's damages model improperly assumed that Broadcom and Apple would have engaged in separate hypothetical negotiations with Caltech, resulting in two vastly different royalty rates for the ***same*** technology in the ***same*** Broadcom chips. That two-tier approach violates this Court's precedent regarding the hypothetical negotiation, exhaustion, and the smallest-saleable-unit requirement. It is also factually unsupported because, in the real world, a Broadcom license would have covered Apple's downstream sales, and Broadcom was [redacted] Apple for any infringement arising from the accused chips.

The specific royalty rates that Caltech sought—and the jury awarded—were equally problematic. Caltech's experts derived the $0.26/unit and $1.40/unit rates using non-comparable settlement agreements, without apportionment, and based on excluded evidence and "black box" calculations. By contrast, and without any reasonable justification, the district court improperly precluded Appellants' experts from offering certain rebuttal opinions regarding comparable licenses and apportionment.

Lastly, the jury impermissibly awarded over $250 million in damages for chips that Broadcom manufactured, shipped, and sold ***outside the United States*** and never imported into the United States. These extraterritorial sales are not compensable under the Patent Act and this Court's precedent.

## ARGUMENT

### I. Standard Of Review

The Ninth Circuit reviews a summary judgment grant *de novo*. *Warren v. City of Carlsbad*, 58 F.3d 439, 441 (9th Cir. 1995). The Ninth Circuit reviews a JMOL denial *de novo*, determining whether substantial evidence supports the jury's verdict. *VHT, Inc. v. Zillow Grp., Inc.*, 918 F.3d 723, 735 (9th Cir. 2019). The Ninth Circuit reviews a new trial denial for abuse of discretion. *Molski v. M.J. Cable, Inc.*, 481 F.3d 724, 728 (9th Cir. 2007). The Ninth Circuit reviews evidentiary rulings for abuse of discretion. *City of Pomona v. SQM N. Am. Corp.*, 866 F.3d 1060, 1065 (9th Cir. 2017). An "erroneous view of the law" is "necessarily" an abuse of discretion. *Highmark Inc. v. Allcare Health Mgmt. Sys., Inc.*, 572 U.S. 559, 563 n.2 (2014).

Statutory interpretation is reviewed *de novo*. *Power Integrations, Inc. v. Semiconductor Components Indus., LLC*, 926 F.3d 1306, 1313 (Fed. Cir. 2019). Patent-eligibility under §101 is reviewed *de novo*. *Recognicorp, LLC v. Nintendo Co.*, 855 F.3d 1322, 1326 (Fed. Cir. 2017). Claim construction relying on intrinsic evidence is reviewed *de novo*. *Teva Pharms. USA, Inc. v. Sandoz, Inc.*, 574 U.S. 318, 333 (2015). Infringement and damages are reviewed for substantial evidence. *Lucent Techs., Inc. v. Gateway, Inc.*, 580 F.3d 1301, 1309, 1324 (Fed. Cir. 2009).

This Court reviews jury instructions on patent law issues *de novo*, ordering a new trial if the instructions as a whole were legally erroneous and the error had prejudicial effect. *Bettcher Indus., Inc. v. Bunzl USA, Inc.*, 661 F.3d 629, 638-639 (Fed. Cir. 2011); *see Caballero v. City of Concord*, 956 F.2d 204, 206-207 (9th Cir. 1992) (instructional error "requires reversal unless the error is more probably than not harmless").

## II. THE INFRINGEMENT JUDGMENT SHOULD BE REVERSED.

### A. The District Court Erred In Construing "Repeat."

Every asserted claim requires "repeating" information bits. Appx265(8:2-4); Appx277-278(8:63-9:34); Appx17-18; Appx291(8:16-17). The district court ultimately—during trial—construed "repeat" to mean "generation of additional bits, where generation can include, for example, duplication ***or reuse*** of bits." Appx171. That construction is inconsistent with the claim language, specification, and Judge Pfaelzer's construction in *Hughes*. "Repeat" should be construed to require generating new, distinct bits (i.e., duplicates) and should not include merely reusing bits. Appx9.

During *Markman*, the district court declined to construe "repeat" and ruled it would have its plain meaning. Appx9-12. The court acknowledged that "[t]he claim language … makes clear that 'repeated bits' are a construct distinct from the original bits from which they are created." Appx10. Yet the court also stated that "'repeat' may encompass duplication and reuse." Appx1. And its mid-trial construction expressly included "reuse" of bits. Appx171. That was error.

When Caltech previously asserted the same patents against Hughes, Judge Pfaelzer held the opposite: "This Court will not redefine 'repeat' to encompass 're-use'" because "Caltech cannot point anywhere in the specification or prosecution history where 'repeat' means re-use." *California Inst. of Tech. v. Hughes Commc'ns Inc.*, 35 F. Supp. 3d 1176, 1185-1186 (C.D. Cal. 2014). As Judge Pfaelzer explained: "[T]he plain meaning of 'repeat' requires the creation of new bits corresponding to or reflecting the value of the original bits. In other words, repeating a bit with the value of 0 will produce another bit with the value of 0. The Court will refer to this concept as duplication." *Id.* at 1184.[5]

This Court should construe "repeat" consistently with Judge Pfaelzer's construction and the aspects of the district court's initial order requiring distinct, duplicate bits, because that construction is consistent with the claim language and specification. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1313 (Fed. Cir. 2005) (en banc).

***First***, the claims distinguish "repeated bits" from the original bits, which are referred to as "bits," "information bits," "message bits," or "data elements."

[5] *Caltech-Hughes* settled for $5 million before any judgment. *Infra* pp. 56-57.

Appx265(7:18-23, 8:2-4); Appx291(8:8-9); Appx277(8:64-65); *see* Appx10 (district court quoting "[e]xpress language in each claim where 'repeat' … has been used" that "indicates generation of additional bits by means of duplicating the original bits"). The claims further demonstrate that "repeating" a bit requires creating a new copy of the bit because the "repeated" bits, not the original bits, are what are interleaved or scrambled. Appx265(8:2-4, 8:33-35) ("repeat said stream of bits" and then "scramble the repeated bits"); Appx277-278(7:64-8:17) ("receiving … message bits" and then summing "repeats of the message bits"); Appx265(7:18-23) ("repeating the data elements" and then "interleaving the repeated data elements").

Despite this claim language, the district court thought that (unasserted) claim 1 of the '032 patent, which refers to "'randomly *chosen* irregular repeats of the message bits,'" somehow suggests the claim could be implemented without making new copies of the bits. Appx10 (emphasis original). But claim 1's choosing among "irregular ***repeats*** of the message bits"—instead of choosing among the "message bits" themselves—***reinforces*** that "repeats" must exist separately from the original message/information bits.

***Second***, the specification confirms that repeating bits means duplicating bits. In describing the "repeat" step, the specification states that "outer coder 202 receives the uncoded data" (i.e., original information bits), which "may be partitioned into blocks of fixed size, say *k* bits." Appx262(2:41-44). It then explains that the outer coder "repeats the *k* bits in a block a number of times *q* to produce a block with *n* bits, where *n=qk*." Appx262(2:50-52). To produce a separate block with ***more*** output bits than input bits, the repeater must make new bits, as Judge Pfaelzer observed. *Hughes*, 35 F. Supp. 3d at 1184; *see* Appx6637-6638.

The specification's only other outer coder embodiment is a low-density generator matrix ("LDGM") coder. Appx262-263(1:64-67, 3:51-59). The district court viewed Appellants' construction as excluding the LDGM embodiment. Appx11. But as Judge Pfaelzer recognized, "[c]onstruing 'repeat' to require duplication does not exclude the LDGM embodiment" because "[a]lthough an LDGM does not necessarily duplicate bits, it is beyond dispute that an LDGM can duplicate bits." *Hughes*, 35 F. Supp. 3d at 1185. And the specification nowhere describes the LDGM coder as merely reusing information bits; rather, it indicates the LDGM coder generates ***more*** repeated bits than input bits. Appx263(3:51-59) (describing "[LDGM] coder that performs an irregular repeat of the *k* bits in the block, as shown in FIG. 4"); Appx258(Fig. 4) (generating *n* repeated bits from *k* input bits). Appellants' construction accordingly is consistent with the LDGM embodiment. *Advanced Media Networks, LLC v. AT&T Mobility LLC*, 748 F. App'x 308, 315 (Fed. Cir. 2018) (exemplary embodiments not excluded by construction limited to certain industry standards where those embodiments could be used in conjunction with those standards).

***Third***, Appellants' construction is consistent with the ordinary, dictionary meaning of "repeat," which is to duplicate, as Judge Pfaelzer found. *Hughes*, 35 F. Supp. 3d at 1186 (citing named inventor's treatise using "repeat" to mean "duplication"); Appx6658-6661 (*Webster's* defining "repeat" as "a duplication or reproduction").

Accordingly, this Court should construe "repeat" to require generating a distinct bit (i.e., a duplicate) and to exclude mere reuse of a bit. If the Court does not reverse the infringement judgment (*infra* Section II.B), it should remand for a new trial where the jury is instructed on the proper, narrower meaning of "repeat." *Enzo Biochem Inc. v. Applera Corp.*, 780 F.3d 1149, 1157 (Fed. Cir. 2015).

### B. Even Under The District Court's "Repeat" Construction, Appellants Do Not Infringe.

Even under the district court's "repeat" construction, no reasonable jury could find that Broadcom's chips "irregularly repeat" bits. The infringement judgment should be reversed.

#### 1. All claims require "irregularly repeating" information bits.

As the jury was instructed, the '710 and '032 patents' claims require repeating information bits ***irregularly***. Appx181; Appx265(8:3-4) (reciting "first coder operative to ***repeat*** said stream of bits ***irregularly***"); Appx17-18 (construing '032 patent's Tanner graph limitation to require "message bits are ***repeated a different number of times***"). In other words, some information bits must be repeated a different number of times from other information bits. Appx180-181; *supra* pp. 6-9.

Claim 13 of the '781 patent likewise requires irregular repetition by reciting that "the information bits appear in ***a variable number of subsets***." Appx291(8:15-16). Indeed, at Caltech's urging, the district court construed this limitation to require irregular repetition in its summary judgment ruling upholding the claim under §101:

- Caltech: "[T]his [variable number of subsets] limitation is simply another way of expressing irregular repetition of information bits." Appx6903; *see* Appx6898; Appx6786(¶122).
- District Court: "[T]he Court agrees with [Caltech] that the phrase 'variable number of subsets' creates a requirement in the relevant claims for irregular repetition of information bits." Appx78; *see* Appx86.

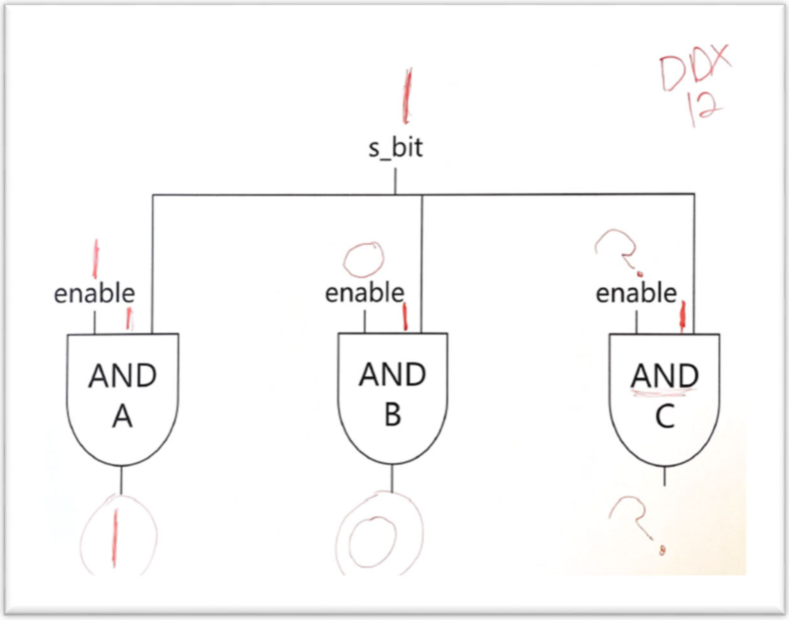
Caltech's expert initially agreed at trial, testifying that the "variable number of subsets" limitation "is about irregular repetition." Appx2829-2830. But during rebuttal, he misleadingly suggested that claim 13 does ***not*** require irregular repetition and that Appellants' expert was wrong for saying it does. Appx4149-4154.

Despite its earlier construction of this term in its §101 ruling, the district court refused Appellants' request to instruct the jury that "variable number of subsets" requires "irregular repetition of information bits." Appx10360-10362; Appx10365; Appx181. Post-trial, the court acknowledged its claim construction from the §101 order but said it "acted within its discretion" by not providing this construction to the jury because it did not want "to confuse the record." Appx207.

Respectfully, the district court's refusal to instruct the jury on its "variable number of subsets" construction was not "within [the court's] discretion." This omission was legally erroneous because it was the court's duty to inform the jury of its construction, *O2 Micro International Ltd. v. Beyond Innovation Technology Co.*, 521 F.3d 1351, 1361-1363 (Fed. Cir. 2008), and because claim scope must be the same for both validity and infringement, *Amazon.com, Inc. v. Barnesandnoble.com, Inc.*, 239 F.3d 1343 (Fed. Cir. 2001). It also prejudiced Appellants by allowing Caltech to sidestep a key noninfringement argument and unfairly portray Appellants and their expert as having misread claim 13 to include additional limitations. Thus, if this Court does not reverse on infringement, it should order a new trial where the jury is instructed that claim 13 requires irregular repetition. *Enzo*, 780 F.3d at 1157; *Seachange Int'l, Inc. v. C-COR, Inc.*, 413 F.3d 1361, 1381-1382 (Fed. Cir. 2005).

**2. Appellants' products do not literally satisfy the "irregular repeat" limitations.**

There is no dispute about how the accused circuitry works. In the RU encoder, a branched wire connects each incoming information bit to 972 AND gates. Appx3686-3690; Appx3017-3018. Each AND gate has two inputs: (1) the branched wire, representing the value of the information bit ("s_bit" below); and (2) a bit whose value is controlled by a parity-check matrix.




Appx3030(75:13-19); Appx3017(62:7-11); Appx3686-3688(195:5-197:20); Appx3951-3954(60:24-63:17). The output of each AND gate depends on ***both*** of its inputs. Appx3719(228:5-17); Appx3948-3951(57:22-60:23); Appx3031-3032(76:23-77:19).

Similarly, in the LA encoder, branched wires send blocks of information bits to a series of multiplexers. Appx3692-3693; Appx2745-2747. Each multiplexer also receives, as another input, a bit from the parity-check matrix. Appx3693-3694(202:23-203:6); Appx3959-3960(68:21-69:7); Appx2746-2748(103:24-105:5); Appx2754-2755(111:2-112:3). Thus, like the AND gates in the RU encoder, each multiplexer output depends on ***both*** the inputted information bit and the corresponding parity-check-matrix bit. *See id.*

These undisputed facts require finding that the Broadcom chips do not "irregularly repeat" information bits for two independent reasons.[6]

***First***, the outputs of the AND gates and multiplexers are not "repeats" of the inputted information bits. In the RU encoder, each AND gate's output is determined by combining an information bit with a bit from the parity-check matrix:

| Input 1 (Information Bit) | Input 2 (Parity-Check Bit) | AND Gate Output |
|---|---|---|
| 0 | 0 | 0 |
| 0 | 1 | 0 |
| 1 | 0 | 0 |
| 1 | 1 | 1 |

Appx3948-3950; Appx3030-3034. As this table shows, the AND gate does not "repeat" the inputted information bit. Indeed, in the third entry above, the output ("0") is ***different*** from the information bit ("1"). That is because the AND gate's output depends on not only the information bit but ***also*** the parity-check-matrix bit. Appx3718-3719(227:21-228:17); Appx3841-3844(110:20-113:1); Appx3956-3958(65:5-67:11); Appx3031-3032(76:23-77:19). The same is true of the LA encoder, where the multiplexers' outputs always depend on ***both*** the information bits

[6] For claim 18 of the '032 patent, Caltech alleged the accused decoder satisfies the "irregular repeat" limitation for the same reasons as the RU and LA encoders. Appx2852-2853; *see* Appx277-278(8:63-9:34, 9:57-10:8); Appx17-18. Therefore, because the encoders do not irregularly repeat, the accused decoder does not infringe claim 18.

and the parity-check-matrix bits, and not information bits alone. Appx3959-3960(68:21-69:7); Appx3692-3695(201:2-204:22); Appx2747(104:7-20).

***Second***, even if the outputted bits could be deemed "repeats" of the information bits (though they are not), any repetition is not "irregular" because each information bit leads to the ***same number*** of outputted bits. In the RU encoder, each AND gate outputs a value—meaning each information bit is processed exactly 972 times. Appx3720(229:21-23); Appx3843-3844(112:13-113:1); Appx3956-3959(65:5-68:20); Appx2830-2831(38:23-39:2); Appx3083(128:2-19). Similarly, in the LA encoder, each multiplexer outputs the same number of bits for each inputted information bit. Appx3959-3960(68:21-69:11); Appx3720(229:21-23). That is not "a different number of times," as the agreed-upon construction of "irregularly" requires. Appx181.

Attempting to shoehorn the accused circuits into the "irregular repeat" limitations, Caltech's expert contended that only ***some*** outputs of the AND gates and multiplexers are repeated bits. Appx3033-3042 (testifying that some information bits "flow through" while others do not); Appx2746-2748(103:24-105:5). But Dr. Shoemake's cherry-picking of some bits while ignoring others cannot transform the outputted bits into "irregular repeats," since each information bit is undisputedly combined with a parity-check-matrix bit and results in the same number of outputted bits as every other information bit. It also ignores that each bit outputted by an AND gate (in the RU encoder) or a multiplexer (in the LA encoder) is processed by subsequent circuits in exactly the same way as every other outputted bit. Appx3956-3957; Appx3843. Dr. Shoemake's conclusion is therefore unsupported and insufficient to prove literal infringement. *Wisconsin Alumni Research Found. v. Apple Inc.*, 905 F.3d 1341, 1350 (Fed. Cir. 2018) ("*WARF*") (despite expert's contrary conclusion, finding "insufficient evidence to support the jury's finding that [the accused] products literally satisfy the [disputed] limitation").

In denying JMOL, the district court did not identify any substantial evidence of infringement for the "irregularly repeat" limitations. Instead, the court reiterated its "repeat" construction and summarily concluded that Appellants did not "present a basis to disturb the jury's verdict." Appx206; *see* Appx204-206. But as explained above, substantial evidence does not support the jury's literal infringement finding even under the district court's construction. *See* Appx10579-10580; Appx10613; Appx10629.

**3. Caltech failed to prove infringement by equivalence for the "irregular repeat" limitations.**

To prove infringement by equivalence, Caltech was required to present "particularized evidence and linking argument as to the 'insubstantiality of the differences' between the claimed invention and the accused device, or with respect to the 'function, way, result test[.]'" *Motionless Keyboard Co. v. Microsoft Corp.*, 486 F.3d 1376, 1382-1383 (Fed. Cir. 2007). But Dr. Shoemake's brief, conclusory testimony on equivalence merely repeated his literal infringement opinion, adding only that, because the claims do not require any particular circuitry, any "differences in the hardware with respect to how repeat is implemented are … not substantial[.]" Appx2858; *see* Appx2853-2860. At most, Dr. Shoemake testified that the "overall goal" of the patents and the accused products is the same. Appx2856.

That is legally insufficient. Dr. Shoemake never explained how the accused circuitry performs the same function with the same result ***in the same way*** as the claimed inventions, nor presented "particularized evidence that links the accused products to the patent on a limitation by limitation basis." *Motionless Keyboard*, 486 F.3d at 1383; *see Network Commerce, Inc. v. Microsoft Corp.*, 422 F.3d 1353, 1363 (Fed. Cir. 2005) ("Generalized testimony as to the overall similarity between the claims and [accused] product … will not suffice."); *Advanced Steel Recovery, LLC v. X-Body Equip., Inc.*, 808 F.3d 1313, 1320 (Fed. Cir. 2015) (no equivalence where accused device "performs … in a substantially different way").

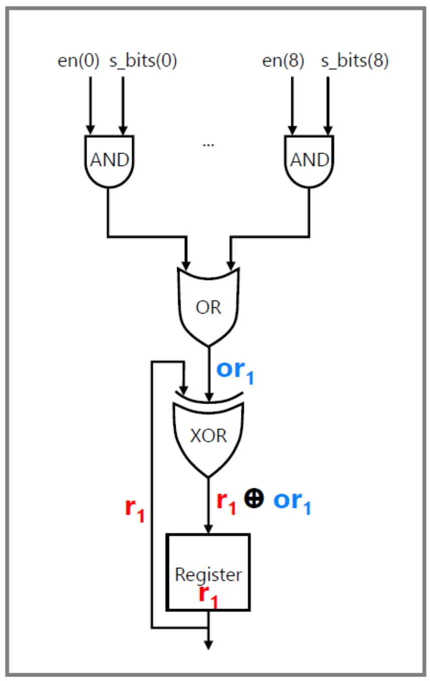
In its JMOL opinion, the district court found it "not necessary" to address Appellants' argument on this point. Appx206. This Court, however, should review the sparse trial record concerning equivalence. Because there is no substantial evidence that Broadcom's chips satisfy the "irregular repeat" limitations literally or equivalently, the Court should reverse the infringement judgment. *WARF*, 905 F.3d at 1350. At minimum, the Court should order a new trial because the district court legally erred by instructing the jury to consider Caltech's defective equivalence theory (Appx4336; Appx10536; Appx10662-10663), and the jury returned only a general verdict on infringement (Appx191). *i4i Ltd. P'ship v. Microsoft Corp.*, 598 F.3d 831, 849-850 (Fed. Cir. 2010) ("We must set aside a general verdict if the jury was told it could rely on any of two or more independent legal theories, one of which was defective."), *aff'd*, 564 U.S. 91 (2011).

### C. Appellants' Products Do Not Meet The '781 Patent's "Sums Of Bits" Limitation.

Claim 13 of the '781 patent requires "accumulation of mod-2 or exclusive-OR sums of bits in subsets of the information bits." Appx291(8:12-13). As Dr. Shoemake explained, "information bits" are the 0s and 1s reflecting the message being encoded. Appx2708. The parties agreed, and the jury was instructed, that this limitation requires "adding together ***two or more information bits***[.]" Appx6577-6578; Appx181.

Applying that same construction in *Hughes*, Judge Pfaelzer denied Caltech's motion for summary judgment of infringement, and ruled the limitation could not be met, because Hughes's products did not add together information bits; rather, they added each new information bit to the output of the previous operation, which was "***not*** an 'information bit'" but instead "a newly created bit that does not appear in the original subset of information bits." Appx6645-6648 (emphasis original).

Broadcom's chips work similarly, and no reasonable jury could find infringement for the same reasons. Again, there is no dispute regarding how the accused circuits operate. In the RU encoder, the output from an OR gate (which processes the outputs of the AND gates discussed above) is XOR-summed with (1) a reset value, in the first cycle, or (2) the output of the previous XOR sum in subsequent cycles, as shown below:




Appx3975-3980(84:12-89:10); Appx3721-3723(230:1-232:11); Appx2772-2773(129:18-130:4); Appx4146-4149(99:19-103:1). Similarly, in the LA encoder, the multiplexers' outputted bits are eventually input into an XOR gate that sums them with (1) a reset value, in the first cycle, or (2) the output of the previous XOR sum in subsequent cycles. Appx3723-3724(232:12-233:11); Appx3979-3980(88:24-89:14); Appx2750-2751(107:7-108:5).

These undisputed facts make clear that at no point are ***two information bits*** added together. Instead, the OR gates' and multiplexers' outputs—which are outputted bits, not information bits—are always XOR-summed with either (1) a reset value, or (2) a previous output of the XOR gate. Appx3721-3724(230:1-233:11); Appx3844(113:5-22); Appx3971-3980(80:8-89:10). The reset value is undisputedly not an information bit. *See* Appx9947-9948(58:15-59:1). And given that a logic gate's output necessarily depends on both of its inputs,[7] no reasonable jury could accept Dr. Shoemake's unsupported, outcome-oriented labeling of the XOR output from a previous clock cycle as an "information bit." *See* Appx4144-4149(98:15-103:1). The evidence thus mandates that the accused circuits do not meet this limitation. *WARF*, 905 F.3d at 1350.

During summary judgment, the district court agreed with Appellants that "sums of bits" means "adding together ***two or more information bits***" and "adding an outputted bit and an information bit ***would not*** satisfy this construction." Appx10139-10140; *see* Appx8405. Later, when denying JMOL, the court stated that Caltech "presented evidence … that the addition of a reset value and an information bit outputs an information bit." Appx208. But the fact that an (alleged) information bit has been input into an XOR operation necessarily means the output of that

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[7] Appx3031-3032(76:23-77:19); Appx3142(45:6-9); Appx3719(228:5-17); Appx3789(58:14-22); Appx3975-3980(84:12-89:10).

operation is an ***outputted bit***, not an information bit. *Supra* pp. 10, 15-16. Thus, what Caltech and its expert pointed to as satisfying this limitation clearly does not add together ***two information bits***.

As Judge Pfaelzer recognized, Caltech's infringement position "[i]n effect" boils down to an argument that the accused products' operations "are equivalent to the claim limitation." Appx6647-6648. But Caltech presented no equivalence theory for the "sums of bits" limitation in this case. Appx183-184. Therefore, this Court should—consistent with Judge Pfaelzer's reasoning—hold that Broadcom's chips do not meet the "sums of bits" limitation as a matter of law.

## III. THE '781 PATENT IS PATENT-INELIGIBLE UNDER §101.

Claim 13 of the '781 patent recites:

> 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.

Appx291(8:7-17).

Accumulating mod-2 or exclusive-OR sums is undisputedly a mathematical operation. Appx6720. And that is the only substantive step claimed: the other steps involve merely "receiving" data and "generating" a codeword from the mathematical operation. Claim 13 is therefore directed to the abstract mathematical algorithm of accumulating sums of inputs. *SAP Am., Inc. v. InvestPic, LLC*, 898 F.3d 1161, 1167 (Fed. Cir. 2018) (claims abstract where "[t]he focus of the claims … is on selecting certain information, analyzing it using mathematical techniques, and reporting or displaying the results"); *Recognicorp*, 855 F.3d at 1327 ("Adding one abstract idea (math) to another abstract idea (encoding and decoding) does not render the claim non-abstract."). Nothing in the claim transforms that algorithm into anything more than a collection of abstractions. *SAP*, 898 F.3d at 1170; *Recognicorp*, 855 F.3d at 1328.

The district court erred in concluding otherwise. The court held that claim 13 is "directed to" an improved method for encoding data that allows for more efficient data transmission and that, because the claim improves a computer's functioning, it is not abstract. Appx88-93; Appx90 (referring to "claimed goal[] of allowing simpler [data] transmission"). But the question is whether the ***claim***—read as broadly as it is written—is abstract. *Berkheimer v. HP Inc.*, 881 F.3d 1360, 1370 (Fed. Cir. 2018). This claim scope must be determined from the claim language, not the specification or the invention's intended or practical use. *American Axle & Mfg., Inc. v. Neapco Holdings LLC*, 967 F.3d 1285, 1302 (Fed. Cir. 2020); *Accenture Global Servs., GmbH v. Guidewire Software, Inc.*, 728 F.3d 1336, 1345 (Fed. Cir.

2013) ("[D]etail in the specification does not transform a claim reciting only an abstract concept into a patent-eligible system[.]"); *Mayo Collaborative Servs. v. Prometheus Labs., Inc.*, 566 U.S. 66, 78 (2012) ("[T]he prohibition against patenting abstract ideas cannot be circumvented by attempting to limit the use of the formula to a particular technological environment.").

Contrary to the district court's opinion, the "goal[] of allowing simpler [data] transmission" appears only in the specification and does not limit claim 13. Appx90. Nor can the "specification and testimony of [Caltech's] experts" (Appx98) transform the claim into one "focus[ed] on providing an improvement to the use of computers as tools through a specific set of encoding steps." Appx93. Claim 13 nowhere mentions computers, circuitry, or software—a point Caltech repeatedly emphasized at trial:

> ***The patent doesn't specify or require a certain way to do it in terms of circuitry****….* ***The patent covers the essential operations*** … of taking these information bits and repeating them irregularly and summing them and accumulating them[.]

Appx4407; *e.g.*, Appx2860 ("[T]he claim language …. doesn't require circuitry at all … to implement … irregular repetition."); Appx3087 ("Q. … Do the claims require specific circuitry? A. They do not.").

Caltech's trial arguments—which correctly recognize that claim 13 does not require circuitry—completely undermine the basis for the district court's patent-eligibility ruling. *Synopsys, Inc v. Mentor Graphics Corp.*, 839 F.3d 1138, 1139

(Fed. Cir. 2016) ("[T]he claims do not call for the involvement of a computer. They therefore cannot be characterized as an improvement in a computer as a tool."). Claim 13 should be held patent-ineligible under §101.

## IV. THE DISTRICT COURT ERRONEOUSLY TREATED THE IPRS AS PRECLUDING SEVERAL OF APPELLANTS' LITIGATION DEFENSES.

### A. The District Court's Interpretation Of The IPR Estoppel Statute Conflicts With This Court's Precedent.

After the PTAB rejected Appellants' IPR challenges to the asserted claims, the district court granted summary judgment of validity based on statutory estoppel. Appx63; Appx136-137. In so doing, the court precluded Appellants from litigating invalidity grounds that were never part of the instituted IPRs. That was error.[8]

The district court's estoppel ruling contradicts the plain language of 35 U.S.C. §315(e)(2), which provides:

> The petitioner in an inter partes review of a [patent] claim … that results in a final written decision … may not assert [] in a civil action … that the claim is invalid on any ground that the petitioner raised or reasonably could have raised ***during that inter partes review***.

When interpreting this statute in *Shaw Industries Group, Inc. v. Automated Creel Systems, Inc.*, 817 F.3d 1293, 1300 (Fed. Cir. 2016), this Court held that "[t]he IPR does not begin until it is instituted" and therefore the petitioner "did not raise—nor

[8] For example, Appellants' invalidity contentions included arguments based on Richardson99 (not part of any instituted IPR grounds) and Divsalar (not part of instituted IPR grounds for '781 patent). Appx40-41; Appx118-119.

could it have reasonably raised—the [prior art] ground during the IPR" that the Board did not institute. Applying *Shaw*, this Court has explained that statutory estoppel does not attach to petitioned, but non-instituted grounds because those grounds "could not be raised in the IPR." *HP Inc. v. MPHJ Tech. Inv., LLC*, 817 F.3d 1339, 1347 (Fed. Cir. 2016).

Other precedent likewise makes clear that an IPR's scope is limited to instituted grounds. *In re IPR Licensing, Inc.*, 942 F.3d 1363, 1369 (Fed. Cir. 2019) ("According to the Board's regulations, an issue upon which the Board does not institute review is not part of the ensuing [IPR] proceeding."); *see AIA Regulation Comments*, 77 Fed. Reg. 48,680, 48,689 (Aug. 14, 2012) ("Any claim or issue not included in the authorization for review is not part of the review."); *cf. Network-1 Techs., Inc. v. Hewlett-Packard Co.*, 2020 WL 6814481, at *9 (Fed. Cir. Nov. 20, 2020) ("Because a joining party cannot bring with it grounds other than those already instituted, that party is not statutorily estopped from raising other invalidity grounds.").

Here, the district court erroneously rewrote the statute to apply estoppel to "any ground that the petitioner raised or reasonably could have raised ~~***during that inter partes review***~~ ***in its IPR petition***." *See* Appx50 ("[T]he Court finds that statutory IPR estoppel applies to invalidity grounds that a petitioner 'reasonably could have raised' ***in its IPR petition[.]***"). But "in its IPR petition" are not the words

Congress chose, although Congress knew how to use such language and did so in other provisions. *E.g.*, 35 U.S.C. §314(a) (Director may authorize IPR based on information "presented ***in the petition***"); *id.* §312(a) ("A petition … may be considered only if … ***the petition identifies*** … the grounds[.]"). By contrast, in §315(e), Congress expressly limited estoppel to what the petitioner raised, or reasonably could have raised, "***during th[e] inter partes review***," and courts must adhere to the statute's text. *See Central Bank of Denver, N.A. v. First Interstate Bank of Denver, N.A.*, 511 U.S. 164, 176 (1994).

The district court's reasons for declining to follow *Shaw*'s clear statutory interpretation are unwarranted. ***First***, the court reasoned that *Shaw* involved "circumstances where the PTAB was permitted to institute … IPR on less than the full grounds and claims requested," and that, after *SAS Institute, Inc. v. Iancu*, 138 S. Ct. 1348 (2018), the precise circumstances of *Shaw* are "unlikely to arise again." Appx46-47. But a district court may not "confine [precedent] to its facts or otherwise cabin a clear statement" from an appellate court. *Ariosa Diagnostics, Inc. v. Sequenom, Inc.*, 809 F.3d 1282, 1288 (Fed. Cir. 2015) (Dyk, J., concurring). *Shaw* unmistakably held that, under §315(e), the petitioner "did not raise—nor could [] have reasonably raised" a ground where "no IPR was instituted on that ground." 817 F.3d at 1300. And *SAS*, which interpreted a ***different*** statutory provision to require that a final written decision address "any patent claim challenged by the petitioner," did nothing to undermine *Shaw*'s plain-language interpretation of §315(e) as applying only to post-institution activity for the IPR. *SAS*, 138 S. Ct. at 1354 (interpreting §318(a)).

***Second***, the district court reasoned that, after *SAS*, "for the words 'reasonably could have raised' to have any meaning at all, they must refer to grounds that were not actually in the IPR petition, but reasonably could have been included." Appx47-48. But it was not necessary to rewrite the statute to give meaning to "reasonably could have raised." Even after *SAS*, §315(e) estoppel applies to instituted grounds the petitioner "reasonably could have raised during that [IPR]," but elects not to pursue. *E.g.*, *One World Techs., Inc. v. The Chamberlain Group, Inc.*, IPR2017-01137, Paper 23 (P.T.A.B. May 17, 2018) (granting motion to withdraw instituted ground).

The district court's estoppel ruling was legally erroneous. This Court should reverse the summary judgment of validity and remand.

### B. The District Court Erred In Granting Summary Judgment Of No Inequitable Conduct.

During prosecution, Caltech successfully argued for patentability over the prior art due to the "irregular" part of the claimed IRA codes. Appx7270-7274. Yet the Caltech inventors were acutely aware of, but chose not to disclose, any prior art teaching irregular repetition. Appx8348-8354; Appx6566-6572(¶¶48-75); *e.g.*, Appx8376; Appx8378; Appx7031. In *Hughes*, Judge Pfaelzer found it "significant that Caltech did not disclose these references," and denied summary judgment of no inequitable conduct because there were disputed facts regarding materiality and intent to deceive the PTO. *Hughes*, 2015 WL 11089495, at *7 (noting "evidence showing that the inventors appreciated the significance of Luby97, Luby98, and Richardson[99]" and "could not explain in their depositions why they failed to disclose the references to the PTO").

The district court reached the opposite conclusion here. It granted Caltech summary judgment of no inequitable conduct based on the court's ***factual*** determination that the undisclosed references were not "but-for material" to patentability. Appx108-112; *see Therasense, Inc. v. Becton, Dickinson & Co.*, 649 F.3d 1276, 1291 (Fed. Cir. 2011) (en banc) ("[P]rior art is but-for material if the PTO would not have allowed a claim had it been aware of the undisclosed prior art."). But there is at least a disputed fact regarding whether one of those references—Richardson99 (Appx8284-8318)—is material to patentability.

Richardson99 was not before the PTO in the original prosecution or any IPR grounds. Appx108. The PTO has thus never considered Richardson99's materiality to the patentability of the patents-in-suit. Nevertheless, the district court found "Richardson99 is not but-for material" because, in the IPRs, "the PTAB considered and rejected obviousness combinations where Luby97 and Luby98 were offered for the same concept [i.e., irregularity] that [Appellants] also would offer Richardson99 [for]." Appx110.

But in the IPRs, the PTAB considered the Luby references for only the '710 and '032 patents and made no express finding that Luby97 or Luby98 discloses the type of irregularity claimed by the patents-in-suit.[9] Indeed, according to Caltech, "[t]he PTAB noted (with seeming approval) Caltech's argument that 'Luby[98] does ***not*** teach irregular repetition of information bits because Luby[98]'s irregularity is different than the '710 patent's irregular repetition of information bits.'" Appx7362; *see* Appx7148-7149. Thus, the fact that the PTAB found some claims patentable over Luby does not mean the PTO would necessarily find that Richardson99 lacks the irregular repetition claimed in Caltech's patents, and that Caltech's claims are patentable over Richardson99, as the district court assumed.

The district court faulted Appellants for arguing that Richardson99 "provides a similar disclosure" to Luby. Appx110 (citing Appx6570(¶65)); *see* Appx8320-8329(Luby97); Appx8331-8340(Luby98). But just because something has a similar disclosure, or addresses a similar concept, does not mean it affects patentability the same way. Richardson99, for example, discloses specific examples of irregular

[9] In its final written decisions, the PTAB rejected obviousness grounds based on the Luby references because it found no motivation to combine other references in the grounds, or Luby with certain references (Frey and Divsalar). Appx7129-7130; Appx7147-7155; Appx10696; Appx10725.

LDPC codes and "present[s] results indicating the remarkable performance that can be achieved by properly chosen *irregular* codes[.]" Appx6570(¶65) (original emphasis); Appx8287-8288. Caltech even argued at trial that the RU encoding method—which is what Richardson99 discloses (Appx8284)—repeats information bits irregularly. Appx2719-2723; Appx2770-2772. If the RU encoding method practices the claims, its disclosure in the prior art surely is material to patentability.

Because a fact dispute exists concerning Richardson99's materiality, this Court should reverse the summary judgment of no inequitable conduct and remand. *Ohio Willow Wood Co. v. Alps S., LLC*, 735 F.3d 1333, 1345 (Fed. Cir. 2013); *see Ferring B.V. v. Allergan, Inc.*, 980 F.3d 841, 843 (Fed. Cir. 2020) ("Where the matter adjudged is a quintessentially fact-laden one, such as the equitable matter at issue here, it is especially important that we guard against a rush to judgment[.]").

### C. The District Court Abused Its Discretion In Preventing Appellants From Introducing Certain Prior-Art Evidence For Purposes Other Than Invalidity.

Before trial, the district court ruled that, under FRE 402 and 403, Appellants could not make any reference at trial to what had been their "main invalidity prior art references." Appx168; *see* Appx160-161. The court limited Appellants to a handful of specific references—***of Caltech's choosing*** (Appx10284-10285)—they could introduce as demonstrating the state-of-the-art and noninfringing alternatives. Appx168; Appx160-161.

In its preliminary instructions, the court told the jury—over Appellants' objection (Appx10316-10317; Appx2220-2235)—that "prior art cannot be a basis for ruling against Caltech in this case on infringement, exce[]pt for limited purposes which the Court will advise you during the course of trial." Appx10667; *see* Appx2241(30:8). The court never told the jury what those "limited purposes" were.

Once trial began, the court repeatedly prevented Appellants from questioning witnesses about the state-of-the-art, even after Caltech opened the door. For example, the court permitted a Caltech fact witness to favorably compare the inventions against known error-correction codes, but then prevented Appellants from fully cross-examining him on the prior art. *Compare* Appx2366-2370, *with* Appx2385-2389; *see* Appx2356; Appx3044; Appx3616-3617; Appx3624; Appx3925-3931.

Post-trial, the district court defended its exclusion of Appellants' "best" state-of-the-art evidence as keeping Appellants from "backdoor[ing] invalidity" into trial. Appx238. But invalidity was not even a question on the verdict form, and that evidence remained relevant and important to other trial issues—including damages. For instance, Caltech's witnesses described the history of error-correction codes (Appx2346-2353; Appx2366-2367), advertised Caltech's inventions as having "achieved all of the positive attributes of codes that existed prior in one single code" (Appx2366-2368), and touted the inventions' superiority over known "irregular

LDPC codes" and "turbo codes" (Appx2370; Appx2367). Appellants should have been permitted to fully rebut those characterizations, which Caltech used to bolster its damages claim. *Exmark Mfg. Co. v. Briggs & Stratton Power Prod. Grp., LLC*, 879 F.3d 1332, 1351 (Fed. Cir. 2018) (court abused discretion by excluding prior-art evidence because "by showing the jury the small differences between the invention and prior art, [defendant] would have demonstrated that many of the benefits [patentee] attributed to the [invention] were already present in the prior art"); *Georgia-Pacific Corp. v. U.S. Plywood Corp.*, 318 F. Supp. 1116, 1120 (S.D.N.Y. 1970) (considering "utility and advantages" of patent over "old modes").

Had Appellants been allowed to fully present their state-of-the-art evidence, they would have shown that the claimed inventions' purported benefits were already known in prior error-correction codes. It is highly unlikely the jury would have awarded the entire $1.1 billion that Caltech sought had it known just how small the patents' incremental benefits were compared to the state-of-the-art. *Ericsson, Inc. v. D-Link Sys., Inc.*, 773 F.3d 1201, 1233 (Fed. Cir. 2014) ("[P]atent holder should only be compensated for the approximate incremental benefit derived from his invention.").

Indeed, after the first trial day, the district court apparently realized its error and stated that "insofar [as] some questions" regarding prior art "were asked of the witnesses, the defense has [to] be allowed the opportunity to address them."

Appx2459-2462. But, by then, it was too late because Appellants had already been prevented from road-mapping the state-of-the-art in their opening statement and fully cross-examining Caltech's witnesses using specific evidence of what was known. This prejudice requires a new trial. *Exmark*, 879 F.3d at 1354.

* * *

If the Court reverses the district court's rulings regarding invalidity, inequitable conduct, and/or state-of-the-art evidence, it should also order a new trial on infringement and damages so that a single jury can decide overlapping fact issues. *Witco Chem. Corp. v. Peachtree Doors, Inc.*, 787 F.2d 1545, 1549 (Fed. Cir. 1986) ("[I]t is inappropriate … to have one jury return a verdict on the validity, [and] enforceability … questions while leaving the infringement questions to a second jury …. [T]he arguments against infringement are indistinguishably woven with the factual underpinnings of the validity and enforceability determinations."); *see Gasoline Prods. Co. v. Champlin Refining Co*., 283 U.S. 494, 500 (1931).

## V. THE DAMAGES JUDGMENT SHOULD BE REVERSED OR VACATED.

### A. Caltech's Damages Model Impermissibly Treated Broadcom And Apple As Negotiating Two Vastly Different Rates For The Same Technology At Two Separate Hypothetical Negotiations.

Caltech's damages theory applied two drastically different royalty rates—$0.26/unit for Broadcom and $1.40/unit for Apple—based on two simultaneous but separate hypothetical negotiations for licenses covering exactly the same technology. As explained below, Caltech's damages theory—which the jury adopted—never should have been allowed at trial and cannot support the verdict. A new trial is required.

#### 1. Caltech's two-tier model violates hypothetical negotiation and exhaustion principles.

A reasonable royalty represents what "a 'willing licensor' and a 'willing licensee'" would have agreed to at a hypothetical negotiation "just before infringement began." *Carnegie Mellon Univ. v. Marvell Tech. Grp.*, 807 F.3d 1283, 1303-1304 (Fed. Cir. 2015). It therefore "makes sense that in each case there should be only a single hypothetical negotiation date … and that a direct infringer or someone who induced infringement should pay ***the same reasonable royalty*** based on a ***single hypothetical negotiation analysis***." *LaserDynamics, Inc. v. Quanta Comput., Inc.*, 694 F.3d 51, 76 (Fed. Cir. 2012). Here, Caltech accused both Appellants of infringement based on the ***same*** technology in the ***same*** Broadcom chips. Caltech even accused Broadcom of inducing Apple's direct infringement by encouraging Apple to sell products containing the accused Broadcom chips in the United States. Appx9829(¶2149); Appx2861-2862. Accordingly, Broadcom and Apple should pay "the same reasonable royalty based on a single hypothetical negotiation analysis." *LaserDynamics*, 694 F.3d at 76.

Making matters worse, Caltech's model artificially excluded from Broadcom's hypothetical license any Broadcom chips incorporated into Apple products sold in the United States, only so Caltech could allocate those identical chips as damages units against Apple at the much higher rate. Appx3312-3314; Appx3319-3320; Appx3331; Appx3368-3369; Appx3396-3397; Appx3516-3517. That violated Caltech's obligation as a "willing licensor" to grant Broadcom a ***complete*** license covering ***all*** of Broadcom's allegedly infringing chips, without carveouts for specific customers, products, or sales in certain locations. *LaserDynamics*, 694 F.3d at 77 ("willing licensor" must grant "voluntary agreement" covering the alleged infringement). And once Broadcom received a license covering its allegedly infringing chips, any "authorized sale[s]" to distributors and module makers would obviate the need for downstream customers (including Apple) to obtain a separate license because those sales "exhaust[] the patent holder's rights and prevent[] the patent holder from invoking patent law to control postsale use of the article." *Quanta Comput., Inc. v. LG Elecs., Inc.*, 553 U.S. 617, 638 (2008).

The district court observed during trial that it was "somewhat troubling" for Apple to pay a much higher rate than Broadcom. Appx3879. Nevertheless, it allowed Caltech's damages case to go to the jury and denied Appellants' post-trial motion, concluding that Caltech could seek different rates when "seek[ing] damages from accused infringers at different levels in the supply chain[.]" Appx225-226. That is incorrect: because the alleged infringement for Broadcom and Apple was based on the same technology in the same Broadcom chips (including when used in the same Apple products), "a reasonable royalty ***for the use made of the invention***," 35 U.S.C. §284, should be the same for both Appellants.

The district court cited *Carucel Investments, L.P. v. Novatel Wireless, Inc.*, 2017 WL 1215838 (S.D. Cal. Apr. 3, 2017) (unpublished), as "instructive" in finding that Caltech's two separate hypothetical negotiations against two defendants was appropriate. Appx226-228. But the court's explanation of *Carucel* is inconsistent with this Court's precedent, including *LaserDynamics*, *supra* pp. 49-50, and *Stickle v. Hueblein, Inc.*, 716 F.2d 1550, 1562 (Fed. Cir. 1983), which held that "the quantum" of a patentee's "recovery for an infringing [device] does not depend on" who the patentee accuses in a supply chain. Simply put, there is no basis for Caltech's two-tier hypothetical negotiation model under the circumstances here.

**2. Caltech's two-tier model violates the smallest-salable-patent-practicing-unit requirement.**

Caltech's two-tier model also conflicts with precedent requiring a reasonable royalty to be "based not on the entire product, but instead on the 'smallest salable patent-practicing unit [SSPPU].'" *LaserDynamics*, 694 F.3d at 67. Caltech violated this principle by assigning one rate for Broadcom at the chip level, and a significantly higher rate for Apple at the end-user device level, for ***the same technology in the same Broadcom chips***. Appx3423-3424(101:21-102:12); Appx3474-3476.

Because both hypothetical licenses cover the same functionality in the same SSPPU (i.e., Broadcom's chips), the rates should have been the same.

Post-trial, the district court suggested that separate hypothetical negotiations resulting in separate rates were permissible because the "damages inquiry focuses on the amount of value that the patented technology adds to a product." Appx225-226. But unless the product's entire value is attributable to the patented feature, the starting point for a royalty calculation is the SSPPU. *Ericsson*, 773 F.3d at 1226-1227. Here, for Broadcom and Apple, the ***same*** accused functionality resides entirely in ***the same SSPPU*** (i.e., Broadcom's chips). Therefore, the incremental value added by the alleged invention is identical for both Broadcom and Apple.

### 3. Caltech's two-tier model is unsupported by real-world evidence.

Caltech's two-tier damages theory is also unsupported by any real-world evidence that Broadcom and Apple would have negotiated separately for two different licenses with very different terms; that Broadcom would have agreed to have its license cover the accused chips when used in Apple products sold abroad, but not when used in the same Apple products sold in the United States; or that Apple would have agreed to a royalty ***five times greater*** than what Broadcom was paying for the same technology in the same chips, for which Broadcom must **Contract provision** Apple. Indeed, the real-world evidence shows that Broadcom and Apple would ***not*** have agreed to Caltech's hypothetical licenses.

***First***, a Master Development and Supply Agreement ("MDSA") required Broadcom to [redacted] Apple for damages arising from the accused chips. Appx6058-6059(§§12.1,13.1). The district court deemed Broadcom's [redacted] irrelevant because it "assumes that ongoing infringement has already occurred" and "damages are [typically] calculated … without consideration given to that [redacted]." Appx228-229. That is wrong and misses the point. Broadcom's [redacted] makes clear that Broadcom and Apple never would have agreed to separately negotiate two different rates under the circumstances here, meaning that Caltech's chosen damages model is inappropriate for this case.

***Second***, Caltech offered no real-world evidence that it would have refused to negotiate with Broadcom unless Broadcom first agreed to exclude chips intended for Apple devices sold in the United States, and then required Apple to negotiate its own license for those chips on far less favorable terms. The ***only*** Caltech license in evidence—the Caltech-Hughes license, which Caltech treated as "comparable" to the Caltech-Apple hypothetical license—did not [redacted] or require a [redacted] its own [redacted]. Appx3545-3546(54:25-55:11); Appx6191(§§4.2.1-4.2.2) (Caltech "[redacted]"). Similarly, the only Broadcom license in evidence—the CSIRO-Broadcom license, which Caltech treated as "comparable" to the Caltech-Broadcom hypothetical license—also had no [redacted]. Appx6144(§3.3) (granting license that "[redacted]").

Lacking any supportive real-world evidence, Caltech's expert offered conclusory testimony that there would be two different hypothetical negotiations because "you got two infringers" and Caltech would "want to negotiate with Apple at the device level because that is where value is most clearly revealed." Appx3424; *see* Appx3541. But Dr. Teece never testified that Caltech would have insisted on, or that Broadcom and Apple would have agreed to, such a two-tier structure. Nor could he have, because that is inconsistent with the real-world evidence.

***Third***, Caltech's two-tier theory depended upon Broadcom and Apple engaging in "simultaneous" hypothetical negotiations with Caltech. Appx3900-3902. To justify that approach, Caltech's expert Ms. Lawton suggested that Broadcom and Apple ***simultaneously*** first infringed by importing and/or testing chips in December 2009. Appx3251-3255; *see LaserDynamics*, 694 F.3d at 75 (hypothetical negotiation occurs on date "infringement began"). That theory makes no sense: the first allegedly infringing act by Broadcom, the chip maker, would naturally come before the first allegedly infringing act by Apple, the end-device maker. Indeed, Caltech's experts recognized in their reports that Broadcom's alleged infringement would ***precede*** Apple's. Appx8865(¶¶294-297); Appx9174-9175; Appx7428-7430(¶¶114-120).

In any event, the evidence Ms. Lawton relied on at trial shows only that: (1) Broadcom imported chip samples for internal testing on December 21, 2009, and planned to make samples available to Apple on January 18, 2010 (Appx6228-6229); and (2) Apple requested initial customer samples in December 2009 (Appx6171). There is no evidence that ***Apple*** imported or tested any chips in December 2009, and thus no basis for Apple to have engaged in a separate hypothetical negotiation at the same time as Broadcom, as Caltech's model improperly assumed.[10]

***Finally***, Caltech would not even have been a party to any hypothetical negotiation with Broadcom or Apple. In 2009, Inforon—a small, profit-less startup formed by named inventor Hui Jin—had exclusive rights to license the Caltech patents. Appx6004; Appx2536-2537; Appx2540-2545; Appx3203-3204; Appx3207(30:4-7). Yet Dr. Teece asserted Caltech would be at the negotiating table, and did nothing to account for the fact that Inforon would have had a weaker bargaining position. Appx3206-3207; Appx3428-3429; Appx3551-3552; *see Finjan, Inc. v. Secure Comput. Corp.*, 626 F.3d 1197, 1211 (Fed. Cir. 2010) (royalty

[10] Appellants did not waive their challenge to the "simultaneous" aspect of Caltech's theory, as the district court suggested (Appx219-220). Appellants preserved the issue during *Daubert* (Appx9160; Appx9837-9838), and in Rule 50(a) and 50(b) motions (Appx10418-10421; Appx10512; Appx10568).

"must account for differences in … economic circumstances of the contracting parties").[11]

### B. Caltech's Royalty Rates Were Based On An Impermissible Analysis.

To calculate the royalty rates for Caltech's separate hypothetical negotiations with Apple and Broadcom, Dr. Teece used rates imputed from two allegedly "comparable" settlement agreements and then applied upward adjustments he had calculated using evidence that was excluded from trial. Both rates should have been excluded and cannot support the jury's award.

#### 1. Caltech's $1.40/unit rate for Apple was legally and factually unsupported.

For the Caltech-Apple hypothetical license, Dr. Teece took an imputed $1.13/unit rate from the Caltech-Hughes agreement—a $5 million lump-sum settlement—and then upwardly adjusted to $1.40/unit. Appx3553-3563; Appx3336-3337. But the Caltech-Hughes agreement states that its terms "[redacted]." Appx6123. As

[11] Given that Caltech's two-tier damages theory was legally and factually unsupported, the district court erroneously instructed the jury that the hypothetical negotiation is "between the ***patent holder*** and ***each alleged infringer***." Appx186; *see* Appx4304; Appx10396. As explained above, there should have been a single hypothetical negotiation between the exclusive licensee (Inforon) and one alleged infringer (Broadcom).

a party to that agreement, Caltech should not have been permitted to use it here for purposes contrary to its express terms. Even apart from that foundational error, Caltech's reliance on a $5 million lump-sum settlement to extract $837 million from Apple was improper for several reasons.

To begin, Caltech's experts did not perform any apportionment. The district court held they were not required to because they "focused on comparable license agreements as the starting point." Appx229. But apportionment is required "in every case." *Garretson v. Clark*, 111 U.S. 120, 121 (1884). And as the district court previously recognized, "apportionment is not necessarily 'built-in'" to a comparable license without a chip-technology to chip-technology comparison. Appx150; *see Vectura Ltd. v. GlaxoSmithKline LLC*, __ F.3d __, 2020 WL 6788757, at *7-8 (Fed. Cir. Nov. 19, 2020) (apportionment may be built-in only if agreement "sufficiently comparable"). Caltech's experts performed no such comparison here, and an apples-to-apples relationship does not exist: the Caltech-Hughes agreement covered satellite technology and Contract provision [redacted] Wi-Fi technology, the technology at issue here. Appx6124; Appx6128; Appx3351-3352; Appx3562-3563.

In the same vein, Caltech's experts also failed to account for the many differences from the hypothetical license, including that the Caltech-Hughes agreement covered a much smaller volume of sales; was executed in 2016, long after the 2009 hypothetical license date; and was a lump-sum. Appx3333-3335;

Appx3350-3352; Appx3382-3383; Appx3561-3563. Nor did Caltech's experts address costs, revenues, or profitability differences between Hughes's licensed products and the accused products here. Appx149-150; *see VirnetX, Inc. v. Cisco Sys. Inc.*, 767 F.3d 1308, 1330 (Fed. Cir. 2014) (comparison to past licenses "must account for differences in the technologies and economic circumstances"). And Dr. Teece made no downward adjustment to reflect that the Caltech-Hughes agreement was a settlement "tainted by the coercive environment of patent litigation[.]" *LaserDynamics*, 694 F.3d at 77-78; *see Rude v. Wescott*, 130 U.S. 152, 164 (1889).

Instead, in his expert report, Dr. Teece upwardly adjusted the $1.13/unit imputed rate to $1.40/unit based on a CSIRO rate card and a [redacted] license. Appx8877-8881(¶¶345-356); Appx8885(¶380); Appx8896(¶434); Appx3461-3462. The district court then ***precluded*** Dr. Teece from relying on either item at trial because, as Appellants argued, the CSIRO rate card was an unaccepted license offer that no party in the litigation could access and the [redacted] license was not produced. Appx3465 ("He's not going to be able to use the [[redacted]] license to go further than [$]1.13."); Appx3469 ("[Caltech's counsel]: [T]his … CSIRO rate card … he points to to support his adjustment of the $1.13 rate and ultimately his opinion that it's $1.40… THE COURT: … He can't do that."); *see* Appx3468; Appx3502-3503; Appx8746-8751; Appx147.

Yet with no supporting evidence to quantify his upward adjustment, Dr. Teece still offered his $1.40/unit rate to the jury. Appx3555-3556 (admitting he used "no formula" for this upward adjustment). Dr. Teece purported to justify his upward adjustment based on the hypothetical negotiation's presumption of validity and infringement and the alleged importance of Caltech's technology to Apple. Appx3473-3474. The district court approved this hand-waving testimony, saying "[no] mathematical formula is required." Appx235. But an upward adjustment "plucked from thin air … cannot be the basis for a reasonable royalty calculation." *Finjan, Inc. v. Blue Coat Sys., Inc.*, 879 F.3d 1299, 1312 (Fed. Cir. 2018); *see LaserDynamics*, 694 F.3d at 69 (rejecting adjustment "based on vague qualitative notions").

#### 2. Caltech's $0.26/unit rate for Broadcom was legally and factually unsupported.

Caltech's royalty rate for the Caltech-Broadcom hypothetical license was similarly problematic. For this calculation, Dr. Teece imputed a [redacted] rate from the CSIRO-Broadcom agreement and upwardly adjusted to $0.26/unit. Appx3563-3570. The CSIRO-Broadcom agreement is also a settlement that states its terms cannot be [redacted]. Appx6147(§5.3). And Caltech's experts again did not apportion or account for the many differences from the hypothetical license, including that the CSIRO-Broadcom agreement covered different patents and technology, and granted [redacted] rights to [redacted] [redacted]. Appx3569-3570; Appx8719.

Equally troubling, Dr. Teece again calculated his upward adjustment using excluded evidence. In his report, he upwardly adjusted the [redacted] imputed rate to $0.26/unit by applying a [redacted] royalty rate from a Caltech-Inforon license to the [redacted] launch price of a Broadcom chip. Appx8883-8884(¶371); Appx3483-3484. The district court then barred Dr. Teece from using the Caltech-Inforon agreement because it violated the entire market value rule. Appx3497-3499; Appx3507-3514. Yet Dr. Teece still offered the $0.26/unit rate at trial, admitting he made no specific calculation to reach that figure. Appx3564-3565. He sought to justify his upward adjustment based on the presumption of validity and infringement, an assertion that Caltech's patents are more valuable than CSIRO's, and a rate from a draft licensing proposal that Caltech alleged without support covered a noninfringing alternative. Appx3481-3483; Appx3485; Appx3505-3506; Appx3570; Appx3572. Again, Dr. Teece's unsupported upward adjustment is an insufficient basis for his royalty calculation and the jury's award. *Finjan*, 879 F.3d at 1312; *LaserDynamics*, 694 F.3d at 69.

### C. The District Court Abused Its Discretion By Excluding Appellants' Expert Opinions Regarding Comparable Licenses And Apportionment.

Despite allowing Caltech's damages experts to present unsubstantiated opinions, the district court excluded several well-supported damages opinions from Appellants' experts. Without those opinions available and with limited time, Appellants did not call any damages experts at trial—a fact the district court improperly held against them. Appx219; *see ResQNet.com, Inc. v. Lansa, Inc.*, 594 F.3d 860, 872 (Fed. Cir. 2010). The court's exclusion of Appellants' expert opinions was an abuse of discretion.

***First***, the district court excluded Appellants' technical expert's opinions "comparing the accused technology to other features in Broadcom chips" as "not supported by a sound methodology." Appx143; *see* Appx236. But Dr. Stark provided 67 pages analyzing the accused functionality's technical value as compared to dozens of other features in Broadcom's chips. Appx8976-9043(¶¶1070-1262). Dr. Stark's opinions were rooted in sound apportionment principles, and would have been important to the jury's valuation of the accused functionality in Broadcom's chips. *Ericsson*, 773 F.3d at 1226 (noting "various ways" to apportion, including adjustments to "discount the value of a product's non-patented features").

***Second***, the district court excluded Mr. Thomas's comparable license analysis based on its incorrect conclusion that Dr. Stark "d[id] not provide sufficient opinions" concerning technological comparability. Appx142; *see* Appx236. But Dr. Stark provided 22 pages explaining just that, including by analyzing representative patents from every patent family in the relied-upon licenses and addressing the field and benefits of the technology for each. Appx9081-9103(¶¶1368-1432). This was more than sufficient to provide a reliable basis for Appellants' comparable license evidence, especially when compared to Dr. Shoemake's bare-bones technological comparability analysis for the CSIRO-Broadcom agreement—which the district court allowed. Appx2880-2881.

***Third***, the district court precluded Mr. Thomas from offering opinions involving standard-essential patents, including opinions concerning comparable licenses, royalty stacking, and patent pools. Appx145; Appx236. Mr. Thomas initially formulated these opinions in view of Caltech's repeated allegations that the patents-in-suit are essential to the Wi-Fi standard—a contention it dropped shortly before trial. Appx6508(¶29); Appx6669-6670; Appx9152. Indeed, the district court expressed "serious concerns" about Caltech's changed infringement strategy. Appx9873-9874; Appx9969 ("[T]he problem is now [Appellants are] stuck with these expert reports that are based upon the position that certainly [Caltech] seem[s] to have maintained at the close of discovery.").

The district court nonetheless excluded Mr. Thomas's opinions after Caltech dropped its claims of standard-essentiality (Appx9874-9875; Appx144-145), while still allowing Caltech's expert Dr. Teece to offer a comparability opinion using the CSIRO-Broadcom agreement, which itself involved a FRAND-committed standard-essential patent (Appx8807(¶148); Appx8809-8810(¶156)). And despite permitting several Caltech experts to amend their reports, the court did not allow Mr. Thomas to do the same after Caltech's changed strategy. Appx155. This was an abuse of discretion, especially with over $1 billion at stake. *Realtime Data LLC v. EchoStar Corp.*, 2018 WL 6266300, at *3-4 (E.D. Tex. Nov. 15, 2018) ("no *per se* ban prohibiting Mr. Thomas from considering FRAND licenses" when calculating reasonable royalty in "non-FRAND hypothetical negotiation"); *Ericsson*, 773 F.3d at 1231 (no "modified version" of *Georgia-Pacific* factors for RAND-encumbered patents).

### D. The Damages Award Impermissibly Compensates Caltech For Extraterritorial Sales.

As this Court explained in *Halo Electronics, Inc. v. Pulse Electronics, Inc.*, 831 F.3d 1369, 1378 (Fed. Cir. 2016):

> [W]hen substantial activities of a sales transaction, including the final formation of a contract for sale encompassing all essential terms as well as the delivery and performance under that sales contract, occur entirely outside the United States, pricing and contracting negotiations in the United States alone do not constitute or transform those extraterritorial activities into a sale within the United States for purposes of §271(a).

The jury's award here included damages for 987,970,643 chips that Broadcom sold to module makers and distributors ***outside the United States*** and never imported into the United States. At trial, there was no dispute that: (1) the sales occurred under purchase orders executed by foreign entities, not Apple; (2) the purchase orders are the only contractual documents defining both price and quantity for the accused chips; (3) final formation of the purchase orders occurred outside the United States; and (4) the chips were manufactured and shipped outside the United States and delivered to buyers (not Apple) outside the United States. Appx6027-6042; Appx3361-3367; Appx10457; Appx10468-10469.[12] Under *Halo*, Broadcom's sales of these chips are not compensable as a matter of law.

Ancillary aspects of the Broadcom/Apple relationship, which the district court relied on in denying JMOL (Appx222; *see* Appx10645-10655), cannot transform these foreign sales into domestic ones. *Halo*, 831 F.3d at 1378 ("evidence that pricing negotiations and certain contracting and marketing activities took place in the United States, which purportedly resulted in the purchase orders and sales overseas," was "insufficient to constitute a 'sale' within the United States"). For example, the MDSAs do not set (or mention) specific quantity or price terms; the

[12] Although the district court stated there was testimony that "review and approval of purchase orders by Broadcom and Apple" occurred in the United States (Appx222), that apparently referred to Ms. Lawton's unsupported conclusion (Appx3301). The underlying factual evidence undisputedly showed that purchase orders are sent by ***foreign*** entity customers (not Apple) to Broadcom ***foreign*** affiliates, which reply to customers with sales order acknowledgments. Appx6027-6042; Appx10482(184:17-25); Appx10484(191:7-192:1).

foreign-executed purchase orders do. *Compare* Appx6043-6122, *with* Appx6027; Appx6030-6037. Likewise, "[redacted]" between Broadcom and Apple do not mention any price terms. Appx6044; Appx6076-6077; *see Halo*, 831 F.3d at 1378 ("negotiated price and projected demand did not constitute a firm agreement to buy and sell"); *Largan Precision Co. v. Genius Elec. Optical Co.*, 86 F. Supp. 3d 1105, 1112 (N.D. Cal. 2015) (MDSA between Apple and supplier did not create U.S. sale, even when combined with documents for "specific individual products that provide … prices and minimum … quantities").

The district court also pointed to "the lengthy sales cycle in the United States resulting in the [redacted] chips that Broadcom manufactured for Apple products." Appx222. But in *Halo*, this Court rejected a similar argument when it considered a sales cycle like the one here, including Pulse's regular meetings "with Cisco design engineers, sending product samples to Cisco for pre-approval, attending sales meetings with its customers, and providing post-sale support for its products." 831 F.3d at 1374, 1378-1379.

At minimum, a new damages trial is required so the jury can be properly instructed regarding extraterritorial sales. ***First***, the district court erroneously refused Appellants' request to tell the jury "[t]here is a presumption against applying [U.S.] patent laws to foreign activities." Appx10538; *see* Appx4339-4340; Appx184-185; *Carnegie Mellon*, 807 F.3d at 1306 ("[P]atent laws … are to be understood against a background presumption against extraterritorial reach."). Without this instruction, which recites a well-established legal principle, the jury apparently gave Caltech the benefit of the doubt—even though patent law requires the opposite on this issue. *Carnegie Mellon*, 807 F.3d at 1310-1311 (ordering new trial based on omission of instruction focusing on place of sale given "fundamental importance of … extraterritoriality").

***Second***, the district court erroneously instructed the jury that "[t]he [U.S.] sales cycle leading to design wins could also trigger [U.S.] sales." Appx184. As the court itself recognized, no law supports that instruction. Appx4383 ("That is how new law is created by trial and error."). A sales cycle leading to design wins cannot trigger U.S. sales, especially where the legal commitment to buy and sell occurs outside the United States. *Halo*, 831 F.3d at 1378. This instructional error prejudiced Appellants, as it allowed the jury to award significant damages based on Ms. Lawton's testimony that Broadcom supposedly secured a "design win[]" from Apple (Appx3277; Appx3300), instead of requiring Caltech to prove those chips were actually sold in the United States.

### E. If This Court Reverses Or Vacates Any Portion Of The Liability Judgment, The Entire Damages Judgment Should Be Vacated.

As explained above, this Court should reverse or vacate the entire judgment. But even if the Court reverses or vacates infringement, invalidity, and/or unenforceability for only a single patent, it must vacate the entire damages award and order a new trial. That is because "the jury rendered a single verdict on damages, without breaking down the damages attributable to each patent," so it is impossible to know what the jury would have awarded for the remaining liability. *Verizon Servs. Corp. v. Vonage Holdings Corp.*, 503 F.3d 1295, 1309-1310 (Fed. Cir. 2007). In these circumstances, the "normal rule" requires a new damages trial. *Id.*; *see VirnetX Inc. v. Apple Inc.*, 792 F. App'x 796, 812-813 (Fed. Cir. 2019); *DDR Holdings, LLC v. Hotels.com, L.P.*, 773 F.3d 1245, 1262 (Fed. Cir. 2014).

The district court refused to apply the "normal rule" solely because Appellants' proposed verdict form included a general damages question. Appx199-202. The court relied on *Alfred E. Mann Foundation for Scientific Research v. Cochlear Corp.*, 2018 WL 6190604, at *9 (C.D. Cal. Nov. 4, 2018) (unpublished), *summarily aff'd*, 798 F. App'x 643 (Fed. Cir. 2020), which applied Ninth Circuit law to find waiver. But Federal Circuit law governs waiver of the "normal rule" because it is a patent law issue. *VirnetX Inc. v. Apple Inc.*, 2020 WL 3635929, at *4 (E.D. Tex. Apr. 23, 2020) ("Federal Circuit law governs …. That court announced its 'normal rule' without reference to regional circuit law."); *see Harris Corp. v. Ericsson Inc.*, 417 F.3d 1241, 1250-1251 (Fed. Cir. 2005) (applying Federal Circuit law to "waiver of a claim construction argument" because it is "unique to patent law").

To Appellants' knowledge, this Court has never held that a party waives the "normal rule" by proposing a general verdict form. Nor should it. *See, e.g.*, *Gillespie v. Sears, Roebuck & Co.*, 386 F.3d 21, 30-31 (1st Cir. 2004) (allowing reliance on "general verdict rule" where party requested general verdict form); *Bruneau ex rel. Schofield v. South Kortright Central Sch. Dist.*, 163 F.3d 749, 759 (2d Cir. 1998) (same), *abrogated on other grounds by Fitzgerald v. Barnstable Sch. Comm.*, 555 U.S. 246 (2009). It was ***Caltech's*** burden to prove damages. *ResQNet.com*, 594 F.3d at 872. By proposing a general verdict form on damages (Appx10490), ***Caltech*** assumed the risk that a partial reversal on liability would require a new damages trial. Caltech should not be forgiven of its burden to support the entire verdict.

**CONCLUSION**

This Court should reverse the judgment, or vacate and remand for further proceedings on infringement, invalidity, inequitable conduct, and damages.

Respectfully submitted,

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**CONFIDENTIAL MATERIAL OMITTED**

The material omitted from Addendum pages Appx138-155, Appx194-240 and Appx241-251 contains confidential provisions from various contracts, including royalty rate, pricing, and other terms from settlement and license agreements with third parties, confidential details of the relationship between Apple and Broadcom, in addition to descriptions of Broadcom's confidential source code, and information relating to Caltech's request for supplemental damages, ongoing royalties, and an injunction, which the district court filed under seal.

UNITED STATES DISTRICT COURT
CENTRAL DISTRICT OF CALIFORNIA
CIVIL MINUTES—GENERAL

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|---|---|---|---|
| Case No. | **CV 16-3714-GW(AGRx)** | Date | July 12, 2017 |
| Title | ***The California Institute of Technology v. Broadcom Limited, et al.*** | Page | 1 of 1 |

Present: The Honorable **GEORGE H. WU, UNITED STATES DISTRICT JUDGE**

| | |
|---|---|
| Javier Gonzalez | None Present |
| Deputy Clerk | Court Reporter |
| Attorneys Present for Plaintiff(s) | Attorneys Present for Defendant(s) |
| None Present | None Present |

**Proceedings: IN CHAMBERS – FINAL RULING ON CLAIM CONSTRUCTION (*MARKMAN* HEARING HELD ON JUNE 29, 2017)**

On June 29, 2017, the Court issued a tentative ruling and held a *Markman* hearing in this patent infringement action. *See* Tentative Ruling on Claim Construction ("Tentative Ruling"), Docket No. 207. During the hearing, the Court asked the parties to submit a joint supplemental brief after Defendants raised certain requests for clarification. The parties have now done so. *See* Joint Supplemental Brief Regarding Claim Construction ("Supp. Br."), Docket No. 212. Defendants essentially seek an order clarifying whether the Court's construction of "repeat" is consistent with Judge Mariana R. Pfaelzer's construction of the same term in an earlier case involving the same patents asserted here, specifically whether "repeat": (1) means "duplicate"; and (2) does not mean "re-use." *See* Supp. Br. at 1. The Court has already addressed the related contentions by the parties in its tentative ruling to the extent necessary for construction. *See* Tentative Ruling at 8-11 (adopting the plain and ordinary meaning of "repeat," explaining further that the term encompasses: (1) "generation of additional bits by means of duplicating the original bits" "without limiting how specifically the duplicate bits are created or stored in the memory"; and (2) choosing or "selecting the [message] bits for use without necessarily storing them at a specific location in computer memory"). Indeed, the Court emphatically added that "the claims do not articulate a specific limitation as to the exact implementation technique" (*id.* at 9) – as such, while the term "repeat" may encompass duplication and reuse, it surely is not limited to those specific implementation techniques. No more clarity is warranted at this stage. Accordingly, the Court adopts its tentative ruling as its final decision on the claim construction for the reasons stated in the tentative ruling.

***The California Institute of Technology v. Broadcom Limited et al.***; Case No. 2:16-cv-03714-GW-AGR; Tentative Rulings on Claim Construction (*Markman* Hearing set for June 29, 2017)

## I. Introduction

Plaintiff The California Institute of Technology sues Defendants Broadcom Limited, Broadcom Corporation, Avago Technologies Limited, Apple Inc., and Cypress Semiconductor for patent infringement in this action. *See generally* First Amended Complaint, Docket No. 36.

Plaintiff claims that Defendants infringe the following patents issued by the U.S. Patent and Trademark Office ("USPTO" or "PTO") and owned by Plaintiff: (1) U.S. Patent No. 7,116,710 ("the '710 Patent"); (2) U.S. Patent No. 7,421,032 ("the '032 Patent"); (3) U.S. Patent No. 7,916,781 ("the '781 Patent"); and (4) U.S. Patent No. 8,284,833 ("the '833 Patent") (collectively, the "Asserted Patents" or the "patents-in-suit"). *See id.* ¶¶ 2-4.

Plaintiff alleges the following facts related to infringement:

The Institute of Electrical and Electronics Engineers ("IEEE") developed Wi-Fi, the industry standard for wireless communications over local area networks. *See id.* ¶ 30. Wi-Fi usage is widespread in modern electronic products such as smartphones. *Id.* The IEEE Wi-Fi standards are set forth in IEEE 802.11 specifications. *See id.* ¶ 31.

Some of the key improvements to the Wi-Fi standard – specifically: (1) the 802.11n version, which includes a high throughput mode that is implemented using a specific type of Low-Density Parity Check ("LDPC"); and (2) the 802.11ac version, which includes a very high throughput mode – include irregular repeat and accumulate operations, and therefore implemented Plaintiff's patented irregular repeat and accumulate ("IRA") error correction code technology. *See id.* ¶¶ 32-33.

Defendants manufacture, use, import, offer for sale, and/or sell Wi-Fi products (such as semiconductor chips) that incorporate IRA/LDPC encoders and/or decoders, and therefore infringe the Asserted Patents. *Id.* ¶¶ 36, 41-42, 47.

In response to the foregoing allegations, Defendants raise several defenses, including the invalidity and non-infringement of the Asserted Patents. *See generally* Answer, Docket No. 47.

The parties now move for construction of numerous claim terms in the Asserted Patents. *See* Pl.'s Opening Claim Constr. Br. ("Pl.'s Motion"), Docket No. 128; Decl. of Matthew Shoemake ("Shoemake Decl."), Docket No. 128-1; Decl. of Todd M. Briggs ("Briggs Decl."), Docket No. 128-2; Defs.' Opening Claim Constr. Br. ("Defs.' Motion"), Docket No. 127; Pl.'s Responsive Claim Constr. Br. ("Pl.'s Opposition"), Docket No. 167; Suppl. Decl. of Todd M. Briggs ("Briggs Suppl. Decl."), Docket No. 167-2; Defs.' Responsive Claim Constr. Br. ("Defs.' Opposition"), Docket No. 168; Pl.'s Suppl. Claim Constr. Br. ("Pl.'s Suppl. Motion"), Docket No. 194; Defs.' Suppl. Claim Constr. Br. ("Defs.' Suppl. Motion"), Docket No. 193; Pl.'s Responsive Suppl. Claim Constr. Br. ("Pl.'s Suppl. Opposition"), Docket No. 199; Defs.' Responsive Suppl. Claim Constr. Br. ("Defs.' Suppl. Opposition"), Docket No. 200.

## II. Technical Background

The Asserted Patents trace their priority to U.S. Provisional Application Serial No. 60/205,095, filed May 18, 2000, and U.S. Application Serial No. 09/922,852, filed August 18, 2000 (now U.S. Patent No. 7,089,477). *See* '710 Patent at 1:8-10; '032 Patent at 1:8-13; '781 Patent at 1:8-15; '833 Patent at 1:8-17. Expectedly, the Asserted Patents utilize a common specification.

The specification purports to disclose a technology for reliable yet efficient data signal transmission over a communication channel, which protects the data from loss due to transmission errors. *See generally* '781 Patent at 1:29-2:16. Reliability is assured by repeating information bits (that is, binary digits "0" and "1," the building blocks for any data signal) in the manner disclosed in the Asserted Patents to generate error correction codes, which are then transmitted along with the original information bits; efficiency is secured by minimizing the repetitions. *See generally id.*; *see also id.* at 2:41-46; *id.*, Abstract (summarizing that the invention is directed at "[a] serial concatenated coder include[ing] an outer coder and an inner coder," where the inner coder receives scrambled, repeated bits from the outer coder and maintains "a rate substantially close to one" as it operates). As Judge Mariana R. Pfaelzer explained generally about the error correction codes in another case involving the Asserted Patents:

> In modern electronic systems, data are stored in the form of bits having the value "1" or "0." During data transmission, a random or irregular fluctuation (known as noise) can occur in the signal and corrupt data. For example, a transmitter may send a bit with the value "1," but noise may corrupt this bit and cause the receiver to read the value as "0." To mitigate this problem, electronic systems use error correction. Error correction depends on redundancy, which refers to "extra" bits that may be duplicates of original information bits and are transmitted along with the original bits. These extra bits are not necessary, in the sense that the original information exists without them, but they serve an important purpose. Using these extra bits, the receiver can ensure that the original information bits were not corrupted during transmission.

*Cal. Institute of Tech. v. Hughes Commc'ns Inc.*, 59 F. Supp. 3d 974, 977-78 (C.D. Cal. 2014) (footnote omitted).

At their core, a mechanism that balances the two (*i.e.* increased reliability by repeating bits versus efficiency by minimizing repetitions) by generating "irregular repeat and accumulate" error correction codes is the claimed novelty in the Asserted Patents, which enables a transmission rate close to the theoretical limit of the amount of data that a channel can carry. *See* '781 Patent at 1:29-43; *see also id.* at 3:36-37 ("An IRA code is a linear code, and as such, may be represented as a set of parity checks."); Transcript of the June 15, 2017 Technology Tutorial ("Tutorial Tr.") at 8-9 ("Caltech's patents are directed to . . . dealing with noise during the transmission process, and they are directed to this field of error correction coding. The point of error correction coding is to try to, despite the fact that there is noise that has to be dealt with in communication, the point is to try to create reliable communication nonetheless."). The Patent

Trial and Appeal Board at the USPTO explained the '781 Patent against this relevant backdrop:

> Error correcting codes are used to communicate information across a noisy communication channel. They enable recovery of a transmitted message that may have become distorted by noise on the communication channel. To error correction encode a message for transmission, its bits are parsed into groups of message bits that are "encoded" into "codewords" that include additional redundant information. (For example, message bits "10011" may be encoded into a codeword "100111" by adding a "parity" bit "1" to the original message.) Thus, the encoded codewords have more information than the original message had prior to encoding. The codewords are transmitted over the communication channel and are received at another location, where the codewords are "decoded" into the original message. No single coding scheme is optimal for all communication channels. There are design tradeoffs between the use of complex codes, which permit better error correction, and less complex codes, which are easier to decode. This has led to the development of many different encoding/decoding schemes. The '781 Patent describes one such scheme.

*Hughes Network Sys., LLC v. Cal. Institute of Tech.*, IPR2015-00059, 2016 WL 3598282, at *1 (Patent Tr. & App. Bd. Apr. 21, 2016) (footnote imported into the text as parenthetical).

The specification discloses an embodiment of the IRA coding system that includes an outer coder – "202," an interleaver – "204," and an inner coder – "206." *See* '781 Patent at Fig. 2.[1]

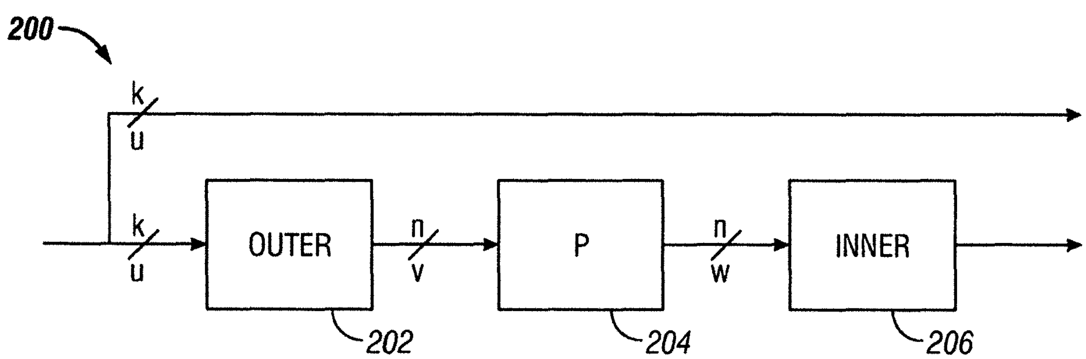



**FIG. 2**

[1] The specification also appears to indicate that the outer coder may encompass the interleaver, the component that scrambles bits. *Compare id.* at 2:3-5 ("The coding system includes an outer coder, which repeats and *scrambles* bits in the data block. The data block is apportioned into two or more sub-blocks, and bits in different sub-blocks are repeated a different number of times according to a selected degree profile. The outer coder may include a repeater with a variable rate and an *interleaver*.") (emphases added), *with id.* at 2:40-41 ("The coder 200 may include an outer coder 202, an interleaver 204, and inner coder 206."), and 2:56-58 ("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.").

In that embodiment, reproduced above, the outer coder 202 receives an un-encoded data block containing a fixed number of original information bits, which it then repeats, acting as a repeater. *See id.* at 1:65-67, 2:50-51. The outer coder has an irregular output, which means that different bits in the data block may be repeated a different number of times. *See id.* at 2:58-60; *see also id.* at 2:60-64 ("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 interleaver 204 then scrambles (or rearranges) the bits. *See id.* at 3:29-33. Finally, the inner coder 206 recursively performs exclusive-OR (also known as "XOR") or modulo-two logical operations on the bits it receives from the interleaver, generating the "accumulate code." *Id.* at 3:3-24; *see also id.* at 2:7-10 ("The repeated and scrambled bits are input to an inner coder that has a rate substantially close to one. The inner coder may include one or more accumulators that perform recursive modulo two addition operations on the input bit stream."). It is the "serial concatenation" of the interleaved irregular repeat code and the accumulate code that produces the IRA code, which is transmitted over the communication channel along with the original information bits. *See id.* at 3:34-36; *see also id.* at 2:11-13 ("The encoded data output from the inner coder may be transmitted on a channel and decoded in linear time at a destination using iterative decoding techniques.").

The specification also discloses an alternate embodiment, reproduced below, where the outer coder may be a low-density generator matrix ("LDGM") coder. *See id.* at Fig. 4. The IRA code in that case is produced by a serial concatenation of the LDGM code and the accumulator code, and the interleaver may be excluded as unnecessary. *See id.* at 3:65-4:1-3.

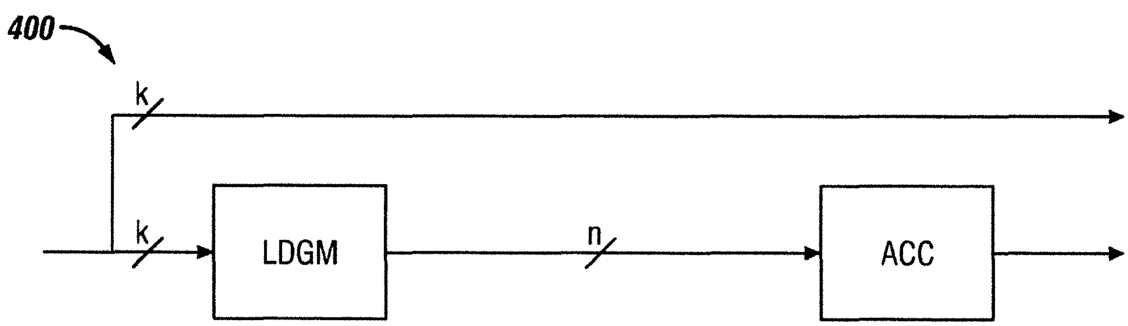



**FIG. 4**

The specification finally discloses yet another embodiment, reproduced below, where the IRA code is represented as a set of parity checks, that set in turn represented in a bipartite graph called the Tanner graph of the IRA code. *See id.* at Fig. 3; *see also id.* at 3:36-61. The Tanner graph includes variable nodes (information nodes $u_1 \ldots u_k$ on the left side of the graph and parity nodes $x_1 \ldots x_r$ on the right side of the graph) and check nodes (filed circles $v_1 \ldots v_r$ on the right side of the graph). *See id.* at 3:42-46. Relatedly, Figs. 5A and 5B, also reproduced below, illustrate, at a more granular level, a message from a variable node going to a check node on the Tanner graph of Fig. 3. *See id.* at 2:28-31; *see also id.* at 5:21-25 (using Figs. 5A and 5B, but only in the context of decoding the IRA codes, to explain that "[t]he outgoing message from a variable node u to a check node v represents information about u, and a message from a check node u to a variable node v represents information about u, as shown in FIGS. 5A and 5B, respectively"). Also using the Tanner graph in Fig. 3 and related illustrations in Figs. 5A and 5B, the specification then discusses an embodiment on how to decode the IRA codes, wherein probabilities associated with encoded bits are used to iteratively decode the information bits:

> "Belief propagation" on the Tanner Graph realization maybe used to decode IRA codes. Roughly speaking, the belief propagation decoding technique allows the messages passed on an edge to represent posterior densities on the bit associated with the variable node. A probability density on a bit is a pair of non-negative real numbers p(0), p(l) satisfying p(0)+p(1)=1, where p(0) denotes the probability of the bit being 0, p(l) the probability of it being 1. Such a pair can be represented by its log likelihood ratio, m=log(p(0)/p(1)). The outgoing message from a variable node u to a check node v represents information about u, and a message from a check node u to a variable node v represents information about u, as shown in FIGS. 5A and 5B, respectively.

*See generally id.* at 5:13-25; *see also id.* at 5:48-62 (explaining an initialization step followed by multiple iterations of the decoding process).

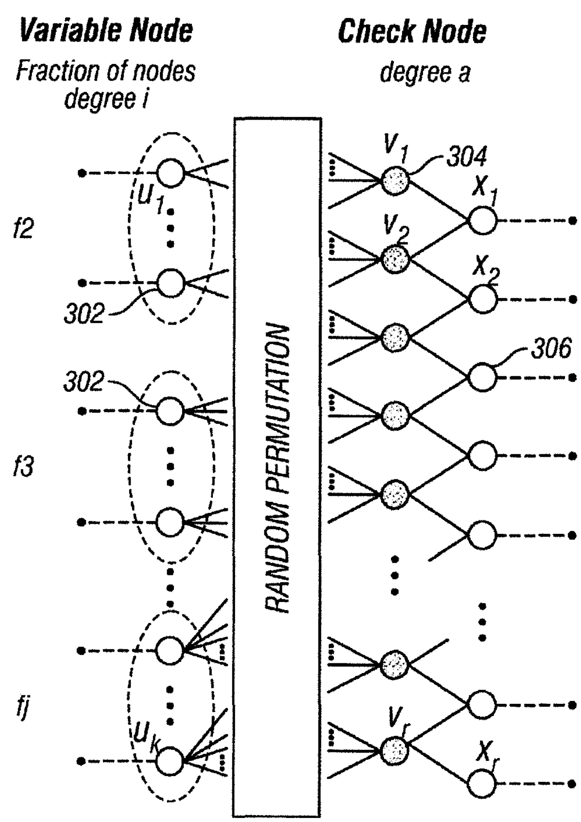



*FIG. 3*

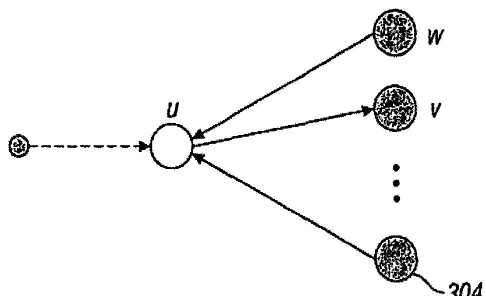



FIG. 5A

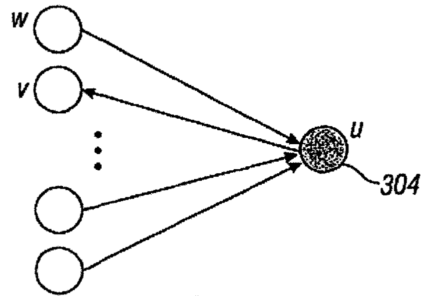



FIG. 5B

The Asserted Patents generally claim methods and apparatuses of encoding and/or decoding bits in accordance with some form of the IRA code. *See, e.g.*, '710 Patent at 7:14-25 (claiming a method of encoding a signal); *id.* at 8:32-41 (claiming a "coding system"); '032 Patent at 8:62-67 (claiming an encoding device); '833 Patent at 7:21-35 (claiming an apparatus for performing encoding operations); '781 Patent at 8:35-39 (claiming a method of encoding a signal).

## III. Legal Standard

Claim construction is an interpretive issue "exclusively within the province of the court." *Markman v. Westview Instruments, Inc.*, 517 U.S. 370, 372 (1996). It is "a question of law in the way that we treat document construction as a question of law," with subsidiary fact-finding reviewed for clear error pursuant to Fed. R. Civ. P. 52(a)(6). *Teva Pharms. USA, Inc. v. Sandoz, Inc.*, 135 S. Ct. 831, 837-40 (2015) (citing *Markman*, 517 U.S. at 388-91).

Claim construction begins with an analysis of the claim language itself. *Interactive Gift Express, Inc. v. Compuserve Inc.*, 256 F.3d 1323, 1331 (Fed. Cir. 2001). That is because the claims define the scope of the claimed invention. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312 (Fed. Cir. 2005). But "the person of ordinary skill in the art is deemed to read the claim term not only in the context of the particular claim in which the disputed term appears, but in the context of the entire patent." *Id.* at 1313. Thus, claims "must be read in view of the specification," which is "always highly relevant to the claim construction analysis." *Id.* at 1315 (internal quotations omitted). "Usually, it is dispositive; it is the single best guide to the meaning of a disputed term." *Id.*

Although claims are read in light of the specification, limitations from the specification must not be imported into the claims. *Comark Commc'ns, Inc. v. Harris Corp.*, 156 F.3d 1182, 1186-87 (Fed. Cir. 1998). "[T]he line between construing terms and importing limitations can be discerned with reasonable certainty and predictability if the court's focus remains on understanding how a person of ordinary skill in the art would understand the claim terms." *Phillips*, 415 F.3d at 1323.

The prosecution history is also part of the intrinsic evidence consulted during claim construction. *See Teleflex, Inc. v. Ficosa N. Am. Corp.*, 299 F.3d 1313, 1324 (Fed. Cir. 2002). "Like the specification, the prosecution history provides evidence of how the PTO and the inventor understood the patent." *Phillips*, 415 F.3d at 1317 (citations omitted). "Furthermore, like the specification, the prosecution history was created by the patentee in attempting to explain and obtain the patent." *Id.* "Yet because the prosecution history represents an ongoing negotiation between the PTO and the applicant, rather than the final product of that negotiation, it often lacks the clarity of the specification and thus is less useful for claim construction purposes." *Id.*

Claim construction usually involves resolving disputes about the "ordinary and customary meaning" that the words of the claim would have had "to a person of ordinary skill in the art in question at the time of the invention." *Id.* at 1312-13 (internal quotations and citations omitted). But in some cases, claim terms will not be given their ordinary meaning because the specification defines the term to mean something else. *Novartis Pharms. Corp. v. Abbott Labs.*, 375 F.3d. 1328, 1334 (Fed. Cir. 2004); *Kumar v. Ovonic Battery Co.*, 351 F.3d 1364, 1368 (Fed. Cir. 2003). For the specification to provide a non-ordinary definition for a term, it must set out its definition in a manner sufficient to provide notice of the meaning to a person of ordinary skill in the art. *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994).

Where the patent itself does not make clear the meaning of a claim term, courts may look to "those sources available to the public that show what a person of skill in the art would have understood disputed claim language to mean," including the prosecution history and "extrinsic evidence concerning relevant scientific principles, the meaning of technical terms, and the state of the art." *Phillips*, 415 F.3d at 1314 (internal quotations omitted). Sometimes, the use of "technical words or phrases not commonly understood" may give rise to a factual dispute, the determination of which will precede the ultimate legal question of the significance of the facts to the construction "in the context of the specific patent claim under review." *Teva*, 135 S. Ct. at 841, 849. "In some cases, the ordinary meaning of claim language as understood by a person of skill in the art may be readily apparent even to lay judges, and claim construction in such cases involves little more than the application of the widely accepted meaning of commonly understood words." *Phillips*, 415 F.3d at 1314. "In such circumstances, general purpose dictionaries may be helpful." *Id.*

## IV. Discussion

As an initial matter, the Court would make a general observation: The parties dispute less the terms in a claim (or the scope of a word or phrase in the claim) and more the scope of the invention claimed by the entirety of the claim language. To that end, for most part, the parties argue like ships passing in the night, only to ask the Court to paraphrase claim terms or rephrase them in terms of other words imported directly from the common specification, even when the claim terms are unambiguous or when no meaningful dispute about their meaning exists, discussed *infra*, in effect requesting the Court to rewrite claims. *See Source Vagabond Sys. Ltd. v. Hydrapak, Inc.*, 753 F.3d 1291, 1303 (Fed. Cir. 2014) (affirming monetary sanctions under Rule 11(b)(2) of the Federal Rules of Civil Procedure against the patentee *and its counsel* for proposing a construction without support from the specification or the prosecution history). Tellingly, neither party cared to define a person of ordinary skill in the art before laying out arguments in their papers in support of their proposed constructions. Indeed, at times, the parties' positions appear strikingly similar to quibbles over infringement or invalidity of the claims, only cloaked in the garb of construction. But it is elementary that "district courts are not (and should not be) required to construe every limitation present in a patent's asserted claims." *O2 Micro Int'l Ltd. v. Beyond Innovation Tech. Co.*, 521 F.3d 1351, 1362 (Fed. Cir. 2008) (citing *Biotec Biologische Naturverpackungen GmbH & Co. KG v. Biocorp, Inc.*, 249 F.3d 1341, 1349 (Fed. Cir. 2001) (deciding that disputed issue was the proper application of a claim term to an accused process rather the scope of the term); *U.S. Surgical Corp. v. Ethicon, Inc.*, 103 F.3d

1554, 1568 (Fed. Cir. 1997) (declaring that claim construction "is not an obligatory exercise in redundancy")); *Silicon Graphics, Inc. v. ATI Techs., Inc.*, 607 F.3d 784, 798 (Fed. Cir. 2010) ("[The] term was not fundamentally in dispute, thus, it was proper for the district court not to construe it.") (quoting *O2 Micro*, 521 F.3d at 1362). Rather, "[c]laim construction is a matter of resolution of disputed meanings and technical scope, to clarify and when necessary to explain what the patentee covered by the claims, for use in the determination of infringement." *O2 Micro*, 521 F.3d at 1362 (citing *U.S. Surgical*, 103 F.3d at 1568). Because: (1) the parties have not presented a fundamental dispute regarding the scope of most of the claim terms; and, alternatively, (2) a person of ordinary skill in the art[2] would be presumed to know the plain or established meaning of the terms, the court need not construe them. *See Star Envirotech, Inc. v. Redline Detection, LLC*, No. SACV1201861JGBDFMX, 2015 WL 12743875, at *3 (C.D. Cal. Apr. 30, 2015) ("[W]hile it is the duty of this Court to resolve all disputes regarding the scope of claim terms, nothing in *O2 Micro* requires this Court to replace every disputed claim term with an explicit definition. In some instances, disputes as to the scope of claim terms can best be resolved simply by rejecting a proposed alternative definition in favor of the claim language itself."); Peter S. Menell et al., Fed. Judicial Ctr., *Patent Case Management Judicial Guide* ("*Menell*") § 5.1.4.3 (3d ed. 2016) ("There is no requirement that a court construe a claim term when there is no genuine dispute about its meaning.") (citing *O2 Micro*, 521 F.3d at 1362); *U.S. Surgical*, 103 F.3d at 1568 ("Claim construction is a matter of resolution of disputed meanings and technical scope, to clarify and when necessary to explain what the patentee covered by the claims, for use in the determination of infringement. It is not an obligatory exercise in redundancy."); *Am. Piledriving Equip., Inc. v. Geoquip, Inc.*, 637 F.3d 1324, 1331 (Fed. Cir. 2011) ("It is well settled that the role of a district court in construing claims is not to redefine claim recitations or to read limitations into the claims to obviate factual questions of infringement and validity but rather to give meaning to the limitations actually contained in the claims, informed by the written description, the prosecution history if in evidence, and any relevant extrinsic evidence.") (citing *Phillips*, 415 F.3d at 1314).

In any event, the Court construes the terms as set forth below, discerning the arguments to the extent they address any relevant "dispute" over terms and in the process steering clear of paraphrasing claim language with less accurate terminology or altering the scope of the invention claimed in the claim language. Incidentally, the end result shows that, for most part, the "disputed" terms speak for themselves.

### A. "repeat"

| Plaintiff's Proposed Construction | Defendants' Proposed Construction |
|---|---|
| Plain and ordinary meaning | "Creating a new bit that corresponds to the value of an original bit (i.e., a new copy) by storing the new copied bit in memory. A reuse of a bit is not a repeat of a bit." |

The relevant analysis starts with the claim language. *Becton, Dickinson & Co. v. Tyco Healthcare Grp., LP*, 616 F.3d 1249, 1254 (Fed. Cir. 2010) ("Claim construction begins and ends in all cases with the actual words of the claim.") (internal quotations and citations omitted);

[2] The Court defines a person of ordinary skill in the art to be someone knowledgeable about error correction codes generally and repeat-accumulate codes specifically, with education and training in information theory.

*see also Thorner v. Sony Computer Entm't Am. LLC*, 669 F.3d 1362, 1365 (Fed. Cir. 2012) ("The words of a claim are generally given their ordinary and customary meaning as understood by a person of ordinary skill in the art when read in the context of the specification and prosecution history."); *Menell* § 5.2.3.2.2.

The parties do not dispute that the term "repeat" appears in claims in the '710 Patent and the '032 Patent. *See* Pl.'s Motion at 11 n.3; Defs.' Motion at 13. Express language in each claim where "repeat" (as well as its variations) has been used, indicates generation of additional bits by means of duplicating the original bits "a different number of times," "irregularly," or "one or more times." *See, e.g.*, '710 Patent at 7:18-21 ("A method of enclosing a signal, comprising . . . first encoding the data block . . . said first encoding including repeating the data elements . . . a different number of times; interleaving the repeated data elements in the first encoded data block . . . "); *id.* at 7:49-55 ("A method of encoding a signal, comprising . . . first encoding the data block such that each bit in the data block is repeated and two or more of said plurality of bits are repeated a different number of times in order to form a first encoded data block . . ."); *id.* at 8:1-4 ("A coder comprising: . . . a first coder having an input configured to receive a stream of bits, said first coder operative to repeat said stream of bits irregularly and scramble the repeated bits . . . "); '032 Patent at 7:62-8:17 ("A method comprising: . . . generating a sequence of parity bits, wherein each parity bit . . . is the value of a sum of . . . randomly *chosen irregular repeats of the message bits* . . .") (emphasis added); *id.* at 8:30-38 ("The method of claim 1, wherein generating the sequence of parity bits comprises . . . generating a random sequence of bits that repeats each of the message bits one or more times with the repeats of the message bits being distributed in a random sequence, wherein different fractions of the message bits are each repeated a different number of times and the number of repeats for each message bit is irregular . . ."). The claim language, therefore, makes clear that "repeated bits" are a construct distinct from the original bits from which they are created, as Defendants contend repeatedly.

But nowhere in the claims is the term "repeat" defined or used in a manner that specifies how the repeated bits are stored in their transitional state – in particular, that the repeated bits are generated only by "storing the new copied bit in memory," as Defendants would like this Court to construe the term. No person of ordinary skill in the relevant art would interpret the claim language so. Defendants' proposed construction rewrites the claims in a manner that impermissibly narrows the scope of the claims. *See Phillips*, 415 F.3d at 1312; *Vitronics Corp. v. Conceptronic, Inc.*, 90 F.3d 1576, 1582 (Fed. Cir. 1996) ("[W]e look to the words of the claims themselves . . . to define the scope of the patented invention."); *see also McCarty v. Lehigh Val. R.R. Co.*, 160 U.S. 110, 116 (1895) ("[I]f we once begin to include elements not mentioned in the claim, in order to limit such claim . . . we should never know where to stop."). The claims simply require bits to be repeated, without limiting how specifically the duplicate bits are created or stored in the memory – in other words, the claims do not articulate a specific limitation as to the exact implementation technique. A person of ordinary skill in the art would be presumed to know that efficient algorithm often craft complex data structures with constituent data elements referenced expressly by their memory references, without copying them in new location in computer memory, using what is commonly referred to in computer science as memory "pointers." Indeed, the Asserted Patents provision for creation of parity bits by "choos[ing]" other bits, thereby repeatedly selecting the bits for use without necessarily storing them at a specific location in computer memory. *See* '032 Patent at 7:62-8:17 ("A method comprising: . . . generating a sequence of parity bits, wherein each parity bit . . . is the value of a sum of . . . randomly *chosen* irregular repeats of the message bits . . .") (emphasis added).

The Asserted Patents also set forth such an implementation in the LDGM coder, which performs the repeat of the message bits using matrix multiplication, the output of which is then fed to an inner coder, an accumulator that performs additional operations on the transitory (repeated and interleaved) bits to produce the final IRA codes. *See, e.g.*, '710 Patent at 3:51-57; *see also Phillips*, 415 F.3d at 1315 (declaring that claims "must be read in view of the specification"). The Asserted Patents set forth another embodiment in the form of a Tanner graph, which too discloses repetition without expressly creating new copies in memory locations. *See* Patent at 3:23-50. Defendants' proposed construction would improperly exclude the LDGM coder expressly set forth in the specification and the implementation model contemplated by the Tanner graph representation in the specification, both of which provision for repeated bits that are manipulated but not stored at specific memory locations. *See MBO Labs., Inc. v. Becton, Dickinson & Co.*, 474 F.3d 1323, 1333 (Fed. Cir. 2007) ("[A] claim interpretation that excludes a preferred embodiment from the scope of the claim is rarely, if ever, correct.") (quoting *On-Line Techs., Inc. v. Bodenseewerk Perkin-Elmer GmbH,* 386 F.3d 1133, 1138 (Fed. Cir. 2004)) (quotation marks omitted); *accord Menell* § 5.2.3.2.3.1.1 (collecting cases). Stated differently, storage of redundant copies of bits in new memory locations is not a predicate to duplication or reuse of bits to create IRA codes or parity bits, especially not when the repeated bits are merely transitory to generation of parity bits. *See* '032 Patent at 7:62-8:17 (making clear that parity bits for message bits, the object of the invention, are created by recursively adding "randomly chosen irregular repeats of the message bits," which are created at an intermediate stage); *see also id.* at 1:57-2:5.

Defendants reference claim 15 of the '710 Patent (*see* Defs.' Motion at 13), which recites "a first coder having an input configured to receive a stream of bits, said first coder operative to repeat said stream of bits irregularly and scramble the repeated bits . . ." ('710 Patent at 8:1-4). Defendants then rely on a tautology to assert that "the act of 'repeat[ing]' bits produces 'repeated bits,' *i.e.*, new copies of the bits that did not exist before." Defs.' Motion at 13. On its face, the conclusion merely restates the premise. Defendants do not show, and the Court cannot find, any support in the claim language for their contention that a new bit is created specifically by "storing the new copied bit in memory." In other words, no special meaning is attached to "repeat" (especially one that requires storage), that can be ascertained from the Asserted Patents. Defendants also assert that Plaintiff's attempt to re-write the claim to cover mere "reuse" of bits would render limitations of the asserted claims superfluous. *See* Defs.' Motion at 14; Defs.' Opposition at 4. But Plaintiff is not asking this Court to construe the claims so. Rather, Plaintiff only proposes that the Court adopts the plain and ordinary meaning of the term.

The manner in which "repeat" has been used in the Asserted Patents, including to generally describe that the invention generates irregular *repeat* and accumulate (or IRA) codes, implies strongly that a plain and ordinary, not a specialized, meaning of the term is intended. *See Thorner*, 669 F.3d at 1367 ("The patentee is free to choose a broad term and expect to obtain the full scope of its plain and ordinary meaning unless the patentee explicitly redefines the term or disavows its full scope."). Moreover, a person of ordinary skill in the art would not approach the term "repeat" with a blank slate. Indeed, such a person would be familiar with the use of the term in the context of error correction codes and would be able to determine its meaning with relative ease without any further help from the Court. In the absence of any showing by Defendants that "repeat" has been limited to generating additional bits by the express means of "storing the new copied bit in memory" – that is, the patentee redefined the term or disavowed its full scope to limit it so, or that the Asserted Patents provide a special definition for the term –

the Court construes the term "repeat" to have its plain and ordinary meaning. *See Unwired Planet, LLC v. Apple Inc.*, 829 F.3d 1353, 1364 (Fed. Cir. 2016) (reiterating the general rule that claim terms take on their ordinary and customary meaning as understood by a person of ordinary skill in the art when read in the context of the specification and prosecution history subject only to two exceptions: "(1) when a patentee sets out a definition and acts as his own lexicographer, or (2) when the patentee disavows the full scope of a claim term either in the specification or during prosecution"); *Poly-America, L.P. v. API Industries, Inc.*, 839 F.3d 1131, 1136 (Fed. Cir. 2016) (same); *see also Cal. Institute of Tech. v. Hughes Commc'ns Inc.* ("*Hughes*"), 35 F. Supp. 3d 1176, 1184 (C.D. Cal. 2014) ("The Court adopts the plain meaning of 'repeat.'").

**B. "accumulation" (and its variations)**

| Plaintiff's Proposed Construction | Defendants' Proposed Construction |
|---|---|
| Plain and ordinary meaning | "a process in which (a) the first output bit equals the first input bit; and (b) for all subsequent bits, the current output bit equals the mod-2 sum of the prior output bit and the current input bit" |

Defendants propose a construction that essentially imports a specific, preferred embodiment described in the specification into the claims. *Compare* Defs.' Motion at 19 (explaining that their proposed construction represents a specific formula for accumulator set forth in the specification), *with* '032 Patent at 2:66-3:19 (disclosing a specific "embodiment," describing it as a "recursive convolutional coder," and setting forth the logical model or formula for the accumulator). This is plainly impermissible. *See Pentair Water Pool & Spa, Inc. v. Hayward Indus., Inc.*, No. CV 11-10280-GW(FMOX), 2012 WL 12887686, at *10 (C.D. Cal. Dec. 12, 2012) ("[I]t is generally improper to import a limitation from a preferred embodiment into the claims.") (citing *Liebel-Flarsheim Co. v. Medrad, Inc.*, 358 F.3d 898, 904 (Fed. Cir. 2004)), *aff'd*, 636 F. App'x 802 (Fed. Cir. 2016).

In any event, the claim language is not so limited. Indeed, the claims are drafted to encompass a broader concept of an accumulator. For example, claim 13 of the '032 Patent makes clear that an accumulator could be "configured to XOR sum in linear sequential fashion a predecessor parity bit and 'a' bits of the random sequence of repeats of the message bits." '032 Patent at 9:43-45. This generic recitation is much more flexible in scope than the specific embodiment described in the specification that is cabined by a fixed formula (*see* '032 Patent at 2:66-3:19), on which Defendants base their proposed construction. Similarly, claim 14 (a claim that depends from claim 12, which in turn depends from claim 11, a claim that provides that parity bits are generated in accordance with a Tanner graph), in that patent sets forth the limitation that the accumulator comprises "*a* recursive convolutional coder" (*see id.* at 9:46-47) – claiming any and all recursive convolutional coders – not *the* recursive convolutional coder disclosed in the preferred embodiment (*see id.* at 2:66-3:19). Finally, claim 17 requires a second accumulator that "defines a second condition that constrains the random sequence of repeats of the message bits." *See id.* at 9:53-56. Defendants' proposed construction for "accumulator" would insert a specific condition (according to the formula in the preferred embodiment in the specification) when the language generally (and broadly) claims only "a second condition" that constrains the repeated bits, introducing a precision that impermissibly limits the scope of the claim. In any case, if the accumulators specified in claims 14 and 17 were limited as Defendants propose, those two claims would be equivalent in scope, surely a consequence not intended by the named inventors. *See RF Del., Inc. v. Pac. Keystone Techs., Inc.*, 326 F.3d 1255, 1263 (Fed. Cir. 2003) ("[E]ach claim in a patent is presumptively different in scope."); *Andersen Corp. v. Fiber Composites, LLC*, 474 F.3d 1361, 1369 (Fed. Cir. 2007) ("[D]ifferent words or phrases used in separate claims are presumed to indicate that the claims have different meanings and scope."). Accordingly, Defendants' proposed construction is not supported by the language used in the claims. *See Phillips*, 415 F.3d at 1316 ("The construction that stays true to the claim language and most naturally aligns with the patent's description of the invention will be, in the end, the correct construction.") (citing *Merck & Co. v. Teva Pharm. USA, Inc.*, 347 F.3d 1367, 1371 (Fed. Cir. 2003)).

The Federal Circuit has also repeatedly cautioned that limitations from the specification generally must not be imported into the claims. *See Comark*, 156 F.3d at 1186-87; *Phillips*, 415 F.3d at 1323 ("[T]here is sometimes a fine line between reading a claim in light of the specification, and reading a limitation into the claim from the specification.") (citing *Comark*, 156 F.3d at 1186-87). On the facts presented here, where the specification discloses a preferred embodiment for an accumulator and the language used in the claims encompass alternative formulations for accumulators, the mere fact that a particular embodiment has been taught (or even "preferred") in the common specification of the Asserted Patents is not sufficient to justify limiting an otherwise broad claim scope to the particular embodiment taught. *See, e.g.*, *GE Lighting Solutions, LLC v. AgriLight, Inc.*, 750 F.3d 1304, 1310 (Fed. Cir. 2014) (reversing claim construction which limited scope of "ICD connector" to features of preferred embodiment); *Azure Networks, LLC v. CSR PLC*, 771 F.3d 1336, 1348 (Fed. Cir. 2014) (reversing claim construction that limited scope of "MAC address" to local address generated by a hub, as taught by embodiments); *Williamson v. Citrix Online, LLC*, 792 F.3d 1339, 1346-47 (Fed. Cir. 2015) (reversing construction limited to the disclosed "pictorial map" in view of broader claim language and the lack of disclaimer); *Laryngeal Mask Co. Ltd. v. Ambu S/A*, 618 F.3d 1367, 1371 (Fed. Cir. 2010) (addressing "a difficult case of claim construction," finding that the term "backplate" is not limited to requiring a tube joint described in the specification; court was "mindful that the specification is the single best guide to the meaning of a disputed term" and that the "specification is replete with discussion of a tube joint," but concluded that the term "backplate" was not so limited because only the preferred embodiment indicated that the tube joint "is part of the backplate"); *Agfa Corp. v. Creo Prods., Inc.*, 451 F.3d 1366, 1376-77 (Fed. Cir. 2006) (finding that a claimed "stack" of printing plates was not limited to the particular horizontal stack shown in the specification); *Ormco Corp. v. Align Tech., Inc.*, 463 F.3d 1299, 1306-07 (Fed. Cir. 2006) (finding that a claimed "geometry" of orthodontic teeth was not limited to the geometries of orthodontics shown in the specification); *Acumed LLC v. Stryker Corp.*, 483 F.3d 800, 807 (Fed. Cir. 2007) (finding that a claimed "transverse" hole in a bone nail was not limited to the particular "perpendicular" orientation shown in the specification).

Finally, as with "repeat," the manner in which "accumulate" (and its variations) has been used in the Asserted Patents, including to generally describe that the invention generates irregular repeat and *accumulate* (or IRA) codes, implies strongly that a plain and ordinary, not a specialized, meaning of the term is intended. *See Thorner*, 669 F.3d at 1367 ("The patentee is free to choose a broad term and expect to obtain the full scope of its plain and ordinary meaning unless the patentee explicitly redefines the term or disavows its full scope."). In any event, the Court cannot say that the claim language makes the term ambiguous or that a person of ordinary skill in the art may not ascertain the meaning of the term. *See Rexnord Corp. v. Laitrop Corp.*, 274 F.3d 1336, 1343 (Fed. Cir. 2001) ("[I]f the term or terms chosen by the patentee so deprive the claim of clarity that there is no means by which the scope of the claim may be ascertained by one of ordinary skill in the art from the language used, a court must look to the specification and file history to define the ambiguous term in the first instance.") (internal marks omitted); *Comark*, 156 F.3d at 1187 (observing that interpreting claim language in light of the specification is proper when a term is "so amorphous that one of skill in the art can only reconcile the claim language with the inventor's disclosure by recourse to the specification."); *cf. Chimie v. PPG Indus., Inc.*, 402 F.3d 1371, 1380 (Fed. Cir. 2005) (limiting claim terms to the preferred embodiments where there was no other way of grounding the ambiguous language). Finally, a person of ordinary skill, reading the term and its usage in light of the specification, would not have trouble deducing its meaning. The Court, therefore, construes the term "accumulate" (and its variations) to have its plain and ordinary meaning. *See Thorner*, 669 F.3d at 1365 (holding that ordinary meaning should apply unless there is an explicit definition or disavowal); *Plantronics, Inc. v. Aliph, Inc.*, 724 F.3d 1343, 1350 (Fed. Cir. 2013) ("When narrowing claim scope, [the Federal Circuit] has recognized that a 'clear and unmistakable' disavowal during prosecution overcomes the 'heavy presumption' that claim terms carry their full ordinary and customary meaning.") (citations omitted).

**C. "generator matrix"**

| Plaintiff's Proposed Construction | Defendants' Proposed Construction |
|---|---|
| Plain and ordinary meaning | "a matrix that, when multiplied by a block of input bits, produces a number of output bits that is greater than or equal to the number of input bits" |

The analysis starts with the claim language. *Becton*, 616 F.3d at 1254. The parties do not dispute that the term "generator matrix" appears in claims 7, 13, 20, and 28 of the '710 Patent; and claims 6 and 13 of the '032 Patent. *See* Pl.'s Motion at 19 n.12; Defs.' Motion at 32.

Claim 20 of the '710 Patent depends from claim 15. *See* '710 Patent at 8:21-22. Both claims recite the following limitations:

> 15. A coder comprising:
> a first coder having an input configured to receive a stream of bits, said first coder operative to repeat said stream of bits irregularly and scramble the repeated bits; and
> a second coder operative to further encode bits output from the first coder at a rate within 10% of one.
> 20. The coder of claim 15, wherein the first coder comprises a low-density generator matrix coder.

'710 Patent at 8:1-6, 8:21-22. Similarly, claim 13 of the '032 Patent recites the following about the generator matrix:

> a low-density generator matrix (LDGM) coder configured to perform an irregular repeat on message bits having a first sequence in a source data stream to output a random sequence of repeats of the message bits . . .

'032 Patent at 9:39-42.

Defendants contend that their proposed construction is supported by the claim language, specifically the language in claim 13 of the '032 Patent. *See* Defs.' Motion at 33-34. To demonstrate the support in the claims, however, Defendants expressly resort to a general purpose dictionary. *See id.* at 33:12-16. That is extrinsic evidence, the use of which must give way to the claim language, the written description, and the prosecution history. *Phillips*, 415 F.3d at 1318-19; *Menell* § 5.2.2; *Pickholtz v. Rainbow Techs., Inc.*, 284 F.3d 1365, 1372-73 (Fed. Cir. 2002) ("Only if a disputed claim term remains ambiguous after analysis of the intrinsic evidence should the court rely on extrinsic evidence.") (citing *Vitronics*, 90 F.3d at 1583).

> The main problem with elevating the dictionary to such prominence is that it focuses the inquiry on the abstract meaning of words rather than on the meaning of claim terms within the context of the patent. [H]eavy reliance on the dictionary divorced from the intrinsic evidence risks transforming the meaning of the claim term to the artisan into the meaning of the term in the abstract, out of its particular context, which is the specification.

*Phillips*, 415 F.3d at 1321; *Searfoss v. Pioneer Consol. Corp.*, 374 F.3d 1142, 1149 (Fed. Cir. 2004) (making clear that the meaning of a claim term is not necessarily what the general public would understand from reading the language of the claim but instead that of ordinarily skilled artisans, for "what the claim terms would mean to laymen is irrelevant"). Moreover, by resorting to a general purpose dictionary, Defendants appear to agree with Plaintiff that the term "generator matrix" is susceptible to a plain and ordinary meaning. *See Phillips*, 415 F.3d at 1314 ("In some cases, the ordinary meaning of claim language as understood by a person of skill in the art may be readily apparent even to lay judges, and claim construction in such cases involves little more than the application of the widely accepted meaning of commonly understood words. In such circumstances, general purpose dictionaries may be helpful.") (internal citation omitted). In any event, Defendants trace "generator" to its root "generate," which they claim means to "create" or "produce." *See* Defs.' Motion at 33. From merely that support in the general purpose dictionary, Defendants leap to the conclusion that the term "generator matrix" must mean creating "new/duplicate" bits to support their proposed construction that the matrix "produces a number of output bits that is greater than or equal to the number of input bits," even though the dictionary definition only supports the notion that the generator matrix creates or produces bits without shedding any light on the numerical relationship between the input fed into the matrix and the output generated.

Continuing their examination of the claim language, Defendants next assert that "generator matrix" is recited as performing an "irregular repeat on message bits" to "output a random sequence of *repeats* of the message bit," emphasizing that the word "repeats," as a plural, indicates that the number of output bits must "at least equal the number of original message bits input to the matrix." *See* Defs.' Motion at 33 (emphasis added). Defendants are correct that term "repeats" indicates generation of additional bits, as the Court itself construed the term under its plain and ordinary meaning. *See generally supra* § IV.A; *see also id.* ("Express language in each claim where 'repeat' (as well as its variations) has been used, indicates generation of additional bits by means of duplicating the original bits[.]") (citations omitted). But Defendants do not appreciate the fact that if, as they claim, "repeats" can also be equated to the proposed limitation that the number of output bits from the generator matrix "must at least equal the number of original message bits input to the matrix," then because the term "repeats" is expressly and separately set forth in the claim language, reading the proposed limitation ("must at least equal the number of original message bits input to the matrix") into the term "generator matrix" is unnecessary and, more critically, makes the "repeat" related limitation in the same claim ("output a random sequence of repeats of the message bits") redundant. *See LSI Indus., Inc. v. ImagePoint, Inc.*, 279 F. App'x 964, 973 (Fed. Cir. 2008) ("Because that limitation appears elsewhere in the claims . . . it should not be engrafted onto the . . . term itself."); Edward D. Manzo, *Patent Claim Constr. in the Fed. Cir.* ("*Manzo*") § 2:27 (2017) ("[O]ne goal in claim construction is to give effect to each term in a claim."). The named inventors only claim, as a part of their invention, a low-density generator matrix that is further limited by the requirement that it output "a random sequence of repeats of the message bits"; they do not claim any and all forms of low-density generator matrix. *See, e.g.*, '032 Patent at 9:39-42. Moreover, the "repeats" limitation referenced by Defendants is not consistently and uniformly used with the term "generation matrix," which indicates that the former is not definitional. *See, e.g.*, '032 Patent at 2:1-3 (disclosing that "the outer coder may be a low-density generator matrix (LDGM) coder" without adding the qualification that the LDGM coder must "output a random sequence of repeats of the message bits"); *id.* at 3:55-58 ("In an alternate embodiment, the outer coder 202 may be a low-density generator matrix (LDGM) coder that performs *an* irregular *repeat* of the k bits in the block") (emphases added); *id.* at 8:41-44 ("The method of claim 5, wherein generating the random sequence of bits comprises coding the collection of message bits using a low-density generator matrix (LDGM) coder.").

Defendants next turn to the specification, attributing mathematical relationship described in one embodiment (which does not refer to or discuss a "generator matrix") to another (which describes a low-density generator matrix) simply because both embodiments have been described in the specification as "outer coders." *See* Defs.' Motion at 34-35. But the specification expressly sets forth that the second example of the outer coder is "an *alternate embodiment*" (*see* '032 Patent at 3:55 (emphases added)), not merely additional description of the first embodiment described earlier in the specification. More critically, if the two embodiments for the outer coder could be represented by the same underlying mathematical relationship, and were that relationship imported into the claim language, certain dependent claims that recite a low-density generator matrix as the sole additional limitation would not be distinct from the independent claim from which they depend, making the dependent claims superfluous. *Compare* Claim 11 of the '710 Patent, *with* Claim 13 of the '710 Patent; *compare* Claim 15 of the '710 Patent, *with* Claim 20 of the '710 Patent; *compare* Claim 25 of the '710 Patent, *with* Claim 28 of the '710 Patent; *compare* Claim 5 of the '032 Patent, *with* Claim 6 of the '032 Patent. This is plainly improper under the doctrine of "pure" claim differentiation. *See Phillips*, 415 F.3d at 1314-15 ("Differences among claims can also be a useful guide in understanding the meaning of particular claim terms. For example, the presence of a dependent claim that adds a particular limitation gives rise to a presumption that the limitation in question is not present in the independent claim.") (citing *Laitram Corp. v. Rexnord, Inc.*, 939 F.2d 1533, 1538 (Fed. Cir. 1991); *Liebel-Flarsheim*, 358 F.3d at 910); *Innova/Pure Water, Inc. v. Safari Water Filtration Sys., Inc.*, 381 F.3d 1111, 1119 (Fed. Cir. 2004) ("[A]ll claim terms are presumed to have meaning in a claim."); *Andersen*, 474 F.3d at 1369 ("[D]ifferent words or phrases used in separate claims are presumed to indicate that the claims have different meanings and scope."); *Menell* § 5.2.3.2.4 ("'Pure' claim differentiation refers to the situation where there is no meaningful difference between an independent claim and its dependent claim, except for the presence of an added limitation in the dependent claim."). Moreover, doing so would impermissibly limit the claims using the term "generator matrix" to a mathematical relationship described in the first embodiment, when there are no facts supporting the fact that the claims should be so limited. *See Pentair*, 2012 WL 12887686, at *10 ("[I]t is generally improper to import a limitation from a preferred embodiment into the claims."); *Liebel-Flarsheim*, 358 F.3d at 913 ("[I]t is improper to read limitations from a preferred embodiment described in the specification – even if it is the only embodiment – into the claims absent a clear indication in the intrinsic record that the patentee intended the claims to be so limited.") (citations omitted); *GE Lighting Solutions*, 750 F.3d at 1310.

The Court is not persuaded that the term "generator matrix" should be given a meaning that deviates from its "ordinary and customary meaning" to a person of ordinary skill in the art, the objective baseline for claim construction. *See Phillips*, 415 F.3d at 1312-13; *Menell* § 5.2.3.2.2. The Court, therefore, construes the term "generator matrix" to have its plain and ordinary meaning. *See Thorner*, 669 F.3d at 1365 (holding that ordinary meaning should apply unless there is an explicit definition or disavowal); *Plantronics*, 724 F.3d at 1350 ("When narrowing claim scope, [the Federal Circuit] has recognized that a 'clear and unmistakable' disavowal during prosecution overcomes the 'heavy presumption' that claim terms carry their full ordinary and customary meaning.") (citations omitted).

**D. Tanner Graph (Diagram Used in Claims 11 and 18 of the '032 patent)**

| Plaintiff's Proposed Construction | Defendants' Proposed Construction |
|---|---|
| A graph representing an 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 check nodes, randomly connected to the repeated message bits, enforce constraints that determine the parity bits. | A graph representing an 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, check nodes, randomly connected to the repeated message bits, enforce constraints that determine the parity bits, and all parity bits are determined as shown by the configuration of nodes and edges in the Tanner graph (*i.e.*, a first parity bit ($x_1$) is determined as a function of information bits alone, and all subsequent parity bits ($x_2$-$x_r$) are determined as a function of both information bits and prior parity bits). |

For most part, the parties agree with respect to the construction of the term "Tanner graph" used expressly in claims 11 and 18 of the '032 Patent. Defendants assert, however, that there is a dispute, in the context where a Tanner graph is used, with respect to whether "*all* parity bits" are generated using the configuration set forth in the Tanner graph. *See* Defs.' Motion at 21 (emphasis added). Defendants propose that the Court qualify further the common construction agreed upon by both parties by adding the following limitation: "all parity bits are determined as shown by the configuration of nodes and edges in the Tanner graph (*i.e.*, a first parity bit ($x_1$) is determined as a function of information bits alone, and all subsequent parity bits ($x_2$-$x_r$) are determined as a function of both information bits and prior parity bits)." *See generally id.* at 20-23. But this proposed qualifying language is contrary to the express language used in the representative claim, claim 11 of the '032 Patent, which recites:

> 11. A device comprising:
> an encoder configured to receive a collection of message bits and encode the message bits to generate *a collection of parity bits* in accordance with the following Tanner graph:
> [reproducing a Tanner graph]

'032 Patent at 8:62-9:34 (emphasis added). The claim expressly contemplates generating "*a collection* of parity bits," not "all parity bits," according to the Tanner graph set forth in the claim. *See id.* at 8:62-67 (emphasis added); *see also id.* at 9:53-56 (setting forth claim 17, a claim that depends from claim 11 and thus necessarily incorporates a Tanner graph, which expressly recites "a second sequence of parity bits," making clear, given the doctrine of claim differentiation, that Tanner graph cannot, by definition, generate *all* parity bits but only a subset). The claim language, therefore, ensures that an encoder configured to generate *some* parity bits in accordance with that particular Tanner graph would infringe the claim, even if that encoder generated additional parity bits according to a different encoding algorithm. Under Defendants' proposed construction, an encoder must generate *all* parity bits in accordance with the Tanner graph to infringe, which is clearly not what the claim language supports. Because the parenthetical in Defendants' proposed construction rests on all (not just a collection of) parity bits being generated according to the Tanner graph, that part of the proposed construction too is not supported by the claim language. In particular, the Court cannot demarcate the boundaries of the claim with the precision added by "*first* parity bit" and "*all subsequent* parity bits" in that parenthetical, when the claim language limits only a subset of parity bits by the limitations in the Tanner graph. *See also Hughes*, 35 F. Supp. 3d at 1192 ("In reality, the Tanner graph term as a whole is exemplary. It informs a person of ordinary skill of the structure of the code, but it does not define specific parameters. . . . A person of ordinary skill would be more than reasonably certain regarding the scope of the term, especially given the detailed explanation in the specification."). The part of the proposed constructions over which the parties agree – that "check nodes . . . enforce constraints that determine the parity bits" – sufficiently describes the edges that connect check nodes with parity nodes, especially in light of the embodiment and related description provided in the specification, and accurately conveys the scope of the claimed invention. *See* '032 Patent at 4:4-18 (disclosing an embodiment of the Tanner graph and explaining the relationship between check nodes and the variable nodes); *see also Hughes*, 35 F. Supp. 3d at 1193 ("[A] person of ordinary skill would be more than reasonably certain of the meaning of the Tanner graph term[.]").

As such, the Court adopts that part of the proposed constructions for the term "Tanner graph" with respect to which the parties concur, which accords with its plain and ordinary meaning. *See, e.g.*, *Hughes*, 35 F. Supp. 3d at 1194 ("[A] person of ordinary skill would be able to decipher the Tanner graph term without difficulty or uncertainty.").

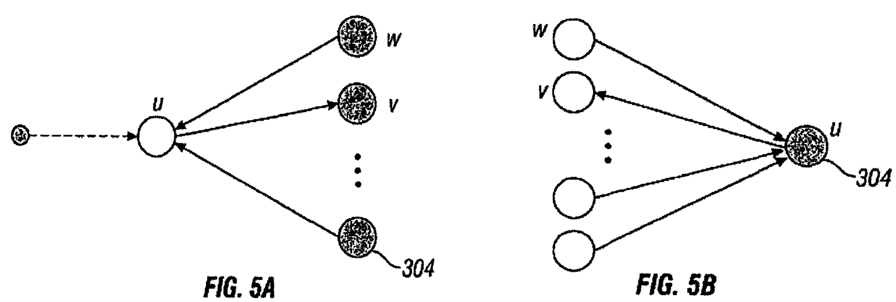
### E. "receive messages from neighboring check/variable nodes and send updated messages to the neighboring variable/check nodes"

| Plaintiff's Proposed Construction | Defendants' Proposed Construction |
|---|---|
| Plain and ordinary meaning | "each of the receiving nodes sends updated messages back to the same adjacent nodes from which they received the original messages" |

The analysis starts with the claim language. *Becton*, 616 F.3d at 1254; *Interactive Gift Express*, 256 F.3d at 1331. Claim 18 of the '032 Patent recites a decoder where "two or more check/variable nodes" "receive messages from neighboring check/variable nodes" and that these receiving nodes then "send updated messages to the neighboring variable/check nodes." '032 Patent at 9:57-10:5. To illustrate, let's assume c1 and v1 are the "two or more check/variable nodes" that receive messages from c2 and v2, the only available "neighboring check/variable nodes." The claim language permits nodes c1 and v1 to receive messages from nodes c2 and v2; then allows node c1 to send updated messages to nodes c2 and v2, and v1 to send an updated message to c2, but not to v2 – collectively, *nodes* (plural) c1 and v1 still send updated messages to the neighboring *nodes* c2 and v2, consistent with the express language used in claim 18. In other words, the claim language is permissive in that it permits a receiving node to forego sending updated messages to its neighboring node from which it received the original message as long as collectively the receiving nodes respond to their neighboring nodes. The same is not true under the Defendants' proposed construction, according to which each receiving node is required to send an updated message back to the neighboring node from which it received the original message. Under that proposed construction, c2 must send an updated message to v2 – individually, *node* (singular) c1 must send updated messages to *nodes* c2 and v2, and *node* (singular) v1 is then separately required to send updated messages to *nodes* c2 and v2. As such, a decoder where a receiving node receives a message from a neighboring node but does not send back an updated message to the neighboring node would infringe claim 18 under the express limitations set forth in the claim language. Not so under the Defendants' proposed construction, under which an additional limitation – that is, each receiving node must also send back an updated message to the neighboring nodes – is required for infringement to be found. This impermissible narrowing of the claim contravenes the express language in the claim, rendering Defendants' proposed construction inaccurate.

The Court turns next to the description in the specification, which provides an alternative basis for rejecting Defendants' proposed construction. When construing claim language, "[t]he construction that stays true to the claim language and most naturally aligns with the patent's description of the invention will be, in the end, the correct construction." *Phillips*, 415 F.3d at 1316. Defendants contend that the specification supports their proposed construction. *See* Defs.' Motion at 25 (citing '032 Patent at 6:4-6 ("In each iteration, every variable/ check node receives messages from its neighbors, and sends back updated messages.")). But that reference in specification is preceded by additional disclosure that there is an "initialization" step in the decoding process (*see* '032 Patent at 6:2-4), in which "[t]he outgoing message from a node u to a node v depends on the incoming messages from all neighbors w of u *except v*" (*see id.* at 5:33-34) (emphasis added), making clear that some of the nodes that receive messages from neighboring nodes need not send updated messages back to the nodes from which they received the original messages. That express disclosure in the specification is fatal to Defendants' proposed construction. Besides, the specification speaks merely to an embodiment of the decoder process (*see* '032 Patent at 5:20-21), and such an embodiment cannot be read into the claim language to imply a limitation where the claim language does not support such an intent, as discussed above, particularly not when the specification does not reveal any special definition to the claim term. *See Straight Path IP Group, Inc. v. Sipnet EU S.R.O.*, 806 F.3d 1356, 1361 (Fed. Cir. 2015) ("When claim language has a plain meaning on an issue . . . leaving no genuine uncertainties on interpretive questions relevant to the case, it is particularly difficult to conclude that the specification reasonably supports a different meaning. The specification plays a more limited role than in the common situation where claim terms are uncertain in meaning in relevant respects."); *Vitronics*, 90 F.3d at 1582 ("[W]e look to the words of the claims themselves . . . to define the scope of the patented invention"); *Markman v. Westview Instruments, Inc.*, 52 F.3d 967, 980 (Fed. Cir. 1995), *aff'd*, 517 U.S. 370 (1996) ("The written description part of the specification itself does not delimit the right to exclude. That is the function and purpose of claims."); *Liebel-Flarsheim*, 358 F.3d at 913 ("[I]t is improper to read limitations from a preferred embodiment described in the specification – even if it is the only embodiment – into the claims absent a clear indication in the intrinsic record that the patentee intended the claims to be so limited.") (citations omitted).

The specification discloses further, in the same context that Defendants reference, that "'[b]elief propagation' on the Tanner Graph realization may be used to decode IRA codes." *See* '032 Patent at 5:20-21. Discussing the example further, the specification expressly references message exchanges between nodes and, in particular, Figs. 5A and 5B as illustrations relevant to the decoding process using "belief propagation," which allows the messages passed between nodes to represent "posterior densities" on the bit associated with the variable node. *See generally id.* at 5:20-32; *see also id.* at 5:28-32 (using Figs. 5A and 5B, but only in the context of decoding IRA codes, to explain that "[t]he outgoing message from a variable node u to a check node v represents information about u, and a message from a check node u to a variable node v represents information about u, as shown in FIGS. 5A and 5B, respectively"). As such, Defendants' assertion that the Tanner graph illustrations must be restricted to encoding process (*see* Defs.' Opposition at 23) is misplaced. The illustrations Figs. 5A and 5B make it concrete, and clearly so, that nodes may receive messages from neighboring nodes but need not necessarily send updated messages back to each node from which they received the original messages.




Based on the foregoing, the Court adopts the plain and ordinary meaning of the term, which accurately reflects the scope of the claim language when read in light of the disclosure in the specification.

**F. "a first set of memory locations . . . a second set of memory locations . . . [and] a permutation module to read a bit from the first set of memory locations . . . a corresponding index of the first set of memory locations and a corresponding index of the second set of memory locations" (Subset of Claim 1 of the '833 Patent)**

| Plaintiff's Proposed Construction | Defendants' Proposed Construction |
|---|---|
| Plain and ordinary meaning | • "a first set of memory locations to store |

| Plaintiff's Proposed Construction | Defendants' Proposed Construction |
|---|---|
| | information bits" means "at least two addresses in an addressable memory array where information bits are stored"<br>• "a second set of memory locations to store parity bits" means "at least two addresses in an addressable memory array, different from the first set of addresses, where parity bits are stored"<br>• "index of the first set of memory locations" means "a list or table that contains the addresses where the information bits are stored"<br>• "index of the second set of memory locations" means "a list or table that contains the addresses where the parity bits are stored"<br>• "a corresponding" means "each index in the first set is associated with at least one index in the second set, and vice versa"<br>• "read a bit" / "reading a bit" means "provide an address to a memory and receiving back the bit that is stored at that address" |

The analysis starts with the claim language. *Becton*, 616 F.3d at 1254; *Interactive Gift Express*, 256 F.3d at 1331. Here, the representative claim 1 in the '833 Patent recites:

> 1. An apparatus for performing encoding operations, the apparatus comprising:
> a first set of memory locations to store information bits;
> a second set of memory locations to store parity bits;
> a permutation module to read a bit from the first set of memory locations and combine the read bit to a bit in the second set of memory locations based on a corresponding index of the first set of memory locations and a corresponding index of the second set of memory locations; and
> an accumulator to perform accumulation operations on the bits stored in the second set of memory locations, wherein two or more memory locations of the first set of memory locations are read by the permutation module different times from one another.

'833 Patent at 8:21-35. Defendants contend that the principal dispute here centers around whether "memory locations" limitation necessarily require that those memory locations be addressable. *See* Defs.' Motion at 28:12-16. Interestingly, Defendants concede that the term "'memory locations' had a plain meaning that was well known to those ordinary skill," but ask that the term be construed so that the claim expressly encompasses the possibility that the memory "can be addressed." *See* Defs.' Motion at 26-27 (citing IEEE Dictionary at 685).

As an initial matter, in the guise of claim construction for one term, Defendants propose an elaborate construction, requesting that three express limitations (and the language used therein) be rephrased. *See* Defs.' Motion at 25-26 (asking, for example, that "a first set" be paraphrased to "at least two addresses"; "a second set" be similarly paraphrased to "at least two addresses"; "index" be rewritten as "a list or table" of addresses; and rewriting "a corresponding" and "read a bit" / "reading a bit"). This is an improper attempt at rewriting a substantial portion of the claim, not merely claim construction for one term, and, relatedly, an improper circumvention of the limit on the number of claim construction terms imposed by this Court. *See* Docket No. 192. Because Defendants emphatically assert that their dispute with Plaintiff centers on "whether the '833 Patent claims require use of addressable memory" (*see* Defs.' Motion at 28), the Court would only construe that term.

Defendants' proposed construction limits the scope of claim 1 to encoders with "addressable memory arrays" implements, but improperly excludes any implementation that could be achieved by means of alternative circuit implements such as registers, which are smaller, faster memory structures directly accessed by the central processing units ("CPUs") and typically not organized as addressable arrays. *See* Pl.'s Motion; Shoemake Decl. ¶ 104; Briggs Suppl. Decl., Ex. S (entitled "Modern Dictionary of Electronics") at 636 (defining register as "[a] short-term, fast-access circuit used to store bits or words *in* a CPU" and, alternatively, "[o]ne word of memory . . . *directly accessible* to a processor") (emphases added), Briggs Decl., Ex. L ("Concise Encyclopedia of Computer Science").

> Different levels of memory (or *storage*) are employed in a computer system. At one extreme are very fast and relatively small storage units used as fast access *registers* by the central processing unit (CPU . . .). At the other extreme are relatively slow, large-capacity units of auxiliary storage. . . . The characteristics of *main memory* lie between these two extremes.

Concise Encyclopedia of Computer Science at 495 (emphases in original); *cf. id.* at 504 ("Main memory consists of a collection of consecutively numbered locations, each of which stores exactly one binary value. Each of the numbered locations corresponds to a specific stored byte. The unique number that identifies each byte is referred to as its address[.]"); *Advanced Micro Devices, Inc. v. Samsung Elecs. Co.*, No. C 08-986 SI, 2009 WL 3007916, at *6 n.4 (N.D. Cal. Sept. 17, 2009) ("'Memory locations' are cells that store data."). Neither the claim language nor the specification supports exclusion of non-addressable but directly accessible memory locations such as registers. Indeed, if the term "memory locations" had a plain meaning well known to persons of ordinary skills in the art at the time the '833 Patent was drafted and that meaning included the possibility that memory "can be addressed," as Defendants contend, then the express exclusion of that well known plain meaning by the named inventors in the '833 Patent further evidences an intent to encompass (and claim) a broader concept of memory locations in the claim limitations without excluding any specific form of implementation.

Defendants respond that surrounding claim language confirms that the "memory locations" terms require addressable memory. Defendants point to the language where claim 1 of the '833 Patent sets forth the limitation of reading a bit from memory locations. *See* Defs.' Opposition at 26. Defendants again exclude the possibility that CPUs in a computer system can read or write from registers directly connected to it through hardware circuitry, instead of resorting to using the main memory locations or addresses. The claim language does not support such a narrowing construction.

Finally, attempting to construe "memory locations" adds little in the way of clarity here. By requesting that the Court to construe "memory locations" as "addressable memory arrays," Defendants essentially ask the Court to substitute a more restrictive synonym for the claim term, where it is more appropriate to just allow the term to speak for itself, specifically that "memory locations" are just that without regard to complex underlying implementation details. There is no evidence here that a person having ordinary skill in the art would bring a more distinctive perspective. *See Menell* § 5.2.3.1.2 ("Where the intrinsic evidence and extrinsic evidence do not meaningfully add to the definition of a term, . . . it is appropriate (and often preferred) to allow straightforward claim language to stand as is."); *see also Phillips*, 415 F.3d at 1314 ("In some cases, the ordinary meaning of claim language as understood by a person of skill in the art may be readily apparent even to lay judges, and claim construction in such cases involves little more than the application of the widely accepted meaning of commonly understood words."); *O2 Micro,* 521 F.3d at 1362 (recognizing that "district courts are not (and should not be) required to construe *every* limitation present in a patent's asserted claims" but only "[w]hen the parties present a fundamental dispute regarding the scope of a claim term"); *C.R. Bard, Inc. v. U.S. Surgical Corp.*, 388 F.3d 858, 863 (Fed. Cir. 2004) ("[M]erely rephrasing or paraphrasing the plain language of a claim by substituting synonyms does not represent genuine claim construction.").

Because Plaintiff does not dispute Defendants' assertion that "the term 'memory locations' had a plain meaning that was well known to those of ordinary skill" when the term was incorporated in the '833 Patent, and the specification does not forth a special definition that differs from that ordinary and customary meaning, the Court finds that plain and ordinary meaning gives the full effect to the scope of relevant claims, and therefore adopts it.

**G. "combine the read bit to a bit in the second set of memory locations"**

| Plaintiff's Proposed Construction | Defendants' Proposed Construction |
|---|---|
| Plain and ordinary meaning | (a) combine (i) the bit read from the first set of memory locations and (ii) a particular bit stored in the second set of memory locations and (b) store the combined result in the second set of memory locations |

Defendants contend that the dispute for this term concerns "where the combining of bits takes place." Defs.' Motion at 29. To that end, Defendants propose that the Court must limit the claim to "store the combined result in the second set of memory locations." *Id.* The analysis starts with the claim language. *Becton*, 616 F.3d at 1254; *Interactive Gift Express*, 256 F.3d at 1331. Here, the relevant limitation of claim 1 in the '833 Patent recites merely: (1) reading of the first bit from "the first set of memory locations" "based on a corresponding index of the first set of memory locations"; then (2) reading of a second bit from "the second set of memory locations" also "based on a corresponding index of the second set of memory locations"; and then, finally, (3) combining the first bit *to* the second bit. *See* '833 Patent at 25-30. There is no ambiguity in these operations to a person of ordinary skill in the art: to combine bits plainly means that the first bit is added to the second bit; exactly where that combination takes place is not claimed by claim 1. Claim 3 (which depends indirectly from claim 1), by contrast, further limits (and thus specifically claims) the combining operation by requiring that the result of the operation is specifically written to "the second set of memory locations based on a corresponding index." *See id.* at 39-42.

In other words, claim 3, not claim 1, is directed to store the combined result in "the second set of memory locations" "based on a corresponding index" of the second set of memory locations, the only memory locations that are the subject of claim 3. Tellingly, Defendants concede as much. *See* Defs.' Opposition at 28 ("Claim 1 recites *looking up* the memory locations of the first bit and second bit in order to determine *what bits to combine* . . . Claim 3, by contrast, defines a precise location where the combined bit must be written back to the second set of memory locations."). Under the doctrine of claim differentiation, claim 1, therefore, does not encompass "stor[ing] the combined result in the second set of memory locations," as Defendants propose, otherwise claim 3 would be superfluous. *See Phillips*, 415 F.3d at 1314-15 ("Differences among claims can also be a useful guide in understanding the meaning of particular claim terms. For example, the presence of a dependent claim that adds a particular limitation gives rise to a presumption that the limitation in question is not present in the independent claim.") (citing *Laitram*, 939 F.2d at 1538; *Liebel-Flarsheim*, 358 F.3d at 910); *Innova/Pure Water*, 381 F.3d at 1119 ("[A]ll claim terms are presumed to have meaning in a claim."); *Andersen*, 474 F.3d at 1369 ("[D]ifferent words or phrases used in separate claims are presumed to indicate that the claims have different meanings and scope."); *Menell* § 5.2.3.2.4 ("'Pure' claim differentiation refers to the situation where there is no meaningful difference between an independent claim and its dependent claim, except for the presence of an added limitation in the dependent claim."). Accordingly, the Court finds no dispute with respect to the claim term and gives the term its plain and ordinary meaning.

### H. "random" / "randomly"

| Plaintiff's Proposed Construction | Defendants' Proposed Construction |
|---|---|
| Plain and ordinary meaning | "non-deterministic" |

The analysis starts with the claim language. *Becton*, 616 F.3d at 1254; *Interactive Gift Express*, 256 F.3d at 1331. Defendants argue that the claim language supports their proposed construction. *See* Defs.' Motion at 30-31. But Defendants rely on extrinsic, not intrinsic evidence, in support of their proposed construction. *See id.* (relying on IEEE Dictionary, a declaration, and Microsoft Press Computer Dictionary to construe the claim term). Defendants' argument can be distilled to the position that because the relevant claim of the '032 Patent recites "randomly chosen" to describe the selection of "repeats of the message bits," that choice must be non-deterministic, and therefore "randomly" should be replaced by "non-deterministic." *Id.* at 31; *see also* Defs.' Opposition at 29; *id.* at 30 (arguing that attaching "plain meaning" to random or randomly "would encompass any number of non-random orders of bits."). As a tautology, the argument is frivolous on its face. In any event, there is no support in the claim language that the random or randomly has any specialized meaning or, for that matter, the term has any inherent ambiguity that requires construction.

Defendants next turn to the specification. *See Phillips*, 415 F.3d at 1316. Referencing to the usage of a phrase plucked out of its context, Defendants assert that because the specification discloses that the value of a parity bit is "determined uniquely" by a condition, the named inventors knew the difference between a "deterministic" choice and a choice made "randomly," and so random or randomly should be construed as "non-deterministic." Defs.' Motion at 31-32. That argument undermines Defendants' proposed construction: If the named inventors indeed appreciated the difference between a "deterministic" choice and a choice made "randomly," and yet opted for the latter in the claims, the Court can only conclude that the named inventors clearly expressed their intent to claim only what is encompassed by that express usage, not by "non-deterministic," a term known by them and the usage of which they chose to forego.

A holistic review of the claim language and the specification indicates that Defendants' proposed construction runs contrary to the intrinsic evidence. Claim 1 in the '032 Patent recites that each parity bit in a sequence of parity bits is generated by combining an earlier parity bit and "randomly chosen irregular repeats of the message bits." *See* '032 Patent at 7:66-8:17. Claim 4, which depends from claim 1, recites that generating the sequence of parity bits comprises performing recursive XOR operations on the "random sequence of bits." *See id.* at 8:26-28; *see also id.* at 8:30-41, 8:42-44. Claim 7 contemplates "randomly permuting" bits to generate the "random sequence of bits." *See id.* at 8:45-52; *see also id.* at 9:38-45 (reciting an output of a "random sequence of repeats of the message bits"). Turning to the specification, the background of the patent discloses that "[t]urbo codes have sufficient randomness to allow reliable communication[.]" '032 Patent at 34-35. The written description further discloses that "[t]he bits from the outer coder 202 are scrambled . . . this scrambling may be performed by the interleaver 204, which performs a pseudo-random permutation of an input block v" of data bits (*id.* at 3:24-27) and that "[t]he interleaver 204 in FIG. 2 may be excluded due to the randomness already present in the structure of the LDGM code" (*id.* at 3:62-64). By inconsistently using random depending on the context – for example, as an adjective to modify "sequence of bits" and "sequence of repeats of the message bits"; as an adverb to modify "choos[ing]" or selection of the "message bits" and "permuting" of repeats of message bits; and as a noun to describe property of turbo codes and the structure of the LDGM code – the intrinsic evidence supports the inference that the named inventors did not attach any specialized meaning to "random" (or its variations), specifically not "non-deterministic" as Defendants improperly suggest, and intended only its plain and ordinary meaning. Substituting "random" with "non-deterministic" hinders, not helps, the factor finder, given the more intricate definition of the latter. *Cf.* Defs.' Motion at 30-31 ("A 'deterministic' choice is the opposite of a 'random' choice. In particular, a deterministic choice is made based upon a desired set of criteria to yield a predictable outcome that does not depend on chance."). Moreover, there is no indication that a person having ordinary skill in the art would bring a distinctive perspective to the term "random" or "randomly" in the context in which the term is used in the claims. To the contrary, a person of ordinary skill would reasonably interpret the term according to its evident meaning.

Accordingly, the Court gives the term its plain and ordinary meaning. *See Menell* § 5.2.3.1.2 ("Where the intrinsic evidence and extrinsic evidence do not meaningfully add to the definition of a term, . . . it is appropriate (and often preferred) to allow straightforward claim language to stand as is."); *see also Phillips*, 415 F.3d at 1314 ("In some cases, the ordinary meaning of claim language as understood by a person of skill in the art may be readily apparent even to lay judges, and claim construction in such cases involves little more than the application of the widely accepted meaning of commonly understood words.").

### I. "said second encoding operation producing at least a portion of a codeword" / "the encoding operation generating at least a portion of a codeword"

| Plaintiff's Proposed Construction | Defendants' Proposed Construction |
|---|---|
| Plain and ordinary meaning | "the encoding operation produces at least a portion of the bits transmitted on a channel" |

The dispute here specifically pertains to the term "codeword." *Compare* Pl.'s Suppl. Motion at 4 ("The parties' dispute centers on the meaning of the term 'codeword.' With the exception of the term 'codeword,' Defendants' proposed construction essentially repeats the language of the longer phrases they identified for construction. Defendants seek to limit the term 'codeword' to 'bits transmitted on a channel.'"), *with* Defs.' Suppl. Motion at 11 (proposing that both "said second encoding operation producing at least a portion of a codeword" and "the encoding operation generating at least a portion of a codeword" be construed as "the encoding operation produces at least a portion of the bits transmitted on a channel," indicating that words prefacing "codeword" are not material to the dispute over the claim term). Defendants propose that the term "codeword" be construed as "the bits transmitted on a channel." Defs.' Suppl. Motion at 11-16; *see also* Defs.' Suppl. Opposition at 11-21. Plaintiff, by contrast, proposes that the term be given its plain meaning, but then adds that the plain meaning refers to "data elements generated by electronic circuitry, computer hardware, and/or computer software." Pl.'s Suppl. Motion at 4-8. Neither construction is supported by the intrinsic evidence.

The problem with Defendants' proposed construction is that it mandates that the bits be transmitted on a channel subsequent to the encoding operation, a construction belied by the express disclosure in the claim language and specification, which imposes no such constraint. Just because the bits resulting from an encoding operation *may* be transmitted following an encoding operation does not mean that the bits *must* be. *See* Defs.' Suppl. Opposition at 11-12 (arguing that the encoded bits must be transmitted given the purpose of the encoding operation). The idea of transmission of codewords is separate and distinct from encoding codewords: IRA codes, the thrust of the claimed invention in the '781 Patent, are generated or produced with the help of, for instance, outer and inner coders, even before such codes are transmitted. *See* '781 Patent at 1:65-2:14 ("The coding system includes an outer coder, which repeats and scrambles bits in the data block. . . . The repeated and scrambled bits are input to an inner coder that has a rate substantially close to one. . . . The encoded data output from the inner coder *may* be transmitted on a channel[.]") (emphasis added). Indeed, where an action is contemplated *after* the parity bits are generated, that action has been so specified and expressly claimed in the claim language. *See, e.g.*, '781 Patent at 7:39-41 (claiming "outputting" of the codeword). This undercuts the thrust of Defendants' proposed construction.

Evidently, Defendants concede that the '781 Patent contemplates an encoder that *permits*, not limits, that encoded data from the inner coder to be transmitted on a channel. *See* Defs.' Suppl. Motion at 13:8-11; *see also* '781 Patent at 2:11-12 ("The encoded data output from the inner coder *may be* transmitted on a channel[.]") (emphasis added); *Hughes*, 35 F. Supp. 3d at 1183 ("These examples show only that *it is possible to transmit* encoded or formatted data. They do not even weakly suggest that a codeword *must be transmitted*.") (emphases added). Defendants' argument that the distinction between the systematic and non-systematic version of IRA codes supports their construction (*see* Defs.' Suppl. Motion at 14-15) similarly misconstrues examples set forth in the specification. Those examples merely explain Fig. 3, an embodiment, not limit the claimed encoding operation in any manner. *See generally* '781 Patent at 4:25-49. While an encoder maybe typecast as systematic or non-systematic, with a corresponding encoding rate, that characterization of the encoder does not limit the independent existence of a "codeword," which results from the encoding operation, a phenomenon preceding and distinct from the possibility of any subsequent transmission. *See id.* at 8:38-44 ("A method of encoding a signal, comprising: . . . performing an encoding operation using the information bits as an input . . . the encoding operation generating at least a portion of a codeword[.]").

Indeed, the disclosure surrounding codeword makes clear that term "codeword" more generally describes the bits resulting from the encoding operations, where such collection of generated bits are either systematic (where codeword includes information bits and parity bits) or nonsystematic (where codeword includes only parity bits), divorced from whether such bits are thereafter transmitted over any channel. *Compare id.* at 4:25-30 (describing the nonsystematic IRA code as is an (r,k) code, in which the *codeword* corresponding to information bits ($u_1, . . . , u_k$) is *($x_1, . . . , x_r$)*.") (emphases added), *with id.* at 4:6-7 (describing ($x_1, . . . , x_r$) as "r parity bits"); *see id.* at 7:40-41 (claiming a method of encoding a signal in claim 2, which depends from claim 1, where the codeword in claim 2 is more specifically limited to "parity bits," indicating that term "codeword" in claim 1 is a more generic limitation that encompasses "parity bits"). Finally, claim 8 in the '032 Patent, a related patent based on a common specification, expressly recites adding "transmitting" limitation to "the sequence of parity bits" (*see* '032 Patent at 8:53:54 ("The method of claim 1, further comprising transmitting the sequence of parity bits.")), which further compels the inference that the named inventors did not intend to limit the term "codeword," which includes parity bits under either systematic or non-systematic encoding, in the absence of such express usage of the "transmitting" limitation. *See Omega Eng'g, Inc, v. Raytek Corp.*, 334 F.3d 1314, 1334 (Fed. Cir. 2003) ("[U]nless otherwise compelled . . . the same claim term in the same patent or related patents carries the same construed meaning."); *In re Rambus Inc.*, 694 F.3d 42, 48 (Fed. Cir. 2012); *see also Unwired Planet*, 829 F.3d at 1358-59 (finding that the district court erred in construing "voice input" as "speech provided over a voice channel" because the plain language of the claims does not dictate the manner in which voice is to be transmitted from a mobile device to a server, and there was no clear and unmistakable disclaimer in the specification or file history); *Hughes*, 35 F. Supp. 3d at 1184 ("The Court declines Hughes' invitation to read a transmission limitation into 'codeword.'").

Despite labeling its construction as plain and ordinary meaning of the term, Plaintiff proposes a construction that too is not grounded in the intrinsic evidence. First, Plaintiff claims that by asking that "codeword" be limited to bits transmitted on a channel, Defendants have conceded that the encoding steps must be performed by a computer or by circuitry. *See* Pl.' Suppl. Motion at 4-5. Because the Court has rejected Defendants' proposed construction, any concession implied therein shall also be rejected. Second, Plaintiff claims that the intrinsic evidence demonstrates that the encoding operation that generates "at least a portion of a codeword" is performed by electronic circuitry, computer hardware, and/or computer software. *See* Pl.'s Suppl. Motion at 5 (citing '781 Patent at 2:39-3:36, 3:63-4:3, Figs. 2, 4). But the disclosure contained in these references to the specification show only that a "coder" *may* produce "encoded data." *See, e.g.*, '781 Patent at 2:39-46. There is no reference to a requirement that the encoded data must require "electronic circuitry, computer hardware, and/or computer software" in those portions of the specification. *See also* Tutorial Tr. at 11-12 (explaining that "[an] encoder actually . . . take[s] the information bits and convert[s] them into what we call coded bits or code words," indicating that the term "codewords" could simply be understood as "coded bits," and without conditioning the generation of the codewords on any sort of "electronic circuitry, computer hardware, and/or computer software"); *id.* at 28:18-20 (equating codeword with the information or message bits, indicating that codeword has a plain and ordinary meaning of simply a "group of bits"); *id.* at 53 ("If you think about the Hamming code, we have four message bits, and we have to select one of 16 code words. We could do that very easily by just writing down a table. We could, in fact, I do that on the next slide. So this would tell us that encoding is easy, just *write down all the code words*, there is 16 of them, and, then, let's just associate each code word with a message.") (emphases added).

In fact, Plaintiff relies on extrinsic evidence, a declaration from its expert, not intrinsic evidence, to make that inference. *See* Pl.' Suppl. Motion at 5 (citing to Briggs Decl.). That inference too is facetious. The fact that a device may generate coded signal does not warrant the conclusion that the coded signal must only be generated through the device, precluding all other methods of generating a coded signal. Moreover, even if the specification were to imply so, the specification makes clear that it is merely illustrating coders using embodiments; there is simply no evidence that the claims must be so limited. *See Liebel-Flarsheim*, 358 F.3d at 913 ("[I]t is improper to read limitations from a preferred embodiment described in the specification – even if it is the only embodiment – into the claims absent a clear indication in the intrinsic record that the patentee intended the claims to be so limited.") (citations omitted); *Omega*, 334 F.3d at 1326 (holding that there was no clear and unmistakable disavowal of claim scope that would compel a result different than the claim language). Finally, the claims in which the term "codeword" is used are method claims setting forth methods of encoding to generate a codeword, but nothing in the claim language or the specification restricts those methods of encoding to be restricted to a specific device; and, in any case, no such device has separately been claimed in the '781 Patent, and is more likely to be claimed in apparatus claims, which is not the subject of the '781 Patent.

The meaning of the term "codeword," the result of an encoding operation, would be clear to a person of ordinary skill in the art, presumed to be familiar with encoding operations and the outputs of such operations, and there is no ambiguity or technical aspect to it that warrants a construction. This is especially true here where the level of a person of ordinary skill in the art is self-evidently higher than average. *See, e.g.*, Tutorial Tr. at 36 ("[T]he level of a person of ordinary skill in the art in this case is higher than average. It is just the nature of the Caltech patents. They are very advanced technology."). Accordingly, the Court gives the term its plain and ordinary meaning. *See Hughes*, 35 F. Supp. 3d at 1183 ("[T]he plain meaning of 'codeword' does not require data elements to be encoded for transmission, and the specification never clearly redefines or disavows the plain meaning of 'codeword.'"); *id.* ("The Court finds that 'codeword' means 'a discrete encoded sequence of data elements.' Once again, Hughes attempts to improperly inject a limitation into *a clear term*.") (emphasis added); *see also U.S. Surgical*, 103 F.3d at 1568 ("Claim construction is a matter of resolution of disputed meanings and technical scope, to clarify and when necessary to explain what the patentee covered by the claims, for use in the determination of infringement. It is not an obligatory exercise in redundancy."); *Am. Piledriving Equip.*, 637 F.3d at 1331 ("It is well settled that the role of a district court in construing claims is not to redefine claim recitations or to read limitations into the claims to obviate factual questions of infringement and validity but rather to give meaning to the limitations actually contained in the claims, informed by the written description, the prosecution history if in evidence, and any relevant extrinsic evidence.") (citing *Phillips*, 415 F.3d at 1314); *Menell* § 5.1.4.3 ("There is no requirement that a court construe a claim term when there is no genuine dispute about its meaning.") (citing *O2 Micro*, 521 F.3d at 1362).

**J. "at least two of the information bits appear in three subsets"**

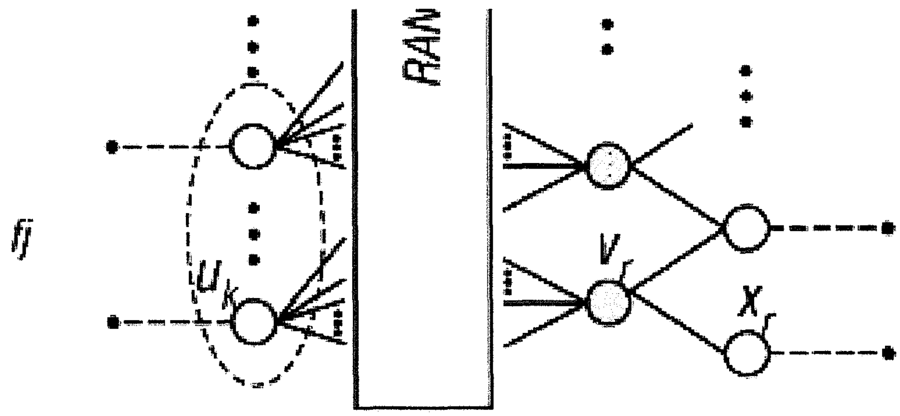
| Plaintiff's Proposed Construction | Defendants' Proposed Construction |
|---|---|
| "at least two, but not all, of the information bits appear in exactly three subsets." | Plain and ordinary meaning |

The analysis starts with the claim language. *Becton*, 616 F.3d at 1254; *Interactive Gift Express*, 256 F.3d at 1331; *Manzo* § 2:26 ("In construing claims, the analytical focus must begin and remain centered on the language of the claims themselves, for that is the language that the patentee chose to use to particularly point out and distinctly claim the subject matter regarded as the invention. . . . [T]he claim language remains the focal point.") (internal citations omitted). Here, the representative claim, claim 19 of the '781 Patent, recites as follows:

> 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.

'781 Patent at 8:34-49. Under its plain language, claim 19 imposes a floor of two, but no ceiling, for the number of "information bits" in the "subsets of the information bits" to be encoded using exclusive-OR operations. *Id.*; *see also* Defs.' Supp. Motion at 3-4 (illustrating how all the information bits may appear in three subsets). There is no ambiguity in the limitations set forth in claim 19 and, therefore, no construction is warranted here. *See Am. Piledriving Equip.*, 637 F.3d at 1331 ("It is well settled that the role of a district court in construing claims is not to redefine claim recitations or to read limitations into the claims to obviate factual questions of infringement and validity but rather to give meaning to the limitations actually contained in the claims, informed by the written description, the prosecution history if in evidence, and any relevant extrinsic evidence.") (citing *Phillips*, 415 F.3d at 1314). Indeed, Plaintiff does not identify a specific term to be construed but instead asks the Court to insert specific terms (*see generally* Pl.'s Suppl. Motion at 9-13) in an otherwise unambiguous limitation. *See also MagSil Corp. v. Hitachi Glob. Storage Techs., Inc.*, 687 F.3d 1377, 1381-83 (Fed. Cir. 2012) (characterizing the claim term "change in the resistance by at least 10%" as an "open-ended" term because it set forth "a lower threshold, but not an upper limit" and that the relevant claims including that term "cover resistive changes from 10% up to infinity"); *Adams Respiratory Therapeutics, Inc. v. Perrigo Co.*, 616 F.3d 1283, 1292 (Fed. Cir. 2010) ("At least 3500 is the simplest way to express greater than or equal to 3500, an open-ended range."); *Lantech, Inc. v. Keip Mach. Co.*, 32 F.3d 542, 546 (Fed. Cir. 1994) ("[T]he term 'at least two' sets forth the *minimum number* of a particular element required.") (emphasis added); *see also York Prod., Inc. v. Cent. Tractor Farm & Family Ctr.*, 99 F.3d 1568, 1575 (Fed. Cir. 1996) (construing "plurality" according to its ordinary meaning, equating it with "at least two," but no other artificial limits); *id.* ("[T]his term requires *only* at least two ridge members on each sidewall to form a load lock.") (emphasis added).

In any case, Plaintiff's proposed construction relies on a stretched reading of a specific embodiment, the Tanner graph, specifically the variable nodes and edges emanating from the variable nodes. *See* Pl.'s Suppl. Motion at 10. But the Tanner graph does not evidence the specificity that Plaintiff wants to import into the plain language of the claim limitation. The graph makes clear that it is merely exemplary in its disclosure by using ellipses between the nodes as well as between the edges that Plaintiff references, and undermines Plaintiff's assertion that the relevant limitation should be read to claim "not all" information bits and "exactly" three subsets of information bits:




'781 Patent, Fig. 3; *see also Hughes*, 35 F. Supp. 3d at 1192 ("In reality, the Tanner graph term as a whole is exemplary. It informs a person of ordinary skill of the structure of the code, but it does not define specific parameters."); *id.* ("Throughout the specification, the Tanner graph is described in generic, exemplary terms. . . . This exemplary nature is reflected by the identical Tanner graph in the claims. . . . Th[e] exemplary nature is demonstrated by the ellipses between the subsets, which indicates that the number of subsets may exceed two. The exemplary nature is also demonstrated by the labels on the graph: $U_k$, $V_k$, and $X_k$."); *id.* at 1193 ("A person of ordinary skill would understand the exemplary nature of the Tanner graph[.]"); *id.* at 1194 ("[A] person of ordinary skill would understand the meaning of the ellipses, which indicate the exemplary nature of the Tanner graph."). Relatedly, there is also no evidence that the plain language of the claim is restricted to claiming only the Tanner graph embodiment at the exclusion of alternative embodiments disclosed in Figs. 2 and 4 and discussed in the written description. *See Pentair*, 2012 WL 12887686, at *10 ("[I]t is generally improper to import a limitation from a preferred embodiment into the claims."); *Liebel-Flarsheim*, 358 F.3d at 913 ("[I]t is improper to read limitations from a preferred embodiment described in the specification – even if it is the only embodiment – into the claims absent a clear indication in the intrinsic record that the patentee intended the claims to be so limited.") (citations omitted); *GE Lighting Solutions*, 750 F.3d at 1310. Indeed, if the named inventors had meant to claim "at least two, but not all" limitation in the claim language, it would have been simple to do so.

Plaintiff also contends that the fact that the very character of the invention centers on generating "irregular" codes warrants the conclusion that not all the information bits are encompassed, otherwise the resulting code may no longer be irregular. *See* Pl.'s Suppl. Opposition at 7-8. First, this undermines Plaintiff's proposed construction. If the code resulting from the use of an encoding process were not irregular, that encoding process would simply not infringe the '781 Patent. There is no reason why the claim limitation must be construed to improperly broaden the scope of the claim to preserve infringement. Second, merely describing the advantages of the present invention does not necessarily limit the claim to methods or systems processing those advantages. *See i4i Limited Partnership v. Microsoft Corp.*, 589 F.3d 1246, 1259-60 (Fed. Cir. 2009). To the extent Plaintiff's proposed construction is an attempt to preserve the validity of the relevant claims of the '781 Patent, the unambiguous limitations do not warrant such a result. *See Generation II Orthotics Inc. v. Medical Technology Inc.*, 263 F.3d 1356, 1365 (Fed. Cir. 2001) ("Claims can only be construed to preserve their validity where the proposed claim construction is 'practicable,' is based on sound claim construction principles, and does not revise or ignore the explicit language of the claims."); *see, e.g.*, *Elekta Instrument S.A. v. O.U.R. Scientific Intern., Inc.*, 214 F.3d 1302, 1309 (Fed. Cir. 2000) ("Elekta further argues that OSI's interpretation would render claim 1 invalid, because a gamma unit with radiation sources solely between 30°-45° would be inoperative. We do not reach the issue of invalidity, and we note that the record is unclear as to whether such a device would be inoperative. Moreover, having concluded that the amended claim is susceptible of only one reasonable construction, we cannot construe the claim differently from its plain meaning in order to preserve its validity (upon which we do not opine).") (citation omitted); *E.I. du Pont de Nemours & Co. v. Phillips Petroleum Co.*, 849 F.2d 1430, 1434 (Fed. Cir. 1988) (rejecting argument that limitations should be added to claims to preserve the validity of the claims).

Plaintiff's proposed construction essentially asks the Court to synthesize language in the claims with the explanation in the specification and then substitute the combination for the claim term that Plaintiff considers disputed. That approach has the effect of impermissibly importing limitations from the specification into the claims. *Cf. Comark*, 156 F.3d at 1186-87. Accordingly, the Court gives the term its plain and ordinary meaning.

**K. "information bits"**

| Plaintiff's Proposed Construction | Defendants' Proposed Construction |
|---|---|
| Plain and ordinary meaning | "binary digits (i.e., 1s and/or 0s) that represent information" |

Defendants' proposed construction self-evidently paraphrases the claim term. *See also* Defs.' Suppl. Motion at 17 ("The plain meaning of 'bits' to a person of ordinary skill in the art is 'binary digits (*i.e.*, 1s and/or 0s).'") (citation omitted).

Plaintiff's proposed construction, on the other hand, while labeled as "plain and ordinary meaning," improperly reads in "electronic circuitry, computer hardware, and/or computer software" limitations, limitations considered and rejected by the Court. *See* Pl.' Suppl. Motion at 13-14; *supra* § IV.I (rejecting the argument that encoding operation that generates "at least a portion of a codeword" is performed by electronic circuitry, computer hardware, and/or computer software); *see also Source*, 753 F.3d at 1299 ("Instead of looking to the words themselves, [the patentee] added language without support from the specification or prosecution history, altering otherwise unambiguous claim language, a practice this court has repeatedly rejected.") (citations omitted). Indeed, just because the claimed invention "can actually be implemented" in a computer chip (*see, e.g.*, Tutorial Tr. at 52:13-16), does not mean that the claims have no meaning beyond that specific implementation. Plaintiff also asserts that construing bits to 0 or 1 would exclude "soft-decision decoding techniques, such as belief propagation," which assign each bit a probability. *See* Pl.'s Suppl. Opposition at 17.

Assigning a probability to a bit does not, however, set the intrinsic value of the bit to a percentage between 0 and 100%, as Plaintiff misunderstands – that value remains set to either 0 or 1 – it is the probabilities attached to the bit that vary. Indeed, the specification expressly discloses so – that is, the probabilities associated with a bit under the belief propagation decoding technique is represented distinctly, and with the help of different notations, as p(0) or p(1), making clear that those *probabilities* of the bit being 0 or 1 are separate and distinct from the definitional value of the bit being 0 or 1. *See* '781 Patent at 5:17-20 ("A probability density on a bit is a pair of non-negative real numbers p(0), p(l) satisfying p(0)+p(1)=1, where p(0) denotes the probability of the bit being 0, p(l) the probability of it being 1."); *see also* Tutorial Tr. at 31-32 ("[L]et's say we wanted to transmit some *information*. We just wanted to *transmit a zero or a one*, and you can think about this zero-one as, I don't know, being a bit inside a movie we are trying to send or even just being a simple answer to a question, 'yes' or 'no.'") (indicating that the information bits exist only in binary states).

There is no showing that the term needs to be clarified, or that the specification defines or uses the term in a special, narrower manner that requires the Court to give the term that meaning. Indeed, the claim term is unambiguous to a person of ordinary skill in the art, who would be presumed to know that information bits refer to binary digits 0 and 1 in the message to be encoded, in light of the claim language and the specification, and would likely interpret the term according to that evident meaning. No construction is, therefore, necessary. *See Am. Piledriving Equip.*, 637 F.3d at 1331. Accordingly, the Court gives the term its plain and ordinary meaning.

## V. Conclusion

Based on the foregoing, the Court adopts the constructions set forth below for the terms or limitations for which the parties offer differing constructions.

| Term | Plaintiff's Proposed Construction | Defendants' Proposed Construction | Court's Construction |
|---|---|---|---|
| "repeat" | Plain and ordinary meaning | "Creating a new bit that corresponds to the value of an original bit (i.e., a new copy) by storing the new copied bit in memory. A reuse of a bit is not a repeat of a bit." | Plain and ordinary meaning |
| "accumulation" (and its variations) | Plain and ordinary meaning | "a process in which (a) the first output bit equals the first input bit; and (b) for all subsequent bits, the current output bit equals the mod-2 sum of the prior output bit and the current input bit" | Plain and ordinary meaning |

| Term | Plaintiff's Proposed Construction | Defendants' Proposed Construction | Court's Construction |
|---|---|---|---|
| "generator matrix" | Plain and ordinary meaning | "a matrix that, when multiplied by a block of input bits, produces a number of output bits that is greater than or equal to the number of input bits" | Plain and ordinary meaning |
| Tanner Graph (Diagram Used in Claims 11 and 18 of the '032 patent) | A graph representing an 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 check nodes, randomly connected to the repeated message bits, enforce constraints that determine the parity bits. | 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, check nodes, randomly connected to the repeated message bits, enforce constraints that determine the parity bits, and all parity bits are determined as shown by the configuration of nodes and edges in the Tanner graph (*i.e.*, a first parity bit ($x_1$) is determined as a function of information bits alone, and all subsequent parity bits ($x_2$-$x_r$) are determined as a function of both information bits and prior parity bits). | A graph representing an 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 check nodes, randomly connected to the repeated message bits, enforce constraints that determine the parity bits. |
| "receive messages from neighboring check/variable | Plain and ordinary meaning | "each of the receiving nodes sends updated messages back to the | Plain and ordinary meaning |

| Term | Plaintiff's Proposed Construction | Defendants' Proposed Construction | Court's Construction |
|---|---|---|---|
| nodes and send updated messages to the neighboring variable/check nodes" | | same adjacent nodes from which they received the original messages" | |
| "a first set of memory locations . . . a second set of memory locations . . . [and] a permutation module to read a bit from the first set of memory locations . . . a corresponding index of the first set of memory locations and a corresponding index of the second set of memory locations" (Subset of Claim 1 of the '833 Patent) | Plain and ordinary meaning | • "a first set of memory locations to store information bits" means "at least two addresses in an addressable memory array where information bits are stored"<br>• "a second set of memory locations to store parity bits" means "at least two addresses in an addressable memory array, different from the first set of addresses, where parity bits are stored"<br>• "index of the first set of memory locations" means "a list or table that contains the addresses where the information bits are stored"<br>• "index of the second set of memory locations" means "a list or table that contains the addresses where the parity bits are stored"<br>• "a corresponding" means "each index in the first set is associated with at least one index in the | Plain and ordinary meaning |

| Term | Plaintiff's Proposed Construction | Defendants' Proposed Construction | Court's Construction |
|---|---|---|---|
| | | second set, and vice versa"<br>• "read a bit" / "reading a bit" means "provide an address to a memory and receiving back the bit that is stored at that address" | |
| "combine the read bit to a bit in the second set of memory locations" | Plain and ordinary meaning | (a) combine (i) the bit read from the first set of memory locations and (ii) a particular bit stored in the second set of memory locations and (b) store the combined result in the second set of memory locations | Plain and ordinary meaning |
| "random" / "randomly" | Plain and ordinary meaning | "non-deterministic" | Plain and ordinary meaning |
| "said second encoding operation producing at least a portion of a codeword" / "the encoding operation generating at least a portion of a codeword" | Plain and ordinary meaning | "the encoding operation produces at least a portion of the bits transmitted on a channel" | Plain and ordinary meaning – but not exactly Plaintiff's version |
| "at least two of the information bits appear in three subsets" | "at least two, but not all, of the information bits appear in exactly three subsets." | Plain and ordinary meaning | Plain and ordinary meaning |
| information bits | Plain and ordinary meaning | "binary digits (i.e., 1s and/or 0s) that represent information" | Plain and ordinary meaning – but not exactly Plaintiff's version |

UNITED STATES DISTRICT COURT
CENTRAL DISTRICT OF CALIFORNIA

**CIVIL MINUTES – GENERAL**

Case No. CV 16-3714 GW (AGRx) Date: December 28, 2018

Title *The California Institute of Technology v. Broadcom Limited, et al.*

Present: The Honorable: GEORGE H. WU, UNITED STATES DISTRICT JUDGE

| | |
|---|---|
| Javier Gonzalez | None Present |
| Deputy Clerk | Court Reporter / Recorder |
| Attorneys Present for Plaintiffs: | Attorneys Present for Defendants: |
| None Present | None Present |

**Proceedings: IN CHAMBERS – FINAL RULING ON:**

**PLAINTIFF'S MOTION FOR PARTIAL SUMMARY JUDGMENT [740]**

***The California Institute of Technology v. Broadcom Limited et al.***; Case No. 2:16-cv-03714-GW-(AGRx)
Final Ruling on Plaintiff's Motion for Partial Summary Judgment of Validity under 35 U.S.C. § 103 Based on IPR Estoppel under 35 U.S.C. § 315(e)(2)

## I. Introduction

Plaintiff The California Institute of Technology currently alleges patent infringement against Defendants Broadcom Limited, Broadcom Corporation, Avago Technologies Limited, and Apple Inc.[1] *See* First Amended Complaint ("FAC"), Docket No. 36; *see also* Docket No. 1. Plaintiff asserts that Defendants infringe fifteen claims from three of its patents: (1) U.S. Patent No. 7,116,710 ("the '710 Patent"); (2) U.S. Patent No. 7,421,032 ("the '032 Patent"); and (3) U.S. Patent No. 7,916,781 ("the '781 Patent") (collectively, the "Asserted Patents").[2] *See* Docket No.

[1] Cypress Semiconductor Corporation was also previously named as a defendant in this case, but the parties filed a Joint Stipulation for Dismissal of all claims between them on September 7, 2018. Docket No. 665.

[2] The fifteen remaining claims in this case are: Claims 20, 22, and 23 of the '710 Patent; Claims 3, 11, 13, 17, and 18 of the '032 Patent; and Claims 5, 6, 9, 10, 13, 19, and 22 of the '781 Patent. Docket No. 409. Of those claims, eleven were selected as representative claims for purposes of adjudication in this lawsuit: Claims 20, 22, and 23 of the '710 Patent; Claims 3, 11, 17, and 18 of the '032 Patent; and Claims 6, 9, 13, and 22 of the '781 Patent. *See id.*; *see also* Docket No. 487, 488. On October 1, 2018, Plaintiff filed a Notice of Withdrawal of Claim 6 of the '781 Patent. Docket No. 705. However, Plaintiff's notice is vague as to whether it solely seeks to withdraw Claim 6 of the '781

409 (Plaintiff's Amended Notice of Withdrawal of Certain Asserted Claims of Asserted Patents).

Pending before the Court is Plaintiff's Motion for Summary Judgment as to Validity under 35 U.S.C. § 103 Based on IPR Estoppel under 35 U.S.C. § 315(e)(2). Docket No. 740-1. The Motion is fully briefed. *See* Docket No. 767 (public); Docket No. 772 (sealed) (Defendants' Opposition to Motion for Partial Summary Judgment); Docket No. 798 (Plaintiff's Reply in Support of Motion for Partial Summary Judgment). A hearing was held on the Motion on December 6, 2018 and the matter was taken under submission. *See* Docket Nos. 824, 828.

For the reasons stated in this Order, the Court **GRANTS** Plaintiff's Motion for Summary Judgment (Docket No. 740) except as to Defendants' invalidity ground against Claims 13 and 22 of the '781 Patent based on Divsalar, Frey/Frey Slides, and Ping.

## II. Legal Standard

Under Federal Rule of Civil Procedure ("Rule") 56, a party may move for summary judgment, identifying each claim or defense – or the part of each claim or defense – on which summary judgment is sought, and the court shall grant it when the pleadings, the discovery and disclosure materials on file, and any affidavits show that "there is no genuine issue as to any material fact and that the movant is entitled to judgment as a matter of law." Fed. R. Civ. P. 56(a); *see also Miranda v. City of Cornelius*, 429 F.3d 858, 860 n.1 (9th Cir. 2005). As to materiality, "[o]nly disputes over facts that might affect the outcome of the suit under the governing law will properly preclude the entry of summary judgment." *Anderson v. Liberty Lobby, Inc.*, 477 U.S. 242, 248 (1986). A dispute as to a material fact is "genuine" if there is sufficient evidence for a reasonable jury to return a verdict for the nonmoving party. *Id.*

To satisfy its burden at summary judgment, a moving party with the burden of persuasion must establish "beyond controversy every essential element of its [claim or defense]." *S. Cal. Gas Co. v. City of Santa Ana*, 336 F.3d 885, 888 (9th Cir. 2003); O'Connell & Stevenson, *Rutter Group*

Patent as one of the eleven claims selected for purposes of adjudication or whether it seeks to withdraw Claim 6 from the lawsuit entirely.

*Prac. Guide: Fed. Civ. Proc. Before Trial* ("*Federal Practice Guide*") § 14:126 (2016). By contrast, a moving party without the burden of persuasion "must either produce evidence negating an essential element of the nonmoving party's claim or defense or show that the nonmoving party does not have enough evidence of an essential element to carry its ultimate burden of persuasion at trial." *Nissan Fire & Marine Ins. Co., Ltd. v. Fritz Cos.*, Inc., 210 F.3d 1099, 1102 (9th Cir. 2000); *see also Devereaux v. Abbey,* 263 F.3d 1070, 1076 (9th Cir. 2001) (en banc) ("When the nonmoving party has the burden of proof at trial, the moving party need only point out 'that there is an absence of evidence to support the nonmoving party's case.'") (quoting *Celotex Corp. v. Catrett,* 477 U.S. 317, 325 (1986), and citing *Fairbank v. Wunderman Cato Johnson,* 212 F.3d 528, 532 (9th Cir. 2000) (holding that the *Celotex* "showing" can be made by "pointing out through argument . . . the absence of evidence to support plaintiff's claim")).

> If the party moving for summary judgment meets its initial burden of identifying for the court the portions of the materials on file that it believes demonstrate the absence of any genuine issue of material fact, the nonmoving party may not rely on the mere allegations in the pleadings in order to preclude summary judgment[, but instead] must set forth, by affidavit or as otherwise provided in Rule 56, specific facts showing that there is a genuine issue for trial.

*T.W. Elec. Serv., Inc., v. Pac. Elec. Contractors Ass'n*, 809 F.2d 626, 630 (9th Cir. 1987) (internal citations and quotation marks omitted) (citing, among other cases, *Celotex*, 477 U.S. at 323). "A non-movant's bald assertions or a mere scintilla of evidence in his favor are both insufficient to withstand summary judgment." *See FTC v. Stefanchik*, 559 F.3d 924, 929 (9th Cir. 2009). In addition, the evidence presented by the parties must be admissible. *See* Fed. R. Civ. P. 56(e). Conclusory, speculative testimony in affidavits and moving papers is insufficient to raise genuine issues of fact and defeat summary judgment. *See Thornhill Publ'g Co., Inc. v. GTE Corp.*, 594 F.2d 730, 738 (9th Cir. 1979). Relatedly, "[a]ny objections to declarations or other evidence must be made at or (preferably) before the hearing, and should be ruled upon by the court before ruling on the motion itself." *Federal Practice Guide* § 14:333 (citing *Hollingsworth Solderless Terminal*

*Co. v. Turley*, 622 F.2d 1324, 1335 n.9 (9th Cir. 1980); *Sigler v. American Honda Motor Co.*, 532 F3d 469, 480 (6th Cir. 2008)). In judging evidence at the summary judgment stage, however, courts do not make credibility determinations or weigh conflicting evidence at the summary judgment stage, and must view all evidence and draw all inferences in the light most favorable to the non-moving party. *See T.W. Elec.*, 809 F.2d at 630-31 (citing *Matsushita Elec. Indus. Co., Ltd. v. Zenith Radio Corp.*, 475 U.S. 574 (1986)); *Anderson*, 477 U.S. at 255 ("The evidence of the non-movant is to be believed and all justifiable inferences are to be drawn in [the non-movant's] favor.").

"If the court does not grant all the relief requested by the motion, it may enter an order stating any material fact – including an item of damages or other relief – that is not genuinely in dispute and treating the fact as established in the case." Fed. R. Civ. P. 56(g); *see also* Federal Practice Guide § 14:352 ("A partial summary judgment may be granted on motion of either party for adjudication of particular claims or defenses.") (citing *id.* § 14:33).

## III. Factual Background

While this litigation has been proceeding, the Patent Trial and Appeal Board ("PTAB"), a branch of the U.S. Patent Office, has considered the validity of the Asserted Patents as part of certain *Inter Partes* Review ("IPR") Proceedings. Defendants[3] filed ten IPR petitions across the patents asserted in this case.[4] The PTAB declined to institute IPR proceedings as to some of the petitioned patent claims, instituted IPR proceedings as to the other petitioned patent claims, and has issued Final Written Decisions as to four of the claims that are still being adjudicated in this case.[5]

[3] Plaintiff explains: "Apple Inc. ('Apple') is identified as the petitioner in all of the IPRs at issue, and Broadcom Corp. ('Broadcom') is identified as a real party-in-interest. Broadcom Corp. and Avago Technologies Ltd. are each subsidiaries of Broadcom Ltd., which is now known as Broadcom Inc." Docket No. 740-1 at 1.

[4] The ten IPR petitions included petitions against a patent that has since been withdrawn from this case.

[5] Instituted IPR remains pending as to two of the claims for adjudication in this case, Claims 20 and 22 of the '710

UNITED STATES DISTRICT COURT
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**CIVIL MINUTES – GENERAL**

Case No. CV 16-3714 GW (AGRx) Date: December 28, 2018

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In particular, the PTAB has issued Final Written Decisions finding that Defendants failed to demonstrate that Claims 13 and 22 of the ’781 Patent and Claims 11 and 18 of the ’032 Patent are invalid. Defendants had specifically raised (and the PTAB considered) three prior art “grounds” during IPR proceedings:

- Ping & MacKay (’781 Patent, Claims 13 and 22);
- Ping, MacKay & Divsalar (’032 Patent, Claim 11); and
- Ping, MacKay, Divsalar & Luby97 (’032 Patent, Claim 18).

In litigation before this Court, the following table summarizes the invalidity grounds Defendants now rely on to assert invalidity of Claims 13 and 22 of the ’781 Patent and Claims 11 and 18 of the ’032 Patent:

| Patent | Claim | References Asserted in IPR | References Asserted in District Court |
|---|---|---|---|
| ’032 Patent | 11, 18 | Claim 11: Ping, MacKay & Divsalar<br><br>Claim 18: Ping, MacKay Divsalar & Luby97 | Ping, Luby98, Divsalar* & Luby97 |
| | | | Ping, Richardson99*, Divsalar* & Luby97 |
| | | | Ping, MacKay & Pfister/Pfister Slides* |
| | | | Divsalar*, MacKay & Luby97 |
| | | | Ping, MacKay, Divsalar* & Luby97 |
| | | | Ping, Luby98 & Divsalar* |
| | | | Ping, Luby98 & Pfister/Pfister Slides* |
| ’781 Patent | 13, 22 | Ping & MacKay | Divsalar*, Ping & Richardson99* |
| | | | Divsalar*, Luby97, Luby98 |
| | | | Divsalar*, Ping & Frey/Frey Slides* |
| | | | Ping & Luby98 |

Patent. Plaintiff notes that it will also seek summary judgment of no invalidity as to those claims on the basis of IPR estoppel after the PTAB issues its Final Written Decision in the IPR proceedings on those claims.

| | | | |
|---|---|---|---|
| | | | Pfister/Pfister Slides*, Luby97 & Luby98 |
| | | | Divsalar*, Ping & Luby98 |
| | | | Divsalar*, Luby97 & Luby98 |

For purposes of their opposition to Plaintiff's summary judgment motion, Defendants assert that the "references" marked with asterisks are being brought under the "known or used" prong of pre-AIA 35 U.S.C. § 102(a).

Plaintiff now moves for partial summary judgment of no invalidity as to Claims 13 and 22 of the '781 Patent and Claims 11 and 18 of the '032 Patent, arguing that IPR estoppel precludes Defendants from raising each invalidity ground that was identified in Defendants' invalidity contentions as to each of those claims. Docket No. 740-1.

## IV. Analysis

A. Scope of IPR Estoppel under 35 U.S.C. § 315(e)(2)

Section 315(e)(2) of the Patent Act states:

> The petitioner in an inter partes review of a claim in a patent under this chapter that results in a final written decision under section 318(a), or the real party in interest or privy of the petitioner, may not assert . . . that the claim is invalid on any ground that the petitioner raised or reasonably could have raised during that inter partes review.

35 U.S.C. § 315(e)(2). Courts have clarified that an invalidity "ground" before the PTAB is "the basis or bases on which a petitioner challenges a claim." *iLife Techs, Inc. v. Nintendo of Am., Inc.*, No. 13-cv-4987-M, 2017 U.S. Dist. LEXIS 87769, at *9 (N.D. Tex. May 30, 2017).

The Federal Circuit had reason to consider the meaning of the statutory IPR estoppel provision in a 2016 decision. *See Shaw Indus. Grp., Inc. v. Automated Creel Sys., Inc.*, 817 F.3d 1293, 1300 (Fed. Cir. 2016), *cert. denied*, 137 S. Ct. 374 (2016). *Shaw* involved an appeal from the PTAB's decision to only partially institute an IPR. The PTAB had partially denied institution of IPR on the basis that certain prior art grounds in the IPR petition were "redundant." *Id.* at 1297.

The Federal Circuit first concluded that the PTAB's decision to deny IPR institution on certain grounds was unappealable. *Id.* at 1299 ("We have no authority . . . to review the Board's decision to institute IPR on some but not all grounds."). The Federal Circuit then commented that, as to the "redundant" invalidity grounds where the PTAB denied IPR institution (*i.e.*, the unappealable portion of the decision with no resulting Final Written Decision), IPR estoppel would not attach. Relying on an interpretation of the plain words of the statutory IPR estoppel provision, the Federal Circuit reasoned that the non-instituted ground was not a ground raised or that reasonably could have been raised "***during*** that inter partes review" because "[t]he IPR does not begin until it is instituted." *Id.* at 1300; *see also HP Inc. v. MPHJ Tech. Inv., LLC*, 817 F.3d 1339, 1347 (Fed. Cir. 2016) (interpreting the analogous estoppel provision that applies to Patent Office proceedings, Section 315(e)(1), and concluding that "noninstituted [redundant] grounds do not become a part of the IPR").

District courts since *Shaw* have grappled with the implications of this holding. In particular, courts have considered whether the statutory IPR estoppel provision reaches to invalidity grounds that a petitioner was aware of at the time it filed its IPR petition, but chose not to bring in the IPR proceeding. Some district courts relying on *Shaw* have concluded that, under the logic provided by *Shaw*, those non-petitioned grounds could not reasonably have been raised ***during*** IPR because ***during*** IPR, the PTAB has already selected the specific invalidity grounds for consideration through its grant of the IPR petition. Under this logic, a petitioner would have no reasonable opportunity to raise new invalidity grounds in the midst of the actual "IPR stage" of IPR proceedings. Other district courts have questioned this approach and declined to follow it. Those courts observe that only allowing estoppel to attach to the invalidity grounds actually considered and ultimately addressed in the PTAB's Final Written Decision would render the phrase "reasonably could have raised" in Section 315(e)(2) largely superfluous. *Milwaukee Elec. Tool Corp. v. Snap-On Inc.*, 271 F. Supp. 3d 990, 1028 (E.D. Wis. 2017) *appeal pending*, No. 18-1516 (Fed. Cir. Feb. 5, 2018) (comparing two approaches). The Eastern District of Wisconsin's decision in *Milwaukee Electric* provided a thoughtful summary and analysis of the competing views at the time it was decided:

> Plaintiffs assert that the exception to IPR estoppel explained in *Shaw* – non-institution of a ground for IPR – has two limitations. First, it only applies to non-instituted grounds when such ground was rejected for purely procedural reasons, such as redundancy, and not when the ground was refused as insufficient on its merits to warrant IPR. (Docket # 188 at 11). Second, in Plaintiffs' view, estoppel operates to bar any non-petitioned ground that the petitioner had reasonably available to it, and therefore could have included in its petition, but chose not to. *Id.*
>
> Several district courts have accepted Plaintiffs' position, finding that while these exceptions to the exception are not totally congruent with the Federal Circuit's quite literal reading of the statute in *Shaw*, they are important in order to further the efficiency-promoting purposes of IPR and deter selective presentation of grounds to the PTAB. *See Biscotti Inc. v. Microsoft Corp.*, Case No. 2:13-CV-01015-JRG-RSP, 2017 WL 2526231, at *7 (E.D. Tex. May 11, 2017); *Clearlamp, LLC v. LKQ Corp.*, No. 12-cv-2533, 2016 WL 4734389, at *8 (N.D. Ill. Mar. 18, 2016). Other courts have hewed to *Shaw* and *HP's* literal approach, finding that only grounds that were or could reasonably have been raised during IPR proceedings − that is, after the PTAB has instituted IPR as to certain grounds − implicate IPR estoppel. *See, e.g.*, *Verinata Health, Inc. v. Ariosa Diagnostics, Inc.*, No. 12-cv-5501, 2017 WL 235048, at *3 (N.D. Cal. Jan. 19, 2017) (collecting cases).
>
> The Court finds that, in the absence of greater clarity provided by the Federal Circuit on these issues, the better view is that recently espoused by Judge Amy St. Eve in *Oil-Dri Corp. of America v. Nestle Purina Petcare Co.*, No. 15-cv-1067, 2017 WL 3278915 (N.D. Ill. Aug. 2, 2017). First, she found that a plain reading of *Shaw* compels the conclusion that a non-instituted ground is not subject to estoppel, whatever the reason for its rejection. *Id.* at *4; *Douglas Dynamics, LLC v. Meyer Prods. LLC*, 14–cv–886–jdp, 2017 WL 1382556, at *5 (W.D. Wis. Apr. 18, 2017) (*Shaw* "makes the Federal Circuit's view of whether § 315(e) estoppel applies to non-instituted grounds crystal clear"). As she explained, the Federal Circuit has had opportunities to revisit *Shaw*'s reasoning and has declined to do so. *Oil-Dri*, 2017 WL 3278915, at *4; *Credit Acceptance Corp. v. Westlake Servs.*, 859 F.3d 1044, 1053 (Fed. Cir. 2017); *HP Inc.*, 817 F.3d at 1347. Further, while it is possible to draw

distinctions between declining to institute IPR for procedural reasons or for merits-related failings, the fact remains that denial of an IPR petition is simply not an adjudication of an invalidity contention. *Oil-Dri*, 2017 WL 3278915, at *4. Holding otherwise would deny the petitioner a full and fair opportunity to litigate the petitioned but non-instituted ground. *See id.*; *Verinata*, 2017 WL 235048, at *3 ("[L]imiting IPR estoppel to grounds actually instituted ensures that estoppel applies only to those arguments, or potential arguments, that received (or reasonably could have received) proper judicial attention."). Thus, a petitioned ground for which IPR was not instituted, for whatever reason, does not give rise to IPR estoppel.

However, the Court is persuaded by Plaintiffs' other proposed limitation on the *Shaw* IPR estoppel exception relating to non-petitioned grounds. Judge St. Eve also persuasively reasoned in *Oil–Dri* that "[i]f a party does not include an invalidity ground in its petition that it reasonably could have included, it necessarily has not raised a ground that it 'reasonably could have raised during . . . IPR.'" *Oil-Dri*, 2017 WL 3278915, at *8 (quoting 35 U.S.C. § 315(e)(2)). The Federal Circuit has not expressly considered this particular question, and so *Shaw* and the cases that follow it, which touch on non-instituted grounds only, do not foreclose such an approach. *Id.* at *7. Moreover, this approach is consistent with the purposes of the AIA, because it incentivizes petitioners to bring all of their invalidity claims before the expert judges of the PTAB in the most efficient manner possible. *Id.*

Indeed, though *Shaw's* plain language prevents IPR estoppel being applied to non-instituted grounds, the Court can preserve some measure of the policy goals animating the creation of IPR by holding that a petitioner is estopped from asserting invalidity contentions based on prior art that it could reasonably have included in its IPR petition but did not. *See Douglas Dynamics*, 2017 WL 1382556, at *4; *Biscotti*, 2017 WL 2526231, at *7. As Judge St. Eve observed, "while it makes sense that noninstituted grounds do not give rise to estoppel because a petitioner cannot − to no fault of its own − raise those grounds after the institution decision, when a petitioner simply does not raise invalidity grounds it reasonably could have raised in an IPR petition, the situation is different." *Oil-Dri*, 2017 WL 3278915, at *8. The PTAB itself takes this view, too. *Great W. Cas. Co. v. Intellectual Ventures II LLC*, IPR No. 2016–01534, Paper No. 13, at 11-14 (PTAB Feb. 15, 2017) ("[A] petitioner makes an affirmative choice to avail itself of *inter partes* review only on certain grounds. That choice, however, comes with

> consequences, most prominently, that grounds petitioner elects not to raise in its petition for *inter partes* review may be subject to the consequences of Section 315(e)(1)."). In order for IPR to fulfill its mission of streamlining patent litigation in the district courts and promoting efficient dispute resolution, a petitioner cannot be left with the option to institute a few grounds for IPR while holding some others in reserve for a second bite at the invalidity apple once in the district court. *See Cobalt Boats, LLC v. Sea Ray Boats, Inc.*, No. 15cv21, 2017 WL 2605977, at *2-3 (E.D. Va. June 5, 2017) ("[T]he broad reading of *Shaw* renders the IPR estoppel provisions essentially meaningless because parties may pursue two rounds of invalidity arguments as long as they carefully craft their IPR petition."); *Douglas*, 2017 WL 1382556, at *4 ("A patent infringement defendant does not have to take the IPR option; it can get a full hearing of its validity challenge in district court. If the defendant pursues the IPR option, it cannot expect to hold a second-string invalidity case in reserve in case the IPR does not go defendant's way."). "Estopping a party in such a situation is both fair – as the party could only blame itself – as well as common." *Oil-Dri*, 2017 WL 3278915, at *9. Therefore, the Court finds that a petitioner is subject to IPR estoppel when it fails to raise those grounds that it "reasonably could have raised" in its IPR petition, which includes prior art that a "'skilled searcher conducting a diligent search reasonably could have been expected to discover.'" *Id.* (quoting *Clearlamp*, 2016 WL 4734389, at *7-8); *Douglas*, 2017 WL 1382556, at *5.

*Id.* at 1028-30.

At the hearing, Defendants argued that the district court's interpretation in *Milwaukee Electric* leads to an inconsistent treatment of the "during IPR" language in § 315(e)(2) depending on the circumstances and is thus contrary to the Federal Circuit's determination in *Shaw*. As Defendants see it, if a prior art reference is included in an IPR petition and IPR is not instituted as to that prior art reference, *Milwaukee Electric* ascribes to *Shaw's* view that the reference could not have been reasonably raised ***during*** IPR. If a prior art reference is not included in an IPR petition, *Milwaukee Electric* would find that IPR estoppel applies so long as the prior art reference could have been found by a skilled searcher conducting a diligent search. In other words, at first glance, it would appear that the "during IPR" language of § 315(e)(2) has taken on a different meaning in the second scenario and specifically a different meaning from the one set out in *Shaw*.

*Shaw*, however, involved very particular circumstances. *Shaw's* estoppel determination was intertwined with: 1) a determination that the Federal Circuit could not hear appeals from PTAB decisions denying institution of IPR and 2) circumstances where the PTAB was permitted to institute (or deny institution) of IPR on less than the full grounds and claims requested by a petitioner. An alternative discussion in *Shaw* could have created a circumstance suggesting estoppel could attach based on an unreviewable non-final determination from the PTAB.[6] The same due process issues are not at play when non-petitioned prior art grounds are being considered, and *Shaw* does not directly address this second scenario in its determination.

The "during IPR" language also should not be read in a vacuum. The full phrase of § 315(e)(2) is whether the ground is one "that the petitioner raised or reasonably could have raised during that inter partes review." There is no reasonable basis by which a petitioner could raise a ground that has been explicitly rejected by the PTAB in making an IPR institution determination. But in the context of non-petitioned grounds, the issue goes back to the choices made by the petitioner itself. In other words, prior art references that a petitioner reasonably could have raised, but chose not to raise, in an IPR petition are also prior art references that reasonably could have been raised during actual IPR had the PTAB been given the opportunity (based on the petitioner's raising them) to consider those references.

The Court acknowledges that at the time *Milwaukee Electric* and *Oil-Dri* were decided, this logic may have held less water. But after those opinions had already issued, the Supreme

[6] In *Shaw*, the defendant had petitioned for a writ of mandamus instructing the PTAB to institute IPR on the supposedly redundant invalidity ground on which IPR had not been instituted. *Shaw*, 817 F.3d at 1299. The defendant argued that relief was necessary for various reasons, including that it could be otherwise estopped from raising the invalidity ground in district court and thus had no other adequate means to attain the desired relief. *Id.* The Federal Circuit addressed the defendant's concern with its analysis of § 315(e)(2) and its conclusion that statutory estoppel would not apply to the invalidity ground rejected by the PTAB. *Id.* In other words, the Federal Circuit found that because defendant would still be able to bring the prior art ground in district court, mandamus was not warranted. Thus, *Shaw* is not a decision directly determining the scope of estoppel, but instead is one where estoppel is considered in the context of a different dispute. Although the Court does not consider *Shaw's* interpretation of § 315(e)(2) to be *dicta*, it does find this distinction notable and significant.

Court in *SAS* found that the language of the Patent Act does not permit the PTAB to only institute IPR on some, but not all, of the petitioned claims. *See SAS Inst., Inc. v. Iancu*, 138 S. Ct. 1348, 200 L. Ed. 2d 695 (2018). The Federal Circuit has since interpreted *SAS* as also requiring the PTAB to take an all-or-nothing approach to the actual invalidity grounds raised in an IPR petition. *See Adidas AG v. Nike, Inc.*, 894 F.3d 1256, 1257 (Fed. Cir. 2018). In other words, the factual circumstances encountered by *Shaw* (partial denial of institution of IPR as to a particular ground, with that denial unappealable) are unlikely to arise again. The result is that the choices of the petitioner – and the petitioner alone – in its initial decision regarding what grounds to bring before the PTAB dictate what grounds are raised (or reasonably could have been raised) "during IPR" and thus could result in estoppel if IPR results in a final written decision. *See* 35 U.S.C. § 315(e)(2).

Indeed, in the only published district court decision since *SAS*, one district court has stated,

> [p]rior to *SAS*, a minority of district courts had held that only grounds actually raised in the petition could count as grounds that "reasonably could have been raised"; under that view, a petitioner could hold back certain grounds from its petition and be free to raise them later before a district court. *E.g., Koninklijke Philips N.V. v. Wangs Alliance Corp.*, 2018 WL 283893, at *3-4 (D. Mass. Jan. 2, 2018) (citing cases that held otherwise); *Finjan, Inc. v. Blue Coat Sys., LLC*, 283 F.Supp.3d 839, 855-57 (N.D. Cal. 2017). *But see Oil-Dri Corp. of Am. v. Nestlé Purina Petcare Co.*, 2017 WL 3278915, at *6-8 (N.D. Ill. Aug. 2, 2017) ("[W]hile it makes sense that noninstituted grounds do not give rise to estoppel because a petitioner cannot − to no fault of its own − raise those grounds after the institution decision, when a petitioner simply does not raise invalidity grounds it reasonably could have raised in an IPR petition, the situation is different."); *Parallel Networks Licensing, LLC v. Int'l Bus. Machs. Corp.*, 2017 WL 1045912, *11-12 (D. Del. Feb. 22, 2017). After *SAS*, that cannot be correct. Because the PTAB must now institute review (if at all) on all claims and grounds, there will be no such thing as a ground raised in the petition as to which review was not instituted. Accordingly, for the words "reasonably could have raised" to have any meaning at all, they must refer to grounds that were not actually in the IPR petition, but reasonably could have been included.

*SiOnyx, LLC v. Hamamatsu Photonics K.K.*, 330 F. Supp. 3d 574, 602 (D. Mass. 2018). This reasoning is persuasive and supports the conclusion that IPR estoppel should extend to non-petitioned invalidity grounds.[7]

*SiOnyx* also addressed the issue of the scope of what constitutes a non-petitioned invalidity ground that reasonably could have been raised during IPR:

> In congressional debates, one of the key architects of the America Invents Act explained that "reasonably could have raised" is meant to include any patent or printed publication that a petitioner actually knew about or that "a skilled searcher conducting a diligent search reasonably could have been expected to discover." 157 Cong. Rec. S1375 (daily ed. Mar. 8, 2011) (statement of Sen. Kyl). Several district courts have adopted this as the standard. *E.g., Parallel*

[7] At the hearing, Defendants argued that the "reasonably could have raised" language is not rendered entirely superfluous by a narrower reading § 315(e)(2). Specifically, Defendants observed that if the PTAB instituted IPR on a ground involving prior art references A, B, and C, some courts have found it appropriate for IPR estoppel to attach to grounds involving sub-combinations of those three prior art references, such as, for instance, a ground involving the combination of only prior art references A and B. *See Verinata Health, Inc. v. Ariosa Diagnostics, Inc*, No. 12-CV-05501-SI, 2017 WL 235048, at *4 (N.D. Cal. Jan. 19, 2017) ("The Court finds that defendants raised, or could have raised, these grounds in the IPR proceedings, as the combination of Dhallan and Binladen is simply a subset of the instituted grounds."). In the Court's view, in most instances, this would be a distinction without a difference. Presumably, a petitioner would believe the full combination of prior art references that it brought as a ground before the PTAB is necessary to make its invalidity argument before the PTAB. Perhaps in limited circumstances a petitioner would have some incentive to throw in more prior art references than it actually needs to support an invalidity argument before the PTAB. For instance, a petitioner might rely on prior art combination A, B, and C before the PTAB even if it personally thinks A and B are sufficient but has concerns that the smaller A/B combination is open to greater challenge. The more logical choice, however, would seem to be to streamline/simplify a submitted invalidity ground, particularly given the petitioner's burden to show it would have been obvious to combine the prior art references (a task that, at least conceptually, would likely become increasingly difficult as the number of prior art references increases). The Court also observes that a narrower interpretation of § 315(e)(2) could create an additional incentive for petitioners to limit the number of prior art references used in invalidity grounds in their IPR petitions. For instance, under the narrower view of IPR estoppel urged by Defendants, a petitioner could take a chance and raise prior art references A and B in a ground before the PTAB, but then bring prior art references A, B, and C in an obviousness ground before district court without fear of estoppel. This would allow the petitioner to first try its luck with the smaller prior art reference combination before the PTAB and then, with the benefit of the PTAB's analysis, take a second bite at the apple by simply adding an additional reference to the mix (even if, for instance, the majority of the invalidity analysis remains the same). This thought exercise also colors the Court's thinking regarding the appropriate scope of IPR estoppel.

> *Networks Licensing*, 2017 WL 1045912, *11-12; *Clearlamp, LLC v. LKQ Corp.*, 2016 WL 4734389, at *7-8 (N.D. Ill. Mar. 18, 2016).

*SiOnyx*, 330 F. Supp. 3d at 602. The Court finds it appropriate to adopt the same standard here.[8]

Finally, *SiOnyx* departed from *Milwaukee Electric's* conclusion regarding how estoppel should be applied to petitioned but noninstituted invalidity grounds where there has been partial IPR institution and a final written decision:

> [h]appily, the issue is easily resolved in this case. At the time the Supreme Court handed down *SAS*, [the IPR petitioner's] time to appeal the PTAB's decision had not yet run. Where relevant, the Federal Circuit has remanded cases to the PTAB to allow it to consider noninstituted claims and grounds following that decision, and has not held that petitioners have waived their right to PTAB adjudication of all claims and grounds by failing to raise the issue before the PTAB prior to *SAS*. [*BioDelivery Scis. Int'l, Inc. v. Aquestive Therapeutics, Inc.*, 898 F.3d 1205, 1207-10 (Fed. Cir. 2018)] (citing cases). [The petitioner in this case] could have appealed and sought such a remand in order to allow the PTAB [to] evaluate the claims and grounds that it raised in its petition on which the PTAB did not institute review. It therefore "reasonably could have raised" those grounds before the PTAB against *any* claim in the [asserted patent], and is estopped from raising them again before this Court.

*SiOnyx*, 330 F. Supp. 3d at 601. Similar circumstances are applicable to certain aspects of this case, and the Court finds the same logic similarly appropriate.

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[8] This legislative history also supports the view that § 315(e)(2) was intended to provide broad estoppel coverage. Statements made by then-Director Kappos during the enactment of the America Invents Act provide the same:

> [i]f I can say that in my own words also, that I believe there are significant advantages for patentees who successfully go through the post-grant system ... because of those estoppel provisions. Those estoppel provisions mean that your patent is largely unchallengeable by the same party.

*America Invents Act: Hearing on H.R. 1249 Before the House Comm. on the Judiciary*, 112th Cong. 52–53 (2011) (statement of Director David Kappos); *see also Tinnus Enterprises, LLC v. Telebrands Corp.*, No. 6:17-CV-00170-RWS, 2018 WL 3993468, at *3 (E.D. Tex. Aug. 21, 2018) (considering Kappos' statements in the context of estoppel due to Post-Grant Review proceedings).

Given the current state of the law, including the dearth of guidance from the Federal Circuit on the issues (particularly in a post-*SAS* IPR landscape) and the Court's consideration of the statutory language, the Court finds that statutory IPR estoppel applies to invalidity grounds that a petitioner "reasonably could have raised" in its IPR petition, which includes prior art that a "'skilled searcher conducting a diligent search reasonably could have been expected to discover.'" *Id.*; *see also Clearlamp*, 2016 WL 4734389, at *7-8; *Douglas*, 2017 WL 1382556, at *5.

B. Application

Defendants do not dispute that: (1) if IPR estoppel applies to them, it applies to all of them (even if, for instance, Apple filed the petitions) and (2) at the time Defendants were filing IPR petitions, they were aware of all the prior art that they now use to support their invalidity arguments for Claims 13 and 22 of the '781 Patent and Claims 11 and 18 of the '032 Patent. *See generally*, Docket No. 772. Aside from their arguments regarding the scope of § 315(e)(2) estoppel, Defendants argue that they are now bringing certain prior art (Divsalar, Frey/Frey Slides, Pfister/Pfister Slides, and Richardson99) under pre-AIA § 102(a), *i.e.*, not as "patents or printed publications," but as information that was "known or used by others" before the patented invention. As Defendants note, in IPR proceedings, the PTAB will only consider patents or printed publications as grounds for invalidity due to anticipation or obviousness. 35 U.S.C. § 311(b); *Synopsis, Inc. v. Mentor Graphics Corp.*, 814 F.3d 1309, 1316 (Fed. Cir. 2016). Because, Defendants argue, they are relying on the "known or used" prong of pre-AIA § 102(a) for all but one[9] of their prior art grounds (*i.e.*, not on prior art patents or printed publications), the prior art could not have been raised during IPR proceedings and IPR estoppel does not apply.

The "pre-AIA" versions of Sections 102 and 103 of the Patent Act apply in this case because each of the Asserted Patents has a priority date that is before the relevant date of enactment

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[9] Defendants raise Ping and Luby98 against Claims 13 and 22 of the '781 Patent. Defendants do not dispute that Ping and Luby98 are printed publications. Under the Court's interpretation of § 315(e)(2), Defendants have provided no independent basis as to why estoppel should not apply to this prior art ground. The Court finds that estoppel precludes Defendants from bringing this prior art ground, irrespective of the analysis in this section.

of the America Invents Act. Pre-AIA § 102(a) states that a person shall be entitled to a patent unless "the invention was known or used ***by others*** in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for patent." 35 U.S.C. § 102(a) (emphasis added). Pre-AIA § 102(b), meanwhile, states that a person shall be entitled to a patent unless "the invention was patented or described in a printed publication . . . more than one year prior to the date of the application for patent." 35 U.S.C. § 102(b). In other words, the two sections complement one another. While pre-AIA § 102(a) referred to information known or used by "others," *i.e.* prior art originating from others besides the patent applicant before the "invention . . . by the applicant," pre-AIA § 102(b) referred to anyone (including the patent applicant and any of the patent applicant's patents or printed publications that were publicly available more than a year before the relevant patent application was filed). Thus, the juxtaposition between § 102(a) and § 102(b) effectively created a one-year grace period for a patent applicant to file a patent application even after s/he/it disclosed information about an invention to the public. Notably, the language of pre-AIA § 102(a) and § 102(b) existed in the context of the pre-AIA first-to-invent system; the America Invents Act has since changed the requirements for obtaining a patent to a first-to-file system.

The "known or used" prong of § 102(a) can come into play in the instance where a scientist gives a public presentation and shows slides, but does not distribute his/her slides or immediately publish a copy of them. The presentation itself (as, for instance, recollected through the scientist's testimony) could still be considered prior art even if the presentation slides were not made "publicly available" at the same time as the presentation. *See Ecolochem, Inc. v. S. California Edison Co.*, 227 F.3d 1361, 1369 (Fed. Cir. 2000) ("A presentation indicative of the state of knowledge and use in this country . . . qualifies as prior art for anticipation purposes under § 102."); *cf. In re Klopfenstein*, 380 F.3d 1345, 1350 (Fed. Cir. 2004) ("The more transient the display, the less likely it is to be considered a 'printed publication.'").

UNITED STATES DISTRICT COURT
CENTRAL DISTRICT OF CALIFORNIA

**CIVIL MINUTES – GENERAL**

Case No. CV 16-3714 GW (AGRx) Date: December 28, 2018

Title *The California Institute of Technology v. Broadcom Limited, et al.*

In comparison, in this case, the prior art that Defendants now assert under the "known or used" prong of § 102(a) includes prior art references that Defendants had included in IPR petitions. Specifically, Defendants represented to the PTAB in various petitions that Divsalar, Frey/Frey Slides, and Pfister Slides were printed prior art publications. Defendants have not withdrawn this assertion, and indeed at the hearing reiterated their belief (particularly with respect to Divsalar) that these prior art documents were publicly available before the time of the invention. This suggests that Defendants would (problematically) seek to avoid estoppel so that they can rely on this prior art as *both* printed publications *and* under the "known and used" prong, depending on what position is ultimately more successful.

Some unique circumstances surround each of the four "references" that Defendants now submit under the "known or used" prong of pre-AIA § 102(a). Thus, they will be individually addressed in turn.

*1. Richardson99*

Unlike Divsalar, Frey/Frey Slides, and Pfister/Pfister Slides, Defendants never raised Richardson99 in an IPR petition. The issue, however, remains that Defendants have maintained that Richardson99 "was published in April of 1999, which is before the filing of the provisional application to which the patents-in-suit claim priority and the alleged conception date." Original Frey Report ¶ 255; Amended Expert Report of Dr. Brenden Frey, Vol. 1 ("Amended Frey Report"), Docket No. 740-25 ¶ 255 (same).

At the hearing, Defendants argued that there has "long been a dispute" about whether authors emailing members of a relevant community with a website link to a paper is sufficient to make the paper a printed publication. Docket No. 826 (Transcript of Hearing on December 6, 2018 ("Dec. Hearing Tr.")) at 21:16-17; *see also* 27:21-28:14. Defendants stated that "what Dr. Frey did in his report was treat [Richardson99] as either a printed publication *or* evidence of what was known or used in the art based on Richardson99." *Id.* at 21:17-20 (emphasis added). Defendants arguments, however, for bringing Richardson99 under the "known or used prong" ring like an argument as to whether Richardson99 was publicly available (*i.e.*, qualified as a printed publication). *See id.* at 22:22-25 ("[Frey] is looking at what would a person of ordinary skill in the 1999 period have known, and he is saying ***Richardson99 is one of the references that would have been known***." (emphasis added)). Importantly, as Plaintiff notes, "the standard for establishing a reference as a 'printed publication' is substantively the same as meeting the 'known or used' standard of 35 U.S.C. § 102(a), at least when the only prior art at issue is a written document." Docket No. 798 at 5. Specifically, under the "known or used" prong, the relevant material must still be "publicly accessible." *Minnesota Min. & Mfg. Co. v. Chemque, Inc.*, 303 F.3d 1294, 1306 (Fed. Cir. 2002) ("For prior art to anticipate because it is 'known,' the knowledge must be publicly accessible."); *Bruckelmyer v. Ground Heaters, Inc.*, 445 F.3d 1374, 1378 (Fed. Cir. 2006) ("Whether a given reference is a 'printed publication' depends on whether it was 'publicly accessible' during the prior period."). In other words, to the extent Defendants would assert that Richardson99 is not a printed publication because it was not publicly accessible, an argument that Richardson99 is prior art "known or used" before the invention would also fail. Although Defendants generally addressed their goal to demonstrate what was "known" at the time of the invention, Defendants did not directly address the issue of the applicability of the same "public availability" standard to both printed publications and "known or used" prior art at the hearing.

Defendants also suggested at the hearing that rather than being used as a printed publication, they are using Richardson99 as a "contemporaneous writing from 1999 that would corroborate what was [known or] used" at the time. *Id.* at 29:4-9. This position, however, is not supported by the Frey Reports, which evaluate Richardson99 like a printed publication rather than relying on it to corroborate the testimony of the authors or others. *See, e.g.*, Original Frey Report ¶ 443 (explaining what Richardson99 "states" and "teaches," including by citing to portions of the Richardson99 document); *see also* Amended Frey Report ¶ 443 (same); *but see* Dec. Hearing Tr. 22:15-25 (referring to paragraph 443 of the Frey Report as supporting Frey performing a "known

UNITED STATES DISTRICT COURT
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or used" analysis of Richardson99). Defendants' invalidity analysis relies on Richardson99 as disclosing certain limitations in the relevant asserted claims, not on Richardson99 as confirming the testimony of a person regarding knowledge during the relevant timeframe. Defendants' position is not persuasive.

Particularly because Defendants have maintained their argument that Richardson99 is a printed publication, they have not provided a sufficient basis to show that IPR estoppel should not apply to this reference or grounds that include this reference in this case.

*2. Divsalar*

Divsalar was fully considered by the PTAB in a Final Written Decision for an IPR proceeding. Defendants note, however, that the Final Written Decision never resolved Plaintiff's challenge to whether Divsalar was publicly available at the time of the invention. The PTAB found Plaintiff's challenge was "ultimately mooted" because even considering Defendants' prior art obviousness combination, including Divsalar, on the merits, Defendants failed to show the relevant claims were unpatentable. Docket No. 767-6 (IPR2017-00701, Paper 67) at 29; *see also* Docket No. 772 at 6-7. In other words, the PTAB fully considered the Divsalar prior art reference on the merits as part of the IPR proceeding.

The parties did not spend much time addressing the Divsalar reference at the hearing,[10] although the Court's tentative order expressed concerns regarding the PTAB's full consideration of that reference. The Court acknowledges the unique record created by the PTAB's decision.

[10] Defendants identify emails from Frey to Divsalar to support their position that certain invalidity arguments are being raised under the "known or used" prong of pre-AIA § 102(a). *See* Dec. Hearing Tr. 30:4-31:6. These emails will be discussed in a separate section regarding the specific prior art ground involving both Frey/Frey Slides and Divsalar. *See, e.g.*, Original Frey Report ¶ 310 ("I remember thinking that Divsalar's work would benefit from the work that David MacKay and I had completed on irregular turbo-codes."); Amended Frey Report ¶ 310; Dec. Hearing Tr. 29:10-16 (stating, "[r]elatedly, just to give . . . a flavor of the evidence . . . the combination that is asserted is the Frey Slides and the Divsalar paper" and proceeding to consider the emails from Frey to Divsalar). Neither the Frey Reports nor Defendants' statements at the hearing provided a basis as to how/why the emails and testimony as between Frey and Divsalar would be relevant to any of the other prior art grounds raised by Defendants. Thus, they are only addressed in the context of that single ground.

However, as with Richardson99, Defendants still maintain their argument that Divsalar is a printed publication in addition to making their argument under the "known or used" prong. Original Frey Report ¶ 309 ("RA codes are described in detail in references such as Divsalar, published more than a year before the alleged conception date of the patents-in-suit."); Amended Frey Report ¶ 309. And again, it appears that Defendants' main basis for now arguing that Divsalar may not qualify as a printed publication relates to public accessibility, which would still remain a problem under the "known or used" prong.[11] Finally, again as with Richardson99, Frey's analysis does not rely on the Divsalar reference as if it is corroborative of some other testimony or knowledge; the Divsalar reference itself forms the basis for the invalidity opinions. These facts again tip the scale to the conclusion that estoppel should generally apply as to this reference and many of the grounds that include this reference in this case.

*3. Frey/Frey Slides [in combination with Divsalar, & Ping]*

At the hearing, Defendants referred to some specific testimony and evidence to support their argument that they are relying on the "known or used" prong of pre-AIA § 102(a) for some of their prior art. Specifically, Defendants identified emails between Frey and Divsalar showing that the two had considered combining the ideas expressed in each of their work. Defendants also submitted deposition testimony from Frey/Divsalar discussing these emails. At the hearing, Plaintiff did not meaningfully respond to Defendants' presentation of this evidence or explain why estoppel should be applied specifically to this invalidity ground.

Although Defendants referred to this example as providing a "flavor" of the evidence they intend to present under the known or used prong, the evidence relating to this prior art ground appears to be an outlier. Frey discusses the emails in his reports. *See* Original Frey Report ¶¶ 310, 481; Amended Frey Report ¶¶ 310, 481. This is unique from the evidence Frey identifies when

[11] Defendants' arguments regarding Divsalar are particularly unpersuasive as to Defendants' prior art ground of Ping in view of MacKay, Divsalar, and Luby97. This is the exact ground considered by the PTAB in its final written decision. Defendants argue that its ground in this case is meaningfully different because Divsalar is being presented under the "known or used" prong. Defendants do not present any evidence to support this assertion.

discussing other prior art, which almost all[12] relates to establishing the publication date of that particular prior art. *See, e.g.*, Original Frey Report ¶¶ 230 (listing evidence to support that the Frey Paper was published and available by a certain date); 245 (same as to Pfister); ¶ 255 (same as to Richardson99); *see also* Amended Frey Report ¶¶ 230, 245, 255.

The Court has some lingering questions regarding the emails and testimony submitted by Defendants with regard to this prior art ground. Namely, this evidence appears to more closely relate to establishing a reason to combine two prior art printed publications than to showing that certain elements of the claims were "known or used" at the time of the invention apart from via printed publications. Problems with the "public accessibility" of the knowledge implicated by the emails and testimony also abound. However, because this issue has not been squarely addressed by Plaintiff, and given the nature of the additional evidence submitted by Defendants, the Court will not extend estoppel to this particular prior art ground at this time.

The Frey/Frey Slides only appear in this prior art ground. The parties presented additional arguments regarding the Frey/Frey Slides in their briefing and at the hearing. For instance, although Defendants did not include the Frey/Frey Slides in their IPR petitions as to the '781 and '032 Patent, the opposition acknowledges that they included "Frey" (the Frey Paper) in IPR petitions for the '710 Patent. Docket No. 772 at 8. In other words, Defendants represented to the PTAB that they believe Frey is a prior art printed publication.[13] They have not withdrawn arguments regarding the Frey/Frey Slides from consideration in the IPR proceedings. This is also

[12] The only other listed evidence in the Frey Reports is used to establish that, for instance, slides were presented at conferences. Under other circumstances, the Frey Slides and Pfister Slides, particularly if they had been submitted alone rather than in combination with papers that Defendants continue to insist were published before the date of the invention, could have presented unique issues warranting further consideration under the "known or used" prong. However, as discussed in the following section, Defendants have particularly offered up the Pfister Slides as printed publications before the PTAB in IPR petitions.

[13] At the hearing, Plaintiff submitted that Defendants included both the Frey Paper and Frey Slides in IPR petitions, but only Frey was "instituted as [a] printed publication."

consistent with how Defendants previously treated Frey/Frey Slides in this case. *See, e.g.*, Docket No. 673 at 9 (Order re Motion to Strike-In-Part Frey's Invalidity Opinions, quoting from Original Frey Report as maintaining the initial opinion that the Frey Paper is prior art, where the Frey Report stated, "[i]n the event that the Court finds that the patents-in-suit are entitled to a date of invention that predates the publication of Frey, and the Frey paper is deemed not to be prior art to the patents-in-suit, then the Frey Slides may be substituted for the Frey paper.").[14] Defendants note, however, that because a final written decision has not been received in an IPR as to the '710 Patent, it is possible the PTAB will find Frey is not a printed publication, making estoppel inappropriate. Although notable, these additional comments are ultimately irrelevant. Because of the additional emails and testimony submitted by Defendants for this particular prior art ground, estoppel will not be applied to preclude Defendants from relying on this prior art ground at this time.

4. *Pfister/Pfister Slides*

Defendants relied on the Pfister Slides in IPR petitions brought against the '781 and '032 Patents. In its initial institution decision, prior to *SAS*, the PTAB partially instituted IPR, but denied institution on the basis of the Pfister Slides. Defendants characterize the record as showing that the PTAB "found" that the Pfister Slides did not qualify as a prior art printed publication. Docket No. 772 at 6. In reality, the PTAB simply found that Defendants had failed to meet their *burden* of making a threshold showing that the Pfister Slides qualified as a printed publication. *See, e.g.*, Docket No. 740-12 at 23-24 (IPR2017-00700, Paper 14) ("With respect to the Pfister Slides, Petitioner fails to meet the burden imposed under § 314(a) to establish in its Petition a reasonable likelihood of success, which includes, among other things, making a threshold showing that the Pfister Slides qualify as a prior art printed publication."). More importantly, Plaintiff

[14] Notably, Frey's Amended Expert Report does not include this same statement regarding substituting the Frey Slides for the Frey Paper. *Compare* Original Frey Report ¶ 242, *with* Amended Frey Report ¶¶ 225-241. The rest of the Amended Frey Report's introductory discussion of Frey/Frey Slides is almost word-for-word the same compared to the Original Frey Report. *Compare* Original Frey Report ¶¶ 225-241 *with* Amended Frey Report ¶¶ 225-241.

observes that after *SAS*, "the PTAB modified its order to include all of the claims Defendants had attempted to raise, including the one based on Pfister Slides . . . . Defendants chose not to pursue them, instead proposing a stipulation that limited the claims the PTAB would consider." Docket No. 798 at 8.

At the hearing, Defendants argued that the PTAB's preliminary decision not to institute IPR as to the Pfister Slides supports the conclusion that Defendants should not be estopped from raising prior art grounds that include the Pfister Slides. But what this record shows is that Defendants had the opportunity to have their arguments regarding the Pfister Slides fully heard by the PTAB (including a second opportunity to meet their burden of showing that the Pfister Slides qualified as a prior art printed publication), yet chose not to take it. For the same reasons the district court found persuasive in *SiOnyx*, it is inappropriate to allow Defendants to have a second bite at the apple here, particularly when they opted not to exhaust all of their available administrative remedies on the issue.

In their opposition, Defendants referred to the Pfister/Pfister Slides as their primary example of how they intended to employ "known or used" prior art:

> The Pfister Paper and Pfister Slides, as well as Dr. Siegel and Dr. Pfister's testimony, will illustrate that RAA codes disclosed many elements of the asserted claims that, in combination with other references, render the patents-in-suit invalid. By presenting the slides at the Allerton Conference, Dr. Pfister and Dr. Siegel made RAA codes known to persons of ordinary skill in the art in the United States, and Dr. Pfister and Dr. Siegel used RAA codes in the United States, while working on the Pfister paper. Thus, regardless of whether the Pfister Paper and Pfister Slides were published prior to the invention of the patents-in-suit (which Caltech disputes), Defendants have ample evidence to show that the invention described in the Pfister Paper and Pfister Slides (*i.e.* RAA codes) was known and used in the United States prior to the invention of the patents-in-suit.

Docket No. 772 at 21-22. At the hearing, Defendants similarly suggested that the Pfister Slides had been presented under circumstances like the hypothetical presented in the Court's tentative order: Pfister had shown these slides to the "who's who" in error correction coding at a conference in 1999, even if Defendants cannot prove publication. But Defendants have not withdrawn the position they advanced before the PTAB that the slides were publicly available prior art printed publications. As with the other "references," the Frey Reports also do not consider the slides as if they are simply corroborating evidence. The Frey Reports again treat the documents themselves as the core evidentiary basis supporting the invalidity theory. This is apparent even from the language in Defendants' opposition, which again focus in on the disclosure provided in the Pfister Paper and Pfister Slide documents themselves.[15] On such a record, estoppel is appropriate.

The Court notes that only the Pfister Slides and not the Pfister Paper were included in IPR petitions submitted by Defendants to the PTAB. This does not change the outcome regarding estoppel, particularly because Defendants have put even heavier emphasis on characterizing the Pfister Paper as a printed publication compared to the Pfister Slides. *See* Original Frey Report ¶ 245; Amended Frey Report ¶ 245.

Defendants argue that their bundling of Pfister and the Pfister Slides supports the conclusion that they are relying on the "known or used" prong of pre-AIA § 102(a) rather than relying on this prior art as a printed publication. Docket No. 772 at 24. Defendants' decision to bundle these two documents has received ongoing objection from Plaintiff and has been touched

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[15] In reply, Plaintiff also notes that:

> none of this purported testimony has been previously disclosed or identified. If Defendants wished to rely on testimony concerning these or other papers to support Dr. Frey's invalidity opinions, they should have disclosed such testimony in fact discovery and in the Frey Report . . . . Although they attempt to rely on the expert report of Dr. Paul Siegel, in the cited portions of his report, Dr. Siegel merely explains the contents of his slide presentation, and the circumstances of its presentation; Defendants do not identify anything that could not reasonably have been raised during the IPR.

Docket No. 798 at 19-20.

on but never fully resolved by the Court.[16] *See, e.g.*, Docket No. 673 at 9 (Court's Tentative Order regarding Motion to Strike-In-Part Invalidity Contentions, modified as stated in minutes and on the record). Notably, in evaluating the Original Frey Report and its references to the Frey/Frey Slides, including that the Frey Slides could be *substituted for* the Frey Paper in the invalidity analysis (*see* Original Frey Report ¶ 242), the Court previously commented:

> This is not the language of an expert purporting to use the Frey Paper/Frey Slides as a single reference. Instead, Defendants/Frey appear to be hedging their bets and trying to maintain two alternative prior art references until a priority date dispute is resolved. Indeed, if it is true as Defendants assert that the "disclosures in the papers and slides are materially the same for purposes of invalidity," (Docket No. 616 at 25), Defendants need to just make their selection[.]

*Id.* Although the Court ultimately allowed Defendants a second attempt to submit an amended Frey report relying on these two references in a bundle, particularly Defendants' assertions − that they were bundling because they were waiting for a priority date issue to be resolved (*see id.*) and that the "disclosures in the papers and slides are materially the same for purposes of invalidity" − remain relevant and support the Court's conclusion that estoppel is appropriate.

*5. Further Thoughts on the Four References*

As Plaintiff notes, one of Defendants' arguments in its opposition for relying on the "known or used" prong of pre-AIA § 102(a) relates to the fact that *Plaintiff*, ***after*** Defendants filed their IPR petitions, challenged whether certain prior art references in the IPR petitions were entitled to a publication date earlier than the effective filing date of the Asserted Patents. The Court agrees with Plaintiff that the relevant focus in evaluating estoppel should be on Defendants'

[16] Defendants assert that "the Court has already authorized Defendants' presentation of the Pfister and Pfister Slides and Frey and Frey Slides as evidence of inventions 'known or used in the United States' under 35 U.S.C. § 102(a)." Docket No. 772 at 13. Although Defendants asserted that their bundling was appropriate at the hearing on the motion to strike and were given the opportunity to submit a supplemental expert report consistent with that position, a final determination as to Defendants' bundling could not be made at that time because the Original Frey Report did not actually consider, for instance, the Frey Paper and Frey Slides together in a meaningful way. Defendants' "notice" on the docket (*see* Docket No. 682) does not change this conclusion.

actions, not Plaintiff's actions, particularly where Defendants continue to argue that Divsalar, Richardson99, Frey/Frey Slides, and Pfister/Pfister Slides are printed publications.

At the hearing, Defendants also emphasized an analogy to a circumstance where a petitioner submits a product manual as printed publication prior art before the PTAB, but is not estopped from submitting a prior art product itself in district court litigation. Even in these circumstances, district courts have sometimes looked skeptically on "dressing up a ground based on publicly available datasheets as a ground based on a product." *SiOnyx*, 330 F. Supp. 3d at 603 (citing *Milwaukee Electric*, 271 F. Supp. 3d at 1032; *Clearlamp*, 2016 WL 4734389, at *9). The district court in *SiOnyx* found that estoppel would not apply to a prior art obviousness invalidity ground involving a product, noting that the defendants had consistently relied on a certain aspect of the product, as reflected in a potentially non-public manufacturing specification, as "the only citation for certain claim limitations." *Id.* at 603-04; *see also Star Envirotech, Inc. v. Redline Detection, LLC*, No. SACV 12-01861 JGB (DFMx), 2015 WL 4744394, at *4 (C.D. Cal. Jan. 29, 2015) ("the physical machine itself discloses features claimed in the ′808 Patent that are not included in the instruction manual, and it is therefore a superior and separate reference."). *Milwaukee Electric* similarly expressed concerns that the defendant should not be allowed to "skirt" estoppel "by purporting to rely on a device without actually relying on the device itself," but otherwise found that estoppel would not extend to prior art grounds including products. *Milwaukee Electric*, 271 F. Supp. 3d at 1032. In *Clearlamp*, the district court found that defendant was attempting to "cloak" its prior art ground based on a datasheet by characterizing it as related to a product itself. *Clearlamp*, 2016 WL 4734389, at *9. Although the district court found this was not appropriate, estoppel did not attach because the plaintiff failed to meet its burden of showing that the product datasheet could have been found by a searcher performing a reasonable search at the time the IPR petition was prepared. *Id.* at *9-10.

The Court notes that each of these cases ultimately declined to extend estoppel to prior art grounds involving a product. The current case offers unique circumstances compared to those

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surrounding a product versus a product manual. In this case, whether brought as a "printed publication" or under the "known or used" prong, the core element that forms the basis of Defendants' prior art includes the same document(s). There is not even a separate and distinct product or document that could be used as the "cloak" to shield Defendants. Moreover, although Defendants assert that there will be a "meaningful difference" in the invalidity presentation under the "known or used" prong, Defendants have not presented sufficient evidence to back that assertion. The Frey Reports show that Defendants still rely on the teachings of the documents themselves to demonstrate that particular claim limitations were taught by the prior art. *See, e.g.*, Amended Frey Report ¶ 245 ("Pfister/Pfister Slides ***explicitly builds on*** the disclosure of Divsalar . . . "), ¶ 246 ("On page 8, Pfister ***illustrates*** . . . "), ¶ 248 ("Likewise, Pfister Slides ***illustrate*** . . ."), ¶ 250 ("A person of ordinary skill in the art would have understood that Pfister/Pfister Slides ***discloses*** a regular code."); Original Frey Report ¶¶ 367-69 (stating "Pfister/Pfister Slides ***discloses*** this limitation" and citing to specific portions of the Pfister Paper and Pfister Slides), ¶ 468 ("incorporating the second accumulator would have been obvious because second accumulators were a known technique ***as disclosed in*** Pfister/Pfister Slides . . ."); ( *see also* Docket No. 767-15 at 5 (Defendants' Final Invalidity Contentions, stating, "[t]he disclosures and inventions ***of these [prior art] references*** were known or used in the United States prior to the invention of the patents-in-suit."). Notably, Defendants do not assert that some evidence beyond the documents supplies missing disclosure related to a particular claim limitation. Defendants have not identified, for instance, circumstances where the only citation for a limitation relies on testimony of a contemporary in the field at the time of the invention. As Plaintiff put it at the hearing, all of Defendants' actual arguments to show that certain limitations were disclosed in the prior art "emanate" from the documents.

The issue may also have been a closer call were Defendants willing to concede that this prior art was not publicly available at the time of the invention. Having refused to withdraw that position, it would be inappropriate to allow Defendants to bypass statutory estoppel as to these references.

After considering the unique facts of this case, including the specific prior art grounds Defendants seek to characterize, in general the Court is not persuaded by Defendants' argument that it is shielded from statutory IPR estoppel by its references to the "known or used" prong of § 102(a). Accordingly, the Court finds that statutory IPR estoppel applies to each of the obviousness combinations Defendants has raised in district court litigation against Claims 13 and 22 of the '781 Patent and Claims 11 and 18 of the '032 Patent except for their invalidity ground against Claims 13 and 22 of the '781 Patent based on Divsalar, Frey/Frey Slides, and Ping.

**V. Conclusion**

For the reasons stated in this Order, the Court **GRANTS** Plaintiff's Motion for Summary Judgment (Docket No. 740) except as to Defendants' invalidity ground against Claims 13 and 22 of the '781 Patent based on Divsalar, Frey/Frey Slides, and Ping.[17]

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[17] At the hearing, Defendants suggested that if the Court were to maintain its tentative views on Plaintiff's summary judgment motion, Defendants would request that the issue be certified for interlocutory appeal. Plaintiff did not respond to Defendants' position at the hearing. Although the Court indicated that Defendants remain free to proceed with the application, to the extent Defendants maintain their intent to seek certification for interlocutory appeal, they will need to confer with Plaintiff on the issue and formally raise any related requests with the Court through the proper procedures.

UNITED STATES DISTRICT COURT
CENTRAL DISTRICT OF CALIFORNIA

**CIVIL MINUTES - GENERAL**

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| Case No. | CV 16-3714-GW (AGRx) | Date | January 18, 2019 |
| Title | *The California Institute of Technology v. Broadcom Limited, et al.* | | |

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| Present: The Honorable | GEORGE H. WU, UNITED STATES DISTRICT JUDGE |

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|---|---|---|
| Javier Gonzalez | None Present | |
| Deputy Clerk | Court Reporter / Recorder | Tape No. |

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| Attorneys Present for Plaintiffs: | Attorneys Present for Defendants: |
| None Present | None Present |

**PROCEEDINGS:** **IN CHAMBERS - FINAL RULING ON DEFENDANTS' MOTION FOR SUMMARY JUDGMENT OF INVALIDITY UNDER 35 U.S.C. § 101 OF ASSERTED CLAIMS OF U.S. PATENT NO.7,916,781**

Attached hereto is the Court's Final Ruling on Defendants' Motion for Summary Judgment Under 35 U.S.C. § 101 of Asserted Claims of U.S. Patent No.7,916,781 – After Consideration of Parties' Supplemental Briefing and Evidence, Including Evidence Presented at November 15, 2018 Hearing and Argument Presented at December 6, 2018 Hearing. Defendant's Renewed § 101 Motion is DENIED.

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***The California Institute of Technology v. Broadcom Limited et al.***; Case No. 2:16-cv-03714-GW-(AGRx)
Final Ruling on Defendants' Motion for Summary Judgment of Invalidity Under 35 U.S.C. § 101 of Asserted Claims of U.S. Patent No.7,916,781 − after Consideration of Parties' Supplemental Briefing and Evidence, Including Evidence Presented at November 15, 2018 Hearing and Argument Presented at December 6, 2018 Hearing

## I. Introduction

Plaintiff The California Institute of Technology currently alleges patent infringement against Defendants Broadcom Limited, Broadcom Corporation, Avago Technologies Limited, and Apple Inc.[1] *See* First Amended Complaint ("FAC"), Docket No. 36; *see also* Docket No. 1. Plaintiff asserts that Defendants infringe fifteen claims from three of its patents: (1) U.S. Patent No. 7,116,710 ("the '710 Patent"); (2) U.S. Patent No. 7,421,032 ("the '032 Patent"); and (3) U.S. Patent No. 7,916,781 ("the '781 Patent") (collectively, the "Asserted Patents").[2] *See* Docket No. 409 (Plaintiff's Amended Notice of Withdrawal of Certain Asserted Claims of Asserted Patents).

Defendants have moved for summary judgment of invalidity under 35 U.S.C. § 101 with respect to the asserted claims of the '781 Patent. *See generally* Docket No. 544; *see also* Docket No. 596 (Plaintiff's Opposition), Docket No. 604 (Defendants' Reply), Docket No. 604-1 (Defendants' Response to Caltech's Statement of Genuine Disputes). A hearing was held in August 2018 on the motion[3] and the parties were ordered to submit supplemental briefing addressing the Court's questions related to the proper scope of the relevant claims. The parties filed opening supplemental briefs and evidence on October 4, 2018. *See* Docket No. 733 (Plaintiff's Sealed Opening Supplemental Brief); Docket No. 714 (Defendants' Opening Supplemental Brief). The parties filed responsive supplemental briefs on October 18, 2018. Docket No. 742 (Plaintiff's Responsive Supplemental Brief); Docket No. 741 (Defendants'

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[1] Cypress Semiconductor Corporation was also previously named as a defendant in this case, but the parties filed a Joint Stipulation for Dismissal of all claims between them on September 7, 2018. Docket No. 665.

[2] The fifteen remaining claims in this case are: Claims 20, 22, and 23 of the '710 Patent; Claims 3, 11, 13, 17, and 18 of the '032 Patent; and Claims 5, 6, 9, 10, 13, 19, and 22 of the '781 Patent. Docket No. 409. Of those claims, eleven were selected as representative claims for purposes of adjudication in this lawsuit: Claims 20, 22, and 23 of the '710 Patent; Claims 3, 11, 17, and 18 of the '032 Patent; and Claims 6, 9, 13, and 22 of the '781 Patent. *See id.*; *see also* Docket No. 487, 488. On October 1, 2018, Plaintiff filed a Notice of Withdrawal of Claim 6 of the '781 Patent. Docket No. 705. However, Plaintiff's notice is vague as to whether it solely seeks to withdraw Claim 6 of the '781 Patent as one of the eleven claims selected for purposes of adjudication or whether it seeks to withdraw Claim 6 from the lawsuit entirely.

[3] At the August 30, 2018 hearing, the Court provided the parties with a tentative ruling wherein it indicated that it would deny the motion because of "concerns" it expressed therein. *See* Docket No. 660.

Responsive Supplemental Brief). Another hearing was held on the motion[4] in November 2018, where the parties submitted argument as well as expert testimony. Additional supplemental briefs were filed at the Court's direction. Docket Nos. 809; 812. Plaintiff also filed a Notice of Supplemental Authority identifying the Federal Circuit's recent decision in *Ancora Techs., Inc. v. HTC Am., Inc.*, No. 2018-1404, 2018 WL 6005021 (Fed. Cir. Nov. 16, 2018). Docket No. 811; *see also* Docket No. 819 (Defendants' Response to Plaintiff's Notice of Supplemental Authority).

On December 6, 2018, after a hearing on other pending motions, the parties were also asked to respond to some further thoughts raised by the Court regarding the Motion. Docket No. 828 at ECF1, ECF22-25; *see also* Docket No. 828 (Hearing Transcript for December 6, 2018 ("Dec. Hearing Tr.")).

For the reasons stated in this Order, Defendants' Motion is **DENIED**.

## II. Procedural History

This case was filed on May 26, 2016. *See* Docket No. 1. In February 2017, Defendants filed a summary judgment motion where they similarly argued that the asserted claims of the '781 Patent were invalid under 35 U.S.C. § 101. Docket No. 108. A hearing was held on April 20, 2017, and the Court circulated a tentative ruling denying the motion. Docket No. 171, 176. At the hearing, the Court concluded that it would be appropriate to proceed to a technology tutorial and claim construction hearing regarding all of the asserted patents before issuing a final ruling on the § 101 motion. Docket No. 176 at 53:19-54:13. Claim construction proceedings were completed in July 2017. Docket No. 213. In the final claim construction order, the Court considered *inter alia* the parties' disputes regarding three terms from the '781 Patent: "codeword," "at least two of the information bits appear in three subsets," and "information bits." *Id.* at 25-31. The Court determined that no construction was necessary for any of these terms. *Id.* Later that month, the parties submitted a joint report that proposed a schedule setting new dates. Docket No. 217. The report did not otherwise reference the § 101 motion or re-raise the dispute. In June 2018, the Court sought the parties' positions regarding whether they continued to dispute the validity of the asserted claims of the '781 Patent under § 101. Docket No. 525; *see also* Docket No. 531. Defendants subsequently filed their current § 101 Motion. Docket No. 544.

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[4] At the November 15, 2018 hearing, the Court provided the parties with another tentative ruling wherein it indicated that it would deny the motion on the merits and find the challenged claims patent eligible. Docket No. 784.

## III. Technical Background

The technology disclosed in the Asserted Patents has been summarized many times before, both by the courts and the Patent Trial and Appeal Board. Although the Court provides a summary of the relevant technical background related to the '781 Patent in this Order, additional information may be found, for example, in this Court's April 2017 tentative order denying Defendants' previous § 101 Motion[5] (Docket No. 171), as well as in Judge Pfaelzer's Order denying a § 101 motion brought against the Asserted Patents by defendants in an earlier case. *California Inst. of Tech. v. Hughes Commc'ns Inc.*, 59 F. Supp. 3d 974, 977-78 (C.D. Cal. 2014) (hereinafter, "*Hughes*")[6]; *see also Hughes Network Sys., LLC v. Cal. Institute of Tech.*, IPR2015-00059, 2016 WL 3598282, at *1 (Patent Tr. & App. Bd. Apr. 21, 2016)

The Asserted Patents trace their priority to U.S. Provisional Application Serial No. 60/205,095, filed May 18, 2000, and U.S. Application Serial No. 09/922,852, filed August 18, 2000 (now U.S. Patent No. 7,089,477). *See* '710 Patent at 1:8-10; '032 Patent at 1:8-13; '781 Patent at 1:8-15. They share a common specification.

As the Court explained in its previous tentative order on this issue, the Institute of Electrical and Electronics Engineers ("IEEE") developed Wi-Fi, the industry standard for wireless communications over local area networks. *See* Docket No. 36 (FAC) ¶ 30. Wi-Fi usage is widespread in modern electronic products such as smartphones and laptops. *Id.* The IEEE Wi-Fi standards are set forth in IEEE 802.11. *See id.* ¶ 31. Some of the key improvements to the Wi-Fi standard – specifically: (1) the 802.11n version, which includes a high throughput mode that is implemented using a specific type of Low-Density Parity Check ("LDPC"), and (2) the 802.11ac version, which includes a very high throughput mode – include irregular repeat and accumulate

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[5] Although the Court references the tentative order for purposes of providing further technical background information related to the '781 Patent, the ultimate determinations in that tentative order have not been adopted as the final ruling of the Court and are not adopted as the final ruling of the Court by means of this reference.

[6] Although the Court references the *Hughes* Order for purposes of providing further technical background information related to the '781 Patent and based on some of its other analysis of § 101 issues, the ultimate determinations in the *Hughes* Order (specifically, that the claims are abstract at *Alice* Step 1, yet patent-eligible based on analysis at *Alice* Step 2) have not been adopted as the final ruling of the Court and are not adopted as the final ruling of the Court by means of these references. The *Hughes* Order was issued before certain other Federal Circuit decisions that refined the Step 1/2 analysis and clarified that claims directed to technological improvements are not abstract at *Alice* Step 1. *See, e.g.*, *McRO, Inc. v. Bandai Namco Games Am. Inc.*, 837 F.3d 1299, 1314 (Fed. Cir. 2016) ("We therefore look to whether the claims in these patents focus on a specific means or method that improves the relevant technology or are instead directed to a result or effect that itself is the abstract idea and merely invoke generic processes and machinery.").

operations, and therefore implemented Plaintiff's patented technology.[7] *See id.* ¶¶ 32-33.

More particularly, the specification purports to disclose solutions for reliable yet efficient data signal transmission over a digital communication channel, specifically by disclosing improved ways to protect data from loss due to transmission errors. *See generally* '781 Patent at 1:29-2:16. The Asserted Patents describe ensuring reliability by repeating/manipulating "information bits," *i.e.* binary digits "0" and "1," to generate error correction codes that are then transmitted along with the original information bits. *See, e.g.*, *id.* at 2:41-46. Repeating every information bit would significantly insulate transmitted data from errors, but it would also significantly increase the size of data, slowing data transmission speeds. *Id.* at 1:29-43; *see also Hughes*, 59 F. Supp. 3d at 978 ("Although greater repetition of every bit would allow for better error correction, it would also force the transmitter to send more bits, decreasing the coding rate and increasing data transfer time."). The Asserted Patents attempt to strike a balance by describing methods of generating "irregular repeat and accumulate" ("IRA") error correction codes. *See generally id.*; *see also id.* at 2:41-46; 3:34-37; *id.*, Abstract. Rather than duplicate every information bit, according to the Asserted Patents, the information bits may first be split into smaller data blocks where information bits are repeated in a particular, irregular way. *Id.* at 1:63-2:3. The information bits may then be further manipulated (such as by scrambling) before they are used to create other bits, including "parity bits" and "codewords." *Id.* "Parity bits" are bits created by summing or otherwise evaluating the original information bits (and potentially other parity bits) in a certain way to create a bit that reflects the value of the selection of original information bits. *Id.* at 4:4-15. "Parity bits" may be combined together to create a "codeword." *Id.* at 4:24-45. "Codewords" can alternatively include a combination of both parity bits and additional information bits. These codewords/parity bits are eventually used to double check whether errors have occurred in the original information bit sequence during data encoding/transmission/decoding (and potentially correct those errors).

Judge Pfaelzer has described these concepts in a similar way, explaining that after the original information bits are irregularly repeated, in one example, they:

> may then be randomly permuted and combined to form intermediate bits, which are accumulated to form parity bits. Parity bits reflect the values of a

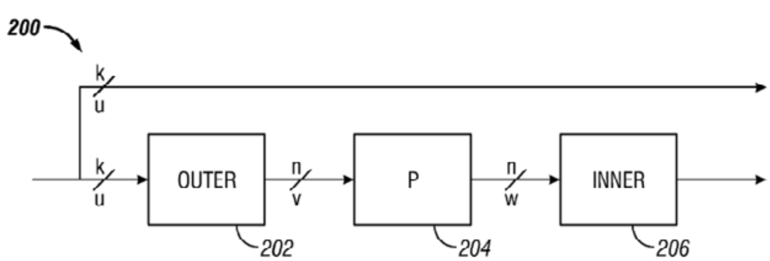
---

[7] As set out in the '781 Patent, "[t]he Government has a paid-up license in this invention and the right in limited circumstances to require the patent owner to license others on reasonable terms as provided for by the terms of Grant No. CCR-9804793 awarded by the National Science Foundation." '781 Patent at 1:19-25.

> selection of original information bits. These parity bits are transmitted along with the original information bits. The receiver ensures that the received original information bits were not corrupted during transmission. It can do this by modulo-2 ("mod-2") adding the original information bits and parity bits. The receiver knows whether this sum is supposed to be odd or even. If the sum is supposed to be odd but is instead even, the receiver will know that an error occurred and can perhaps correct the error using other information it has received.

*Hughes*, 59 F. Supp. 3d at 978. According to the asserted patents, IRA codes aim to both minimize errors and maintain a transmission rate close to the theoretical limit of the amount of data that a channel can carry. *See, e.g.*, '781 Patent at 2:54-64.

As explained in the Court's April 2017 tentative order, the specification section of the '781 Patent specifically describes two embodiments for an IRA coding system:

> The specification discloses an embodiment of the IRA coding system that includes an outer coder 202, an interleaver 204, and an inner coder 206. *See* '781 Patent at Fig. 2.[2]
>
> [2] [Footnote in original] The specification also appears to indicate that the outer coder may encompass the interleaver, the component that scrambles bits. *Compare id.* at 2:3-5 ("The coding system includes an outer coder, which repeats and *scrambles* bits in the data block. The data block is apportioned into two or more sub-blocks, and bits in different sub-blocks are repeated a different number of times according to a selected degree profile. The outer coder may include a repeater with a variable rate and an *interleaver*.") (emphases added); *with id.* at 2:40-41 ("The coder 200 may include an outer coder 202, an interleaver 204, and inner coder 206."), 2:56-58 ("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.").
>
> 
> 
>
> FIG. 2
>
> In that embodiment, reproduced above, the outer coder 202 receives an un-encoded data block containing a fixed number of original information bits, which it then repeats, acting as a repeater. *See id.* at 1:65-67, 2:50-51. The outer coder has an irregular output, which means that different bits in the data block may be repeated a different number of times. *See id.* at 2:58-60; *see also id.* at 2:60-64 ("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 interleaver 204 then scrambles (or rearranges) the bits. *See id.* at 3:29-33. Finally, the inner coder 206 recursively performs exclusive-OR or modulo-two logical operations on the bits it receives from the interleaver, generating the "accumulate code." *Id.* at 3:3-24; *see also* at 2:7-10 ("The repeated and scrambled bits are input to an inner coder that has a rate substantially close to one. The inner coder may include one or more accumulators that perform recursive modulo two addition operations on the input bit stream."). It is the "serial concatenation" of the interleaved irregular repeat code and the accumulate code that produces the IRA code, which is transmitted over the communication channel along with the original information bits. *See id.* at 3:34-36; *see also id.* at 2:11-13 ("The encoded data output from the inner coder may be transmitted on a channel and decoded in linear time at a destination using iterative decoding techniques.").

The specification also discloses an alternate embodiment, reproduced below, where the outer coder may be a low-density generator matrix ("LDGM") coder. *See id.* at Fig. 4. The IRA code in that case is produced by a serial concatenation of the LDGM code and the accumulator code, and the interleaver may be excluded as unnecessary. *See id.* at 3:65-4:1-3.

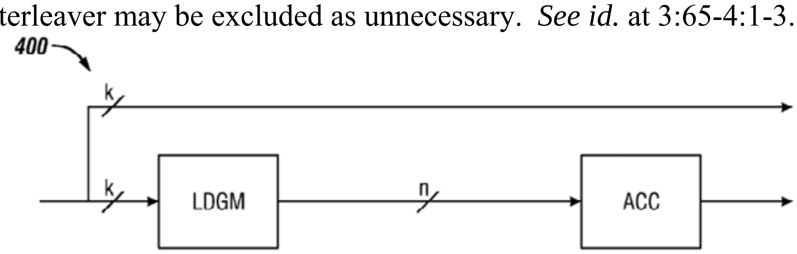



***FIG. 4***

*See* Docket No. 171 at 3-4.

## IV. Legal Standards

### *A. Summary Judgment*

Under Federal Rule of Civil Procedure ("Rule") 56, a party may move for summary judgment, identifying each claim or defense – or the part of each claim or defense – on which summary judgment is sought, and the court shall grant it when the pleadings, the discovery and disclosure materials on file, and any affidavits show that "there is no genuine issue as to any material fact and that the movant is entitled to judgment as a matter of law." Fed. R. Civ. P. 56(a); *see also Miranda v. City of Cornelius*, 429 F.3d 858, 860 n.1 (9th Cir. 2005). As to materiality, "[o]nly disputes over facts that might affect the outcome of the suit under the governing law will properly preclude the entry of summary judgment." *Anderson v. Liberty Lobby, Inc.*, 477 U.S.

242, 248 (1986). A dispute as to a material fact is "genuine" if there is sufficient evidence for a reasonable jury to return a verdict for the nonmoving party. *Id*.

To satisfy its burden at summary judgment, a moving party with the burden of persuasion must establish "beyond controversy every essential element of its [claim or defense]." *S. Cal. Gas Co. v. City of Santa Ana*, 336 F.3d 885, 888 (9th Cir. 2003); O'Connell & Stevenson, *Rutter Group Prac. Guide: Fed. Civ. Proc. Before Trial* ("*Federal Practice Guide*") § 14:126 (2016). By contrast, a moving party without the burden of persuasion "must either produce evidence negating an essential element of the nonmoving party's claim or defense or show that the nonmoving party does not have enough evidence of an essential element to carry its ultimate burden of persuasion at trial." *Nissan Fire & Marine Ins. Co., Ltd. v. Fritz Cos.*, Inc., 210 F.3d 1099, 1102 (9th Cir. 2000); *see also Devereaux v. Abbey,* 263 F.3d 1070, 1076 (9th Cir. 2001) (en banc) ("When the nonmoving party has the burden of proof at trial, the moving party need only point out 'that there is an absence of evidence to support the nonmoving party's case.'") (quoting *Celotex Corp. v. Catrett,* 477 U.S. 317, 325 (1986), and citing *Fairbank v. Wunderman Cato Johnson,* 212 F.3d 528, 532 (9th Cir. 2000) (holding that the *Celotex* "showing" can be made by "pointing out through argument . . . the absence of evidence to support plaintiff's claim")).

> If the party moving for summary judgment meets its initial burden of identifying for the court the portions of the materials on file that it believes demonstrate the absence of any genuine issue of material fact, the nonmoving party may not rely on the mere allegations in the pleadings in order to preclude summary judgment[, but instead] must set forth, by affidavit or as otherwise provided in Rule 56, specific facts showing that there is a genuine issue for trial.

*T.W. Elec. Serv., Inc., v. Pac. Elec. Contractors Ass'n*, 809 F.2d 626, 630 (9th Cir. 1987) (internal citations and quotation marks omitted) (citing, among other cases, *Celotex*, 477 U.S. at 323). "A non-movant's bald assertions or a mere scintilla of evidence in his favor are both insufficient to withstand summary judgment." *See FTC v. Stefanchik*, 559 F.3d 924, 929 (9th Cir. 2009). In addition, the evidence presented by the parties must be admissible. *See* Fed. R. Civ. P. 56(e). Conclusory, speculative testimony in affidavits and moving papers is insufficient to raise genuine issues of fact and defeat summary judgment. *See Thornhill Publ'g Co., Inc. v. GTE Corp.*, 594 F.2d 730, 738 (9th Cir. 1979). Relatedly, "[a]ny objections to declarations or other evidence must be made at or (preferably) before the hearing, and should be ruled upon by the court before ruling on the motion itself." *Federal Practice Guide* § 14:333 (citing *Hollingsworth Solderless Terminal*

*Co. v. Turley*, 622 F.2d 1324, 1335 n.9 (9th Cir. 1980); *Sigler v. American Honda Motor Co.*, 532 F3d 469, 480 (6th Cir. 2008)). In judging evidence at the summary judgment stage, however, courts do not make credibility determinations or weigh conflicting evidence at the summary judgment stage, and must view all evidence and draw all inferences in the light most favorable to the non-moving party. *See T.W. Elec.*, 809 F.2d at 630-31 (citing *Matsushita Elec. Indus. Co., Ltd. v. Zenith Radio Corp.*, 475 U.S. 574 (1986)); *Anderson*, 477 U.S. at 255 ("The evidence of the non-movant is to be believed and all justifiable inferences are to be drawn in [the non-movant's] favor.").

"If the court does not grant all the relief requested by the motion, it may enter an order stating any material fact – including an item of damages or other relief – that is not genuinely in dispute and treating the fact as established in the case." Fed. R. Civ. P. 56(g); *see also Federal Practice Guide* § 14:352 ("A partial summary judgment may be granted on motion of either party for adjudication of particular claims or defenses.") (citing *id.* § 14:33).

*B. Patent Eligibility under 35 U.S.C. § 101*

An invention or a discovery is patentable if it is a "new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof." 35 U.S.C. § 101. "In choosing such expansive terms . . . Congress plainly contemplated that the patent laws would be given wide scope." *Diamond v. Chakrabarty*, 447 U.S. 303, 308 (1980). Still, the Supreme Court has identified exceptions to this wide scope to "distinguish between patents that claim the building blocks of human ingenuity and those that integrate the building blocks into something more." *Alice Corp. Pty. v. CLS Bank Int'l*, 573 U.S. 208, 217 (2014) (quoting *Mayo Collaborative Servs. v. Prometheus Labs., Inc.*, 566 U.S. 66, 89 (2012)) (internal quotations omitted). These exceptions to patent protection are "laws of nature, natural phenomena, and abstract ideas." *Diamond v. Diehr*, 450 U.S. 175, 185 (1981). While the boundaries of the judicial exceptions remain subject to further development, the Supreme Court has clearly delineated the policy underlying those exceptions: avoiding patents that "too broadly preempt the use of a natural law [or abstract idea]." *Mayo*, 566 U.S. at 72. Thus, patent law should "not inhibit further discovery by improperly tying up the future use of laws of nature [or abstract ideas]." *Id*. at 85.

In *Mayo*, the Supreme Court "set forth a framework for distinguishing patents that claim laws of nature, natural phenomena, and abstract ideas from those that claim patent-eligible applications of those concepts." *Alice*, 573 U.S. at 217. The first step is to ask "whether the claims at issue are directed to one of those patent-ineligible concepts." *Id.* at 218. If not, the claims fall within the scope of § 101 and are patent-eligible. If the claims are directed to one of the exceptions, the second step is to search for an "inventive concept" that is "sufficient to ensure that the patent in practice amounts to significantly more than a patent upon the natural law [or abstract idea] itself." *Mayo*, 566 U.S. at 72-73. In doing so, a court must "consider the elements of each claim both individually and 'as an ordered combination' to determine whether the additional elements provide for an "inventive concept" that 'transform[s] the nature of the claim' into a patent-eligible application." *Alice*, 573 U.S. at 217 (quoting *Mayo*, 566 U.S. at 78-79). If, in considering the claim elements individually and as an ordered combination, they merely recite well-understood, routine, and conventional steps, they will not constitute an inventive concept for patent eligibility purposes. *Aatrix Software, Inc. v. Green Shades Software, Inc.*, 882 F.3d 1121, 1128 (Fed. Cir. 2018).

"Like indefiniteness, enablement, or obviousness, whether a claim recites patent eligible subject matter is a question of law which may contain underlying facts." *Berkheimer v. HP Inc.*, 881 F.3d 1360, 1368-69 (Fed. Cir. 2018). The Federal Circuit has held, for example, that fact questions may arise in the context of step two of the patent eligibility inquiry. *Aatrix*, 882 F.3d at 1128 ("[w]hether the claim elements or the claimed combination are well-understood, routine, conventional is a question of fact."). To the extent patent eligibility questions do turn on a factual issue, an accused infringer must prove invalidity by clear and convincing evidence. *Microsoft Corp. v. i4i Ltd. P'ship*, 564 U.S. 91, 112 (2011).

## V. Analysis

### *A. Parties' Disputes Regarding the Scope of the Relevant Claims*

Before resolving Defendants' § 101 arguments, the parties' various disputes regarding the scope of the claims are addressed. *See Bancorp Serv., L.L.C. v. Sun Life Assur. Co. of Canada*, 687 F.3d 1266, 1273-74 (Fed Cir. 2012) ("the determination of patent eligibility requires a full understanding of the basic character of the claimed subject matter."). Determining the scope of the claims is an interpretive issue "exclusively within the province of the court." *Markman v. Westview Instruments, Inc.*, 517 U.S. 370, 372 (1996). It is "a question of law in the way that we treat document construction as a question of law," with subsidiary fact-finding reviewed for clear error pursuant to Fed. R. Civ. P. 52(a)(6). *Teva Pharms. USA, Inc. v. Sandoz, Inc.*, 135 S.Ct. 831, 837-40 (2015) ("*Teva I*"). Courts may rely on extrinsic evidence, including expert testimony, to resolve factual disputes. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1318 (Fed. Cir. 2005) ("[E]xtrinsic evidence in the form of expert testimony can be useful to a court for a variety of purposes, such as to provide background on the technology at issue, to explain how an invention works, to ensure that the court's understanding of the technical aspects of the patent is consistent with that of a person of skill in the art, or to establish that a particular term in the patent or the prior art has a particular meaning in the pertinent field."). But while "[e]xperts may explain terms of art and the state of the art at any given time, . . . they cannot be used to prove the legal construction of a writing." *Teva Pharms. USA, Inc v. Sandoz, Inc.*, 789 F.3d 1335, 1339 (Fed. Cir. 2015) ("*Teva II*") (citing *Teva I*, 135 S.Ct. at 841).

Not all of the claim scope arguments discussed in the following subsections ultimately have bearing on the *outcome* of the § 101 analysis. However, they have been raised by the parties as potentially relevant and thus will be considered as provided herein.

*i. Meaning of the "wherein the information bits appear in a variable number of subsets" Clause and Related Clauses in the Claims for Adjudication*

The three claims of the '781 Patent identified for adjudication in this case each include a "variable number of subsets" requirement. The parties both dispute the meaning of this requirement and its impact on § 101 patentability. Specifically, Plaintiff suggests that this limitation supports the conclusion that the claims are limited to the field of IRA correction/detection codes and thus patent eligibility. Defendants argue that this limitation is not specific to IRA code and does not save the claims under § 101. Claim 22 of the '781 Patent, which depends from Claim 21 and thus incorporates all the limitations of Claim 21, together with Claim 21 recites:

21. A method comprising:
***receiving a collection of information bits***;
mod-2 or exclusive-OR adding a ***first subset of information bits in the collection*** to yield a first parity bit;
mod-2 or exclusive-OR adding a ***second subset of information bits in the collection <u>and</u>*** the first parity bit to yield a second parity bit; and
outputting a codeword that includes the first parity bit and the second parity bit.

22. The method of claim 21, wherein:
the method further comprises mod-2 or exclusive-OR adding ***additional subsets of information bits in the collection <u>and</u>*** parity bits to yield additional parity bits; and
***the information bits <u>in the collection</u> appear in a variable number of***

***subsets***.

Claim 13 of the '781 Patent recites:

> 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***.

Claim 9 of the '781 Patent depends from numerous claims of the '781 Patent. They collectively recite:

> 1. 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***;
> performing a first encoding operation on at least some of the information bits, the first encoding operation being a linear transform operation that generates L transformed bits; and
> performing a second encoding operation using the L transformed bits as an input, the second encoding operation including an accumulation operation in which the L transformed bits generated by the first encoding operation are accumulated, said second encoding operation producing at least a portion of a codeword, wherein L is two or more.
>
> 2. The method of claim 1, further comprising:
> outputting the codeword, wherein the codeword comprises parity bits.
>
> 5. The method of claim 2, wherein performing the first encoding operation comprises transforming the at least some of the information bits via a low density generator matrix transformation.
>
> 6. The method of claim 5, ***wherein generating each of the L transformed bits comprises mod-2 or exclusive-OR summing of bits in a subset of the information bits***.
>
> 9. The method of claim 6, ***wherein the information bits appear in a variable number of subsets***.

Notably, Plaintiff agrees with Defendants' characterization of the "variable number of subsets" limitation as meaning "some information bits are used in more mod-2 or exclusive-OR operations (*i.e.*, more 'subsets') than others." Docket No. 714 at 8; *see* Docket No. 742 at 10 ("what Defendants describe ***is*** irregular repetition"). Plaintiff's concern rises out of the example Defendants gave at the August 2018 hearing and in their supplemental briefs where Defendants purport to apply this understanding in practice. Specifically, Defendants refer back to an example the Court had used in its April 2017 tentative order when it was discussing the requirements of Claim 21 (which does not include the "variable number of subsets" limitation). *See* Docket No. 171 at 15-16. In the April 2017 tentative order, the Court had provided an example of a mod-2 summation of information bits:

> Applying the steps or limitations claimed in method claim 21 to the information sequence "0, 1, 1, 0, 1" – that is, where the input block [$x_1$, $x_2$, $x_3$, $x_4$, $x_5$] is [0, 1, 1, 0, 1] – in light of the relationship disclosed above yields the following output block (or codeword of parity bits):
>
> $y_1 = x_1 = 0$
> $y_2 = x_1 \oplus x_2 = 0 \oplus 1 = 1$
> $y_3 = x_1 \oplus x_2 \oplus x_3 = 1$ (output of the previous step) $\oplus\ 1 = 0$
> $y_4 = x_1 \oplus x_2 \oplus x_3 \oplus x_4 = 0 \oplus 0 = 0$
> $y_5 = x_1 \oplus x_2 \oplus x_3 \oplus x_4 \oplus x_5 = 0 \oplus 1 = 1$
>
> The codeword of parity bits [$y_1$, $y_2$, $y_3$, $y_4$, $y_5$] generated, therefore, is [0, 1, 0, 0, 1]. It is "[t]he serial concatenation of the interleaved irregular repeat code" generated by the outer coder and this "accumulate code" of [0, 1, 0, 0, 1] "that produces an irregular repeat and accumulate (IRA) code," the thrust of the claimed invention. *See id.* at 3:34-36[.]

Docket No. 171 at 16. Defendants effectively argue that this mod-2 summing step of Claim 21 itself shows information bits appearing in a variable number of subsets:

| '781 Claim 22 | Illustration Of "A Variable Number Of Subsets" |
|---|---|
| [6] the information bits in the collection appear in a variable number of subsets. | $Y_1 = x_1$<br>$Y_2 = x_1 + x_2 = Y_1 + x_2$<br>$Y_3 = x_1 + x_2 + x_3 = Y_2 + x_3$<br>$Y_4 = x_1 + x_2 + x_3 + x_4 = Y_3 + x_4$<br>$Y_5 = x_1 + x_2 + x_3 + x_4 + x_5 = Y_4 + x_5$ (*Id.*) |

Docket No. 714 at 10. According to Defendants, because $x_2$ appears in four summations and $x_3$ appears in 3 summations, these information bits appear in a variable number of subsets. The plain language of Claim 21, however, explains that the relevant "subsets" in the "variable number of subsets" limitation relate to subsets of the original collection of data, not to information bits that have already been used to create a parity bit. Claim 21 states, "mod-2 or exclusive-OR adding a ***second subset of information bits in the collection <u>and</u> the first parity bit*** to yield a second parity bit." As Plaintiff explains, "Defendants' example . . . incorrectly defines each 'subset' to include ***both*** the additional information bits added to the previous parity bit, ***and*** all the information bits that were previously used to generate the prior parity bits . . . [instead,] exactly one new information bit is used to generate each successive parity bit, and that information bit is different every time." Docket No. 742 at 11. Using Defendants' example, Plaintiff identifies the actual subsets of information bits, consistent with the claim language, in green boxes:

| | |
|---|---|
| [6] the information bits in the collection appear in a variable number of subsets. | $Y_1 = \boxed{x_1}$<br>$Y_2 = x_1 + x_2 = Y_1 + \boxed{x_2}$<br>$Y_3 = x_1 + x_2 + x_3 = Y_2 + \boxed{x_3}$<br>$Y_4 = x_1 + x_2 + x_3 + x_4 = Y_3 + \boxed{x_4}$<br>$Y_5 = x_1 + x_2 + x_3 + x_4 + x_5 = Y_4 + \boxed{x_5}$ (*Id.*) |

*Id.* From this perspective, Plaintiff shows that Defendants' example does not meet the "variable number of subsets" requirement of Claim 22 – each new subset added to the previous parity bit includes only one new information bit used exactly once.[8] *See also* Shoemake Declaration in Support of Plaintiff's Opposition to Defendants' Renewed Summary Judgment Motion ("Shoemake Decl."), Docket No. 596-9, ¶ 102.

Defendants' disputed example focuses on Claim 22. Claims 9 and 13 appear to similarly identify "information bits" as relating back to the original block of data. Both of these claims

[8] Notably, in their opening memorandum in support of their July 2018 § 101 motion, Defendants provided a slightly altered example to support § 101 arguments. *See* Docket No. 544-1 at 10-11. In that slightly altered example, they made the following modification to support their position:

| | |
|---|---|
| [6] the information bits in the collection appear in a variable number of subsets. | $Y_1 = x_1$<br>$Y_2 = x_1 + x_2 = Y_1 + x_2$<br>$Y_3 = x_1 + x_2 + x_3 = Y_2 + x_3$<br>$Y_4 = x_1 + x_2 + x_3 + x_4 = Y_3 + x_4$<br>$Y_5 = x_1 + x_2 + x_3 + x_4 + \cancel{x_5}\ x_4 = Y_4 + \cancel{x_5}\ x_4$<br>(*Id.*) |

*Id.* at 10; *see also* Declaration of Brendan Frey in Support of Defendants' § 101 Motion ("Frey Decl."), Docket No. 544-3 at 14. In other words, at the time of their original motion briefing, Defendants suggested through their example that they agreed with Plaintiff's position regarding the "variable number of subsets" limitation and its meaning. *See also* Shoemake Decl., Docket No. 596-9, ¶ 102.

separately refer to, for instance, "generating at least a portion of a codeword" through encoding operations that involve "accumulation" of "mod-2 or exclusive-OR summing of bits in subsets of the information bits." In their responsive supplemental brief, Defendants provide another example of how they believe the "variable number of subsets" requirement in Claim 13 is met. Defendants state, "if the input bits are $i_1$, $i_2$, $i_3$, then we can group bits into two subsets: (1) subset 1: $i_1$, $i_2$ and (2) subset 2: $i_2$, $i_3$. These bits appear in variable numbers of subsets: $i_2$ appears in two subsets whereas $i_1$ and $i_3$ each only appear in one subset." Docket No. 741 at 15. Defendants' example appears to be consistent with Plaintiff's interpretation of the "variable number of subsets" claim phrase: under Plaintiff's logic, it would seem that this example focuses on categorizing information bits, not previous parity bits, and there is "irregular" repetition of information bits because $i_2$ appears in more subsets than $i_1$ and $i_3$.

In the November 2018 tentative order, the Court questioned why, even keeping these examples in mind, they showed that the "variable number of subsets" limitation necessarily required ***irregular*** repetition of subsets. At the November 2018 hearing, Plaintiff directed attention to the parties' First Amended Joint Claim Construction Statement, filed in March 2017, where the parties had agreed to a construction for the terms "irregular"/"irregularity" (appearing in other claims of the Asserted Patents not at issue here) as "a different number of times." Docket No. 125 at 1. With this understanding of the meaning of the term "irregular," the Court agrees with Plaintiff that the phrase "variable number of subsets" creates a requirement in the relevant claims for irregular repetition of information bits.[9]

*ii. Parties Apparently Agree the Claims Do Not Require Scrambled Information Bits as an Input; Patent Does Not Require Scrambling to Create IRA Code*

In their briefing, Defendants argue that the relevant claims do not require scrambled information bits as an input. In its Responsive Supplemental Brief, Plaintiff states, "even if the

[9] As Plaintiff observes, language in decisions from the Patent Office suggests that the Patent Trial and Appeal Board ("PTAB") also understood these claims as requiring irregular repetition. In one of the *inter partes* review decisions, the PTAB stated, "Claim 13 and its dependent claims are directed to encoding methods that produce irregular repeat accumulate codes" and alternatively observed that Claim 1 "does not require irregularity." Docket No. 742-10 at 7 (Preliminary Decision (declining to institute review of Claim 13), April 27, 2015, IPR2015-00059). Defendants dismiss this statement as "dicta" (*see* Docket No. 741 at 12), but do not dispute that in another decision, the PTAB found Claims 13-15, 18, and 22 of the '781 Patent were not invalid because it would not have been obvious to combine the teaching of the benefits of "irregular" code in one reference with the method of another reference that did not disclose irregular repetition of information bits. *See also* Docket No. 550-1 (Final Written Decision, June 29, 2018, IPR2017-00297).

IRA encoders disclosed in the specification of the '781 patent include a scrambling operation, that has no bearing on the patent eligibility of claims 9, 13, and 22. It is black letter law that a patentee may draft claims broader than the particular embodiments disclosed in a patent's specification." Docket No. 742 at 12. In other words, while Plaintiff argues (and the Court agrees) that the input data for the claimed method steps includes variably repeated bits, Plaintiff apparently agrees with Defendants that the relevant claims do not require scrambled information bits as an input. Defendants argue in their supplemental briefs that the lack of a scrambling requirement supports the conclusion that the claims are not patent eligible under § 101 because it shows that the claims are not limited to error correction/detection encoding in general and IRA codes in particular.

Defendants' arguments in their supplemental briefs suggest that "code" is not IRA code unless it includes both irregularly repeated ***and*** scrambled information bits as an input. Defendants' expert states, without further explanation, that "[b]ecause the claimed method does not require irregular repetition and scrambling of bits before an accumulation operation, a person of ordinary skill in the art would not understand the output of the method to be an IRA code or a precursor to an IRA code." Declaration of Dr. Brendan Frey in Further Support of Defendants' Motion for Summary Judgment ("Supp. Frey Decl."), Docket No. 738, ¶ 186. As Plaintiff observes, however, Figure 4 of the '781 Patent relates to an embodiment that uses a "low-density generator matrix (LDGM) coder" that "performs an irregular repeat" of the bits of the input data block. '781 Patent, 3:63-64; *see also* Docket No. 714 at 3 (Defendants' supplemental brief, acknowledging the Figure 4 embodiment). In this embodiment, "[t]he interleaver **204** in FIG. 2 may be excluded due to the randomness already present in the structure of the LDGM code." '781 Patent at 4:1-3; *see id.* at 3:30-31 (explaining that scrambling may be performed by the interleaver). In other words, the '781 Patent describes embodiments for methods of creating IRA code that do not, on their face, require scrambling. *See also* Docket No. 714 at 3-4 (Defendants' supplemental brief, referring to Figure 4 but failing to explain how they believe Figure 4 either: (1) requires scrambling data or (2) fails to teach an alternative method of creating IRA code compared to Figure 2). Neither the parties nor their experts further addressed the dispute as to whether IRA code requires scrambling at the November 2018 hearing, and based on the specification's disclosure, the argument that scrambling is required is not persuasive.

*iii. Plaintiff Does Not Dispute that Claimed Methods Require Encoding, Not Necessarily Transmission, of Data*

In its Supplemental Brief, Plaintiff does not appear to dispute that the claims are related to data encoding, not necessarily to data transmission. *See* Docket No. 733. Defendants have previously argued that the fact that the claims do not require transmission supports the conclusion that the claims are patent-ineligible on the basis that the claimed methods could be applied in contexts other than error correction/detection encoding.

The conclusion that the claims do not require data transmission is consistent with the claim language, which does not refer to data transmission. It is also consistent with the Court's Markman Order, where the Court rejected Defendants' argument that the term "codeword" in certain claims of the '781 Patent required bits transmitted on a channel. Docket No. 213 at 25 ("The problem with Defendants' proposed construction is that it mandates that the bits be transmitted on a channel subsequent to the encoding operation, a construction belied by the express disclosure in the claim language and specification, which imposes no such constraint.").[10]

*iv. Other Claim Language Considered Collectively and in Context of Specification Supports that Claims Are Limited to Field of Error Correction/Detection Encoding*

Defendants downplay language in the claims referring to "information bits," "codewords," "parity bits," "signal," "encoding," and "low density generator matrix transformation" to support their argument that the scope of the claims extend beyond error correction encoding. According to Defendants, these terms are not used solely in the context of error correction encoding, and thus the scope of the claims is not necessarily limited to error correction encoding. Defendants, however, target these terms in a piecemeal fashion. In other words, Defendants fail to argue that the use of these terms in the collective combinations found in the claims could relate to anything other than error correction codes and error detection codes.[11] For instance, Defendants' expert states that the term "irregularity" (a term not used in these claims) is used in contexts outside error correction/detection codes when, for instance, "young children learn about . . . irregular polygons." Supp. Frey Decl., Docket No. 738, ¶ 89. Such a characterization is particularly unhelpful where it is clear that irregular polygons are not also described to young children in terms of "information bits" and "parity bits." The same is true as far as the examples Frey raises in his rebuttal declaration

[10] Plaintiff's expert, Mitzenmacher, in acknowledging that the relevant claims do not require data transmission, has also presented the opinion that IRA codewords have other useful real-world applications besides those related to data transmission. Declaration of Dr. Michael Mitzenmacher in support of Plaintiff's First Supplemental § 101 Brief ("Mitzenmacher First Supp. Decl."), Docket No. 710-37, ¶ 56.

[11] The parties' dispute regarding error correction encoding versus error detection encoding is addressed in a later section, *supra*.

as to these technical terms. Rebuttal Declaration of Dr. Brendan Frey in Further Support of Defendants' Motion for Summary Judgment ("Rebuttal Frey Decl."), Docket No. 741-1, ¶¶ 67-83. Frey refers to references that supposedly use the terms in the relevant claims in fields other than error correction encoding. However, Frey picks and chooses terminology between the references and patent claims to make his point. Frey does not identify an article that, for instance, uses the phrases "signal," "encoding," "information bits," and "codeword" as in Claim 13 in a context outside of error correction/detection encoding.

At the November 2018 hearing, Defendants emphasized an article submitted in connection with the Rebuttal Frey Declaration as an example of a reference outside of the field of error correction encoding that uses the same nomenclature that appears in the claims in the '781 Patent. "An Optimal Class of Symmetric Key Generation Systems," Rolf Blom (1985), Docket No. 741-5 ("Blom article"). The Blom article relates to the field of data encryption. The Blom article describes using linear transformation operations to create a "codeword" for use with encrypted data. In one instance, the article uses the term "encoded." *See id.* at 2 ("If $d=GF(q)^k$ denotes a vector of k information symbols, they will be ***encoded*** into $c=dG$."). Defendants/Frey also suggest that the Blom article's use of the term "information symbols" is equivalent to the phrase "information bits" in the claims. *See* Rebuttal Frey Decl., Docket No. 741-1, ¶ 80. The fact that the Blom article uses the term "information symbols" rather than "information bits," however, is exactly the point: although there may be some overlapping terminology among different fields, even the Blom article still fails to use the same collection of phrases used in the claims of the '781 Patent.[12] *See also* Shoemake Decl., Docket No. 596-9, ¶ 156 ("I do not believe the claimed methods have any practical application outside the context of communications systems.").

At the hearing, Defendants raised a second point with the Blom article. Nomenclature aside, Defendants argued that if the relevant claims are found patent eligible under § 101, they could be relied on to prevent others from "us[ing] the math of the claims to do what Blom is talking about for encryption." Hearing Transcript for November 15, 2018 ("Nov. Hearing Tr."), 68:9-11.

[12] Defendants submit multiple references regarding only the term "parity bit" and its appearance in contexts outside of error correction/detection encoding. Rebuttal Frey Decl., Docket No. 741-1, ¶¶ 74-78. This appears to be in response to Plaintiff's unequivocal statement in one of its earlier briefs that "[t]he term 'parity bits' is not used in any other field." Docket No. 710 at 2 (emphasis omitted). Although Defendants apparently have proven Plaintiff wrong on this point, for the reasons stated in this Order, this is still insufficient to inevitably lead to Defendants' preferred conclusion regarding the scope of the claims.

As an initial matter, if this were true, the Court questions why Defendants did not rely on Blom as a prior art reference under 35 U.S.C. § 102 and/or § 103 to seek invalidation of the '781 Patent claims.[13] The Court also observes that after the significant written record that has developed in this case with Plaintiff consistently urging that the claims are limited to the field of error correction encoding, Plaintiff would likely face an uphill battle with attempts to assert these patents against technology existing outside of the field of error correction encoding. These issues aside, Defendants have not provided evidence that the steps required by the claims, including the "variable number of subsets" limitation would be practiced outside of the field of error correction encoding. Although Defendants state that "the math of the claims" could be used in other contexts, that statement does not reflect all of the limitations of the claims and thus is not the relevant inquiry.

The specification also supports the conclusion suggested by the wording of the claims that the claims are directed to error correction encoding. As explained in the background section of this Order, the specification discloses various embodiments for creating IRA code. Indeed, in documents both in and out of this lawsuit, the '781 Patent has been characterized as relating to error correction codes, and specifically to IRA codes. For instance, as Plaintiff notes, in Defendants' opening claim construction brief, they stated, "[t]he four asserted patents . . . are directed to a specific type of error correcting code for use in wireless communications." Docket No. 127 at 3. Moreover, in the PTAB's IPR determinations, it similarly considered and characterized the relevant claims as relating to IRA codes. *See supra* n.9. Particularly in combination with the "variable number of subsets" limitations in each of the relevant claims and the other nomenclature used in the relevant claims, the specification supports that the relevant scope for the claims is to some form of error correction/detection encoding.

Defendants emphasize that the Court declined to incorporate certain limitations proposed by Plaintiff into certain claim terms during claim construction. The Court, for instance, declined Plaintiff's proposal that a codeword be understood as "data elements generated by electronic circuitry, computer hardware, and/or computer software," Docket No. 213 (Markman Order) at

[13] Mitzenmacher has presented opinions that "encryption and error correction coding have essentially opposite goals and functions," Mitzenmacher First Supp. Decl., Docket No. 710-37, ¶ 48, perhaps explaining why Defendants have not relied on Blom as § 102 or § 103 prior art in this case. Plaintiff otherwise notes that "all of the prior art Defendants raised in this case and in their IPRs is from the field of error correction encoding." Docket No. 710 at 18.

26-27, finding that there was no reference to such a requirement in the specification.[14] It reached a similar conclusion for the term "information bits." However, these conclusions in the Markman Order are different from the conclusion that the overall scope of the claims appear to relate to a method for error correction encoding in the field of digital wireless communications based on the combination of terms used within the relevant claims and their roles in the claimed methods. *See id.* at 7 (observing that many of the parties' claim construction arguments did not relate to particular claim terms, but to the overall scope of the claims). The latter is the issue here.

*v. Whether Claim Steps Can Be Used to Create Code That Can Only Detect, Not Correct, Errors*

In another aspect of the parties' argument, they dispute the relevance of Plaintiff's concession in its supplemental briefing that the field of error correction encoding necessarily includes the field of error detection encoding. According to Defendants, Plaintiff has not only changed its position about the relationship between error correction and detection encoding, but also effectively conceded that the limitations of the claims could result in an output codeword that is only able to perform error detection. Plaintiff's briefs, although adamant that "[a]ny code with the ability to correct errors necessarily has the ability to detect errors," (Docket No. 742 at 7) are not so adamant about whether the claimed methods could be used in creating codewords that could only perform error detection. That is, error correction and detection are not coextensive. While the evidence suggests that all codes with the ability to correct errors necessarily have the ability to detect errors, Plaintiff's expert admits that not all codes with the ability to detect errors have the ability to correct errors.

Plaintiff's expert states:

> while IRA codes can detect errors, they do so in conjunction with error correction. I am not aware of any system that uses IRA codes to detect but not correct errors. Indeed, it would not make any sense to use IRA codes for just one purposes (foregoing their error correction capabilities) when there are less complex options if detecting errors alone is the goal.

*See* Declaration of Dr. Matthew B. Shoemake Regarding § 101 Eligibility ("Supp. Shoemake Decl."), Docket No. 733-1, ¶ 301. In earlier sections, Shoemake explains how the concept of the "parity bit" introduces redundancy that enables error correction. *See, e.g.*, *id.* at ¶ 198. This

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[14] The meaning of the term "codeword" and its relevance in the context of the parties' § 101 dispute will be further addressed *infra* in light of discussion at the November 2018 hearing.

statement is not exactly supported by Shoemake's earlier declaration, which suggested that parity bits could be used in codes that only performed error correction. *See* Shoemake Decl., Docket No. 596-9, ¶ 42 ("it is possible to form codewords by adding on a single parity bit [*i.e.*, by performing an encoding operation]. This may be done by adding all the information bits together and determining if the sum is odd or even . . . This type of code is known as an error *detection* code but is not an error *correction* code because it cannot correct errors at the receiver."). It is possible, however, that Shoemake's later statements regarding "parity bit" were made because of Shoemake's understanding that the "variable number of subsets" limitation of the relevant claims would inherently lead to claimed parity bits with some level of redundancy (because at least some of the information bits must be repeated different numbers of times in the data block subsets forming the parity bits). Even then, evidence at the November 2018 hearing demonstrated that the real question regarding whether the claims could cover simple error detection encoding is inherently tied to whether there is a required length for the codeword (or portion of codeword) output as a result of the claimed steps. The examples submitted by the parties show that the relevant claims cover codes that can only detect (but not correct) errors even though in most instances, a code that practices the claims will be able to both correct and detect errors. *See* Further Declaration of Dr. Matthew B. Shoemake Regarding § 101 Eligibility ("Shoemake Second Supp. Decl."), Docket No. 809-2, ¶ 37 ("I also am not aware of an existing system using the IRA encoding of the '781 patent claims for any application other than error correction coding with at least hundreds of information bits being encod[ed] into codewords that likewise have at least hundreds of bits.").

*vi. Whether the "Codeword" (or "Portion of a Codeword") Output by the Claims Must Be a Certain Length*

At the November 2018 hearing, Defendants' expert showed that his example using three information bits to satisfy Claim 13 would lead to parity bits (*i.e.*, a codeword) that could only perform some level of error detection, not error correction. Nov. Hearing Tr. 138:23-139:5. Indeed, Defendants' expert conceded that in certain circumstances, the three-information-bit example would not be able to even perform full error detection. *Id.* Plaintiff's expert (Dr. Shoemake), meanwhile, referred to the three-information-bit example as "fundamentally flawed" and "not . . . reversible." *Id.* at 138:10-12. In its supplemental brief submitted after the hearing, Plaintiff stated,

> [d]uring the hearing, Caltech also informed the Court that it would address

> the question of whether the claims can lead to an IRA codeword that can only perform error detection. Such an IRA codeword could be generated in limited circumstances through the unique and inventive methods covered by the asserted claims, and is useful as confirmed by both parties' experts.

Docket No. 809 at 3 (citing Supp. Frey Decl., Docket No. 738, ¶¶ 95, 97-104; Shoemake Second Supp. Decl., Docket No. 809-2, ¶¶ 24-39; Further Declaration of Dr. Michael Mitzenmacher Regarding § 101 Eligibility ("Mitzenmacher Second Supp. Decl."), Docket No. 809-1, ¶¶ 39-40). In other words, Plaintiff effectively concedes that beyond some claims' requirements for at least two parity bits, there is no minimum required length for the codewords output by the claims.[15] The parties do not appear to dispute that only very limited circumstances will result in codewords or portions of codewords covered by the claims that can before error detection, but not error correction.

Defendants suggest that not only has Plaintiff shifted its position regarding the relationship between error correction and detection and the relevant scope of the claims, but the fact that the claims are broad enough to cover instances where a codeword can only be used to for error detection shows that the claims are patent ineligible. *See* Docket No. 741 at 11-12; *see also* Rebuttal Frey Decl., Docket No. 741-1, ¶¶ 44-52. Plaintiff, for its part, argues in its supplemental briefs that error correction and detection are simply part of the same technological field, making it largely irrelevant whether the claims also cover some error detection codes in addition to error detection/correction codes. Docket No. 733 at 18; *see also* Supp. Shoemake Decl., Docket No. 733-1, ¶¶ 302-311; *but see* Shoemake Decl., Docket No. 596-9, ¶ 42 ("Unfortunately, since this is a very weak code, the receiver is able to determine that an error occurred, but cannot deduce the

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[15] Despite this, in his Second Supplemental Declaration, Shoemake observes:

> I am not aware of any system that uses IRA encoding to facilitate error detection alone. In situations where error detection alone is needed, there are other encoding options available to practitioners that fall outside the bounds of the IRA encoding claims of the '781 patent . . . . I am also not aware of an existing system using the IRA encoding of the '781 patent claims for any application other than error correction coding with at least hundreds of information bits being encod[ed] into codewords that likewise have at least hundreds of bits. In these situations, the full value of the asserted '781 patent is clear . . . . [A]lthough shorter codewords could be implemented by following the steps of the claims and those codewords would have utility in detect[ing] and correcting errors, a significant technological contribution made by Caltech's invention is the generation of codewords that enable near Shannon limit levels of performance.

Shoemake Second Supp. Decl., ¶¶ 37-38.

nature of the error. This type of code is known as error *detection* code but is not an error *correction* code, because it cannot correct errors at the receiver.").

There appears to be no real dispute that error correction codes and error detection codes are different. That is all Shoemake said in his original declaration, and it is all Frey says in his rebuttal declaration. *See* Rebuttal Frey Decl., Docket No. 741-1, ¶ 45 ("As I explained in my October 4 Declaration, error detection codes and error correction codes are different"); Shoemake Decl., Docket No. 596-9, ¶ 42. But the relevant question is whether error correction and error detection are part of the same technological *field*. Supp. Shoemake Decl., Docket No. 733-1, ¶ 303 ("Those of ordinary skill in the art would be well aware that, because of this close relationship, error correction and detection go hand-in-glove, and should not be seen as separate fields."); *see also id.* ¶¶ 302-311. Although Defendants assert that error correction/detection are "different technologies" (Docket No. 741 at 12), Defendants do not explicitly state that error correction/detection are part of different technological fields. Neither does Frey. The evidence thus supports the conclusion that error correction and detection are interconnected technological fields and thus, although the evidence shows that the claims may cover some codes that can only perform error detection, this fact does not necessarily separate them from the error correction/detection field.[16]

*B. Application in § 101 Analysis*

As explained in the sections above, the evidence supports the conclusion that the relevant claims are rooted in the field of error correction/detection encoding. More specifically, the claims' "variable number of subsets" limitation supports the conclusion that the claims require irregular repetition of information bits. In other words, the claims are directed to "IRA codes," although IRA codes that do not necessarily require scrambled information bits as input.

Software claims have long been greeted with some consternation by the courts in the context of § 101:

> Computer software-related inventions—due to their intangible nature—can be particularly difficult to assess under the abstract idea exception. *See* [*Elec. Power Grp., LLC v. Alstom S.A.*, 830 F.3d 1350, 1354 (Fed. Cir. 2016)] (noting that the *Alice*-recognized distinction between "computer-functionality improvements" and "uses of existing computers as tools in aid of processes

[16] Although Frey otherwise suggests that if the claims extend to error detection, they must also extend to other unrelated technological fields (*see, e.g.*, Rebuttal Frey Decl., Docket No. 741-1, ¶ 48), he does not adequately support these assertions (relying on scattered, piecemeal nomenclature from various references, as previously discussed and rejected) and they are unpersuasive.

> focused on "abstract ideas" " "has common-sense force even if it may present line-drawing challenges because of the programmable nature of ordinary existing computers"). The exception nevertheless applies to new and old technologies alike. Importantly, we have found a number of software-based claims to be patent-eligible, observing that "[s]oftware can make non-abstract improvements to computer technology just as hardware improvements can, and sometimes the improvements can be accomplished through either route." *Enfish, LLC v. Microsoft Corp.*, 822 F.3d 1327, 1335 (Fed. Cir. 2016); *id.* at 1339 (claims directed to a self-referential table "designed to improve the way a computer stores and retrieves data in memory"); *see also Bascom Glob. Internet Servs., Inc. v. AT&T Mobility LLC*, 827 F.3d 1341, 1348-49 (Fed. Cir. 2016) (claims directed to improved content filter); *McRO, Inc. v. Bandai Namco Games Am. Inc.*, 837 F.3d 1299, 1313–14 (Fed. Cir. 2016) (claims directed to a technical improvement in animation techniques); *Core Wireless Licensing S.A.R.L. v. LG Elecs., Inc*., 880 F.3d 1356, 1362 (Fed. Cir. 2018) (holding that claims which were directed to "particular manner of summarizing and presenting information in electronic devices" were patent-eligible).

*Interval Licensing LLC v. AOL, Inc.*, 896 F.3d 1335, 1343-44 (Fed. Cir. 2018); *Finjan, Inc. v. Blue Coat Sys., Inc.*, 879 F.3d 1299, 1304 (Fed. Cir. 2018); *Ancora Techs., Inc. v. HTC Am., Inc.*, 908 F.3d 1343, 1347 (Fed. Cir. 2018); *see also Hughes*, 59 F. Supp. 3d at 990-91 ("computer software and codes remain patentable. The Supreme Court approved a patent on computer technology in *Diehr* and suggested that software and code remain patentable in *Alice.* The America Invents Act further demonstrates the continuing eligibility of software. Moreover, *Alice* did not significantly increase the scrutiny that courts must apply to software patents. It held only that an ineligible abstract idea does not become patentable simply because the claim recites a generic computer. Courts must not extend the reach of *Alice* too far, lest they read in § 101 limitations that do not exist.").

Claims concerning data compression and encoding, which by their very nature focus on the manipulation of arguably intangible data, present even more challenges. But courts have not categorically relegated such claims to abstractness, either. *See Sycamore IP Holdings LLC v. AT & T Corp.*, 294 F. Supp. 3d 620, 652 (E.D. Tex. 2018) (Bryson, J.) (collecting district court cases and stating, "a compression protocol is not fundamentally different from other computer-driven programs that improve the accuracy, speed, and security of communications such as error correction programs, encryption protocols, and methods for synchronizing data, all of which have been held to survive section 101 challenges without serious doubts as to their patentability."); *TQP Development, LLC v. Intuit Inc.*, No. 2:12-cv-180-WCV, 2014 WL 651935, at *5 (E.D. Tex. Feb.

19, 2014) (Bryson, J.) ("Typically, transforming data from one form to another does not qualify as the kind of transformation that the Supreme Court in *Bilski* regarded as an important indicator of patent eligibility. In the case of an invention in the field of encryption, however, the entire object of the invention is to transform data from one form into another that will be recognizable by the intended recipient but secure against decryption by unintended recipients." (citation omitted)).

The Court finds that the relevant claims in this case set out a method of performing error correction/detection encoding, including with the requirement that information bits in a data set appear in a "variable number of subsets," that is patent-eligible. The claims are "directed to" a method for encoding data that, according the specification and testimony of Plaintiff's experts, improves on previous data encoding methods by allowing for more efficient data transmission. These technological improvements are sufficient for the relevant claims to pass muster under § 101.

Defendants compare the claims at issue in this case to claims found patent-ineligible in many Federal Circuit cases, but have repeatedly emphasized four cases in particular where the Federal Circuit found claims invalid under § 101: *Digitech Image Techs., LLC v. Elecs. for Imaging, Inc.*, 758 F.3d 1344 (Fed. Cir. 2014); *Synopsys, Inc. v. Mentor Graphics Corp.*, 839 F.3d 1138, 1148 (Fed. Cir. 2016), *cert. denied sub nom. Sypnosys, Inc. v. Mentor Graphics Corp.*, 138 S. Ct. 71 (2017); *RecogniCorp, LLC v. Nintendo Co.*, 855 F.3d 1322, 1324 (Fed. Cir. 2017), *cert. denied*, 138 S. Ct. 672 (2018); and *Interval Licensing*, 896 F.3d 1335. Each case is distinguishable.

*Digitech* included some claims that did not even require data manipulation on their face, let alone describe how data manipulation could be achieved. One of the *Digitech* claims, for instance, referred to a "device profile" comprising "first data" and "second data" that together defined "device dependent transformation of spatial and color information." *Digitech*, 758 F.3d at 1349. Another claim referred to a "method of generating a device profile" by generating a first data, generating a second data, and combining the two. Some of the sweeping language in *Digitech* is oft-quoted by Defendants: "Data in its ethereal, non-physical form is simply information that does not fall under any of the categories of eligible subject matter under section 101." *Id.* at 1350; *see also id.* at 1351 ("Without additional limitations, a process that employs mathematical algorithms to manipulate existing information to generate additional information is not patent eligible."). Judge Pfaelzer has observed problems with applying *Digitech's* language too broadly:

> *Digitech* seems to set forth a bright-line rule: if a claim consists of

> mathematical algorithms that transform data, the claim is not patentable. But that cannot be what *Digitech* means. . . . this interpretation results in the incorrect conclusion that software is not patentable. The essence of software is manipulating existing data and generating additional data through algorithms. This simplistic take on *Digitech* would eviscerate all software patents, a result that contradicts Congress's actions and the Supreme Court's guidance that software may be patentable if it improves the functioning of a computer.

*Hughes*, 59 F. Supp. 3d at 987 (internal citations omitted). A closer review of *Digitech* reveals that one of the core problems with the claims at issue was their result-oriented nature and large breadth. *Digitech*, 758 F.3d at 1349-50 ("The claims encompass all embodiments of the information contained in the device profile, regardless of the process through which this information is obtained or the physical medium in which it is stored."). The same concerns are not present in this case, which includes claims to a specific method of encoding, including the actual steps that must be performed to achieve the desired result. The specific limitations of the claims in the '781 Patent are thus distinguishable from the result-oriented claims of *Digitech*.

*Synopsys* also included distinguishable claims related to "translat[ing] from a functional description of a level sensitive latch into a hardware component description of that same latch." *Synopsis*, 839 F.3d at 1142. In its analysis, the Federal Circuit found it relevant that all of the steps claimed for translating the descriptions of the level sensitive latch could be performed mentally, and the patent inventors admitted as much. *Id.* at 1148. The Federal Circuit distinguished *TQP*, a district court decision authored by Federal Circuit Judge Bryson (sitting by designation) that involved a § 101 challenge to claims for transmitting encrypted data by generating sequences of pseudo-random key values. *TQP*, 2014 WL 651935, at *1. According to the Federal Circuit in *Synopsis*, the court in *TQP*

> explained that . . . the plaintiff's "invention involves a several-step manipulation of data that, *except in its most simplistic form, could not conceivably be performed in the human mind or with pencil and paper*." [*TQP*, 2014 WL 651935,] at *4 (emphasis added). This case is different. Representative claim 1 is directed to generating a representation of a single specific hardware component and can be—and was—performed mentally or with pencil and paper.

*Synopsys*, 839 F.3d at 1148 (emphasis in original). *Synopsys* further considered the fact that the *Synopsys* patent claims at issue did not call for any form of computer implementation: "Because the Asserted Claims make no mention of employing a computer or any other physical device, they are so broad as to read on an individually performing the claimed steps mentally or with pencil and paper." *Id.* at 1149. The relevant claims in this case are closer aligned with *TQP* than with *Synopsys*. Although the parties here have demonstrated that the most simplistic of examples could conceptually be performed using pen and paper (setting aside the inherent nature of "information bits"), Defendants have not shown that a representation of a *typical* IRA code—generally relying on hundreds of information bits at a minimum as input—could be generated mentally or with pencil and paper, and particularly in a way that would meet the claimed goals of allowing simpler transmission of data at or near the Shannon limit.[17] *See also* Shoemake Decl., Docket No. 596-9, ¶ 104 (explaining that IRA codes allow operation near the Shannon Limit). *TQP* also considered the fact that the claims at issue did not specifically recite particular machines, "such as a computer, particular types of transmitters and receivers, or a particular type of pseudo-random number generating machine." *TQP*, 2014 WL 651935, at *5. The court in *TQP* stated,

> it is apparent from the patent that computing devices and electronic transmitters, receivers, and pseudo-random number generating machines would be required for all but the most fanciful uses of the invention. To invalidate claim 1 on the ground that it does not expressly require the use of a computer or other specific mechanisms would be to adopt an overly formalistic approach to subject-matter eligibility.

*Id.* *TQP* and *Synopsys* (as well as *Digitech*) together thus suggest that the "pen and paper test" and the "association with hardware" test go hand in hand: if a patent claim is sufficiently complex that it could only be performed mentally in the most simplistic of circumstances, that fact that physical hardware components are not explicitly claimed does not doom the claims. Such circumstances are present here. In particular, the "variable number of subsets" limitation plays a key role in the pen and paper determination. This is also aside from the nomenclature of the claims which, as discussed, have not been shown to appear in contexts outside of error correction/detection encoding.

Judge Pfaelzer had reason to consider and reject a similar issue in considering the patent eligibility of a related patent at *Alice* step two:

> One of Hughes' arguments deserves special attention. Hughes argues that calculating parity bit values involve "mental steps [that] can be performed by

[17] "Shannon Limit," or "channel capacity," refers to the theoretical concept that "it is possible through error correction coding to communicate [*i.e.*, send data over a transmission channel] with practically no chance of error . . . as long as [the coding techniques] do not exceed the capacity of the [communications] channel." Shoemake Decl., Docket No. 596-9, ¶¶ 35-37.

> a person with pencil and paper." Therefore, Hughes, argues the claim is not patentable . . . . The Court finds this mode of analysis unhelpful for computer inventions. Many inventions could be theorized with pencil and paper, but pencil and paper can rarely produce the actual effect of the invention. Likewise, with regard to software, a human could spend months or years writing on paper the 1s and 0s comprising a computer program and applying the same algorithms as the program. At the end of the effort, he would be left with a lot of paper that obviously would not produce the same result as the software.[19]
>
> > [Footnote 19: Courts should not view software as abstract simply because it exists in an intangible form. It is as fruitless to say that a human could use pencil and paper to perform the same calculations as a computer, as it is to say that a human could use pencil and paper to write down the chemical structure of a DNA strand. In either case, any effort on the part of a human will only be a symbolic representation. The effort will not produce the same effect as executing a computer program or isolating a DNA strand.]
>
> The problems of pencil-and-paper analysis are heightened in the context of software, which necessarily uses algorithms to achieve its goals. Pencil-and-paper analysis can mislead courts into ignoring a key fact: although a computer performs the same math as a human, a human cannot always achieve the same results as a computer. Hughes' statement is theoretically correct. A human could perform the calculations that would yield the value of a parity bit. But Hughes' statement is literally wrong. It states the obvious to say that a pencil and paper cannot actually produce parity bits. Hughes' proposed analysis oversimplifies § 101 and ignores the fact that the '032 patent creates an algorithmic solution for a computing problem − the corruption of data during transmission.
>
> The pencil-and-paper test is a stand-in for another concern: that humans engaged in the same activity long before the invention of computers . . . . This concern is highly relevant, but courts should not scan patents for this concern by using a test that creates false positives. In the case at hand, it is clear that Caltech's error correction codes were not conventional activity that humans engaged in before computers, and the codes do not become conventional simply because humans can do math. Pencil-and-paper analysis is inappropriate at least for this area of technology.

*Hughes*, 59 F. Supp. 3d at 994-95. The Court finds her reasoning to be additionally persuasive, in addition to its interpretation of *Synopsys* and *TQP*.[18]

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[18] For the same reasons and others, the parties' dispute regarding the deposition testimony of Caltech professor Dr. Babak Hassibi, who was directed by Defendants' counsel to write out on a piece of paper a three "information bit"

In *Recognicorp*, the Federal Circuit considered claims for "[a] method for creating a composite image," which included displaying facial feature images on a screen and deriving composite facial image code by "performing at least one multiplication operation on a facial code" and reproducing the composite facial image code on a display. *Recognicorp*, 855 F.3d at 1324. The Federal Circuit stated that the claimed method:

> is directed to the abstract idea of encoding and decoding image data . . . This method reflects standard encoding and decoding, an abstract concept long utilized to transmit information. Morse code, ordering food at a fast food restaurant via a numbering system, and Paul Revere's "one if by land, two if by sea" signaling system all exemplify encoding at one end and decoding at the other end.

*Id.* at 1326; *see also id.* at 1327 ("Adding one abstract idea (math) to another abstract idea (encoding and decoding) does not render the claim non-abstract."). The claims of *Recognicorp* did not relate to a specific method of encoding, and let alone to a particular method of encoding tied to error correction/detection. Instead, as the Federal Circuit observed, the method reflected "***standard*** encoding and decoding." *Id.* at 1326 (emphasis added). Here, the entire purpose of the asserted patents is focused on claiming encoding/decoding methods/means that are new and improved compared to standard methods/means. The claims are not comparable to Paul Revere's "one if by land, two if by sea," but to something that Paul Revere did not (and, in most cases beyond very limited examples, could not and need not) accomplish. For much the same reasons mentioned as to *Digitech* and *Synopsys*, it would be inappropriate to extend some of the sweeping language in *Recognicorp* to apply to a system directed at improved error correction encoding/decoding methods.

Like *Digitech*, the Federal Circuit panel in *Interval Licensing* strongly emphasized concerns with result-oriented claiming. The Federal Circuit considered claims to "[a] computer readable medium . . . encoded with one or more computer programs for enabling acquisition of a set of content data and display of an image or images generated from the set of content data on a display device during operation of an attention manager." *Interval Licensing*, 896 F.3d at 1339-40. The Federal Circuit had previously construed the term "attention manager" as "a system that displays images to a user either when the user is not engaged in a primary interaction or in an area

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example following the claimed methods, is irrelevant and Defendants' suggestion that it demonstrates the invalidity of the claims is unpersuasive. *See* Docket Nos. 785, 807; *see also* Docket Nos. 789, 816.

of the display screen that is not used by the user's primary activity." *Id.* at 1338. The Federal Circuit focused on the lack of information in the intrinsic record about the claimed "attention manager." *See, e.g.*, *id.* at 1342-43. After commenting about the difficulty of assessing computer software-related inventions under § 101 (*see supra* at 22-23), the Federal Circuit emphasized:

> ***Other software-based claimed inventions . . . have failed to pass section 101 muster, because they did not recite any assertedly inventive technology for improving computers as tools and/or because the elements of the asserted invention were so result-based that they amounted to patenting the patent-ineligible concept itself.*** *See Elec. Power Grp.*, 830 F.3d at 1354, 1355 (claims lacking "any requirements for *how* the desired result is achieved") (emphasis in original); *SAP Am., Inc.*, 890 F.3d at 1022 ("the focus of the claims [wa]s not any improved computer or network").

*Interval Licensing*, 896 F.3d at 1343-44 (emphasis added). The Federal Circuit found the focus of the claims at issue "is directed to 'providing information to a person without interfering with the persons primary activity,' i.e., the result-centric construction of the claimed 'attention manager.'" *Id.* (citing *Interval Licensing LLC v. AOL INC*, 193 F. Supp. 3d 1184, 1188 (W.D. Wash. 2016), *aff'd sub nom. Interval Licensing*, 896 F.3d 1335). The Federal Circuit further noted, "[r]ecitation, as in this case, of the collection, organization, and display of two sets of information on a generic display device is abstract absent a 'specific improvement to the ways computers [or other technologies] operate.'" *Id.* at 1345 (citing *Enfish*, 822 F.3d at 1336). For much the same reasons distinguishing *Digitech*, *Interval Licensing's* concerns about result-oriented claiming are not present here. The claims relate to a specific method of encoding, including the actual steps that must be performed to achieve the desired result.

Ultimately, the focus of the claims of the '781 Patent is on improving error correction encoding itself, not on using standard encoding/decoding as a means to accomplish an abstract result. By purporting to present a novel error correction encoding method, the claims focus on providing an improvement to the use of computers as tools through a specific set of encoding steps. *See also Finjan*, 879 F.3d at 1305 ("Here, the claims recite more than a mere result. Instead, they recite specific steps—generating a security profile that identifies suspicious code and linking it to a downloadable—that accomplish the desired result."); *Ancora*, 908 F.3d at 1348 ("Improving security—here, against a computer's unauthorized use of a program—can be a non-abstract computer-functionality improvement if done by a specific technique that departs from earlier approaches to solve a specific computer problem.").

Defendants' § 101 challenge over the last two years has focused (as it ought to) on both defining the scope of the relevant claims in this case and interpreting/applying the numerous and varied Federal Circuit cases addressing § 101 issues. By November/December 2018, Plaintiff had made two important concessions about the scope of the claims that became a focus of the parties' dispute over the contours of § 101 jurisprudence. First, Plaintiff agreed that the relevant claims in this case can be met by outputting a full codeword (Claims 9 and 22) or a portion of a codeword (Claim 13) of almost any length, including very short codewords based on even three or four input information bits. Docket No. 809 at 3 (citing Supp. Frey Decl., Docket No. 738, ¶¶ 95, 97-104; Shoemake Second Supp. Decl., Docket No. 809-2, ¶¶ 24-39; Mitzenmacher Second Supp. Decl., Docket No. 809-1, ¶¶ 39-40). Second, at the November Hearing, Plaintiff's expert (Dr. Shoemake) referred to a three-information-bit example as "fundamentally flawed" and "not . . . reversible." Nov. Hearing Tr. 138:10-12; *see also supra* at 21. Although Plaintiff later recharacterized short codewords as still "useful as confirmed by both parties' experts," Dr. Shoemake's statements at the hearing are enlightening.

Based on these characterizations about the scope of the claims, the Court asked Plaintiff to file a supplemental report that provided legal authority, if any existed, for the proposition that a claim can be found patent eligible where the overall framework could be applied in a way that improves the operation of computers, but the claim is broad enough to cover specific examples that do not actually provide any improvement to computer operations. Nov. Hearing Tr. 110:24-111:8 (requesting briefing to support the proposition that "if you have a claim that . . . can be utilized for a very, very sophisticated and inventive purpose but it also can cover something that is very simple that probably no one would actually utilize it in the simplistic context, that . . . can be found to be patentable."). Defendants were also given an opportunity to file a response. The parties' supplemental briefing was not particularly helpful.

Rather than identifying legal authority based on *Alice* and its progeny, Plaintiff's supplemental brief invokes the utility prong of § 101. Docket No. 809 at 1; *see also Brooktree Corp. v. Advanced Micro Devices, Inc.*, 977 F.2d 1555, 1571 (Fed. Cir. 1992) ("If the claimed subject matter is inoperable, the patent may indeed be invalid for failure to meet the utility requirement of § 101 and the enablement requirement of § 112 . . . . To violate § 101 the claimed device must be totally incapable of achieving a useful result." (citations omitted)). The question of patent utility or usefulness, however, is a separate inquiry compared to whether a claim is directed to patent-ineligible subject matter such as an abstract idea. *In re Nuijten*, 500 F.3d 1346, 1365 (Fed. Cir. 2007) (Linn, J., concurring-in-part and dissenting-in part) ("[W]e have treated the utility requirement of § 101 as a distinct concept from the question of whether an invention qualifies as patentable subject matter . . . .").

Defendants, meanwhile, relied on statements from *Interval Licensing* and *Synopsys* that the Court has already discussed, *supra*. *See supra* at 25-29. Neither of these cases provide for the overarching legal proposition that when actually practiced, a claim must *always* improve the functioning of a computer.

Indeed, the Court's review of claims found patent-eligible supports the opposite conclusion: a claim is not invalid simply because in practice, it may cover one or more examples where there is not actually an improvement to the relevant technological field.

In *Diehr*, for instance, the Supreme Court considered claims directed to a process of curing rubber with the assistance of a computer. There, the Court observed, even though the claims at issue relied on a mathematical formula,

> the [patentees] here do not seek to patent a mathematical formula. Instead, they seek patent protection for a process of curing synthetic rubber. Their process admittedly employs a well-known mathematical equation, but they do not seek to pre-empt the use of that equation. Rather, they seek only to foreclose from others the use of that equation in conjunction with all of the other steps in their claimed process. These include installing rubber in a press, closing the mold, constantly determining the temperature of the mold, constantly recalculating the appropriate cure time through the use of the formula and a digital computer, and automatically opening the press at the proper time. Obviously, one does not need a 'computer' to cure natural or synthetic rubber, but if the computer use incorporated in the process patent significantly lessens the possibility of 'overcuring' or 'undercuring,' the process as a whole does not thereby become unpatentable subject matter.

*Diehr*, 450 U.S. at 187. It is not difficult to imagine that, despite the aid of a digital computer, *Diehr's* claimed method of operating a rubber-molding press for precision molded compounds could still result in burned rubber. But despite this reality, the claims were not found invalid on this basis. The fact that the claimed process "***significantly lessens the possibility*** of 'overcuring' or 'undercuring'" was enough, and the focus was on "the process as a whole." *See id.* Similarly, the relevant claims in this case are directed as a whole to solving problems that arise within the context of error correction encoding in digital communications. They require particular encoding steps, including that information bits appearing in a variable number of subsets be included in the encoding process. These steps mean that the relevant claims do not preempt the use of the recited mathematical formulas outside of this error correction encoding context, again particularly because of this "variable number of subsets" limitation. In other words, the claims recite mathematical formulas, but do not seek to patent them. *See also Thales Visionix Inc. v. U.S.*, 850 F.3d 1343, 1347-48 (Fed. Cir. 2017) ("claims are patent eligible under § 101 'when a claim containing a mathematical formula implements or applies that formula in a structure or process which, when considered as a whole, is performing a function which the patent laws were designed to protect.'") (citations omitted); *see also Core Wireless*, 880 F.3d at 1362 (discussing *Thales* "[w]e noted that even though the system used conventional sensors and a mathematical equation, the claims specified a particular configuration of the sensors and a particular method of utilizing the raw data that eliminated many of the complications inherent in conventional methods."). And although the relevant claims of the '781 Patent encompass a specific example that arguably fails to provide an improvement to computer functioning, like *Diehr*, the focus on the claims as a whole and the framework they create provides for patent eligibility.

In *Visual Memory*, the Federal Circuit considered claims to "[a] computer memory system connectable to a processor and having one or more programmable operational characteristics, said characteristics being defined through configuration by said computer based on the type of said processor." *Visual Memory LLC v. NVIDIA Corp.*, 867 F.3d 1253, 1257 (Fed. Cir. 2017). The Federal Circuit, considering the claims at the motion to dismiss stage, found the claims as informed by the patent specification related to an improvement to the operation of computers. It found that the claims avoided the need to design separate memory systems for each type of processor, while also avoiding performance problems of prior art memory systems. *Id.* at 1259. Of course, these improvements assume a certain type of programming is employed in practice. The claims of *Visual Memory* themselves do not require that the programmable operational characteristic is actually programmed in a way that improves computer functioning. *See id.* at 1257 (listing language of Claim 1 of the relevant patent). Indeed, the dissent specifically noted that the patent did not describe how to implement the programmable operational characteristic. *Id.* at 1263. The majority responded by stating,

> the dissent assumes that the "innovative" effort in the '740 patent lies in the

> programming required for a computer to configure a programmable operational characteristic of a cache memory. This assumption is inconsistent with the patent specification itself. The specification makes clear that the inventors viewed their innovation as the creation of "a memory system which is efficiently operable with different types of host processors," '740 patent col. 2 ll. 65-67, and the patent discloses how to implement such a memory system. Specifically, as demonstrated above, both the specification and the claims expressly state that this improved memory system is achieved by configuring a programmable operational characteristic of a cache memory based on the type of processor connected to the memory system. . . . ***Configuring the memory system based on the type of processor connected to the memory system is the improvement in computer technology to which the claims are directed.*** *Alice* requires no more from the claims or the specification to support our conclusion that the claims are not directed to an abstract idea. This conclusion is particularly proper on a motion to dismiss under Rule 12(b)(6), where all factual inferences drawn from the specification must be weighed in favor of Visual Memory, the non-moving party.

*Visual Memory*, 867 F.3d at 1261-62 (emphasis added). The majority elsewhere suggested that the dissent's concerns were better suited for an enablement challenge than an eligibility challenge under § 101. *Id.* at 1261.

At the December 2018 hearing, Defendants argued that there is a core difference between claims found patent-eligible in cases such as *Enfish* and the claims at issue in the '781 Patent. Dec. Hearing Tr. 59:7-9. Defendants argued that in *Enfish*, for example, "the claims themselves recited the specific elements that were the improvement to how the self-referential database functioned." *Id.* at 59:10-13. Defendants argued that even a simple version of the *Enfish* claims as written would still lead to an improvement in computer functioning. *Id.* at 59:14-19. The *Enfish* patent involved a system claim (for "[a] data storage and retrieval system for a computer memory") and included a "means for configuring" phrase that had been construed to require a four-step algorithm. *Enfish*, 822 F.3d at 1336. As Defendants put it, "no matter how simple you made [the self-referential table], you still have those elements as a part of the claim." Dec. Hearing Tr. 60:14-16. Defendants' position appears to be that the claims in *Enfish* would always include the *capability* to build a more complex self-referential table, even if a particular example included only a very simple self-referential table. Although perhaps true for the claims in *Enfish*, the Court is not persuaded that Defendants' argument (that all implementations of patent-eligible claims lead to technological improvements) holds true for circumstances like those presented in *Visual Memory*. But more importantly, the relevant claims in this case set out a method of performing error correction/detection encoding, including with the requirement that information bits in a data set appear in a "variable number of subsets." Like *Enfish* and *Visual Memory*, this element remains part of the claims, no matter the surrounding circumstances when the claims are practiced. Much like *Visual Memory*, that the inventors created a framework where there is always encoding that includes information bits in a variable number of subsets leads to the improvement in error correction/detection encoding technology. The innovative effort was not the actual information bits inputted, but that data can be encoded by this overall method.[19] *See also Finjan*, 879 F.3d at 1302 (method comprising receiving a executable program, generating a security profile for it, and linking the security profile to the program found patent-eligible).

What *Diehr* and *Visual Memory* show is that in the § 101 patent eligibility context, the issue is not whether a claim used in practice always leads to an improvement, but whether the overall structure and framework created by the claims leads to a situation where certain benefits/improvements flow from that structure. This is also consistent with how courts are instructed to perform the § 101 analysis at step 1. Whether claims are "directed to" an abstract idea requires an inquiry into the nature of the claims "as a whole," not dissecting specific examples of the claims in use. *Elec. Power Grp.*, 830 F.3d at 1353. Here, the claims are "directed to" a method for encoding data that, according to the patent specification and testimony of Plaintiff's experts, leads to a framework that improves on previous data encoding methods. Claims directed to such improvements in computer technology are patent eligible. *See Enfish*, 822 F.3d at 1336 ("[W]e find that the claims at issue in this appeal are not directed to an abstract idea within the meaning of *Alice.* Rather, they are directed to *a specific improvement to the way computers operate*.") (emphasis added).

Certain district court cases further inform the Court's determination. More often, district courts have considered the same issue of claims directed to improved methods or systems for encoding/encrypting/transmitting data in a technological context and found such claims patent eligible. *TQP* for instance, a case already discussed, found claims directed to a method of transmitting data in encrypted form patent-eligible. *TQP*, 2014 WL 651935, at *1; *see also supra* at 25-26. In *Evolved Wireless, LLC v. Apple Inc.*, 221 F. Supp. 3d 485, 493 (D. Del. 2016), the

[19] The Court also speculates but declines to further consider whether the effect of Defendants' position would be significantly more questions about the validity of method claims under § 101 compared to the validity of system and apparatus claims.

district court found claims reciting "[a] method of transmitting a preamble sequence in a mobile communication system" patent eligible.

In *Huawei Techs., Co, Ltd v. Samsung Elecs. Co, Ltd.*, No. 3:16-CV-02787-WHO, 2016 WL 6834614, at *6 (N.D. Cal. Nov. 21, 2016), a district court similarly found claims related to "reduc[ing] signal interference when a mobile device connects to a cellular network" patent-eligible, although they relied on various mathematical equations. Of note, the court observed that mathematical equations employed by the relevant claims had "no significance outside of decreasing interference between mobile devices." *See id.* at *8 ("The only 'abstract idea' identified by Samsung is the mathematical equation used . . . But Samsung itself admits that the equation has no significance when removed from the context of mobile devices connecting to a base station within a cell. . . . If the equation has no independent significance outside the technological environment of mobile communication systems, then the claims tying the equation to a mobile device cannot be an attempt to limit something that could be broader, and thus, there is no attempt to 'circumvent' patent law."). Similarly here, even in their simplest version, Defendants present no basis for why a person would ever choose to perform the claimed steps, including the "variable number of subsets" limitation, in contexts outside of error detection/correction encoding. Defendants' argument – that the "variable number of subsets" requirement fails to save the claims from abstraction because it is itself an abstract concept (*see, e.g.*, Docket No. 714 at 17) – is unpersuasive; both because Defendants have failed to show that such a step would have any relevance outside of the context of error correction/detection encoding and because that limitation must be considered in combination with the other language of the relevant claims, which by their steps and nomenclature, have been shown to be limited to the error correction/detection encoding field. *But see Huawei Techs.*, 2016 WL 6834614, at *8 (suggesting that a claim must be tied to a "concrete structure" to be patent eligible).

*Sycamore*, 294 F. Supp. 3d at 653, is particularly instructive. In *Sycamore*, Judge Bryson found claims relating to encoding information groups and control codes were patent eligible. In doing so, Judge Bryson distinguished many of the same Federal Circuit decisions finding claims patent ineligible addressed in this Order and found them distinguishable for similar reasons. *See id.* at 652-653 (addressing *Recognicorp*, *Digitech*, *Synopsys*, and others.). As *Synopsys* explained,

> While it is true that the invention in this case involves the manipulation of data, the point of the invention is not simply the transmission of data in coded form, but the conversion of the data into a form that makes the communication

> of the data more efficient. The specific function of the recited encoding scheme is to add efficiency to the process in a particular manner. As such, the recited protocol, even though expressed (as are all computer operations) as an algorithm, is a concrete technical contribution and not simply the embodiment of an abstract idea.

*Id.* The same reasoning applies here.

Because the claims are directed to patent-eligible subject matter at *Alice* Step 1, it is not necessary to reach *Alice* Step 2.[20]

**VI. Conclusion**

For the reasons stated in this ruling (and in the consistent portions of the August 30, 2018 and November 15, 2018 tentative rulings), Defendants' Renewed § 101 Motion is **DENIED**.

[20] Perhaps the problem is not really one of whether the '781 Patent claims raise an abstract idea issue under Section 101, but rather under the concepts of enablement, written description, or prior art. *C.f. McRO*, 837 F.3d at 1313-14 ("Patent law has evolved to place additional requirements on patentees seeking to claim a genus; however, these limits have not been in relation to the abstract idea exception to § 101. Rather they have principally been in terms of whether the patentee has satisfied the tradeoff of broad disclosure for broad claim scope implicit in 35 U.S.C. § 112."). Plaintiff's arguments in particular related to "scrambling" and its belief that the claims are broader than the embodiments disclosed in the specification may create § 112 concerns.

UNITED STATES DISTRICT COURT
CENTRAL DISTRICT OF CALIFORNIA
****AMENDED****
**CIVIL MINUTES - GENERAL**

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|---|---|---|---|
| Case No. | CV 16-3714-GW (AGRx) | Date | July 1, 2019 |
| Title | *The California Institute of Technology v. Broadcom Limited, et al.* | | |

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| Present: The Honorable | GEORGE H. WU, UNITED STATES DISTRICT JUDGE |

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|---|---|---|
| Javier Gonzalez | None Present | |
| Deputy Clerk | Court Reporter / Recorder | Tape No. |

| Attorneys Present for Plaintiffs: | Attorneys Present for Defendants: |
|---|---|
| None Present | None Present |

**PROCEEDINGS:** **IN CHAMBERS - FINAL RULINGS ON PLAINTIFF'S MOTION FOR SUMMARY JUDGMENT AS TO NO INEQUITABLE CONDUCT [942]**

Attached hereto is the Court's Final Rulings on Plaintiff's Motion for Summary Judgment as to No Inequitable Conduct. Plaintiff's Motion is GRANTED.

:

Initials of Preparer JG

***The California Institute of Technology v. Broadcom Limited et al.***; Case No. 2:16-cv-03714-GW-(AGRx)
Final Rulings on: Plaintiff's Motion for Summary Judgment as to No Inequitable Conduct (Partial) (Docket No. 942 - public; Docket No. 957 - sealed; *see also* Docket No. 994 (notice of errata)); Opposition (Docket No. 1070 - public; Docket No. 1104 - sealed); Reply (Docket No. 1153 - public; Docket No. 1180 - sealed)

[Portions of the parties' briefing related to the pending motions addressed by this Final Ruling were filed under seal. The parties will be expected to state their positions as to whether any material should remain under seal within three days of this order being issued.]

## I. <u>Introduction</u>

Plaintiff California Institute of Technology currently alleges patent infringement against Defendants Broadcom Limited, Broadcom Corporation, Avago Technologies Limited, and Apple Inc. *See* First Amended Complaint ("FAC"), Docket No. 36; *see also* Docket No. 1. Plaintiff asserts that Defendants infringe fifteen claims from three of its patents: (1) U.S. Patent No. 7,116,710 ("the '710 Patent"); (2) U.S. Patent No. 7,421,032 ("the '032 Patent"); and (3) U.S. Patent No. 7,916,781 ("the '781 Patent") (collectively, the "Asserted Patents").[1] *See* Docket No. 409 (Plaintiff's Amended Notice of Withdrawal of Certain Asserted Claims of Asserted Patents); *see also* Docket No. 953 (Joint Report Regarding Pending Disputed Issues).

The parties have filed this first "round" of motions for summary judgment and motions to exclude.[2] Those motions have been fully briefed. A hearing was held on all pending matters in

[1] The fifteen remaining claims in this case are: Claims 20, 22, and 23 of the '710 Patent; Claims 3, 11, 13, 17, and 18 of the '032 Patent; and Claims 5, 6, 9, 10, 13, 19, and 22 of the '781 Patent. Docket No. 409. Of those claims, eleven were selected as representative claims for purposes of adjudication in this lawsuit: Claims 20, 22, and 23 of the '710 Patent; Claims 3, 11, 17, and 18 of the '032 Patent; and Claims 6, 9, 13, and 22 of the '781 Patent. *See id.*; *see also* Docket No. 487, 488. On March 22, 2019, in a joint report filed by the parties, Plaintiff stated that it intended to file a "formal notice of withdrawal" on the basis that it has "withdrawn its infringement allegations with respect to claims 5, 6, 9, and 10 of the '781 patent and claim 13 of the '032 patent." Docket No. 953 at 2; *see also* Docket No. 998 at 2 (Plaintiff's memorandum in support of motion to exclude improper claim construction opinions, stating that it alleges that Defendants infringe Claims 20, 22, and 23 of the '710 Patent, Claims 3, 11, 17, and 18 of the '032 Patent, and Claims 9, 13 and 22 of the '781 Patent). Plaintiff has not yet filed such a notice, which, once filed, will be understood to remove those five claims from the case entirely given that Plaintiff does not represent that any of the claims "[s]elected for adjudication" are representative of any of the withdrawn claims.

[2] Specifically, the following seven motions have been filed: (1) Plaintiff's Motion for Summary Judgment as to No Inequitable Conduct (Partial) (Docket No. 942); (2) Defendants' Motion for Summary Judgment as to No Joint Infringement (Docket No. 959); (3) Plaintiff's Motion to Strike Certain Opinions of Defendants' Experts Brendan Frey and Wayne Stark (Docket No. 974); (4) Defendants' Motion to Exclude Infringement Opinions of Dr. Michael Tanner (Docket No. 964); (5) Plaintiff's Motion to Strike Late-Disclosed Non-Infringing Alternative (Docket No. 971); (6) Plaintiff's Motion to Exclude Improper Claim Construction Opinions of Dr. Stark and Dr. Blanksby (Docket No. 968); (7) Broadcom's Motion for Summary Judgment as to Non-Infringement as to Extraterritorial Sales (Docket No. 975).

this case on June 6, 2019.[3] A second hearing was held on the same pending matters on June 17, 2019. This Order addresses Plaintiff's Motion for Summary Judgment as to No Inequitable Conduct (Partial).[4] Docket No. 942.

For the reasons stated in this Order, the Court **GRANTS** Plaintiff's Motion for Summary Judgment as to No Inequitable Conduct (Partial).

## II. Legal Standard

Under Federal Rule of Civil Procedure ("Rule") 56, a party may move for summary judgment, identifying each claim or defense − or the part of each claim or defense − on which summary judgment is sought, and the court shall grant it when the pleadings, the discovery and disclosure materials on file, and any affidavits show that "there is no genuine issue as to any material fact and that the movant is entitled to judgment as a matter of law." Fed. R. Civ. P. 56(a); *see also Miranda v. City of Cornelius*, 429 F.3d 858, 860 n.1 (9th Cir. 2005). As to materiality, "[o]nly disputes over facts that might affect the outcome of the suit under the governing law will properly preclude the entry of summary judgment." *Anderson v. Liberty Lobby, Inc.*, 477 U.S. 242, 248 (1986). A dispute as to a material fact is "genuine" if there is sufficient evidence for a reasonable jury to return a verdict for the nonmoving party. *Id.*

To satisfy its burden at summary judgment, a moving party with the burden of persuasion must establish "beyond controversy every essential element of its [claim or defense]." *S. Cal. Gas Co. v. City of Santa Ana*, 336 F.3d 885, 888 (9th Cir. 2003); O'Connell & Stevenson, *Rutter Group Prac. Guide: Fed. Civ. Proc. Before Trial* ("*Federal Practice Guide*") § 14:126 (2016). By contrast, a moving party without the burden of persuasion "must either produce evidence negating an essential element of the nonmoving party's claim or defense or show that the nonmoving party does not have enough evidence of an essential element to carry its ultimate burden of persuasion at trial." *Nissan Fire & Marine Ins. Co., Ltd. v. Fritz Cos.*, Inc., 210 F.3d 1099, 1102 (9th Cir. 2000); *see also Devereaux v. Abbey*, 263 F.3d 1070, 1076 (9th Cir. 2001) (en banc) ("When the nonmoving party has the burden of proof at trial, the moving party need only point out 'that there

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[3] At the June 6, 2019 hearing, tentative rulings were issued providing the Court's initial views on the issues raised by the parties. The tentative order has not been adopted as a final ruling of the Court and is not a final determination in this matter.

[4] *See* Plaintiff's Motion for Summary Judgment as to No Inequitable Conduct (Partial), Docket No. 942 (public), Docket No. 957 (sealed), *see also* Docket No. 994 (notice of errata); Opposition, Docket No. 1070 (public), Docket No. 1104 (sealed); Reply, Docket No. 1153 (public), Docket No. 1180 (sealed).

is an absence of evidence to support the nonmoving party's case.'") (quoting *Celotex Corp. v. Catrett,* 477 U.S. 317, 325 (1986), and citing *Fairbank v. Wunderman Cato Johnson,* 212 F.3d 528, 532 (9th Cir. 2000) (holding that the *Celotex* "showing" can be made by "pointing out through argument . . . the absence of evidence to support plaintiff's claim")).

> If the party moving for summary judgment meets its initial burden of identifying for the court the portions of the materials on file that it believes demonstrate the absence of any genuine issue of material fact, the nonmoving party may not rely on the mere allegations in the pleadings in order to preclude summary judgment[, but instead] must set forth, by affidavit or as otherwise provided in Rule 56, specific facts showing that there is a genuine issue for trial.

*T.W. Elec. Serv., Inc., v. Pac. Elec. Contractors Ass'n*, 809 F.2d 626, 630 (9th Cir. 1987) (internal citations and quotation marks omitted) (citing, among other cases, *Celotex*, 477 U.S. at 323). "A non-movant's bald assertions or a mere scintilla of evidence in his favor are both insufficient to withstand summary judgment." *See FTC v. Stefanchik*, 559 F.3d 924, 929 (9th Cir. 2009). In addition, the evidence presented by the parties must be admissible. *See* Fed. R. Civ. P. 56(e). Conclusory, speculative testimony in affidavits and moving papers is insufficient to raise genuine issues of fact and defeat summary judgment. *See Thornhill Publ'g Co., Inc. v. GTE Corp.*, 594 F.2d 730, 738 (9th Cir. 1979). Relatedly, "[a]ny objections to declarations or other evidence must be made at or (preferably) before the hearing, and should be ruled upon by the court before ruling on the motion itself." *Federal Practice Guide* § 14:333 (citing *Hollingsworth Solderless Terminal Co. v. Turley*, 622 F.2d 1324, 1335 n.9 (9th Cir. 1980); *Sigler v. American Honda Motor Co.*, 532 F3d 469, 480 (6th Cir. 2008)). In judging evidence at the summary judgment stage, however, courts do not make credibility determinations or weigh conflicting evidence at the summary judgment stage, and must view all evidence and draw all inferences in the light most favorable to the non-moving party. *See T.W. Elec.*, 809 F.2d at 630-31 (citing *Matsushita Elec. Indus. Co., Ltd. v. Zenith Radio Corp.*, 475 U.S. 574 (1986)); *Anderson*, 477 U.S. at 255 ("The evidence of the non-movant is to be believed and all justifiable inferences are to be drawn in [the non-movant's] favor.").

"If the court does not grant all the relief requested by the motion, it may enter an order stating any material fact – including an item of damages or other relief – that is not genuinely in dispute and treating the fact as established in the case." Fed. R. Civ. P. 56(g); *see also* Federal Practice Guide § 14:352 ("A partial summary judgment may be granted on motion of either party for adjudication of particular claims or defenses.") (citing *id.* § 14:33).

**III. <u>Analysis</u>**

**1. Unpled Inequitable Conduct Theories**

Defendants' operative Answer and Counterclaims specifically alleged that the patent applicant committed equitable conduct by failing to disclose Luby97, Luby98, and Richardson99 during prosecution of the asserted patents. *See* Docket No. 47 at Answer, Sixth Affirmative Defense; *id.* at Counterclaims, Count IX. Defendants have since identified some inequitable conduct theories that were not pled in their Answer and Counterclaims. Specifically, Defendants argue that they properly disclosed additional inequitable conduct theories relating to Frey and Pfister in a supplemental interrogatory response served on the last day of fact discovery. Docket No. 1104 at 9-10, 24. Defendants frame these new undisclosed prior art theories as relying on undisclosed "known or used" invalidity theories. *Id.*

Inequitable conduct, however, is a claim for relief that is subject to a Rule 9(b) pleading standard. *Ferguson Beauregard/Logic Controls, Div. of Dover Resources, Inc. v. Mega Sys., LLC*, 350 F.3d 1327, 1344 (Fed. Cir. 2003) ("[I]nequitable conduct, while a broader concept than fraud, must be pled with particularity" under Rule 9(b)."). Unlike notice pleading, an inequitable conduct pleading must identify the "'who, what, when, where and how' of the alleged material misrepresentation, and offer 'sufficient underlying facts from which a court may reasonably infer that a party acted with the requisite state of mind.'" *Parallax Grp. Int'l LLC v. Incstores LLC*, No. SACV 16-00929 AG (DFMx), 2017 WL 3453299, at *3 (C.D. Cal. June 30, 2017) (quoting *Exergen Corp. v. Wal-Mart Stores, Inc.*, 575 F.3d 1312, 1327 (Fed. Cir. 2009)).

The Court finds that in the particular circumstances of this case, it was not appropriate for Defendants to bypass their pleading obligations under Rule 9(b) by incorporating new inequitable conduct theories into an interrogatory response served on the fact discovery deadline. In these circumstances, there was no opportunity for the parties to conduct additional fact discovery relating to Defendants' new theories.

Other district courts have similarly found inequitable conduct theories waived if not pled. Plaintiff cites *CSB-Sys. Int'l Inc. v. SAP Am., Inc.*, No. CIV.A. 10-2156, 2012 WL 1645582, at *6 (E.D. Pa. May 10, 2012), which itself similarly collected cases:

> As set forth above, "inequitable conduct, while a broader concept that fraud, must be ***pled*** with particularity." *Cent. Admixture Pharm. Servs, Inc. v. Adv. Cardiac Solutions, P.C.*, 482 F.3d 1347, 1356 (Fed. Cir. 2007) (emphasis

> added) (quoting *Ferguson Beauregard/Logic Controls, Inc. v. Mega Sys., LLC,* 350 F.3d 1327, 1344 (Fed. Cir. 2003)). Defendants' pleadings must "give notice to the other party of the facts on which the defense is premised." *Id.* at 1357. "Without such a pleading, a party may not raise, as an affirmative defense, inequitable conduct in a motion for summary judgment." *Lab. Skin Care, Inc. v. Ltd. Brands, Inc.,* No. Civ.A.06-601, 2009 WL 2524577, at *2 (D. Del. Aug. 17, 2009). Repeatedly, courts have declined to allow a defendant to assert a new theory of inequitable conduct if the answer and counterclaims asserted a different theory of inequitable conduct than that relied upon in summary judgment proceedings. *See, e.g., id.* at *3-4 (declining to consider new theory of inequitable conduct where defendant's answer "does not support the particular theory of inequitable conduct in Defendants' Motion for Summary Judgment"); *ChemFree Corp. v. J. Walter, Inc.,* No. Civ.A.04-3711, 2008 WL 3884365, at *2 (N.D. Ga. June 10, 2008) (finding that "Defendants may not now change their theories of inequitable conduct at the final stages of this litigation in an effort to avoid summary judgment. Therefore, the Court will only consider Defendants' original allegations of inequitable conduct as pleaded in their Amended Answer and Counterclaims"); *Inline Connection Corp. v. AOL Time Warner, Inc.,* 237 F.R.D. 361, 367-68 (D. Del. 2006) (finding that, even assuming defendants did not have all necessary information to plead new theory of inequitable conduct when filing Second Amended Answer, the defendants had an obligation to file a Third Amended Answer to include new theory of inequitable conduct as soon as they had that information; even though previous Answer alleged inequitable conduct, their failure to amend their Answer to include new theory precluded their reliance on that theory); *Heraeus Electro-Note Co. v. Midwest Instrument Co., Inc.,* No. Civ.A.06-355, 2006 WL 3004877, at *6 (E.D. Pa. Oct.18, 2006) (finding that the defendant's best mode theory of inequitable conduct, as pled, failed to satisfy Rule 9(b) because none of the assertions contained in the defendant's response to the plaintiff's motion to dismiss were pled in the amended counterclaims).

*Id.* (emphasis in original).

*EMC Corp. v. Storage Tech. Corp.*, 921 F. Supp. 1261, 1263-64 (D. Del. 1996) presents another example and collection of cases:

> Only a handful of courts have addressed the issue of whether pleadings found to be inadequate under Rule 9(b) may be salvaged by future discovery. The Courts that have examined the issue have held that they cannot. *See, e.g., Nichols Motorcycle Supply, Inc. v. Dunlop Tire Corp.,* No. 93 C 5578, 1994 WL 113108, at *2-3 (N.D. Ill. March 30, 1994) (plaintiff cannot "indirectly amend its complaint to include its responses to interrogatories"); *see also id.,* at *3 (even if interrogatory recites all information, defendant is entitled to reassurance that response is entire basis for fraud claim); *National Union Fire Ins. Co. of Pittsburgh v. Continental Illinois Corp.,* 658 F.Supp. 775, 778 (N.D. Ill 1987) (not deciding issue but

> pointing out that "how discovery responses can cure threshold pleading defects is another unexplained mystery"). Other courts have held that where the allegations are pled with particularity, the parties may then rely upon interrogatories for specific details. *Union Mutual Life Ins. Co. v. Simon,* 22 F.R.D. 186, 187 (E.D. Pa. 1958) (where pleadings are particular, purpose of interrogatories is to elicit complete and exact details); *Scervini v. Miles Laboratories, Inc.,* 91 U.S.P.Q. 206, 207, 11 F.R.D. 542 (S.D.N.Y. 1951) (where pleadings fulfil particularity requirements, defendants can use interrogatories to obtain additional information). Thus, the Court concludes that EMC may not use its interrogatory responses to fulfill the particularity requirements of Rule 9(b). Accordingly, the Court concludes that Paragraph Seven of EMC's Counterclaim and Answer to STK's Third Counterclaim fails to meet the particularity requirement of Rule 9(b).

*EMC Corp. v. Storage Tech. Corp.*, 921 F. Supp. 1261, 1263-64 (D. Del. 1996).

In the particular circumstances presented here, the Court agrees with these district courts and declines to permit Defendants to rely on an unpled inequitable conduct claim on the basis that it was disclosed in written discovery.[5] Defendants' Answer and Counterclaims govern in this case, and Defendants should have sought leave to amend their operative pleading consistent with Rule 9(b), to ensure that both the substance of Defendants' proposed new allegations and any procedural concerns relating to their timing could be considered. Moreover, the Court is not persuaded that Defendants, in their interrogatory responses, sufficiently disclosed an inequitable conduct theory relying on the underlying "known or used" invalidity theories they now raise. Although Defendants' supplemental interrogatory response generally referred to the presentations made of Pfister/Pfister Slides and Frey/Frey Slides at the Allerton Conference, the email and testimony Defendants now invoke to support such a theory, and the material information allegedly provided to support such a theory, were not sufficiently disclosed in Defendants' response. Defendants suggest that the timing of their supplemental interrogatory response was based on the late timing of two depositions during the fact discovery period. Defendants also blame Plaintiff for not raising an earlier challenge to the new theories disclosed in Defendants' supplemental response. These arguments are not persuasive. It is still Defendants' responsibility to ensure that the operative

[5] At the June 17, 2019 hearing, Defendants cited a case for the proposition that a Rule 9(b) objection can be waived. Defendants' cited case, a non-patent case, concluded that because the objecting party had already filed an answer in response to the Rule 9(b) pleadings, the argument that the objecting party did not understand the basis for the Rule 9(b) allegations was unpersuasive. Different factual circumstances are at play here, where Defendants' inequitable conduct claim spans multiple theories, some disclosed in pleadings, some not. Defendants' cited case is unpersuasive for this reason as well as in light of the other legal authority identified herein.

pleading governing their case aligns with the arguments and theories they seek to raise in this case. That is not a responsibility that changes based on the late timing of certain discovery or the opposing side's failure to raise the issue, particularly in the context of Rule 9(b) pleading obligations.

Because Defendants failed to take these steps, Defendants' unpled inequitable conduct theories are deemed waived and are not considered on their merits.[6]

**2. Pled Inequitable Conduct Theories**

As noted, Defendants' operative Answer and Counterclaims allege inequitable conduct theories based on Plaintiff's failure to disclose Luby97, Luby98, and Richardson99 during prosecution of the asserted patents. *See* Docket No. 47.

Although Plaintiff does not dispute that these references were not disclosed to the Patent Office before the asserted patents issued, the Patent Office has had reason to consider at least two of them subsequently. Luby97 and Luby98 were identified as part of one or more obviousness combinations in challenges to some of the asserted claims during *inter partes* review proceedings. After considering the various obviousness combinations that included these references, the Patent Trial and Appeal Board found the challenged claims at issue not unpatentable over them. Plaintiff argues that on this basis, Defendants cannot show that Luby97, Luby98, or Richardson99 satisfy the but-for materiality standard required to prove inequitable conduct.

Defendants argue that the exact prior art grounds they intend to present at trial were not considered by the PTAB. Defendants also emphasize the claims that were not subject to IPR: Claim 23 of the '710 Patent, Claims 3 and 17 of the '032 Patent, and Claim 9 of the '781 Patent. *See, e.g.* Docket No. 1104 at 23. Defendants argue that if the jury invalidates the claims at trial based on obviousness combinations that include these references, that would more than support a conclusion of but-for materiality for purposes of an inequitable conduct analysis.

"When an applicant fails to disclose prior art to the PTO, that prior art is but-for material if the PTO would not have allowed a claim had it been aware of the undisclosed prior art." *Therasense, Inc. v. Becton, Dickinson & Co.*, 649 F.3d 1276, 1291 (Fed. Cir. 2011). Importantly,

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[6] At the June 17, 2019 hearing, Defendants for the first time requested leave to amend their operative answer and counterclaims to incorporate their unpled inequitable conduct theories. On June 27, 2019, Defendants followed up this request by actually filing a motion requesting leave to file an amended answer and counterclaims. Docket No. 1289. The Court addressed that request by a separate order. *See* Docket No. 1301.

"[i]n making this patentability determination, the court should apply the preponderance of the evidence standard and give claims their broadest reasonable construction." *Id.* at 1291-92 (citing Manual of Patent Examining Procedure ("MPEP") §§ 706, 2111 (8th ed. Rev.8, July 2010)). The Federal Circuit in *Therasense* went on to state, "even if a district court does not invalidate a claim based on a deliberately withheld reference, the reference may be material if it would have blocked patent issuance under the PTO's different evidentiary standards." *Id.* at 1292 (citing MPEP §§ 706 (preponderance of the evidence), 2111 (broadest reasonable construction)).

In their opposition, Defendants mix in their position regarding their pled inequitable conduct theories with arguments relating to their unpled inequitable conduct theories. Indeed, Defendants appear to place much more emphasis on their Frey/Pfister "known or used" invalidity theories than they do emphasizing Luby97, Luby98, and Richardson99.

Defendants' Answer and Counterclaims allege that Luby97, Luby98, and Richardson99 were material to the patentability of the Asserted Patents because they "expressly teach the benefits of making regular codes irregular." Docket No. 47 at ¶ 67. During IPR, Defendants identified Luby97 and Luby98 for the same purpose. Namely, Defendants argued that a person of ordinary skill in the art would modify another prior art reference, Divsalar, to incorporate "irregularity" based on these two references. *See* Docket No. 1180 at 4. The PTAB rejected this argument. Importantly, in reviewing these asserted claims during IPR, the PTAB applied the broadest reasonable interpretation standard to determine the scope of the claims. This is the same claim construction standard *Therasense* states should be applied in considering whether an undisclosed reference is but-for material. Moreover, Defendants relied in Luby97 and Luby98 in the IPR proceedings for the same concept of making codes irregular that they argue supports theses references' but-for materiality. On this record, the Court finds as a matter of law that Luby97 and Luby98 were not but-for material to the patentability of the asserted claims that were reviewed against these references during IPR.[7]

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[7] At the hearing, Defendants characterized the Court's tentative conclusion regarding the materiality of these references as an improper application of collateral estoppel. This is not an accurate characterization of the Court's determination, and is rejected. The disputed issue is whether the Patent Office would have found the omitted references but-for material to the patentability of the Asserted Patents. The Patent Office had a later opportunity to consider two of those exact references, and concluded that the claims were not invalid based on a combination of those references with other prior art. Indeed, the Patent Office found arguments that Luby97 and Luby98 disclosed irregular repetition and could be combined with other prior art references did not support finding the patents invalid. *AAMP of Fla., Inc v. Auto. Data Sols., Inc.*, No. 8:13-CV-2019-T-35TGW, 2015 WL 12843845, at *29 (M.D. Fla. Oct. 8, 2015) ("There is simply no space for speculation regarding what the PTO would have done had it known of the Soundgate references. It issued the '825 patent notwithstanding disclosure of the Soundgate references, and it then expressly

As to Richardson99, the Answer and Counterclaims allege that Richardson99 "provides a similar disclosure" to Luby98. Docket No. 47 ¶ 65; *see also* Docket No. 944-4 at 30-31 (Apple's Supplemental Interrogatory Response and Objections to Plaintiff's Common Interrogatory No. 7). The Answer and Counterclaims highlight excerpts of Richardson99's disclosure referring to the benefits of irregular low-density parity check codes. *Id.* In their opposition, Defendants similarly state that Richardson99 was "building on [the] work" of Luby97 and Luby98 in its discussion of irregular low-density parity check codes. Docket No. 1104 at 5. Defendants do not provide an independent basis in their pleading or opposition as to how Richardson99 is arguably but-for material in some way that differs from Luby97 and Luby98. The fact that the PTAB considered and rejected obviousness combinations where Luby97 and Luby98 were offered for the same concept that Defendants also would offer Richardson99 similarly supports the conclusion that Richardson99 is not but-for material to the patentability of the asserted claims.

Beyond their collateral estoppel argument, Defendants did not raise additional arguments at the hearing regarding the materiality of Luby97 and Luby98 as those references related to the asserted claims subject to IPR. They did, however, emphasize Richardson99. Defendants argued that Richardson99 includes additional, material disclosure compared to Luby97 and Luby98 that supports their inequitable conduct claim. In presenting their argument, however, Defendants did not actually identify what was disclosed differently (or less so) in Luby97 and Luby98 such that an efficient comparison could be made between the disclosure of Richardson99 and those two references. Plaintiff responded to Defendants' descriptions of Richardson99 by arguing that Luby97 and Luby98 included similar disclosure to the material in Richardson99 highlighted by Defendants, but beyond this assertion, Plaintiff did not show how this was the case.

In previous circumstances, the Court has been inclined to permit parties to raise evidence for the first time at hearings, and indeed then considered that evidence in making its

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found [in requested reexamination proceedings] those references did not raise 'substantial new questions of patentability'.")

Defendants relatedly argued that there is no parity of the issues between the PTAB determinations and the disputes raised in this case because Defendants are relying on different combinations of prior art in this case compared to the PTAB decisions. Defendants, however, reference their obviousness invalidity theories in making this assertion about different combinations, rather than the inequitable conduct theories they disclosed in their operative pleading. Those inequitable conduct theories simply focus on the fact that these three references disclose irregular repetition, without regard to particular other references that they could have been combined with in office action rejections from the Examiner. *See* Docket No. 47 at Answer, Sixth Affirmative Defense; *id.* at Counterclaims, Count IX. Under the circumstances, Defendants' arguments are not persuasive.

determinations. Here, however, the issue runs deeper than simply the fact that these explanations of Richardson99 and its materiality were not included in Defendants' opposition. Defendants' new theory - which relies on a comparison of a chart in Richardson99 and a chart in the '710 Patent specification - is not described in Defendants' operative pleading or even in its supplemental interrogatory responses. *See also* Amended Expert Report of Brendan Frey, Vol. V, Docket No. 1081-39 ¶¶ 23-32 (considering Richardson99 and Luby98 together in a single section, not separately). Although Plaintiff's response at the hearing did not necessarily clarify the issues, the fact that it seems Plaintiff was not on notice of this version of Defendants' inequitable conduct theory until the hearing itself raises concerns that cannot be ignored. On this record, the Court declines to consider these arguments about the additional substantive relevance of Richardson99 compared to Luby97 and Luby98 for similar procedural reasons to those stated with respect to Defendants' other unpled inequitable conduct theories.

For the four asserted claims that were not examined during IPR, Defendants also have not specifically explained how the application of Luby97, Luby98, or Richardson99 to those claims would have impacted their allowability in a way unique from the asserted claims that were the subject of IPR proceedings. This is particularly the case where Defendants' disclosed inequitable conduct theories against all of the asserted claims simply rely on the fact that Luby97, Luby98, and Richardson99 disclose irregular codes. Defendants did not identify other disclosure in Luby97, Luby98, or Richardson99 that is allegedly but-for material to the patentability of individual asserted claims, whether that claim was subject to IPR proceedings or not. In their opposition, Defendants highlight Claim 9 of the '781 Patent, which was not subject to IPR proceedings, as presenting factual issues because Claims 1 and 2 of the '781 Patent were found anticipated by Divsalar during IPR proceedings. Docket No. 1104 at 20. Defendants state, "[t]he additional limitations of claim 9 are every bit as invalid." *Id.* at 21. Defendants do not further explain their position in their opposition memorandum, and this conclusory assertion is insufficient to create a factual question regarding the but-for materiality of Luby97, Luby98, or Richardson99 with respect to that claim.[8] Defendants did not further address Claim 9 at the hearing, but instead

[8] Claim 9 of the '781 Patent recites: "[t]he method of claim 6, wherein the information bits appear in a variable number of subsets." The Court had occasion to consider the scope of the "variable number of subsets" limitation when considering Defendants' challenge to the patentability of these claims under 35 U.S.C. § 101 and found that "the phrase 'variable number of subsets' creates a requirement in the relevant claims for irregular repetition of information bits." *See* Docket No. 849 at 14.

reiterated the general assertion that they should be permitted to allege inequitable conduct against these claims because they were not compared against Luby97 and Luby98 during IPR proceedings.

## IV. Conclusion

For the reasons stated in this Order, the Court **GRANTS** Plaintiff's Motion for Summary Judgment as to No Inequitable Conduct (Partial). Docket No. 942.

UNITED STATES DISTRICT COURT
CENTRAL DISTRICT OF CALIFORNIA
CIVIL MINUTES—GENERAL

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| Case No. | **CV 16-3714-GW(AGRx)** | Date | August 9, 2019 |
| Title | ***The California Institute of Technology v. Broadcom Limited, et al.*** | Page | 1 of 1 |

Present: The Honorable **GEORGE H. WU, UNITED STATES DISTRICT JUDGE**

| | |
|---|---|
| Javier Gonzalez | None Present |
| Deputy Clerk | Court Reporter |
| Attorneys Present for Plaintiff(s) | Attorneys Present for Defendant(s) |
| None Present | None Present |

**Proceedings:** **IN CHAMBERS – FINAL RULINGS ON:**

**CALTECH'S MOTION FOR PARTIAL SUMMARY JUDGMENT OF VALIDITY ON CLAIMS 20 AND 22 OF THE '710 PATENT UNDER 35 U.S.C. § 103 BASED ON IPR ESTOPPEL UNDER 35 U.S.C. § 315(e)(2) [844];**

**PLAINTIFF'S RENEWED MOTION FOR PARTIAL SUMMARY JUDGMENT OF VALIDITY UNDER 35 U.S.C. § 103 BASED ON IPR ESTOPPEL UNDER 35 U.S.C. § 315(E)(2) FOR U.S. PATENT NO. 7,916,781 [845];**

**DEFENDANT'S MOTION FOR CERTIFICATION UNDER 28 U.S.C. § 1292(b) [887];**

**DEFENDANTS' MOTION SEEKING PARTIAL RECONSIDERATION OF THE COURT'S DECEMBER 28, 2018 ORDER REGARDING IPR ESTOPPEL OF CERTAIN CLAIMS OF U.S. PATENT NOS. 7,916,781 AND 7,421,032 [888];**

**CALTECH'S MOTION TO EXCLUDE DEFENDANTS' LATE-PRODUCED DOCUMENTS AND DR. HENRY PFISTER'S UNTIMELY EXPERT DEPOSITION TESTIMONY [1024]**

Attached hereto is the Court's Final Rulings on the Motions above.

***The California Institute of Technology v. Broadcom Limited et al.***; Case No. 2:16-cv-03714-GW-(AGRx)
Final Rulings on: (1) Plaintiff's Motion for Partial Summary Judgment of Validity of Claims 20 and 22 of the '710 Patent Under 35 U.S.C. § 103 Based on IPR Estoppel under 35 U.S.C. § 315(e)(2); (2) Plaintiff's Renewed Motion for Partial Summary Judgment of Validity Under 35 U.S.C. § 103 Based on IPR Estoppel under 35 U.S.C. § 315(e)(2) for U.S. Patent No. 7,916,781; (3) Defendants' Motion for Reconsideration of the Estoppel Order; (4) Defendants' Motion for Certification Under 28 U.S.C. § 1292(b); and (5) Plaintiff's Motion to Exclude Defendants' Late Produced Documents and Dr. Henry Pfister's Untimely Expert Deposition Testimony.

[Portions of the parties' briefing related to the pending motions addressed by this Tentative Order were filed under seal. The parties will be expected to state their positions as to whether any material should remain under seal during the hearing on the motions, including the basis for any continued request to seal.]

## I. Introduction

Plaintiff The California Institute of Technology currently alleges patent infringement against Defendants Broadcom Limited, Broadcom Corporation, Avago Technologies Limited, and Apple Inc. *See* First Amended Complaint ("FAC"), Docket No. 36; *see also* Docket No. 1. Plaintiff asserts that Defendants infringe fifteen claims from three of its patents: (1) U.S. Patent No. 7,116,710 ("the '710 Patent"); (2) U.S. Patent No. 7,421,032 ("the '032 Patent"); and (3) U.S. Patent No. 7,916,781 ("the '781 Patent") (collectively, the "Asserted Patents").[1] *See* Docket No. 409 (Plaintiff's Amended Notice of Withdrawal of Certain Asserted Claims of Asserted Patents); *see also* Docket No. 953 (Joint Report Regarding Pending Disputed Issues).

On December 28, 2018, the Court issued a Final Ruling resolving Plaintiffs' summary judgment motion regarding *inter partes* review ("IPR") estoppel under 35 U.S.C. § 315(e)(2) as to certain obviousness invalidity grounds raised by Defendants against the '032 and '781 Patents. "Estoppel Order," Docket No. 830. The Court held Defendants were estopped from raising all but

[1] The fifteen remaining claims in this case are: Claims 20, 22, and 23 of the '710 Patent; Claims 3, 11, 13, 17, and 18 of the '032 Patent; and Claims 5, 6, 9, 10, 13, 19, and 22 of the '781 Patent. Docket No. 409. Of those claims, eleven were selected as representative claims for purposes of adjudication in this lawsuit: Claims 20, 22, and 23 of the '710 Patent; Claims 3, 11, 17, and 18 of the '032 Patent; and Claims 6, 9, 13, and 22 of the '781 Patent. *See id.*; *see also* Docket No. 487, 488. On March 22, 2019, in a joint report filed by the parties, Plaintiff stated that it intended to file a "formal notice of withdrawal" on the basis that it has "withdrawn its infringement allegations with respect to claims 5, 6, 9, and 10 of the '781 patent and claim 13 of the '032 patent." Docket No. 953 at 2; *see also* Docket No. 998 at 2 (Plaintiff's memorandum in support of motion to exclude improper claim construction opinions, stating that it alleges that Defendants infringe Claims 20, 22, and 23 of the '710 Patent, Claims 3, 11, 17, and 18 of the '032 Patent, and Claims 9, 13 and 22 of the '781 Patent). Plaintiff has not yet filed such a notice, which, once filed, will be understood to remove those five claims from the case entirely given that Plaintiff does not represent that any of the claims "[s]elected for adjudication" are representative of any of the withdrawn claims.

one obviousness invalidity ground (against the '781 Patent involving Divsalar, Ping, and Frey/Frey Slides). The Estoppel Order is incorporated by reference in its entirety, and should hereinafter be understood and interpreted based on the applicable clarifications and statements made in this Order.

One day before the Estoppel Order issued, the Patent Trial and Appeal Board ("PTAB") issued Final Written Decisions finding that Defendants had failed to demonstrate that Claims 20 and 22 of the '710 Patent were invalid as obvious over various prior art combinations. Based on these additional PTAB decisions, Plaintiff filed a Motion for Summary Judgment of Validity of Claims 20 and 22 of the '710 Patent under 35 U.S.C. § 103 Based on IPR Estoppel under 35 U.S.C. § 315(e)(2). *See* Docket No. 844. Plaintiff also filed a Renewed Motion for Partial Summary Judgment of Validity under 35 U.S.C. § 103 Based on IPR Estoppel under 35 U.S.C. § 315(e)(2) for U.S. Patent No. 7,916,781. Docket No. 845-1 (public); Docket No. 852 (sealed). Those Motions were fully briefed[2] and a hearing was held on them on February 7, 2019.[3] Docket No. 884. At the hearing, the parties were permitted leave to submit additional briefing related to some overlapping issues.[4] Defendants filed a motion for reconsideration of portions of the Estoppel Order. Docket No. 888. They also asked the Court to certify the Estoppel Order for interlocutory appeal under 28 U.S.C. § 1292(b) as it relates to one question: "whether IPR estoppel applies to non-petitioned, IPR-eligible invalidity grounds of which the petitioner was aware at the time it filed its IPR petition." Docket No. 887-1 at 1.

Another hearing was held on these issues, including the fully-briefed motions for

[2] *See* Docket No. 854 (public); Docket No. 871 (sealed) (Defendants' Opposition to '710 Patent Motion for Partial Summary Judgment); Docket No. 864 (public); Docket No. 876 (sealed) (Plaintiff's Reply in Support of '710 Patent Motion for Partial Summary Judgment); Docket No. 857 (public); Docket No. 872 (sealed) (Defendants' Opposition to Renewed '781 Patent Motion for Partial Summary Judgment); Docket No. 863 (public); Docket No. 877 (sealed) (Plaintiff's Reply in Support of Renewed '781 Patent Motion for Partial Summary Judgment).

[3] At the February 7, 2019 hearing, a tentative ruling was issued providing the Court's tentative views on the issues raised by the parties. *See* Docket No. 884. The tentative order has not been adopted as a final ruling of the Court and is not a final determination in this matter.

[4] After the February 2019 hearing, Plaintiff and Defendants each filed a short supplemental brief regarding their proposals for when a patent challenger should be permitted to present an invalidity theory under the "known or used" prong of 35 U.S.C. § 102(a), despite statutory estoppel as to related prior art publication invalidity theories. Docket Nos. 891, 903.

reconsideration[5] and certification,[6] on March 11, 2019.[7] At the March 11, 2019 hearing, after further discussion, Defendants were directed to file and serve a "listing of particularized evidence for their 'known or used' prior art (Pfister/Pfister Slides and Frey/Frey Slides) in support of their obviousness invalidity theories." Docket No. 936. The parties agreed the listing would not be due until after depositions of certain individuals - Pfister and Siegel - had been taken.

After Pfister's deposition, the parties became embroiled in yet another dispute. Plaintiff filed an *ex parte* application to exclude documents that were produced on the morning of Pfister's deposition and to strike expert testimony during Pfister's deposition. Docket No. 1018. Multiple hearings were held in quick succession on this dispute. *See* Docket Nos. 1042 (Minutes of Hearing April 16, 2019); 1048 (Minutes of Hearing April 18, 2019), 1100 (Minutes of Hearing April 25, 2019). The parties have submitted supplemental briefs and reports as directed by the Court at those hearings on various issues related to Pfister's and Siegel's depositions. *See, e.g.* Docket Nos 1083, 1084, 1105, 1191.

After these supplemental briefs were filed, the parties returned again for two more hearings on June 6, 2019 and June 17, 2019.[8] The parties' "known or used" dispute was discussed at both of these hearings as well before the matters were again taken under submission.

For the reasons stated in this Order, the Court would rule as follows:

- The Court would **GRANT** Defendants' Motion for Reconsideration of the Estoppel Order (Docket No. 888) and accordingly reconsider its determinations in the Estoppel Order with respect to invalidity grounds involving Pfister/Pfister Slides.
- The Court would **CLARIFY** the Estoppel Order as provided herein.
- The Court would **GRANT** Plaintiff's Motion to Exclude (Docket No. 1024) and **EXCLUDE** the documents produced at the depositions of Pfister and Siegel and

[5] *See* Docket No. 905 (Plaintiff's Opposition); Docket No. 909 (public), Docket No. 919 (sealed) (Defendants' Reply).

[6] *See* Docket No. 904 (Plaintiff's Opposition); Docket No. 917 (Defendants' Reply).

[7] At the March 2019 hearing, a tentative ruling was issued providing the Court's initial views on the issues then raised by the parties. The tentative ruling has not been adopted as a final ruling of the Court and is not a final determination in this matter. Docket No. 936.

[8] At the June 6, 2019 hearing, tentative rulings were issued providing the Court's tentative views on the issues raised by the parties. The tentative order has not been adopted as a final ruling of the Court and is not a final determination in this matter.

**STRIKE** certain testimony provided at Pfister's deposition as improperly relating to matters of expert opinion.

- The Court would **GRANT** Plaintiff's Motion for Summary Judgment of Validity as to Claims 20 and 22 of the '710 Patent (Docket No. 844) as it relates to each of Defendants' proffered 35 U.S.C. § 103 prior art grounds.
- The Court would **GRANT** Plaintiff's Renewed Motion for Partial Summary Judgment of Validity Under 35 U.S.C. § 103 Based on IPR Estoppel under 35 U.S.C. § 315(e)(2) for U.S. Patent No. 7,916,781 and in doing so **MODIFY** the Estoppel Order as it pertains to that patent such that Defendants are estopped from presenting each of their 35 U.S.C. § 103 obviousness invalidity grounds for Claims 13 and 22 of the '781 Patent and Claims 11 and 22 of the '781 Patent;
- The Court would **DENY** Defendants' Motion for Certification Under 28 U.S.C. § 1292(b).

## II. Legal Standard

### A. IPR Statutory Estoppel

The Court specifically incorporates by reference the Legal Standard Section of the Estoppel Order. Docket No. 830 at 2-4. The Court also incorporates by reference the legal analysis and determination in the Estoppel Order regarding the scope of IPR estoppel under 35 U.S.C. § 315(e)(2). *Id.* at 6-15. Specifically, the Court reiterates its conclusion that "statutory IPR estoppel applies to invalidity grounds that a petitioner 'reasonably could have raised' in its IPR petition, which includes prior art that a 'skilled searcher conducting a diligent search reasonably could have been expected to discover.'" *Id.* at 15 (citing *SiOnyx, LLC v. Hamamatsu Photonics K.K.*, 330 F. Supp. 3d 574, 601 (D. Mass. 2018)). For the sake of additional clarity, the Court acknowledges and recognizes that such grounds include only grounds "that could be raised under section 102 or 103 and [that] only . . . consist[ ] of patents or printed publications." 35 U.S.C. § 311(b).

### B. Rule 37(c)(1)

Under Rule 37(c)(1), "[i]f a party fails to provide information or identify a witness as required by Rule 26(a) or (e), the party is not allowed to use that information or witness to supply evidence on a motion, at a hearing, or at a trial, unless the failure was substantially justified or is harmless." Fed. R. Civ. P. 37(c)(1). The burden is on the party facing the sanction to show that the failure to disclose is substantially justified or harmless. *Yeti by Molly, Ltd. v. Deckers Outdoor*

*Corp.*, 259 F.3d 1101, 1107 (9th Cir. 2001). "Among the factors that may properly guide a district court in determining whether a violation of a discovery deadline is justified or harmless are: (1) prejudice or surprise to the party against whom the evidence is offered; (2) the ability of that party to cure the prejudice; (3) the likelihood of disruption of the trial; and (4) bad faith or willfulness involved in not timely disclosing the evidence." *Lanard Toys Ltd. v. Novelty, Inc.*, 375 Fed. App'x. 705, 713 (9th Cir. 2010) (citing *David v. Caterpillar, Inc.*, 324 F.3d 851, 857 (7th Cir. 2003)).

Generally, "the district court's discretion to issue sanctions under Rule 37(c)(1)" is given "particularly wide latitude." *Yeti by Molly,*259 F.3d at at 1107. However, the discretion is somewhat limited when the sanction amounts to dismissal of a claim. *R & R Sails, Inc. v. Ins. Co. of Pa.*, 673 F.3d 1240, 1247 (9th Cir. 2012). In such a case, the district court is "required to consider whether the claimed noncompliance involved willfulness, fault, or bad faith, and also to consider the availability of lesser sanctions." *Id.*

## III. <u>Factual Background Related to IPR Proceedings</u>

The relevant factual background related to the '781 and '032 Patents has already been described in the Estoppel Order, and the Court specifically incorporates that portion of the Estoppel Order by reference. *See* Docket No. 830 at 4-6.

As mentioned, the PTAB issued two Final Written Decisions finding that Defendants[9] had failed to demonstrate that Claims 20 and 22 of the '710 Patent are invalid. The PTAB specifically considered prior art "grounds" during this round of '710 Patent IPR proceedings that involved the Frey Paper, Divsalar, and Luby97. *See* Docket No. 844-10 (IPR2017-00210, Paper 77 (Final Written Decision) at 8). In litigation before this Court, the following table summarizes the invalidity grounds Defendants now rely on to assert invalidity of Claims 20 and 22 of the '710 Patent:

| Patent | Claim | References Asserted in District Court |
|---|---|---|
| '710 Patent | 20, 22 | Divsalar*, Frey/Frey Slides*, and Luby97 |
| | | Pfister/Pfister Slides*, Frey/Frey Slides*, and Luby97 |
| | | Pfister/Pfister Slides*, Luby97, and Luby98 |
| | | Divsalar*, MacKay, and Luby97 |

[9] Plaintiff previously explained: "Apple Inc. ('Apple') is identified as the petitioner in all of the IPRs at issue, and Broadcom Corp. ('Broadcom') is identified as a real party-in-interest. Broadcom Corp. and Avago Technologies Ltd. are each subsidiaries of Broadcom Ltd., which is now known as Broadcom Inc." Docket No. 740-1 at 1.

| | | |
|---|---|---|
| | | Divsalar*, Richardson99*, and Luby97 |
| | | Divsalar*, MacKay, Luby97, and Pfister/Pfister Slides |
| | | Divsalar*, Luby98, and Luby97 |

Defendants have asserted that the "references" marked with asterisks are being brought under the "known or used" prong of pre-America Invents Act, 35 U.S.C. § 102(a).

## IV. Analysis

As observed in the Estoppel Order (Docket No. 830 at 15), Defendants again do not dispute that, if IPR estoppel applies to them, it applies to all of them (even though, for instance, Apple filed the petitions).

In addition, Defendants state: "[a]lthough [they] maintain that they should be permitted to present the inventions disclosed in Richardson99 and Divsalar, Defendants understand that the Court's estoppel findings as to these two grounds in its December [28], 2018 ruling are unlikely to be changed." Docket No. 871 at 10 n.2; *see also id.* at 15 n.4, Docket No. 830 at 17-20. In their summary judgment briefing, Defendants do not attempt to present any additional evidence or argument regarding these pieces of prior art, although both of them appear in prior art combinations raised by Defendants as to the '710 Patent, which was not previously the subject of a summary judgment motion. Notably, however, in their first "known or used" prior art listing filed May 3, 2019, Defendants devoted an entire section of their proffer to re-asserting a prior art theory based on Richardson99 as "known or used" prior art. *See, e.g.*, Docket No. 1118 at 46-57. Defendants argue that they did so because "Caltech has recently alleged that Richardson99 is not a printed publication that could have been raised in an IPR." Docket No. 1118 at 54-55. Defendants' assertion does not support revisiting the parties' dispute relating to Richardson99, which was addressed in the Estoppel Order. *See* Docket No. 830 at 17-19. There, the Court observed that "to the extent Defendants would assert that Richardson99 is not a printed publication because it was not publicly accessible, an argument that Richardson99 is prior art 'known or used' before the invention would also fail." *Id.* at 18. Defendants do not explain why the Court's determination would no longer apply, nor do they explain their earlier failure to present arguments regarding Richardson99 in their opposition to Plaintiff's IPR estoppel summary judgment motion for the '710 Patent. Defendants also did not re-raise their arguments regarding Richardson99 in the context of the IPR estoppel dispute at the June hearings. Defendants have failed to submit evidence that would preclude summary judgment of no invalidity based on estoppel as to their invalidity grounds involving Divsalar and Richardson99 as to Claims 20 and 22 of the ’710 Patent. Plaintiff’s summary judgment motion (Docket No. 844) would be **GRANTED-IN-PART** on these bases.

The parties focus their arguments in the briefing for the pending estoppel-related motions on: 1) Pfister/Pfister Slides and 2) Frey/Frey Slides. Defendants specifically identify “the following invalidity grounds based on inventions that were ‘known or used’ in the United States before Caltech’s alleged conception:”

| Claims | Obviousness Combinations in this Case |
|---|---|
| Claims 20 and 22 of the ’710 Patent | Pfister/Pfister Slides*, Frey/Frey Slides*, and Luby97 |
| | Pfister/Pfister Slides*, Luby97, and Luby98 |
| | Divsalar, MacKay, Luby97, and Pfister/Pfister Slides* |
| | Divsalar, Frey/Frey Slides*, and Luby97 |
| Claims 11 and 18 of the ’032 Patent | Ping, MacKay, and Pfister/Pfister Slides* |
| | Ping, Luby98, and Pfister/Pfister Slides* |
| Claims 13 and 22 of the ’781 Patent | Divsalar, Ping, and Frey/Frey Slides* |
| | Pfister/Pfister Slides*, Luby97, and Luby98 |

Docket No. 871 at 10 (“known or used” prong references identified with asterisks).

### A. Requests for Reconsideration as to the ’781 and ’032 Patents

In the round of briefing leading up to the February 2019 hearing, the parties’ arguments included explicit or implicit requests for reconsideration of aspects of the Estoppel Order. *See, e.g.*, Docket No. 871 at 2 (Title of Defendants’ opposition as “Defendants’ Opposition . . . and Request for Reconsideration as to Pfister” and stating, “[t]o the extent that the Court concluded that the Pfister Slides are a printed publication subject to estoppel . . . Defendants respectfully request reconsideration”); Docket No. 852 (Title of Plaintiff’s motion as “Renewed Motion” and referring to “questions and issue[s] raised by the Court in its December 28th Order”). Neither party referenced the legal standard that applies to a motion for reconsideration.[10] Nor did either party,

[10] Local Rule 7-18 states in part:

> A motion for reconsideration of the decision on any motion may be made only on the grounds of (a) a material difference in fact or law from that presented to the Court before such decision that in the exercise of reasonable diligence could not have been known to the party moving for reconsideration at the time of such decision, or (b) the emergence of new material facts

through its briefing, otherwise demonstrate that the requirements for bringing a motion for reconsideration had been met. At the hearing, after Defendants renewed their request that portions of the Estoppel Order be modified based on the analysis in the Court's February 2019 tentative ruling, the Court directed Defendants to bring any requests for reconsideration of the Estoppel Order in the form of a proper motion for reconsideration.

Apparently, however, the parties agree that the Court has now been presented with a more complete factual record and "the Court should consistently apply the legal standard it determines to be appropriate to the facts for each of the claims and prior art combinations at issue on all asserted patents." Docket No. 905 at 11-12; *see also* Docket No. 911-1 at 1. In light of this agreement and the particular procedural circumstances in this case, the Court thus **GRANTS** Defendants' request for reconsideration of the Estoppel Order with respect to obviousness combinations asserted against the '781 and '032 Patents involving the Pfister/Pfister Slides.

As Defendants note, Plaintiff takes its opposition to Defendants' reconsideration motion as an opportunity to expound on its arguments regarding when a patent challenger should be permitted to present an invalidity theory under the known or used prong of 35 U.S.C. § 102(a), despite statutory estoppel as to related prior art publication invalidity theories. *See generally* Docket No. 905. Defendants respond in kind in their Reply.[11] Docket No. 911-1. Although the Court has concerns with *both parties* circumventing the page limits that the Court set on supplemental briefing related to this issue (Docket No. 884), the Court will also consider the parties' arguments on this issue.

### B. Legal Standard for Distinguishing a Non-Estopped Invalidity Ground from an Estopped Invalidity Ground Involving a Prior Art Patent or Printed Publication

The parties disagree about what is required to take an invalidity ground out of the realm of

> or a change of law occurring after the time of such decision, or (c) a manifest showing of a failure to consider material facts presented to the Court before such decision.

C.D. Cal. L.R. 7-18; *see also Orange St. Partners v. Arnold*, 179 F.3d 656, 665 (9th Cir. 1999) ("[A] motion for reconsideration should not be granted, absent highly unusual circumstances, unless the district court is presented with newly discovered evidence, committed clear error, or if there is an intervening change in the controlling law.").

[11] Defendants also argue that Plaintiff is again raising reconsideration arguments without meeting the procedural requirements for reconsideration. Docket No. 911-1. Although the Court tends to agree with Defendants' contention, given both parties' emphasis and request for consistent determinations across the three asserted patents, the Court will consider all arguments presented to the extent they are deemed relevant.

a prior art patent or printed publication theory of invalidity (where such patent or printed publication has been presented to and reviewed by PTAB) and into the realm of some other related invalidity theory not subject to IPR statutory estoppel (*e.g.* a speech at an industry conference or a physical product). To the Court and the parties' knowledge, this dispute has never been addressed by the Federal Circuit. A handful of district court cases have considered whether IPR statutory estoppel can preclude a patent challenger from relying on a prior art product or system, where that product or system is related to a prior art printed publication that could have been asserted in an IPR. Notably, of those district court decisions, none have extended estoppel to prior art grounds involving the product or system. No cases have dealt with the specific issue presented here: when/if statutory IPR estoppel can preclude a patent challenger from relying on a "known or used" invalidity theory that is related to a prior art printed publication that could have been asserted in an IPR.

In *Star Envirotech*, the court declined to extend statutory estoppel to preclude an invalidity argument based on a machine, finding that "the physical machine itself discloses features claimed in the '808 Patent that are not included in the instruction manual, and it is therefore a superior and separate reference." *Star Envirotech, Inc. v. Redline Detection, LLC*, No. SACV 12-01861 JGB (DFMx), 2015 WL 4744394, at *4 (C.D. Cal. Jan. 29, 2015). The *SRAM* case, cited by Plaintiff, followed *Star Envirotech's* "superior and separate reference" standard in declining to apply statutory estoppel. *SRAM, LLC v. RFE Holding (Can.) Corp.*, No. 15-cv-11362, Docket No. 102 at 11-12 (N.D. Ill. Jan. 25, 2019).

Similarly in *SiOnyx*, the court found that estoppel would not apply to a prior art obviousness invalidity ground involving a product, noting that the defendants had consistently relied on a certain aspect of the product, as reflected in a potentially non-public manufacturing specification, as "the only citation for certain claim limitations." *SiOnyx, LLC v. Hamamatsu Photonics K.K.*, 330 F. Supp. 3d 574, 602, 603-04 (D. Mass. 2018). Although at first blush *SiOnyx's* conclusion thus appears to similarly adopt the *Star Envirotech* standard, elsewhere, the court more generally stated that the plaintiff had not "carried its burden to show that publicly available materials are the 'real' references that defendants are now trying to pass off as the product itself." *Id.*

The court in *Clearlamp* also mentioned *Star Envirotech's* "superior and separate" standard, but observed, "[s]ince *Star Envirotech* found that the product was not cumulative of other prior art, the court did not reach the issue of when cumulative prior art would not be allowed in district court proceedings." *Clearlamp, LLC v. LKQ Corp.*, No. 12 C 2533, 2016 WL 4734389, at *8 (N.D. Ill. Mar. 18, 2016). After considering a PTAB decision where the PTAB found estoppel did not attach to a prior art reference found "redundant" in a previous IPR proceeding, the court found, "[t]he relevant inquiry . . . is not whether the ground is redundant of a ground that was asserted but, rather, whether the ground reasonably could have been raised." *Id.* In considering the dispute at hand, the district court found that the defendant was attempting to "cloak" its prior art ground based on a datasheet by characterizing it as a prior art ground based on a product itself. *Id.* at *9 ("While LKQ seeks to cloak its reliance upon UVHC3000 as a product, so as to avoid § 315(e)(2) estoppel, such an argument is disingenuous as it is the UVHC3000 datasheet upon which LKQ relies to invalidate the asserted claims"). Ultimately, estoppel did not attach because the plaintiff failed to meet its burden of showing that the product datasheet could have been found by a searcher performing a reasonable search at the time the IPR petition was prepared. *Id.* at *9-10.

*Milwaukee Elec. Tool Corp. v. Snap-On Inc.*, 271 F. Supp. 3d 990, 1032 (E.D. Wis. 2017), *appeal pending*, No. 18-1516 (Fed. Cir. Feb. 5, 2018), is consistent with *Clearlamp* and *SiOnyx*. In that case, the court similarly expressed concerns that the defendant should not be allowed to "skirt" estoppel "by purporting to rely on a device without actually relying on the device itself," but otherwise found that estoppel would not extend to prior art grounds including products. Indeed, considering an argument that a party should be estopped from relying on a prior art product because a diligent searcher could be expected locate the underlying printed publications, the court in *Milwaukee Electric* stated it was "not convinced that the principle of excluding non-petitioned grounds should be extended so far, given the clear limitation of Section 311(b) to written materials." *Id.*

The same is true for *Biscotti*. In that case, the plaintiff characterized the defendant's system prior art "as printed subject matter in disguise." *Biscotti Inc. v. Microsoft Corp.*, No. 2:13 CV 01015 JRG-RSP, 2017 WL 2526231, at *8 (E.D. Tex. May 11, 2017). The court noted that the defendant "could not have raised a prior art 'system' during IPR proceedings. If, however, [defendant's] purported system prior art relies on or is based on patents or printed publications that [defendant] would otherwise be estopped from pursuing at trial . . . then [defendant] should be estopped from presenting those patents and printed publications at trial." *Id.* The court did not make an ultimate determination on the issue beyond that observation.

After considering the two apparent schools of thought on the issue, the Court declines to adopt a "superior and separate reference" standard or any other higher standard that would require, for instance, that certain claim limitations be independently satisfied by prior art in a way that is different from an associated prior art patent or printed publication. The statute does not include such requirements, and they would likely extend the reach of statutory IPR estoppel beyond its intended scope. As Defendants noted at the hearing, "redundant" prior art grounds appear commonly in patent litigation. For instance, a primary reference may be used to argue that the majority of claim limitations are disclosed, and a patent challenger may then simply swap out secondary references to show that one final limitation is also disclosed in the prior art. Finding that a patent challenger should be estopped from relying on a piece of prior art because that piece of prior art is used to meet the same claim limitations as a related prior art printed publication would be contrary to this practice and ignore the importance of the difference in the underlying evidence used to support the prior art theory. Instead, the Court agrees with *Clearlamp*, *Milwaukee Electric* and other decisions that attempt to discern if a patent challenge is simply swapping labels for what is otherwise a patent or printed publication invalidity ground in order to "cloak" its prior art ground and "skirt" estoppel.[12]

There can be, of course, a unique connection between prior art invalidity theories that requires closer scrutiny. For instance, in a classic example of a "known or used" prior art invalidity theory, a scientist presents their research at a scientific conference to others in the field. What if the scientist simply read his or her slide presentation – and those slides were publicly available the same day – verbatim out loud to the conference attendees? In such circumstances, a "known or used" invalidity theory based on the presenter's oral statements would seem to be an exact duplicate of the invalidity theory based on the printed document itself. Although the Court does not believe that a "known or used" invalidity theory need be "superior" to a printed publication invalidity theory to survive estoppel (or similarly, that it needs to provide some disclosure of an independent claim limitation that was not provided by the printed publication), there must be *some*

[12] That being said, in certain circumstances the Court recognizes that if a piece of prior art is indeed "superior and separate," this may be a helpful benchmark to a court considering whether a patent or printed publication has merely been "cloaked." *Clearlamp*, for instance, suggests that might have been the case in *Star Envirotech*. *See Clearlamp*, 2016 WL 4734389, at *8.

*substantive* difference between the two theories that is germane to the invalidity dispute at hand.[13]

The analysis in the Estoppel Order was somewhat ambiguous on this issue and thus the Court specifically **CLARIFIES** the Estoppel Order, and specifically its analysis of the same cases and issue, to reflect this conclusion. Docket No. 830 at 26-27.

### C. Procedural Background and Analysis of Procedural Issues Related to Defendants' Remaining Purported "Known or Used" Prior Art

As early as May 2018, Defendants were suggesting in filings that they were asserting certain prior art invalidity grounds, including "Pfister Slides/Paper," under a "known or used" theory. Docket No. 517 at 9, 11-12. But despite these assertions, the invalidity expert report that Defendants served in August 2018 did not meaningfully disclose a "known or used" theory of invalidity separate and apart from a review of the prior art documents themselves. Instead, the Frey Report simply stated:

> [i]n the event that the Court finds that the patents-in-suit are entitled to a date of invention that predates the publication of Frey, and the Frey paper is deemed not to be prior art to the patents-in-suit, then the Frey Slides may be substituted for the Frey paper in all of the positions explained below.

Original Opening Invalidity Expert Report of Dr. Brendan Frey, Docket No. 599-4 ("Original Frey Report") at ¶ 242 (emphasis added). In resolving Plaintiff's motion to strike portions of the Frey Report, the Court found, "[t]his is not the language of an expert purporting to use the Frey Paper/Frey Slides as a single reference. Instead, Defendants/Frey appear to be hedging their bets and trying to maintain two alternative prior art references until a priority date dispute is resolved." Docket No. 673 at 9. Defendants were permitted to file a supplemental Frey Report. In a "Notice" filed with the Court soon after, and purportedly in response to discussion at the hearing, Defendants also stated that they "intend[ed] to present the Pfister Paper and Pfister Slides and the Frey Paper and Frey Slides as evidence of inventions 'known or used by others in this country' under 35 U.S.C. § 102(a)." Docket No. 682.

In Volume I of the supplemental Frey Report, however, Frey did not provide opinions that integrated paper and slides, let alone present invalidity theories that considered, first and foremost, what was known or used in the United States at the time the invention was filed. *See generally* Amended Opening Invalidity Expert Report of Dr. Brendan Frey, Docket No. 740-25 ("Amended

[13] At the hearing, the parties should be prepared to present their positions on this issue, and particularly their positions on the example of the scientist reading his or her slides verbatim out loud at a conference.

Frey Report Vol. I"). Instead, supplemental Frey Report, Volume I goes through substantially the same analysis of the specific documents in question that was present in the original Frey Report. *Compare, e.g.* Original Frey Report ¶¶ 225-242 *with* Amended Frey Report Vol. I ¶¶ 225-241. Only two real differences separate Volume I of the supplemental Frey Report from the original Frey Report with respect to Pfister/Pfister Slides and Frey/Frey Slides – *i.e.* (1) Frey conveniently omits his statement that the Frey/Pfister Slides could be substituted for the Frey/Pfister Paper (*Compare, e.g.* Original Frey Report ¶ 241-42 *with* Amended Frey Report Vol. I ¶¶ 241-42); and (2) Frey adds three perfunctory sentences that reference a "known or used" theory (Amended Frey Report Vol. I ¶¶ 225, 230, 244).

At the June 17 hearing, Defendants observed, however, that the supplemental Frey Report spans at least five separate volumes. *See* Docket Nos. 1081-37 (Amended Frey Report Vol. II), 1081-38 (Amended Frey Report Vol. IV), 1081-39 (Amended Frey Report Vol. V), 1081-41 (Amended Frey Report Vol. III). Volumes II through IV include Frey's invalidity opinions patent-by-patent. Volume V includes Frey's inequitable conduct opinions. Taking Volume II as an example, Frey presents his invalidity opinions with respect to the '710 Patent. Early in this volume, Frey introduces Pfister/Pfister Slides and Frey/Frey Slides as "known or used" prior art. For instance, he states:

> As an initial matter, Pfister and the Pfister Slides are authored by the same individuals and are both directed to the same methods and systems for encoding signals involving repeat-accumulate codes. Accordingly, one of ordinary skill in the art would have considered these documents together as evidence of what was known and used by persons of ordinary skill in the art.

Amended Frey Report Vol. II, Docket No. 1081-37 ¶ 2; *see also id.* ¶ 6 (similar opinions presented for Frey/Frey Slides). Beyond statements relating to a motivation to combine the prior art, however, Frey's limitation-by-limitation invalidity analysis again focuses on the disclosure within the text of the documents themselves. *See, e.g.*, *id.* ¶¶ 23-35 (considering the disclosure of Pfister/Pfister Slides as it relates to the preamble of Claim 20 as part of a combination including Pfister/Pfister Slides, Frey/Frey Slides, and Luby97). Also notably, as Plaintiff observed at the June 17 hearing, Frey states in Volume I of his amended report that his Allerton Conference presentation "covered the contents disclosed in Frey/Frey Slides." Amended Frey Report Vol. I ¶ 226.

After this early chain of events, Plaintiff filed its motion for partial summary judgment of no invalidity based on IPR estoppel for two of the three asserted patents. At the first (of many) hearings that would be held on the IPR estoppel dispute, the Court issued a tentative ruling that voiced concerns with the supplemental Frey Report's failure to present a meaningful "known or used" invalidity theory, as well as concerns with the lack of any other factual evidence submitted by Defendants to support such an alternative theory. Docket No. 828. In the latest Estoppel Order issued on December 28, 2019, the Court permitted Defendants to maintain one "known or used" invalidity theory based on certain documentary evidence that they had raised at the hearing. The IPR estoppel summary judgment motion for the third asserted patent followed. And soon after, supplemental briefing the motion for reconsideration of the Estoppel Order were filed.

In the meantime, some of the parties' earlier agreements in this case began coming back to complicate the prosecution of this litigation. Back in 2017 while fact discovery was still open, the parties struck a deal regarding the depositions of certain witnesses. The deal, somewhat ironic in retrospect, apparently sought to cut down on the time and expense of taking depositions of certain witnesses twice. The parties agreed that "certain fact witnesses who will also be providing expert reports" should only have their depositions taken during expert discovery after they had submitted their expert reports. Docket No. 685-7. The parties specifically agreed that Frey, Siegel, Pfister, and Jacobsen, each identified on Defendants' Initial Disclosures, would not be deposed during fact discovery. Defendants only ultimately served expert reports for Frey and Siegel. Defendants attempted to block Plaintiff from taking Pfister's deposition on a technicality, requiring the Court's intervention in October 2018. Docket No. 746. But apparently, delays continued for the depositions of some of these individuals. Frey's deposition was not taken until December 2018, and Pfister's and Siegel's depositions were delayed until April 2019, after the parties had even filed their first round of summary judgment motions in March 2019.

And therein lies the rub: Despite the grave concerns raised by Defendants' earlier shifts in arguments and failure to present an expert report that meaningfully laid out a "known or used" invalidity theory, since January 2019, the Court has allowed significant additional briefing and argument on the topic of Defendants' supposed "known or used" invalidity theories because of fairness concerns. The difficulty with a "known or used" invalidity theory is that, unlike an invalidity theory that simply relies on one or more prior art reference documents, "known or used" is more likely to implicate highly factual evidence in the form of testimony and contemporaneous documentation. The parties *agreed* to delay the depositions of witnesses with significant factual information relating to these "known or used" invalidity theories, and ultimately delayed them significantly. As testimonial evidence continued trickling in, Defendants continued to add it to their filings to support their assertions about "known or used" invalidity theories.

But ultimately, agreeing to delay the depositions of witnesses known to possess material factual information relating to an invalidity theory cannot excuse, as a general matter: (1) Defendants' failure to search for and disclose other evidence, such as documents, that factually support that invalidity theory and (2) Defendants' failure to timely disclose the general contours of a "known or used" invalidity theory. With numerous submissions now before the Court, these procedural shortcomings control the outcome.

**a. Late Disclosure of the Pfister and Siegel Documents**

Regarding the first issue, the Court and parties have now conferred multiple times on the issue of whether documents produced on the morning of Pfister's and Siegel's depositions should be excluded from this case. During the most recent of the numerous hearings on the dispute, the Court asked the parties to respond in writing to the following question:

> If a party has retained an individual as an independent contractor / expert consultant such that the other party is not permitted to contact that individual independently, and that individual has relevant factual information pertaining to the retaining party's claims or defenses, does the retaining party have an obligation to direct the individual to search for relevant documents for production in a timely fashion?

Tr. at 31:22-32:4. The parties attack this "prompt" from two opposing angles. Plaintiff focuses on a party's obligations to search for and produce evidence that supports that party's claims and defenses. Defendants focus on the scope of a party's discovery obligations with respect to third-party material that is not technically in the party's custody or control. Other peripheral arguments abound, but the core dispute begins with whether the question is best viewed from one of these two angles.

Although Defendants ultimately did not ask Pfister to prepare an expert report, Defendants retained Pfister, Siegel, and Frey as expert consultants. At least when Defendants retained Pfister in January 2017, Pfister was instructed to contact Defendants if he was contacted by Plaintiff or its attorneys regarding the case.[14] In their amended initial disclosures listing Pfister, Siegel, and

[14] Defendants submitted Pfister's engagement agreement for *in camera* review after the April 18, 2019 hearing on the dispute.

Frey, Defendants further stated that these individuals should be contacted via Defendants' counsel. Docket No. 1030-1 at 2, 4.

The issue of whether these facts meant that Defendants did or did not have "control" over these consultants and their documents, however, is not the central concern. Nor is Plaintiff's ability to request documents from these individuals a central concern (although, arguably, Plaintiff's ability to do so was limited by those individuals' relationships with Defendants). In this case, at least since May 2018, Defendants have stated that they intend to assert "known or used" invalidity theories based on the work of these three men. Indeed, Defendants have stated at hearings that they chose to have Siegel serve an expert report (rather than Pfister) because Siegel is the person who actually presented his and Pfister's work at a particular conference. In other words, Defendants have known for quite some time that the factual knowledge of their expert consultants was relevant - indeed, central - to some of Defendants' invalidity arguments. Why, then, did Defendants fail to at least request that Pfister, Siegel, and Frey fully search their files for all relevant material in a timely fashion for materials that might factually support Defendants' invalidity claims? And, moreover, why did Defendants fail to timely produce such documents if obtained?

The issue regarding these documents is not that they were not disclosed in invalidity contentions or expert reports. It is that they were not sought after for disclosure in a timely manner *at all*. Defendants argue that placing a duty on them to search their experts' documents creates an unfair double standard and expands the scope of their obligations under the Federal Rules. Docket No. 1169 at 5-6. The issue is not that Defendants had a duty to search their experts' documents. The issue is that Defendants, if they wished to rely on certain factual evidence to support particular claims, should have timely sought discovery from the witnesses likely in possession of that factual evidence so that it, in turn, could be timely disclosed to Plaintiff. For these reasons, the Court finds that the documents produced at Pfister's and Siegel's depositions were not timely disclosed, and that their late disclosure was not substantially justified or harmless. Indeed, the Court finds the timing of disclosure of the documents highly prejudicial to Plaintiff, strongly supporting exclusion.[15]

Defendants make other arguments, including that Pfister and Siegel fully complied with the subpoenas Plaintiff served on them.[16] This argument is insufficient in the current circumstances. The Court is concerned by the technical reading of the subpoenas that inspired Defendants' counsel to wait to produce the documents on behalf of Pfister and Siegel until the morning of their depositions. Defendants' counsel's decision to delay in sharing with Plaintiff's counsel hundreds of pages of substantive factual material from its expert consultants on the morning of those consultants' depositions does not support a finding of lack of prejudice. It also fails to excuse Defendants' earlier shortcomings and lack of diligence in their discovery efforts.

At the hearing, Defendants emphasized that they *did* make an earlier request of their experts and consultants to search their files for relevant materials. Indeed, Pfister did produce a collection of documents before the fact discovery cutoff. However, Defendants represented at the hearing that at least Pfister misunderstood the scope of relevant documents he was being asked to produce at the time, which is why the collection of documents the parties dispute now were not produced at the time.[17] Defendants argued that their experts' and consultants' honest misunderstanding about the material they were expected to identify and produce should not be held against Defendants themselves. But this argument does not negate the undue prejudice Plaintiff faces by this late disclosure, and the Court finds it insufficient to support permitting production and use of these documents in this case.

For these reasons, the Court would adhere to the tentative views that it expressed during the April 25, 2019 hearing (*see* Docket No. 1100) regarding exclusion of the Pfister and Siegel documents and the other matters related to the depositions of those two individuals. It would **EXCLUDE** the late-produced documents and **STRIKE** certain portions of Pfister's deposition

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[15] Defendants' counsel also stated at a previous hearing that it would be willing to withdraw any reliance on the Siegel documents. Defendants' have apparently gone back on this statement. The Court finds Defendants' statement at the hearing as an independent basis for exclusion of the Siegel documents.

[16] Defendants also argue about Plaintiff's conduct in relying on 28 *public* documents (that had not been earlier disclosed) during the deposition of Jacobsen. Docket No. 1169 at 6. Defendants did not originally request that those *public* documents be excluded, and Defendants' current arguments regarding the circumstances of Jacobsen's deposition are not persuasive.

[17] At the hearing, Plaintiff observed that Pfister was also an expert in the *Hughes* case before Judge Pfaelzer and an expert in at least some of the IPR proceedings.

that implicate expert opinion.[18] The parties should be prepared to discuss at the hearing issues including whether Defendants would still seek to reopen the deposition of Siegel based on these determinations.

**b. Whether Disclosure of "Known or Used" Invalidity Theories Now Asserted Was Timely and Whether Current Theories Include Germane Differences Compared to Printed Publication Invalidity Theories**

Regarding the second issue - whether Defendants timely disclosed the general contours of a "known or used" invalidity theory such that they can now assert that particular theory - the analysis has not been easy. In addition to the shortcomings in Frey's expert reports, the Court agrees with Plaintiff that meaningful review of the dispute has been obscured by how Defendants have opted to present information in their recent proffers for those theories. Although Defendants may have opted to include additional information for completeness, the Court agrees, for instance, that it is irrelevant and indeed unhelpful to the present inquiry for Defendants to include in their supplemental charts information relating to Divsalar, Luby97, Luby98, Ping, and MacKay. *See* Docket No. 1196 at 23. The Court had hoped that Defendants would submit just two charts - one for Pfister / Pfister Slides and one for Frey / Frey Slides - that focused specifically on showing how evidence related to these two specific pieces of "§ 102(a) known or used prior art" would be used to support Defendants' invalidity theories. Having determined that the late-disclosed Pfister

[18] The parties have filed ongoing briefing regarding objections to portions of Pfister's deposition testimony on the basis that it is impermissible expert testimony. *See, e.g.*, Docket No. 1084, 1105, 1191. Defendants have also filed an *ex parte* application attaching another extensive brief in response to Plaintiff's most recent iteration of Pfister objections. Docket No. 1201. In excluding Pfister's and Siegel's late-disclosed documents, the Court would further exclude any testimony about those documents. This determination moots many of Plaintiff's objections to specific Pfister testimony. In addition, Plaintiff's objections to the following portions of Pfister's testimony would be tentatively granted at this time: 145:33-146:15, 161:24-165:8, 172:17-172:23, 174:1-174:10, 190:7-190:10, 209:2-215:2, 217:10-220:7, 220:19-221:4, 226:11-227:20, 228:18-231:14, 245:6-247:20, 264:7-266:11, 268:11-269:6. These portions of Pfister's testimony largely relate to characterizations of the Pfister Slides and Pfister Paper, as well as comparison to and characterization of other prior art references. In this case, the Court finds these matters slip too far into the realm of expert testimony regarding the scope of the prior art. Plaintiff also presented objections to some of Pfister's testimony as impermissibly interpreting the meaning or scope of terms that appear in the asserted patent claims. Although the Court does not find that wholesale exclusion of this testimony is appropriate at this time, the Court cautions Defendants that use of this testimony for certain purposes (such as evidence to support a particular interpretation of a claim term or as evidence to support an infringement analysis) may later warrant an objection. The Court overrules Plaintiff's objections to Pfister's testimony in response to Plaintiff's own questioning. *See* Docket No. 1191 at 5 n.5, 6; *see also* Docket No. 1202-2 at 4-5. Plaintiff's other objections to Pfister's testimony in response to Defendants' questioning are otherwise overruled at this time.

The parties are to resolve the practical effects as to the scope of the Court's rulings on the evidence to be proffered at trial. In that regard, any disagreement should be presented to the Court thirty days before the pre-trial conference.

and Frey documents must be excluded, Defendants' current listing also includes many now-irrelevant references to those documents.

What should remain for review is: (1) (expected) *factual* testimony from Frey, Siegel, and Pfister (that is not tied to excluded documents); and (2) timely-produced documents and evidence relating to the "inventions known or used in the art" due to the work of these individuals, including, as corroborating evidence, their papers and slides themselves. The specific information from these sources that pertains to a particular claim limitation should be identified. And while the Court does not find it improper in this exercise for Defendants to also identify, for instance, where information from these sources supports motivation to combine references or expectation of success, the Court agrees with Plaintiff that such evidence could have been submitted to the PTAB for those purposes, and thus does not support the conclusion that Defendants' "known or used" invalidity theory is different from a prior art printed publication theory.[19] *Yeda Research v. Mylan Pharm. Inc.*, 906 F.3d 1031, 1041 (Fed. Cir. 2018).

The Court notes that it disagrees with Plaintiff's suggestion that under a proper "known or used" invalidity theory, Defendants should be wholly precluded from referencing or relying on the papers and slides themselves. However, the Court agrees (and Defendants' statements at previous hearing suggest they also agree) that the papers and slides themselves cannot serve as the primary source of information for a known or used theory that is not precluded by IPR estoppel. Instead, for a "known or used" theory to possibly take on any meaningful difference from an invalidity theory based on a printed publication itself, these documents should merely play a corroborating or supportive role to other evidentiary sources.[20]

The Court has endeavored to sift through Defendants' hundreds of pages of tables to focus on this key information. Once parsed out, two new problems emerge. First, in their organization of evidence, Defendants rely primarily on the papers and slides themselves for substantive

[19] On this basis, the Court would also find, in reconsidering the Estoppel Order, that Plaintiff has shown that the emails and deposition evidence that Defendants submitted to support the "Frey/Frey Slides" "known or used" invalidity theory, which related to motivation to combine these references with Divsalar, are insufficient to preclude the application of IPR estoppel.

[20] Plaintiff additionally observed at the hearing that there must also be some indication from these evidentiary sources that they are related to corroborating information that was indeed *publicly* known or used at the time of the invention. Of course, although not a ripe consideration at this time, introducing indisputably non-public evidence to demonstrate that certain other evidence was publicly known raises a host of additional concerns with respect to the understanding of a jury.

disclosure of the limitations of the asserted claims. Only after Defendants walk through the disclosure in these publications do they identify for each claim limitation a separate sub-section of additional "known or used" evidence. Second, the Court requested that Defendants "include a column stating where, in their final invalidity contentions and/or final Frey Invalidity Report and/or Siegel Invalidity Report, Defendants disclosed the specific portion of their invalidity ***theory*** underlying each portion of their new evidentiary listing." Docket No. 1172 (emphasis in original). The Court explained that "Defendants are expected to perform this identification on a limitation-by-limitation basis with specificity, not just by identifying previous disclosures at a generalized level." *Id.* Defendants provide a range of pin citations to these earlier sources on a limitation-by-limitation basis, but within each of these chart rows, Defendants are alleging multiple invalidity theories based on different evidentiary sources. Defendants do not separate out their citations theory-by-theory.

The stakes in this case are high, and Defendants may have feared that if they did not throw the "kitchen sink" at the Court, Plaintiff would later by crying "waiver." However, despite litigants' unexpressed beliefs, "Judges are not like pigs, hunting for truffles buried in briefs." *United States v. Dunkel*, 927 F.2d 955, 956 (7th Cir. 1991). Defendants' choices in how they have organized and presented their proffer for the Court's review in this dispute create concerns, and ultimately, the Court is unable to conduct a full and meaningful review of the actual dispute between the parties because of those concerns.

After over half a year litigating this particular dispute in this now three year old lawsuit, the Court's tentative order questioned whether Defendants should be permitted yet another opportunity to argue that they can present a "known or used" invalidity theory in this case that is meaningfully different from the invalidity theories they reasonably raised or could have raised before the PTAB. The Court expressed ongoing concerns about the timing of disclosure of certain known or used ***theories*** as well as the nature of the evidence that Defendants proffer to support those theories.

For example, one of the parties' current disputes relates to one of Defendants' current "known or used" theories involving Pfister/Pfister Slides. As Plaintiff explains, "[t]hroughout this case, Defendants have always conceded that Pfister/Pfister Slides do not disclose irregular repetition of information bits." Docket No. 1196 at 18. According to Plaintiff, "[n]ow, however, Defendants apparently contend that Dr. Pfister developed some sort of IRA codes by February

2000, and that their 'known or used' evidence for RAA codes thus discloses irregular repetition of bits." *Id.* at 19. Indeed, in a 14-page brief attached to an *ex parte* application, Defendants took the opportunity to include some responsive arguments to Plaintiff's assertions that Defendants are presenting "new invalidity theories," and specifically this Pfister theory. *See* Docket No. 1201-2 at 8. Defendants assert that they have consistently contended that "it would have been obvious to combine prior art related to repeat-accumulate codes . . . with the concept of using irregular repetition." *Id.* at 7. Defendants state, "Dr. Pfister's testimony . . . demonstrates that, before the claimed conception of the '710 patent, practitioners in this field in fact made the exact combination identified in [Defendants'] invalidity contentions and in Dr. Frey's expert reports." *Id.* at 8. In other words, Defendants effectively concede that they did not disclose a theory where Pfister/Pfister slides disclosed irregularity, but they argue that they are not disclosing a new invalidity theory because Defendants previously identified other references unrelated to Pfister/Pfister slides as disclosing irregularity and being combine-able with Pfister/Pfister slides. ***But*** Defendants have also insisted that it is the "Pfister/Pfister Slides" itself that was their "known or used" prior art, and that they previously disclosed it as such. Defendants' logic would essentially extend to say that because Defendants disclosed prior art that is combine-able to meet all the limitations of the claims, they have adequately disclosed an invalidity theory where their "known or used" evidence discloses a particular limitation of the claims. This position is not persuasive. Because Defendants failed to disclose an invalidity theory where ***Pfister/Pfister Slides***, as the "known or used" prior art, disclosed irregular repetition, they cannot assert such an invalidity theory now.

For the "known or used" theories that Defendants ***did*** timely disclose, it is not possible to tell from Defendants' proffer of evidence how Defendants would intend to present information in a way such that it includes germane differences to the prior art publications that were reviewable by the PTAB. On the current record, the Court is not persuaded that Defendants have made such a showing.[21] In the tentative order, the Court stated that it would "leave this final question - and

[21] Defendants argue that judicial estoppel should be applied against Plaintiff with respect to their arguments regarding the Frey Slides (and Pfister Slides). Docket No. 871 at 8-10, 22-24. They essentially present an estoppel argument as a basis to preclude an estoppel argument. Defendants assert that because Plaintiff successfully argued that the Frey Slides (and Pfister Slides) did not qualify as prior art printed publications before the PTAB, Plaintiff cannot now argue that the Frey Slides and Pfister Slides do qualify as prior art printed publications and thus that statutory estoppel is appropriate. Judicial estoppel is a discretionary, equitable doctrine intended to "protect the integrity of the judicial process by prohibiting parties from deliberately changing positions according to the exigencies

the question of whether Defendants should be permitted yet another opportunity to demonstrate as much - for additional discussion at the hearing." At the hearing, although Defendants generally listed off evidence they would suggest supports their invalidity theory, Defendants did not persuasively explain – setting aside the excluded, late-disclosed evidence from Siegel and Pfister – what timely-disclosed evidence beyond the four corners of the prior art documents that is germanely, substantively different from the documents themselves would support their purported known or used invalidity theories.[22] Ultimately, the Court finds that Defendants failed to show that estoppel should not be applied as to Defendants' obviousness invalidity theories for the asserted claims that were addressed in IPR proceedings in final written decisions.

The Court notes that at the June 17, 2019 hearing, as a basis to support the argument that they should be permitted to present their "known or used" invalidity grounds, Defendants emphasized that they should be permitted to rebut certain of Plaintiff's experts' "counter-factual

of the moment." *New Hampshire v. Maine*, 532 U.S. 742, 750 (2001) (internal citations and quotations omitted). The record in this case does not support the conclusion that Plaintiff has improperly used judicial machinery in its presentation of arguments before the PTAB and this Court regarding the public availability of certain prior art. The Court is not persuaded, for instance, that Plaintiff has taken "clearly inconsistent" positions between the two proceedings (or that Defendants' characterizations of Plaintiff's position is strictly correct). The Court also incorporates by reference the portions of the Estoppel Order explaining that in determining whether statutory estoppel applies to the invalidity grounds presented by Defendants, it is Defendants' actions, not Plaintiff's, that matter. Docket No. 830 at 25-26. In this regard, the Court reconsiders and again rejects Defendants' renewed arguments that (1) the Pfister slides were different from the Pfister paper and (2) were not and could not have been addressed by the PTAB. Defendants themselves submitted the Pfister slides to the PTAB as a prior art reference in part of their obviousness grounds for IPR, and have not withdrawn their position. *See* Docket No. 830 at 22-24 ("Defendants have not withdrawn the position they advanced before the PTAB that the slides were publicly available prior art printed publications.").

[22] The Court notes that Defendants were in receipt of the Court's tentative ruling on June 6, 2019 and had until the June 17, 2019 to ruminate on it in preparing their oral presentation regarding this dispute. In a new set of slides provided to the Court at the beginning of the June 17, 2019 hearing, Defendants included what they referred to as specific examples showing how they would prove invalidity under a known or used theory for one of the asserted claims. However, Defendants' first example, spanning fifteen slides, focused almost exclusively on explaining how Defendants' "known or used" evidence supported a motivation to combine the various prior art references. As Plaintiff has previously observed, however, evidence of "the knowledge, motivations, and expectations of a POSITA regarding the prior art" can be considered by the PTAB. *Yeda*, 906 F.3d at 1041. The same is true for other "proper supporting roles" previously served by non-prior art reference evidence, "e.g., indicating the level of ordinary skill in the art, what certain terms would mean to one with ordinary skill in the art, and how one with ordinary skill in the art would have under-stood a prior art disclosure." *Id.* (quotations omitted). The Court finds that evidence used for such a purpose does not take an invalidity theory outside of the estoppel realm on the basis that it becomes a "known or used" invalidity theory, and for that reason evidence of this type (including certain of Dr. Mitzenmacher's testimony) is found unpersuasive to support Defendants' argument here. In addition to these concerns, the Court also notes that Plaintiff properly raised issues regarding Defendants' failure to demonstrate that certain aspects of their proffered evidence were publicly available during the relevant timeframe.

assertions." Although the Court does not find Defendants' arguments sufficient to support permitting Defendants to present certain invalidity theories or to rely on late-disclosed factual evidence from its experts, the Court is not at this time ruling that Defendants may not rely on timely-disclosed evidence to rebut statements made by Plaintiff's experts. The Court finds this to be a different issue that may more properly be addressed in the context of motions *in limine*.[23] Its determination here is simply that Defendants are estopped from raising certain invalidity grounds, not certain individual pieces of timely-produced evidence.

### D. Request to Certify Pending Interlocutory Appeal

There are three statutory requirements for certifying an order for interlocutory appeal: (1) there must be a "controlling question of law"; (2) there must be "substantial ground[s] for difference of opinion" on this question; and (3) it must appear that "an immediate appeal from the order may materially advance the ultimate termination of the litigation." 28 U.S.C. § 1292(b)[24]; *see also Jang v. Bos. Sci. Corp.*, 767 F.3d 1334, 1338 (Fed. Cir. 2014).

Previously, the Court expressed a willingness to certify this matter for interlocutory appeal. The Estoppel Order initially found that Defendants would be precluded from presenting all but one invalidity argument with respect to the '032 and '781 Patents. The Court is now leaning towards finding that all of Defendants' obviousness arguments with respect to all of the asserted patents would properly be estopped. However, the primary basis for that latter determination is the procedural shortcomings in Defendants' discovery and disclosure of evidence and theories to support its "known or used" invalidity arguments. On the record before it, the Court finds that the three statutory requirements for certifying an order for interlocutory appeal have not been met.

## V. Conclusion

For the reasons stated in this Order, the Court would rule as follows:

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[23] At the June 17 hearing, Plaintiff represented that it was not intending to make certain assertions at trial in the manner suggested by Defendants, and further stated that it was "certainly . . . not going to open up the door" at trial by asserting, for instance, "if it was so obvious why didn't Pfister do it." 6/17/2019 Tr. at 82.

[24] 28 U.S.C. § 1292(b) provides, in part, as follows:

> When a district judge, in making in a civil action an order not otherwise appealable under this section, shall be of the opinion that such order involves a controlling question of law as to which there is substantial ground for difference of opinion and that an immediate appeal from the order may materially advance the ultimate termination of the litigation, he shall so state in writing in such order.... That application for an appeal ... shall not stay proceedings in the district court unless the district judge or the Court of Appeals or a judge thereof shall so order.

- The Court would **GRANT** Defendants' Motion for Reconsideration of the Estoppel Order (Docket No. 888) and accordingly reconsider its determinations in the Estoppel Order with respect to invalidity grounds involving Pfister/Pfister Slides.
- The Court would **CLARIFY** the Estoppel Order as provided herein.
- The Court would **GRANT** Plaintiff's Motion to Exclude (Docket No. 1024) and **EXCLUDE** the documents produced at the depositions of Pfister and Siegel and **STRIKE** certain testimony provided at Pfister's deposition as improperly relating to matters of expert opinion.
- The Court would **GRANT** Plaintiff's Motion for Summary Judgment of Validity as to Claims 20 and 22 of the '710 Patent (Docket No. 844) as it relates to each of Defendants' proffered 35 U.S.C. § 103 prior art grounds.
- The Court would **GRANT** Plaintiff's Renewed Motion for Partial Summary Judgment of Validity Under 35 U.S.C. § 103 Based on IPR Estoppel under 35 U.S.C. § 315(e)(2) for U.S. Patent No. 7,916,781 and in doing so **MODIFY** the Estoppel Order as it pertains to that patent such that Defendants are estopped from presenting each of their 35 U.S.C. § 103 obviousness invalidity grounds for Claims 13 and 22 of the '781 Patent and Claims 11 and 22 of the '781 Patent;
- The Court would **DENY** Defendants' Motion for Certification Under 28 U.S.C. § 1292(b).

# Appx138-155

## CONFIDENTIAL MATERIAL FILED UNDER SEAL REDACTED

UNITED STA'I RICT COURT
CENTRAL DISTRICT OF CALIFORNIA

**AMENDED**

**CIVIL MINUTES – GENERAL**

Case No. CV 16-3714 GW (AGRx) Date: December 30, 2019

Title The California Institute of Technology v. Broadcom Limited, et al.

Present: The Honorable: GEORGE H. WU

| Kevin Reddick | Laura Elias |
|---|---|
| Deputy Clerk | Court Reporter / Recorder |

| Attorneys Present for Plaintiffs: | Attorneys Present for Defendants: |
|---|---|
| Todd Briggs | Mark Selwyn |
| James Asperger | Aaron Thompson |
| Bill Price | James Dowd |
| Rachel McCracken | Jason Choy |
| John Yin | Joe Mueller |
| | Mindy Sooter |

**Proceedings: Pretrial Conference**

Court and counsel confer. Court provides its comments regarding the parties' proposed joint juror questionnaire.

The Court **CONTINUES** the evidentiary hearing set for January 6, 2020 at 8:30 am to January 9, 2020 at 8:30 am.

Court and counsel confer regarding jury instructions, parties' joint technology tutorial, and parties' long statement of the case and Court provides its views. Court states that Defendants should be listed in the order of "Broadcom and Apple" in jury instructions.

Plaintiff is directed to file an updated long statement of the case, consistent with the Court's instructions, by January 3, 2020 at noon. Defendants shall respond by January 6, 2020 at noon. Plaintiff may file a reply by January 7, 2020 at noon.

Plaintiff is permitted to file a request, either in the form of a motion or a joint stipulation, regarding jury instructions or other "clarification" related to the Court's claim constructions, by

UNITED STATES DISTRICT COURT
CENTRAL DISTRICT OF CALIFORNIA

**CIVIL MINUTES – GENERAL**

Case No. CV 16-3714 GW (AGRx) Date: December 30, 2019

Title The California Institute of Technology v. Broadcom Limited, et al.

January 3, 2020 at noon and not to exceed five pages. Any response is due by January 6, 2020 at noon and not to exceed five pages.

Court and counsel confer regarding length of trial. Court indicates it may shorten the length of trial, but parties should expect approximately 40-42 hours of total time for taking evidence.

Court and counsel confer regarding depositions of Jacobsen and Hitt. Parties state they will report back at January 9 hearing.

Court and counsel confer regarding prior art. Plaintiff is directed to respond to slide 2 of Defendants' PowerPoint presentation regarding prior art by January 3, 2020 at noon. Parties are permitted to file simultaneous briefs, not to exceed four pages, regarding the relevance of prior art, including the testimony of Dr. Blanksby, by January 3, 2020 at noon. Parties are permitted to file responsive simultaneous briefs, not to exceed three pages, by January 6, 2020 at noon.

Court and counsel confer regarding supplemental damages disclosures. Parties are directed to file simultaneous supplemental briefing on the issue. Opening briefs are due on January 3, 2020 at noon, not to exceed four pages. Responsive briefs are due on January 6, 2020 at noon, not to exceed three pages.

2:12

**Initials of Preparer** CKR

***The California Institute of Technology v. Broadcom Limited et al.***; Case No. 2:16-cv-03714-GW-(AGRx)
Court's Responses to: (1) Parties' Competing Agendas for December 30, 2019 Hearing (Docket Nos. 1764 − Plaintiff's Agenda and Docket No. 1762 − Defendants' Notice of Additional Issues); (2) Defendants' Prior Art Identification (Docket No. 1763); (3) Defendants' Objection from Being Required to Submit Long Statement of the Case (Docket No. 1765) and Plaintiff's Notice of Submission of Draft Long Statement (Docket No. 1770-1 (sealed application); (4) Plaintiff's Notice of Submission of Joint Technology Tutorials (Docket No. 1772); and (5) Parties' Joint Notice re FJC Patent Process Overview Video (Docket No. 1767)

The Court has reviewed the parties' December 26-29 filings and provides the following agenda and tentative rulings for the December 30, 2019 hearing. Topics have been arranged somewhat in order of increasing complexity:

1. Agreed "Short" Joint Statement of the Case and Agreed *Voir Dire* Questions for the Court (*see* Docket No. 1764-1, 1764-2): Plaintiff states that the parties have reached agreement on these items. Docket No. 1764 at 1. The Court has some questions/comments as to the parties' Juror Questionnaire form ("JQF") (Docket No. 1676-1) which it will delineate at the hearing. As to the parties' Joint Revised Proposed *Voir Dire* Questions (Docket No. 1764-2), the Court would suggest incorporating those into the JQF.
2. Preliminary Jury Instructions (Docket No. 1764-3): Plaintiff has submitted a set of the Parties' Proposed Preliminary Jury Instructions" ("PJI") "with the claim constructions modified to comply with the Court's direction." *See* Docket No. 1764 at 1, 1764-3. The Court will consider the parties' objections and rule on them before trial.

   At the start of the trial and before the presentation of the evidence, there is an opportunity for the Court to give the jury an initial and preliminary set of instructions that cover only the trial process itself ("Trial Process Instructions"). *See* Ninth Circuit Manual of Model Civil Jury Instructions ("NCMCJI"), Introductory Comment. The Court will do so here and will utilize NCMCJI Nos. 1.2, 1.5, 1.6, and 1.9 through 1.21. The PJI includes additional proposed instructions which the Court finds are not necessary to provide at the start of the trial but rather should be given either during the trial and/or at the conclusion of the evidentiary presentation. In this case, the Trial Process Instructions will be supplemented by: (1) the FJC's Patent Process Overview video; (2) the Joint Technology Tutorial which the parties are preparing; and (3) what the parties have been referring to as the "Long Statement of the Case" ("Long Statement"). It is the Court's intention to include transcripts of these three items in the jury binder that will be provided to each juror at the start of the case.

It appears to the Court that the primary disputes between the parties as to the PJI involve: (1) the "Instructions on Patent System" ("IPS") (Docket No. 1764-3 at 25-23); (2) the "Instructions Providing Summary of Claims [and Defenses] and Law" ("IPSCL") (*Id.* at 24-38); and (3) the inclusion of the Court's claims constructions (*Id.* at 39-40). The Court would briefly note its initial positions as to those disputes. As to the IPS, it would seem to the Court that most, if not all, of the disputes will eventually go away once the final text of the FJC video, the Joint Technology Tutorial, and the Long Statement are agreed upon. The first two items are seemingly going to be resolved shortly with the Court's ruling on some remaining areas of dispute.

As to the Long Statement, the parties are apparently of the position that they cannot reach any agreement as to form and content of said statements. *See* Docket Nos. 1765, 1773. The parties are under an apparent misunderstanding of what this Court meant with the Long Statement requirement. The Long Statement is really the same as the NCMCJI No. 1.5, but set out completely in a non-superficial and understandable fashion for purposes of this case. Thus, merely stating that the Plaintiff brings claims of infringement of U.S. Patent Nos. 7,116,710, 7,421,032, and 7,916,781 against Defendants is insufficient without delineating why and how each of Defendants' accused products and methods allegedly infringe each of the relevant claims of each of the patents. Likewise, Defendants as to each of their affirmative defenses must do more than refer to a concept; they must identify precisely how said defense is specifically applicable to the particular infringement claim. In other words, to the extent the parties dispute whether particular limitations of the asserted claims of the asserted patents are infringed by the accused products, they are expected to explain that dispute at least at a high level, including with reference to the aspects of the accused products that they believe do or do not satisfy the relevant limitation at issue. This requirement cannot be that difficult because surely Plaintiff must understand the infringement and damage claims it is bringing against Defendants; and, conversely, Defendants must be aware of the exact defenses they will be asserting to oppose Plaintiff's case.

As to the Court's claim constructions, it would appear that a presentation of those constructions would most appropriately be placed in the Technology Tutorial.

3. Parties' Joint Notice re FJC's Patent Process Overview Video (Docket No. 1767): The parties have submitted a joint notice showing that they are largely in agreement regarding what portions of the FJC's video should be played to the jury. They have one dispute remaining. Docket No. 1767-1 at 5-6. The Court would tentatively rule that both the yellow and blue highlighted portions of the FJC video shall be played for the jury and overrule Plaintiff's objections to their inclusion.

4. Motion *in Limine* Status (Docket No. 1764-4): As directed by the Court, the parties have provided their positions regarding motions *in limine*. The Court will consider the parties' statements and issue final rulings on motions *in limine* to the extent still necessary before trial.

5. Trial Time (Docket No. 1764 at 3; Docket No. 1762 at 3): Plaintiff states that "[t]he parties seek clarification on the total amount of trial time that will be available for witness examinations, including the number of hours available on full Court days, the number of hours available on days the Court holds hearings on other matters, and the number of days the Court anticipates holding hearings on other matters during this trial." Defendants propose 43.5 hours total of testimony trial for the two parties. The Court will provide further guidance at the hearing.

6. Trial Deposition of Jacobsen (Docket No. 1764 at 3): Plaintiff states it "will provide a brief update to the Court on the issue."

7. Teece/Hitt Depositions (Docket No. 1764 at 3, Docket No. 1762 at 1): Apparently Defendants offered Hitt for deposition on December 27, 28, and 29, and Plaintiff did not accept. Plaintiff will not be permitted to serve interrogatories for Hitt, and Plaintiff is expected to proceed with his deposition as soon as possible. If Plaintiff refuses to accept additional times for a deposition of Hitt, it must inform the Court in a notice that it has done so within 4 hours of its refusal, including with a reason why it has refused. If the Court finds the reasons insufficient, it will simply allow Hitt to testify without any additional prior opportunity for Plaintiff to question him.

8. Use of Prior Art at Trial (Docket No. 1763): The Court has reviewed both Defendants' prior art submission and the response filed by Plaintiff on Sunday (December 29) afternoon. The Court agrees with Plaintiff's detailed discussion and proposal regarding

references to prior art at trial in this case. Defendants have now had two opportunities to submit a listing of their prior art positions for trial and the Court agrees that the manner in which Defendants have organized their most recent listing obfuscates both (1) the purposes Defendants would seek to introduce particular references at trial and (2) the places in Defendants' expert reports where Defendants relied on a particular prior art reference for a particular purpose that they would now seek to introduce it at trial. The Court would fully adopt Plaintiff's proposal, including by limiting any presentation of prior art in this case specifically to the portions of Defendants' expert reports that have been specifically identified for (a) state of the art and (b) non-infringing alternatives and which are not prejudicial to Plaintiff given the prior rulings by the Court in this case. The Court also agrees with Plaintiff that even after the Court's tentative motion *in limine* rulings, Defendants have failed to tie a presentation of prior art references in this case to any subjective intent or belief of Defendants at relevant times during this litigation, creating no relevance of the introduction of prior art references at trial to willfulness.

9. <u>Joint Technology Tutorial (Docket No. 1772-1 (Plaintiff's updated proposed submission of tutorials, including both sides' proposals and objections))</u>: The Court has conducted an initial review of the parties' joint technology tutorial proposals and objections and provides the following comments:

- Defendants' objections to language and slide organization that they themselves relied on at the claim construction tutorial in 2017 are rejected. Plaintiff's proposals are adopted in each regard where they track with the language, organization, and slides (including the Mona Lisa slide) of Defendants' 2017 presentation. In this regard, Defendants' open-ended language in describing the role of information bits as the language of computers is also rejected. However, the Court agrees with Defendants that the "Repetition Code" slides should include all yellow 0's output by the encoder and no discussion of whether one of the 0s output by the encoder is an information bit (the Court would otherwise exclude reference to k=1, q=3).
- In presenting the case in introductory slide 1, it should track the case caption in the name order for Defendants. Otherwise, Defendants should be listed in alphabetical order.
- References to Hamming and Bell Labs, the concept of redundancy, the concept of

systematic and non-systematic codes, technology examples of text messaging (Caltech slides 27-37), and bit voltages are all excluded unless the parties can agree otherwise. High-level statement regarding the historical development of error correction codes in the 1950s with reference to the Shannon Limit but without reference to Hamming or specifics of the life of Claude Shannon would likely be permitted if neutrally drafted.

- "Caltech Slide 2" can only be included if all the blue text in the white box is changed to say "asserted patents."

10. Long Statements of the Case (Docket Nos. 1770-1 (Plaintiff's updated proposed submission of long statements, including both sides' proposals and objections), 1765 (Defendants' notice of objection to long statement)): Plaintiff has submitted a document that includes each side's objections (in footnotes) to the other side's long statement of the case. Defendants submit over 100 footnotes for their objections to Plaintiff's long statement, and Plaintiff submits over 50 for its objections to Defendants' long statement. Docket No. 1770-1. In response, the Court would refer the parties to its discussion in Item No. 2, *supra*.

11. Supplemental Damages Data, "Independent Development" Narrative, and "Need for Clarification of Plaintiff's Infringement Contentions (Docket No. 1764 at 3; Docket No. 1762 at 2-3): More information is needed from the parties before the Court can begin to consider these three items and determine whether anything further can be done about them in the short timeframe that remains before trial. The Court additionally notes and reiterates that it agrees with both parties' objections to the other's long statement for failing to use phrases like "contends" or "alleges" to make clear that the long statement is simply a non-superficial introduction of each party's contentions. Both long statements include argumentative language that should be made neutral.

12. Supplemental Damages Data, "Independent Development" Narrative, and "Need for Clarification of Plaintiff's Infringement Contentions" (Docket No. 1764 at 3; Docket No. 1762 at 2-3): More information is needed from the parties before the Court can begin to consider these three items and determine whether anything further can be done about them in the short timeframe that remains before trial. The Court notes that it agrees with Plaintiff that Defendants should not be permitted to present arguments at trial that are contrary to clear Federal Circuit authority, including a "practicing the prior art" defense to

infringement or "independent development" defense to infringement. The Court would also like to further discuss with the parties whether both parties' reliance on 802.11 in this case presents a side show that is irrelevant to the infringement question such that both sides should be precluded from relying on 802.11 standard arguments in their entirety. The Court also invites further discussion regarding the parties' dispute over references to actual sales of the direct encoder starting in summer/fall 2019.

13. Doctrine of Equivalents / Prosecution History Estoppel Dispute (Docket No. 1757-1, 1766): The parties' DOE/PHE disputes are addressed in a separate tentative ruling.

***<u>The California Institute of Technology v. Broadcom Limited et al.</u>***; Case No. 2:16-cv-03714-GW-(AGRx)
Tentative Ruling on Motion to Exclude Doctrine of Equivalents Theories as Barred by Prosecution History Estoppel

At the Court's direction, the parties have submitted briefs regarding whether Plaintiff should be subject to prosecution history estoppel ("PHE") such that it cannot present doctrine of equivalents ("DOE") theories of infringement for certain claim limitations against certain aspects of the accused products. *See* Defendants' Motion, Docket No. 1755 (public), Docket No. 1757-1 (sealed application); Opposition (Docket No. 1766).

"[W]hether prosecution history estoppel applies, and hence whether the doctrine of equivalents may be available for a particular claim limitation, presents a question of law." *Festo Corp. v. Shoketsu Kinzoku Kogyo Kabushiki Co.* ("*Festo II*"), 344 F.3d 1359, 1367-68 (Fed. Cir. 2003). "[T]he patentee . . . bear[s] the burden of showing that the amendment does not surrender the particular equivalent in question." *Festo Corp. v. Shoketsu Kinzoku Kogyo Kabushiki Co.* ("*Festo I*"), 535 U.S. 722, 740 (2002).

PHE can be triggered by "either (1) by making a narrowing amendment to the claim ('amendment-based estoppel') or (2) by surrendering claim scope through argument to the patent examiner ('argument-based estoppel')." *Conoco, Inc. v. Energy & Envtl. Int'l, L.C.*, 460 F.3d 1349, 1363 (Fed. Cir. 2006). For amendment-based estoppel,

> a "patentee's decision to narrow his claims through amendment may be presumed to be a general disclaimer of the territory between the original claim and the amended claim." [*Festo I*, 535 U.S. at 740]. The presumption may be overcome if the patentee can show the applicability of one of several exceptions identified by the Supreme Court: (1) the equivalent was "unforeseeable at the time of the application"; (2) "the rationale underlying the amendment may bear no more than a tangential relation to the equivalent in question"; or (3) "there may be some other reason suggesting that the patentee could not reasonably be expected to have described the insubstantial substitute in question." *Id.* at 740-41.

*Pharma Tech Sols., Inc. v. LifeScan, Inc.*, 942 F.3d 1372, 1380 (Fed. Cir. 2019). For argument-based estoppel, "the prosecution history must evince a clear and unmistakable surrender of subject matter." *Conoco*, 460 F.3d at 1364 (quoting *Deering Precision Instruments, L.L.C. v. Vector Distribution Sys., Inc.*, 347 F.3d 1314, 1326 (Fed. Cir. 2003)). "Clear assertions made during prosecution in support of patentability, whether or not actually required to secure allowance of the claim, may also create an estoppel . . . because [t]he relevant inquiry is whether a competitor would reasonably believe that the applicant had surrendered the relevant subject matter." *PODS, Inc. v. Porta Stor, Inc.*, 484 F.3d 1359, 1368 (Fed. Cir. 2007) (alterations in original) (citations omitted).

Defendants' PHE Motion focuses on eight claim limitations in the asserted patents, which are addressed in turn:

- <u>"accumulator"</u>: Plaintiff notes that Defendants' Long Statement of the Case did not list the "accumulator" limitation in their non-infringement arguments. Docket No. 1766 at 6. Plaintiff states, "Caltech's DOE argument for this limitation is thus moot, and so is Defendants' estoppel theory." *Id.* Without more information regarding the relevance of this dispute to disputed issues for trial, the Court sees no reason to expend resources addressing it. Hence, Defendants' motion is denied as to this issue.

- "first coder . . . second coder," "low-density generator matrix," and "stream": The Court first notes that Defendants cite no ***Federal Circuit*** cases for the proposition that "prosecution history ***estoppel***" can attach based on statements made in ***IPR*** proceedings. Plaintiff, however, does not object to Defendants' arguments on this basis. Moreover, in addition to the interrelated subject matter addressed by PHE and prosecution history disclaimer, *see Trading Techs. Int'l, Inc. v. Open E Cry, LLC*, 728 F.3d 1309, 1322 (Fed. Cir. 2013), legal authority does exist for the proposition that other post-grant PTO proceedings can lead to PHE. *See Festo I*, 535 U.S. at 728 (involving a patent amendment made during a reexamination proceeding). The Court will consider the parties' disputes for these three terms.

    - "stream": The Court has considered the parties' arguments and finds that they do not "evince clear and unmistakable surrender of subject matter" because, as Plaintiff notes, "[a] 'stream' can be participated into 'blocks,' but not every block is necessarily part of a stream." Docket No. 1766 at 6; *see also id.* at 5-6 ("Caltech never argued that the 'stream' limitations ***cannot*** be met by receiving data blocks as input."), Docket No. 1213 at 17-18.

    - "low-density generator matrix": During IPR proceedings, Plaintiff asserted that Defendants had failed to show that the LDGM limitation of certain claims in the '710 Patent was rendered obvious by the prior art. Plaintiff made assertions distinguishing the claimed LDGM from a "repeater" disclosed in Frey/Divsalar and from a "dense generator matrix" in the context of discussing secondary considerations. However, whether or not these statements created PHE as to repeaters and dense generator matrices, the Court agrees that there is insufficient basis at this time to conclude that they created clear and unmistakable surrender as to the accused instrumentalities. *See Cordis Corp. v. Medtronic Ave, Inc.*, 511 F.3d 1157, 1178 (Fed. Cir. 2008). The Court would defer a determination on this dispute until after the factual record has been further developed regarding the similarities/differences between the accused products and the distinguished prior art components discussed during IPR proceedings.

    - "first coder . . . second coder": As Plaintiff notes,

        > Defendants group "first coder . . . second coder" together with "low-density generator matrix["] . . . even though the term "coder" is subject [to] a separate dispute . . . All prosecution history statements identified by Defendants relate solely to LDGM/generator matrix . . . . [E]ven if there is estoppel for the "low-density generator matrix" limitation, the estoppel does not extend to "coder" or "first coder . . . second coder."

Docket No. 1766 at 5. The Court agrees. *See also* Docket No. 1213 at 10.[1]

- "repeat . . . irregularly" (and "repeat"[2]): Plaintiff states, "Caltech never argued '***regular*** repeating is equivalent to ***irregular*** repeating.'" Docket No. 1766 at 2. As Plaintiff further explains, "the issue [during prosecution] was that Wang's output did not contain ***any*** irregular repetition. Thus, any estoppel is limited to the overall result (regular vs. irregular) and not the specific implementation used to achieve that result." *Id.* at 3. The Court agrees. *See also* Docket No. 1213 at 14. Because the claims on their face already require "irregular" repetition, and Plaintiff will be held to its statement that it is not arguing that the ***overall*** implementation of the asserted products constitutes regular repetition, the Court finds that PHE does not apply in the circumstances presented.

- Tanner Graph ("random,"[3] "check nodes . . . enforce constraints that determine the parity bits"): The parties appear to argue that their PHE dispute regarding the Tanner Graph actually involves three different disputes (including the two limitations identified here and a dispute about whether the claims require "parity bits generated in the encoder [to] rely on the immediately preceding parity bit").[4] It cannot be reasonably disputed that the Tanner Graph added to Claim 18 of the '032 Patent during prosecution from former dependent Claim 20 encapsulates many significant and varied "limitations." Plaintiff has presented arguments sufficient to overcome the presumption that PHE applies in the specific circumstances presented, including by explaining that the disputed concepts raised by Defendants in their Motion were tangential to patentability during prosecution. *See* Docket No. 1766 at 6-7, 7.

For the reasons stated, the Court **DENIES** Defendants' Motion on all grounds except "low-density generator matrix." Resolution of the PHE dispute relating to that term is **DEFERRED**.

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[1] Given the proximity to trial, the Court finds both parties have waived claim construction arguments regarding a remaining dispute over the meaning of the term "coder," if any, by failing to present them in a cognizable fashion for resolution by the Court. The Court further notes that Defendants are expected to abide by both the letter and spirit of the previous determinations reached by the Court in this case. For example, Defendants should rethink their citations to portions of Stark's report asserting that Claims 15 and 20 of the '710 Patent require an LDGM coder where the outputted bits must be greater than or equal to the inputted bits. *Compare* Docket No. 1213 at 10 *with* Docket No. 1757-1 at 7 (citing Stark Rebuttal Report, Docket No. 1242-7 ¶¶ 564-68; *see id.* ¶ 567). The Court will consider sanctions for repeated insistence of explicitly-rejected arguments and theories, including attempts to inject them into a trial presentation.

[2] As Plaintiff notes, Defendants list "repeat" as an independent term subject to PHE in this case, but do not present independent arguments for it compared to the term "repeat . . . irregularly." *See* Docket No. 1757-1 at 4; *see also* Docket No. 1766 at 4. Thus, the Court does not independently consider a PHE dispute for the term "repeat" in isolation.

[3] Although Plaintiff opts to address the "term" "random" separate from the claimed Tanner Graph, the Court finds they are more appropriately addressed in a single section.

[4] Given the proximity to trial, the Court finds both parties have waived claim construction arguments regarding this dispute, if any, by failing to present them in a cognizable fashion for resolution by the Court.

UNITED STATES DISTRICT COURT
CENTRAL DISTRICT OF CALIFORNIA

**CIVIL MINUTES - GENERAL**

| | | | |
|---|---|---|---|
| Case No. | CV 16-3714-GW (AGRx) | Date | January 9, 2020 |
| Title | *The California Institute of Technology v. Broadcom Limited, et al.* | | |

| | |
|---|---|
| Present: The Honorable | GEORGE H. WU, UNITED STATES DISTRICT JUDGE |

| | | |
|---|---|---|
| Javier Gonzalez | Terri A. Hourigan | |
| Deputy Clerk | Court Reporter / Recorder | Tape No. |

| Attorneys Present for Plaintiffs: | Attorneys Present for Defendants: |
|---|---|
| James R. Asperger | James M. Dowd |
| Todd M. Briggs | Jason F. Choy |
| Rachel McCracken | Mary V. Sooter |
| William C. Price | Joseph J. Mueller |
| Brian Biddinger | Jim Quarles |

**PROCEEDINGS: PRETRIAL CONFERENCE**

The Court's "Thoughts" are circulated and attached hereto. Court confers with counsel.

Each side will provide their own version of the video which will be presented to the Jury by noon on January 10, 2020.

The parties are also reminded to submit to the Court all relevant pretrial documents, including exhibit list, witness list, verdict form, and jury instructions before trial.

Plaintiff is directed to explain in an updated proposed long statement how each limitation of each asserted claim is met by the accused products. *See* Rough Tr. 21:18-23:24, 27:8-11.

Parties are instructed to return on January 13, 2020 at 10:00 a.m. to address additional open issues as discussed on the record, for final rulings, and the beginning of jury impanelment.

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Initials of Preparer JG

4. "Independent Development" Theory (Prior Art Creation of Accused Products)

The Court agrees with Defendants that if Plaintiff (1) intends to assert copying of its patented technology by Defendants' products (and will not agree to a joint stipulation otherwise), (2) intends to maintain its claim for post-suit willful infringement, and (3) actually offers a "robust invention story" at trial, there may be a basis for Defendants to respond to the extent necessary to adequately rebut by referring generally to prior art error correction codes and how they may have informed the development of the accused products. However, Defendants' Long Statement of the case continues to imply noninfringement based on the different historical development of the accused products compared to the asserted patents. Defendants will not be permitted to make such an implication, either in the form of a "practicing the prior art" or "independent development" defense to infringement at trial, and Defendants' suggestions at the December 30 hearing that this type of "context" can be considered and is relevant to the infringement analysis is not adequately supported by Defendants' submitted legal authority. It should go without saying, but the Court also notes that these bases for the presentation of prior art should in no way implicate or involve a direct comparison to limitations in the asserted patents to disclosure in a specific prior art reference.

Regarding willfulness, the Court emphasizes that before this evidence could be used to specifically support a defense to willful infringement, Defendants would be required to lay the foundation by showing that the subjective intent of Broadcom or Apple (not simply an employee of those companies who is not a company representative on the particular topic) regarding infringement of the asserted patents during the relevant timeframe (i.e. this lawsuit) was influenced by a particular understanding and belief that the accused products were developed in a certain manner unrelated to the asserted patents.

Regarding doctrine of equivalents, Defendants' position is rejected. They have had many previous opportunities to explain the relevance of the introduction of prior art in this lawsuit to matters at issue for trial, and this is the first time they have flagged it for DOE purposes, with no showing that they adequately disclosed such a theory during this litigation.

The Court otherwise would adopt all portions of its December 30 Tentative Ruling regarding the use of prior art at trial that are not inconsistent with these views. In reaching this determination, the Court notes that it agrees with Plaintiff that permitting Defendants to present their main invalidity prior art references to a jury is inappropriate under FRE 402 and 403.

5. Request Regarding Certain Claim Terms Constructed by the Court as Having "Plain and Ordinary Meaning"

Based on the submissions, which do suggest that the parties continue to disagree regarding the plain meaning of the terms "repeat," "random," and "generator matrix" and the import of statements in the Court's previous orders as to that plain meaning, the Court is considering providing the following constructions for the terms to the jury:

- "random permutation" as it appears in the Court's construction of the "Tanner Graph" in Claims 11 and 18 of the '032 Patent: "permutation process that is either purely random or pseudo random such that it results in an output that appears random" (see Docket No. 1639 at 9).

- "repeat" as it appears in Claim 20 of the '710 Patent and in the Court's construction of the "Tanner Graph" in Claims 11 and 18 of the '032 Patent: "generation of additional bits, where generation can include duplication or reuse of bits" (see Docket No. 213 at Cover, 9, 14).
- "low-density generator matrix coder" as it appears in Claim 20 of the '710 Patent: "coder that generates output bits, where process of generating output bits comprises multiplying a low-density matrix by input bits, and the output bits outputted by the coder can be less than, equal to, or more than the number of input bits." (Docket No. 1213 at 10).

6. Direct Encoding et al.

Regarding the Direct Encoder dispute, Defendants can rely on all timely-disclosed evidence to support their defense and respond to Plaintiff's assertions (and allegedly "counter-factual narrative") about the Direct Encoder, including Blanksby's deposition testimony and email correspondence regarding the development and planned launch of the Direct Encoder in Defendants' products. Defendants cannot rely on any data or evidence served in December 2019 to support their defense regarding the Direct Encoder, in any fashion. The Court finds that Defendants failed to timely produce this information, particularly given Defendants' current representation that a sale of a chip including a direct encoder occurred in July 2019, almost half a year before Defendants' belated supplemental production. *See also* Docket No. 1422-2 at 35. Moreover, as Plaintiff notes, there continues to be scanty information regarding the sales implicated by Defendants' recent evidentiary supplementation.

# UNITED STATES DISTRICT COURT
# CENTRAL DISTRICT OF CALIFORNIA

## CIVIL MINUTES - TRIAL

| | | | |
|---|---|---|---|
| Case No. | CV 16-3714-GW-AGRx | Date | January 16, 2020 |
| Title: | *The California Institute of Technology v. Broadcom Limited, et al.* | | |

Present: The Honorable GEORGE H. WU, UNITED STATES DISTRICT JUDGE

| Javier Gonzalez | Laura Elias / Terri A. Hourigan |
|---|---|
| *Deputy Clerk* | *Court Reporter/Recorder* |

| Attorneys Present for Plaintiff(s): | Attorneys Present for Defendants: |
|---|---|
| J. Asperger; R. McCracken; T. Briggs; B. Biddinger, et al. | M. Selwyn; J. Dowd; J. Mueller; M. Sooter, et al. |

____ Day Court Trial 4th Day Jury Trial

___ One day trial: ___ Begun (1st day); ✔ Held & Continued; ___ Completed by jury verdict/submitted to court.

___ The Jury is impaneled and sworn.

___ Opening statements made by ____

✔ Witnesses called, sworn and testified. ✔ Exhibits Identified ✔ Exhibits admitted.

___ Plaintiff(s) rest. ___ Defendant(s) rest.

___ Closing arguments made by ___ plaintiff(s) ___ defendant(s). ___ Court instructs jury.

___ Bailiff(s) sworn. ___ Jury retires to deliberate. ___ Jury resumes deliberations.

___ Jury Verdict in favor of ___ plaintiff(s) ___ defendant(s) is read and filed.

___ Jury polled. ___ Polling waived.

___ Filed Witness & Exhibit Lists ___ Filed jury notes. ___ Filed jury instructions.

___ Judgment by Court for ____ ___ plaintiff(s) ___ defendant(s).

___ Findings, Conclusions of Law & Judgment to be prepared by ___ plaintiff(s) ___ defendant(s).

___ Case submitted. ___ Briefs to be filed by ____

___ Motion to dismiss by ____ is ___ granted. ___ denied. ___ submitted.

___ Motion for mistrial by ____ is ___ granted. ___ denied. ___ submitted.

___ Motion for Judgment/Directed Verdict by is ___ granted. ___ denied. ___ submitted.

___ Settlement reached and placed on the record.

___ Clerk reviewed admitted exhibits with counsel to be submitted to the Jury/Court for deliberation/findings.

___ Counsel stipulate to the return of exhibits upon the conclusion of trial. Exhibit Release Form prepared and filed.

___ Trial subpoenaed documents returned to subpoenaing party.

✔ Case continued to January 17, 2020 at 8:20 a m. for further trial.

✔ Other: Open issues are discussed on the record.

The Court's Additional Claim Constructions is circulated and attached hereto.

4 : 20

Initials of Deputy Clerk ____

cc:

***The California Institute of Technology v. Broadcom Limited et al.***; Case No. 2:16-cv-03714-GW-AGR
Court's Additional Claim Constructions

| Claim Term | Court's Construction |
|---|---|
| "random permutation" (as it appears in the Court's construction of the "Tanner Graph" in Claims 11 and 18 of the '032 Patent) | "changing the order of data elements by a purely random or pseudo random process" |
| "repeat" (as it appears in Claim 20 of the '710 Patent and in the Court's construction of the "Tanner Graph" in Claims 11 and 18 of the '032 Patent) | "generation of additional bits, where generation can include, for example, duplication or reuse of bits" |
| "low-density generator matrix coder" (as it appears in Claim 20 of the '710 Patent) | "coder that generates output bits, where process of generating output bits comprises multiplying a low-density matrix by input bits, and the output bits outputted by the coder can be less than, equal to, or more than the number of input bits." |

FILED
CLERK, U.S. DISTRICT COURT
JAN 29 2020
CENTRAL DISTRICT OF CALIFORNIA
BY JG DEPUTY

**UNITED STATES DISTRICT COURT**

**CENTRAL DISTRICT OF CALIFORNIA**

| | |
|---|---|
| CALIFORNIA INSTITUTE OF TECHNOLOGY,<br><br>Plaintiff,<br><br>v.<br><br>BROADCOM LIMITED AND APPLE, INC.,<br><br>Defendants. | No. CV 16-3714-GW-AGRx<br><br>**FINAL JURY INSTRUCTIONS** |

**Final Jury Instructions**

## I. Introductory Instructions

Members of the Jury: Now that you have heard all of the evidence, it is my duty to instruct you on the law that applies to this case. Each of you has received a copy of these instructions that you may take with you to the jury room.

It is your duty to find the facts from all the evidence in the case. To those facts you will apply the law as I give it to you. You must follow the law as I give it to you whether you agree with it or not. And you must not be influenced by any personal likes or dislikes, opinions, prejudices, or sympathy. That means that you must decide the case solely on the evidence before you. You will recall that you took an oath to do so.

Please do not read into these instructions or anything that I may say or do or have said or done that I have an opinion regarding the evidence or what your verdict should be.

This case is a civil lawsuit alleging patent infringement. In this case, the California Institute of Technology, which I will refer to as "Caltech," is suing Defendants Apple Inc., Broadcom Corporation, Broadcom Limited, and Avago Technologies, Limited, for what it claims is unauthorized use of three Caltech patents, in products sold by Defendants. Broadcom Corporation, Broadcom Limited, and Avago Technologies, Limited are related entities and can be treated as a single defendant which I will refer to as "Broadcom."

Caltech owns three patents issued by the United States Patent and Trademark Office in 2006, 2008 and 2011, related to encoders and decoders that use a specific type of error correction coding. Caltech claims and bears the burden of proof by a preponderance of the evidence that Apple's products that support Wi-Fi (including its iPhones, iPads, iMacs, MacBooks, and AppleTV) and Broadcom's chips (that support Wi-Fi) infringe Caltech's patents.

Broadcom and Apple claim that their products do not use Caltech's technology, and that their products instead use a form of error correction coding that is different from the specific type of error correction coding claimed by Caltech's patents.

Caltech is seeking what it believes to be a reasonable royalty from Broadcom and Apple to compensate for the alleged infringement. Broadcom and Apple deny that Caltech is entitled to any damages because: (1) they deny infringement, and (2) they believe that what Caltech is seeking is not reasonable.

When a party has the burden of proving any claim or affirmative defense by a "preponderance of the evidence," it means you must be persuaded by the evidence that the claim or affirmative defense is more probably true than not true.

You should base your decision on all of the evidence, regardless of which party presented it. Unless I instruct you otherwise, all issues in this case must be established by a preponderance of the evidence.

You should decide the case as to each Defendant separately. Unless otherwise stated, the instructions apply to all parties.

The evidence you are to consider in deciding what the facts are consists of:

1. the sworn testimony of any witness;
2. the exhibits that are admitted into evidence;
3. any facts to which the lawyers have agreed; and
4. any facts that I have instructed you to accept as proved.

In reaching your verdict, you may consider only the testimony and exhibits received into evidence. Certain things are not evidence, and you may not consider them in deciding what the facts are. I will list them for you:

1. Arguments and statements by lawyers are not evidence. The lawyers are not witnesses. What they have said in their opening statements, closing arguments and at other times is intended to help you interpret the evidence, but it is not evidence. If the facts as you remember them differ from the way the lawyers have stated them, your memory of them controls.
2. Questions and objections by lawyers are not evidence. Attorneys have a duty to their clients to object when they believe a question is improper under the rules of evidence. You should not be influenced by the objection or by the court's ruling on it.
3. Testimony that is excluded or stricken, or that you have been instructed to disregard, is not evidence and must not be considered.
4. Anything you may have seen or heard when the court was not in session is not evidence. You are to decide the case solely on the evidence received at the trial.

Evidence may be direct or circumstantial. Direct evidence is direct proof of a fact, such as testimony by a witness about what that witness personally saw or heard or did. Circumstantial evidence is proof of one or more facts from which you could find another fact. You should consider both kinds of evidence. The law makes no distinction between the weight to be given to either direct or circumstantial evidence. It is for you to decide how much weight to give to any evidence.

There are rules of evidence that control what can be received into evidence. When a lawyer asked a question or offers an exhibit into evidence and a lawyer on the other side thought that it was not permitted by the rules of evidence, that lawyer raised an objection. If I overruled the objection, the question was answered or the exhibit received. If I sustained the objection, the question was not answered, and the exhibit not admitted. Whenever I sustained an objection to a question, you must ignore the question and must not guess what the answer might have been.

Sometimes I may order that evidence be stricken from the record and that you disregard or ignore that evidence. That means when you are deciding the case, you must not consider the stricken evidence for any purpose.

In deciding the facts in this case, you may have to decide which testimony to believe and which testimony not to believe. You may believe everything a witness says, or part of it, or none of it. In considering the testimony of any witness, you may take into account:

1. the opportunity and ability of the witness to see or hear or know the things testified to;

2. the witness's memory;
3. the witness's manner while testifying;
4. the witness's interest in the outcome of the case, if any;
5. the witness's bias or prejudice, if any;
6. whether other evidence contradicted the witness's testimony;
7. the reasonableness of the witness's testimony in light of all the evidence; and
8. any other factors that bear on believability.

Sometimes a witness may say something that is not consistent with something else he or she said. Sometimes different witnesses will give different versions of what happened. People often forget things or make mistakes in what they remember. Also, two people may see the same event but remember it differently. You may consider these differences, but do not decide that testimony is untrue just because it differs from other testimony.

However, if you decide that a witness has deliberately testified untruthfully about something important, you may choose not to believe anything that witness said. On the other hand, if you think the witness testified untruthfully about some things but told the truth about others, you may accept the part you think is true and ignore the rest.

The weight of the evidence as to a fact does not necessarily depend on the number of witnesses who testify. What is important is how believable the witnesses were, and how much weight you think their testimony deserves.

During your deliberations, you will not have a transcript of the trial testimony.

You have been allowed to take notes during the trial to help you remember the evidence. If you did take notes, please keep them to yourself until you go to the jury room to decide the case. When you leave, your notes should be left in the jury room. No one will read your notes.

Whether or not you take notes, you should rely on your own memory of the evidence. Notes are only to assist your memory. You should not be overly influenced by your notes or those of other jurors.

A deposition is the sworn testimony of a witness taken before trial. The witness is placed under oath to tell the truth and lawyers for each party asked questions. The questions and answers are recorded either in written form or by means of a video recording.

Certain depositions were presented to you in the form of playing the recording of the witness's deposition testimony in lieu of those witnesses' live testimony during the trial. Insofar as possible, you should consider deposition testimony, presented to you in court in lieu of live testimony, in the same way as if the witness had been present to testify. During the playing of those depositions, not only were you able to see and hear that testimony but also a transcription of the testimony was simultaneously scrolled at the bottom of the screen to assist you when listening to the recordings. However, bear in mind that the recording is the evidence, not the transcript. If you heard something different from what appeared in the transcript, what you heard is controlling.

During the trial, you heard testimony from certain witnesses who because of their education, training and/or experience were allowed to give opinions on issues in the case and the reasons for their opinions.

Such opinion testimony should be judged like any other testimony. You may accept it or reject it, and give it as much weight as you think it deserves, considering the witness's education and experience, the reasons given for the opinion, and all the other evidence in the case.

Certain charts and summaries *not* admitted into evidence have been shown to you in order to help explain the contents of books, records, documents, or other evidence in the case. Charts and summaries are only as good as the underlying evidence that supports them. You should, therefore, give them only such weight as you think the underlying evidence deserves.

Certain charts and summaries have been admitted into evidence to illustrate information brought out in the trial. Charts and summaries are only as good as the testimony or other admitted evidence that supports them. You should, therefore, give them only such weight as you think the underlying evidence deserves.

Corporations and other legal entities are allowed to sue and be sued in court. All parties are equal before the law and a corporation is entitled to the same fair and conscientious consideration by you as any party.

Under the law, a corporation is considered to be a person. It can only act through its employees, agents, directors, or officers. Therefore, a corporation is responsible for the acts of its employees, agents, directors, and officers performed within the scope of authority.

From time to time during the trial, the parties presented information that is confidential to one or more of the parties. At those times, it became necessary for measures to be taken to protect the confidentiality of the information, such as sealing the courtroom. The parties agreed to these procedures to protect the confidentiality of the information and undue weight should not be given to these measures.

Each of you are required to maintain the confidentiality of the information that was presented under seal. You may discuss this information in your deliberations with other jurors, but may not discuss it with any other individuals or after the completion of your jury service.

## II. Stipulated Facts

The parties have agreed to the following and you must therefore treat these facts as having been proved.

1. Caltech is the owner of all right, title and interest in U.S. Patent No. 7,116,710.
2. Caltech is the owner of all right, title and interest in U.S. Patent No. 7,421,032.
3. Caltech is the owner of all right, title and interest in U.S. Patent No. 7,916,781.
4. U.S. Patent No. 7,116,710 (the "'710 patent") is titled "Serial Concatenation of

Interleaved Convolution Codes Forming Turbo-Like Codes."

5. The '710 patent issued on October 3, 2006.

6. The named inventors listed on the '710 patent are Hui Jin, Aamod Khandekar, and Robert J. McEliece.

7. The '710 patent expires on August 23, 2022.

8. U.S. Patent No. 7,421,032 (the "'032 patent") is titled "Serial Concatenation of Interleaved Convolution Codes Forming Turbo-Like Codes."

9. The '032 patent issued on September 2, 2008.

10. The named inventors listed on the '032 patent are Hui Jin, Aamod Khandekar, and Robert J. McEliece.

11. The '032 patent expires on August 18, 2020.

12. U.S. Patent No. 7,916,781 (the "'781 patent") is titled "Serial Concatenation of Interleaved Convolution Codes Forming Turbo-Like Codes."

13. The '781 patent issued on March 29, 2011.

14. The named inventors listed on the '781 patent are Hui Jin, Aamod Khandekar, and Robert J. McEliece.

15. The '781 patent expires on October 16, 2021.

16. Broadcom Corporation is a California corporation with a principal place of business at 5300 California Avenue, Irvine, California 92617.

17. Avago Technologies Ltd. is a corporation organized under the laws of the country of Singapore with principal places of business at 1320 Ridder Park Dr., San Jose, California 95131 and 1 Yishun Avenue 7, Singapore 768923.

18. Apple Inc. is a corporation organized under the laws of the State of California, with principal place of business at One Apple Park Way, Cupertino, California 95014.

19. The California Institute of Technology is a non-profit private university located in Pasadena, California.

20. The parties entered a stipulation identifying the representative products for purposes of the infringement and non-infringement analysis.

The parties have further agreed to the following:

1. For purposes of evaluating infringement or noninfringement of the claims asserted in this case, the RU encoder is representative of the Prediction Correction encoder (also known as the "PC encoder"). No evidence regarding the Prediction Correction Encoder shall be offered or discussed at trial.

2. If Caltech proves by a preponderance of the evidence that any accused product meets all limitations of one or more asserted claims based on its incorporation of the RU

encoder shall constitute proof that all other accused products incorporating the RU encoder or the PC encoder, as listed in Exhibit 1, Sections II and IV, meet all limitations of the same one or more claims.

3. If Caltech fails to prove by a preponderance of the evidence that any accused product meets all limitations of one or more asserted claims based on its incorporation of the RU encoder, that failure shall mean that all other accused products incorporating the RU encoder or the PC encoder, as listed in Exhibit 1, Sections II and IV, also do not meet all limitations of the same one or more claims.

4. For purposes of evaluating infringement or noninfringement, the Permuted Layer decoder is representative of the Submatrix Layer decoder with regard to the limitations of claim 18 of the '032 patent. No evidence regarding the Sub-Matrix Layer decoder shall be offered or discussed at trial.

5. If Caltech proves by a preponderance of the evidence that any accused product meets all limitations of claim 18 of the '032 patent based on its incorporation of the Permuted Layer decoder shall constitute proof that all other accused products incorporating the Permuted Layer decoder or the Sub-Matrix Layer decoder, as listed in Exhibit 1, Sections V and VI, meet all limitations of the same claim.

6. If Caltech fails to prove by a preponderance of the evidence that any accused product meets all limitations of claim 18 of the '032 patent based on its incorporation of the Permuted Layer decoder, that failure shall mean that all other accused products incorporating the Permuted Layer decoder or the Sub-Matrix Layer decoder, as listed in Exhibit 1, Sections V and VI, also do not meet all limitations of the same claim.

## III. <u>Patents in General and the Three Patents Involved in This Case</u>

Patents are granted by the United States Patent and Trademark Office (referred to herein as "PTO"). A valid United States patent gives the patent holder the right to prevent others from making, using, offering to sell, or selling the patented invention within the United States, or from importing it into the United States, during the term of the patent without the patent holder's permission. A violation of the patent holder's rights is called "infringement." The patent holder can try to enforce its patent against persons believed to be infringers by means of a lawsuit filed in federal court.

This case involves three patents that were issued by the PTO which were "assigned" to Caltech. An assignment is the transfer of ownership of a patent application or a patent from one entity or person to another.

The three patents are: (1) Patent No. 7,116,710 issued on October 3, 2006, (2) Patent No. 7,421,032 issued on September 2, 2008, and (3) Patent No. 7,916,781 issued on March 29, 2011. Copies of the three patents are included in the Jury Notebook at Tabs 2, 3 and 4, respectively. Henceforth, the patents will be referred to by their last three digits – for example the 7,116,710 patent will be called the '710 Patent.

A patent and the claims contained in the patent issued by the PTO are presumed to be valid. The validity or invalidity of the three patents herein is not an issue in this case. Your job in this trial is to determine whether Caltech has proved by a preponderance of the evidence that Broadcom and/or Apple infringed any of the claims in Caltech's patents and, if so, the amount of damages to be awarded because of the acts of infringement.

A patent usually has three main parts. The first part will contain informational items such as (but not limited to) the patent number, the date the patent application was filed, the date it was issued, the names of the inventors of the patent, whether the patent has been assigned, a list of other patent documents that the PTO looked at in evaluating the patent application, and a section sometimes called "Other Publications" which sets out books and articles which discuss the technology involved and what was generally known about the specific area at the time of the application. For example, if you look at the '710 Patent at Tab 2 at the pages marked at the bottom as JTX 1-1 and JTX 1-2, that is the first part of that patent.

The second part of a patent is referred to as the "specification" which typically includes: (1) a paragraph entitled "Abstract" which briefly summarizes the invention, (2) a background section that describes the nature of the problem the invention is supposed to solve, (3) one or more drawings called "figures" that assist in delineating the invention and/or illustrate various aspects of the application, and (4) a detailed description of one or more embodiments of the invention. An embodiment is a specific device or method that uses the invention; for example as to Thomas Edison's lightbulb patent, it would be a particular form of a lightbulb. In the '710 patent, the specification section begins at the lower right-hand corner of page JTX 1-1, skips page JTX 1-2, and goes from JTX 1-3 through 1-11. You will notice that starting on page JTX 1-8, there are two columns which are numbered sequentially on each page and there are numbers in the center of each page going from 5 to 65. Those numbers are to assist in locating references; for example in the '710 patent, a reference to column 6 lines 33 through 49 would be to Table 1 on page JTX 1.10.

The third (and most important) part of a patent is a statement of the "claims" in the patent. The claims are what give the public notice of the definitions or boundaries of the invention. They are similar to the description of property you may have seen in a deed, referring to precise measurements taken on the ground. The claims are numbered and appear at the end of the patent document. Each claim constitutes a separate definition of the invention. For example, as to the '710 Patent, there are 33 separate claims numbered from 1 to 33 on page JTX 1-11 starting on Column 7 line 14 and ending on Column 8 line 63.

A claim sets forth, in words, a set of requirements. Each claim sets forth its requirements in a single sentence. If a device or a method satisfies each of these requirements, then it is covered by the claim.

The coverage of a patent is assessed claim-by-claim. In patent law, the requirements of a claim are often referred to as "claim elements" or "claim limitations." When a thing (such as a product or a process) meets all of the requirements of a claim, the claim is said to "cover" that thing, and that thing is said to "fall" within the scope of that claim. In other words, a claim covers a product or process where each of the claim elements or limitations is present in that product or process.

Claims can either be "independent" or "dependent." An "independent claim" sets forth all of the requirements that must be met in order to be covered by that claim. Thus, it is not necessary to look at the language in any other claim to determine what an independent claim covers. In this case, claims 11 and 18 of the '032 patent, and claim 13 of the '781 patent are each independent claims.

Claims 20 and 22 of the '710 patent are "dependent claims." A dependent claim does not itself recite all of the requirements of the claim but refers to another claim for some of its requirements. In this way, the claim "depends" on another claim. A dependent claim incorporates all of the requirements of the claim(s) to which it refers. The dependent claim then adds its own additional requirements. To determine what a dependent claim covers, it is necessary to look at both the dependent claim and any other claim(s) to which it refers. A product or method that meets all of the requirements of both the dependent claim and the claim(s) to which it refers is covered by that dependent claim. Normally, a dependent claim will begin by referencing the earlier claim which it is incorporating. For example, claim 20 of the '710 Patent is a dependent claim because it begins by including "the coder of claim **15**."

## IV. <u>Claims Construction</u>

Before you decide whether Apple and/or Broadcom have infringed any of the asserted claims of the '710, '032, and '781 Patents, you will need to understand the patent claims. As I mentioned at the beginning of the case, the patent claims are the numbered sentences at the end of the patent that describe the boundaries of the patent's protection. It is my job as judge to explain to you the meaning of any language in the claims that needs interpretation.

I have interpreted the meaning of some of the language in the patent claims involved in this case. I handed out a document earlier in this case reflecting those meanings and instructed you to place it in your juror notebook. It should be located at Tab 9 of your juror notebook. You must accept those interpretations as correct.

Those terms and their definitions are as follows:

The Tanner Graph diagram that is claimed in Claims 11 and 18 of the '032 Patent has been construed as "a graph representing an 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 check nodes, randomly connected to the repeated message bits, enforce constraints that determine the parity bits."

The term "random permutation" as it appears in the Tanner Graph in Claims 11 and 18 of the '032 Patent has been construed as "changing the order of data elements by a purely random or pseudo random process."

The term "repeat" as it appears in Claim 15 of the '710 Patent, which is incorporated into Claims 20 and 22 of the '710 Patent, and as it appears in the Court's construction of the Tanner Graph in Claims 11 and 18 of the '032 Patent has been construed as "generation of additional bits, where generation can include, for example, duplication or reuse of bits."

The term "low-density generator matrix coder" as it appears in Claim 20 of the '710 Patent has been construed as "coder that generates output bits, where process of generating output bits comprises multiplying a low-density matrix by input bits, and the output bits outputted by the coder can be less than, equal to, or more than the number of input bits."

The term "irregularly" as it appears in Claim 15 of the '710 Patent, which is incorporated into Claims 20 and 22 of the '710 Patent, has been construed as "a different number of times."

The term "scramble" as it appears in Claim 15 of the '710 Patent, which is incorporated into Claims 20 and 22 of the '710 Patent, and the term "permute" as it appears in Claims 11 and 18 of the '032 Patent, have each been construed as "changing the order of data elements."

The term "sums of bits in subsets of the information bits" as it appears in Claim 13 of the '781 Patent has been construed as "the result(s) of adding together two or more information bits from a subset of information bits."

My interpretation of the language should not be taken as an indication that I have a view regarding the issue of infringement. The decisions regarding infringement are yours to make.

For a claim term for which I have not provided a definition, you should apply the ordinary and customary meaning as understood by a person of ordinary skill in the art at the time of the invention when read in the context of the specification and prosecution history.

In these instructions, when there is a reference to a "person of ordinary skill in the art," the reference is to a person who is working in the technology of the asserted invention at the time of the filing date of the patent. In deciding the level of ordinary skill, you should consider all the evidence introduced at trial, including:

(1) the levels of education and experience of persons working in the field;
(2) the types of problems encountered in the field; and
(3) the sophistication of the technology.

## V. <u>Caltech's Infringement Claims</u>

I will now instruct you concerning patent infringement. Infringement is assessed on a claim-by-claim basis. Therefore, there may be infringement as to one claim but no infringement as to another.

In this case, Caltech has asserted two types of infringement: (1) direct infringement which includes both "literal infringement" and infringement under the "doctrine of equivalents," and (2) active inducement of a third party to infringe the patent(s), sometimes referred to as "indirect infringement." Additionally, Caltech has asserted that certain of the acts of infringement were "willful."

Caltech asserts that Broadcom and Apple have directly infringed Claims 20 and 22 of its '710 Patent, Claims 11 and 18 of its '032 Patent, and Claim 13 of its '781 Patent by making, importing, using selling and/or offering for sale certain products within the United States. As to Apple, the alleged infringing products are Apple's devices which support Wi-Fi (including its iPhones, iPads, iMacs, MacBooks, AppleTV, and Airport Routers) and which incorporate Broadcom's chips (that support Wi-Fi). As to Broadcom, the alleged infringing products are those purportedly infringing chips that support WI-Fi.

Caltech also contends that Broadcom and Apple have actively induced infringement of these claims of Caltech's asserted patents by others.

Broadcom and Apple deny that they have infringed the asserted claims of Caltech's patents.

Your job is to decide whether Caltech has proved by a preponderance of the evidence any of the alleged acts of infringement.

If you decide that any claim(s) of the patent(s) has been infringed, you will then need to decide any money damages to be awarded to Caltech to compensate it for the infringement. You will also need to make a finding as to whether the infringement was "willful." If you decide that any infringement was willful, that decision should not affect any damage award you make. I will take willfulness into account later.

I will now instruct you on the rules you must follow in deciding whether Caltech has proven that either Broadcom or Apple has infringed one or more of the asserted claims of the '710, '032 and/or '781 Patents. To prove infringement of any claim, Caltech must persuade you that it is more likely than not that Apple and/or Broadcom has infringed a particular claim.

A. Direct Infringement

A patent's claims define what is covered by the patent. A party directly infringes a patent if its product or method is covered by at least one claim of the patent.

Deciding whether a claim has been directly infringed is a two-step process. The first step is to decide the meaning of the patent claim. I have already instructed you as to the meaning of certain words and terms in the asserted patent claims.

The second step is to decide whether Apple and/or Broadcom have made, used, sold, offered for sale, or imported within the United States a product covered by Claims 20 or 22 of the '710 Patent, or Claims 11 or 18 of the '032 Patent, or whether Apple and/or Broadcom practice within the United States Claim 13 of the '781 patent.

You, the jury, are to make these decisions. With one exception, you must consider each of the asserted claims of each of the three Patents separately and individually, and decide whether the accused Apple and/or Broadcom products and/or methods infringe that claim.

The one exception to considering claims individually concerns dependent claims. A dependent claim includes all the requirements of the particular independent claim it depends from, plus additional requirements of its own. As a result, if you find that an independent claim is not infringed, you must also find that its dependent claims are not infringed. On the other hand, if you find that an independent claim has been infringed, you must still separately decide whether the additional requirements of its dependent claims have also been infringed.

Whether or not Broadcom or Apple knew its product(s) infringed or even knew of the Caltech's patents does not matter in determining direct infringement. A defendant can directly infringe a patent even though it is unaware that what it is doing amounts to infringement. Further, you heard evidence that the accused products may have been developed through independent research. This is not relevant to the question of whether an accused product infringes. An independently developed product or process that falls within the scope of the asserted patent claims nevertheless infringes. However, independent development can be considered in your determination of whether an infringement was willful.

There are two ways in which a patent claim may be directly infringed. A claim may be "literally" infringed, or it may be infringed under the "doctrine of equivalents." The following instructions will provide more detail on these two types of direct infringement.

1) Literal Infringement

To decide whether Apple's and/or Broadcom's products and/or methods literally infringe Claims 20 and 22 of the '710 Patent, Claims 11 and 18 of the'032 Patent, and/or Claim 13 of the '781 Patent, you must compare the products and methods with the patent claims and determine whether every requirement of the claim is included in the product or method. If so, that product or method literally infringes that claim. If, however, the product or method does not have every requirement in the patent claim, that product or method does not literally infringe the claim. You must decide literal infringement for each asserted claim separately.

In this case, the asserted patent claims use the term "comprising." If the patent claim uses the term "comprising," that patent claim is to be understood as an "open" claim. An open claim may be infringed as long as every requirement in the claim is present in Broadcom's or Apple's product or method. The fact that Broadcom's or Apple's product or method also includes other parts or steps will not avoid infringement, as long as it has every requirement in the patent claim.

2) Infringement under the Doctrine of Equivalents

If you decide that one of Apple's or Broadcom's products or methods does not literally infringe an asserted patent claim, you must then decide whether that product or method infringes the asserted claim under what is called the "doctrine of equivalents."

Under the doctrine of equivalents, the product or method infringes an asserted patent claim if it includes parts or steps that are identical or equivalent to the requirements of the claim. If the product or method is missing an identical or equivalent part or step to even one requirement of the asserted patent claim, the product or method cannot infringe the claim under the doctrine of equivalents. Thus, in making your decision under the doctrine of equivalents, you must look at each individual requirement of the asserted patent claim and decide whether the product or method has either an identical or equivalent part or step to that individual claim requirement.

A part or step of a product or method is equivalent to a requirement of an asserted claim if a person of ordinary skill in the field would think that the differences between the product or method and the requirement were not substantial as of the time of the alleged infringement.

Changes in technique or improvements made possible by technology developed after the patent application is filed may still be equivalent for the purposes of the doctrine of equivalents if it still meets the other requirements of the doctrine of equivalents set forth in this instruction.

One way to decide whether any difference between a requirement of an asserted claim and a part or step of the product or method is not substantial is to consider whether, as of the time of the alleged infringement, the part or step of the product or method performed substantially the same function, in substantially the same way, to achieve substantially the same result as the requirement in the patent claim.

Caltech contends that Broadcom and/or Apple infringe the following claim requirements under the doctrine of equivalents:

- "repeat" and
- "repeat … irregularly"

You may not use the doctrine of equivalents in analyzing infringement for any other claim elements.

3) <u>Sale or Importation within the United States</u>

An alleged infringer is liable for direct infringement of a claim if the patent holder proves by a preponderance of the evidence that the infringer, without the patent holder's authorization, imports, offers to sell, sells, or uses within the United States.

Broadcom and/or Apple may infringe Caltech's asserted patents by agreeing to sell a product or by using a method within the United States covered by a claim of Caltech's Asserted Patents. Sales may be found to have occurred in the United States where a substantial level of sales activity occurs here, even for products manufactured, delivered, and used entirely abroad.

Whether a sale occurs in the United States may depend on facts including where the legal commitment to buy and sell occurred and where other substantial activities of the sales transactions occurred, such as negotiating and contracting. A sale agreed to in the United States can be completed in the United States even though delivery is to be made outside the United States in the future. Also, a sale can occur in the United States based on the "design win" process. In a design win market, the sales are design wins made in the United States where the design of the products or method occurs in the United States and the buyer selects that design in the United States, not a steady flow of discrete product sales outside the United States. The United States sales cycle leading to design wins could also trigger United States sales.

However, if substantial activities of a sales transaction, including the final formation of a contract for sale encompassing all essential terms as well as the delivery and performance under that sales contract occurs entirely outside the United States, then pricing and contracting negotiations in the United States alone do not constitute or transform those extraterritorial activities into a sale within the United States.

B. Inducing Patent Infringement (Indirect Infringement)

Caltech alleges that Broadcom and Apple are each liable for infringement by actively inducing a third party to directly infringe the asserted claims. As with direct infringement, you must determine whether there has been active inducement on a claim-by-claim basis.

In order to be liable for inducing infringement, Broadcom or Apple must have:
(1) intentionally taken action that actually induced direct infringement in the United States;
(2) been aware of Caltech's Asserted Patents; and
(3) known that the acts it was causing would infringe the patent.

If you find that Broadcom (or Apple) was aware of the patent, but believed that the acts it encouraged did not infringe that patent, it cannot be liable for inducement.

In order to establish active inducement of infringement, it is not sufficient that the third party itself directly infringed the claim. Nor is it sufficient that Broadcom or Apple was aware of the act(s) by the third party that allegedly constitute the direct infringement. Rather, in order to find active inducement of infringement, you must find either that Broadcom or Apple specifically intended the third party to infringe the patent, or that Broadcom or Apple believed that there was a high probability that the third party would infringe the patent, but deliberately avoided learning the infringing nature of the third party's acts. The mere fact, if true, that Broadcom or Apple knew or should have known that there was a substantial risk that the third party acts would infringe the patent would not be sufficient for active inducement of infringement.

C. Willful Infringement

In this case, Caltech argues that Broadcom and Apple willfully infringed Caltech's patents *after* this lawsuit had been filed against them.

To prove willful infringement, Caltech must first persuade you that Broadcom or Apple infringed a claim of Caltech's patents. The requirements for proving infringement were discussed in my prior instructions.

In addition, to prove willful infringement of a claim, Caltech must persuade you that it is more likely true than not true that Broadcom or Apple intentionally ignored or recklessly disregarded that claim. You must base your decision on Apple's and Broadcom's knowledge and actions at the time of any infringement occurring after Caltech filed this lawsuit. Evidence that Broadcom or Apple had knowledge of the patent at the time of infringement by itself is not sufficient to show willfulness. Rather, to show willfulness, you must find that Broadcom or Apple engaged in additional conduct evidencing deliberate or reckless disregard of Caltech's patent rights.

In deciding whether Broadcom or Apple willfully infringed, you should consider all of the facts surrounding the infringement including: whether Broadcom or Apple intentionally copied Caltech's patented technology in developing the accused products or methods; whether Broadcom or Apple knew, or should have known, that its conduct involved an unreasonable risk of infringement; and whether Broadcom or Apple had a reasonable belief that at the time of infringement that its products or methods did not infringe the asserted patent.

## VI. Damages

I will instruct you about the measure of damages. By instructing you on damages, I am not suggesting which party should win on any issue. If you find that Apple and/or Broadcom infringed any of the five asserted claims herein (Claims 20 and 22 of the '710 Patent, Claims 11 and 18 of the '032 Patent, and/or Claim 13 of the '781 Patent), you must then determine the amount of money damages to be awarded to Caltech to compensate it for the infringement.

The amount of those damages must be adequate to compensate Caltech for any infringement. A damages award should put the patent holder in approximately the financial position it would have been in had the infringement not occurred, but in no event may the damages award be less than a reasonable royalty. You should keep in mind that the damages you award are meant to compensate the patent holder and not to punish an infringer.

Caltech has the burden to persuade you of the amount of its damages. You should award only those damages that it more likely than not suffered. While Caltech is not required to prove its damages with mathematical precision, it must prove them with reasonable certainty. Caltech is not entitled to damages that are remote or speculative.

In this case, Caltech is seeking a reasonable royalty for all alleged infringement.

A "royalty" is a payment made to a patent holder in exchange for the right to make, use or sell the claimed invention. This right is called a "license." A reasonable royalty is the payment for the license that would have resulted from a hypothetical negotiation between the patent holder and each alleged infringer taking place at the time when the infringing activity first began. In considering the nature of this negotiation, you must assume that both parties would have acted reasonably and would have entered into a license agreement. You must also assume that both parties believed the patent was valid and infringed. Your role is to determine what the result of that negotiation would have been. The test for damages is what royalty would have resulted from the hypothetical negotiation and not simply what either party would have preferred.

A royalty can be calculated in several different ways and it is for you to determine which way is the most appropriate based on the evidence you have heard. You should consider all the facts known and available to the parties at the time the alleged infringement began. Some of the factors you may consider in making your determination are:

(1) The value that the claimed invention contributes to the accused product.

(2) The value that factors other than the claimed invention contribute to the accused product.

(3) The amount that a licensor (such as the patentee) and a licensee (such as the infringer) would have agreed upon (at the time the infringement began) if both had been

reasonably and voluntarily trying to reach an agreement; that is, the amount which a prudent licensee – who desired, as a business proposition, to obtain a license to manufacture and sell a particular article embodying the patented invention – would have been willing to pay as a royalty and yet be able to make a reasonable profit and which amount would have been acceptable by a prudent patentee who was willing to grant a license.

(4) Comparable license agreements, such as those covering the use of the claimed invention or similar technology.

One way to calculate a royalty is to determine what is called an "running royalty." To calculate a running royalty, you must first determine the "base," that is, the quantity of products on which the alleged infringer is to pay royalties. You then need to multiply that base by the royalty rate that you find would have resulted from the hypothetical negotiation.

You may decide that the appropriate royalty that would have resulted from a hypothetical negotiation is a fixed amount per unit sold. If you do, the royalty would be that fixed amount times the number of units sold.

Another way to calculate a royalty is to determine a one-time lump sum payment that the alleged infringer would have paid at the time of the hypothetical negotiation for a license covering all sales of the licensed product, both past and future. This differs from payment of a running royalty because, with a running royalty, the licensee pays based on the number of actual licensed products it sells. When a one-time lump sum is paid, the alleged infringer pays a single price for a license covering both past and future sales.

In this case, the asserted patents are alleged to cover only one component of the product that Broadcom or Apple imports, uses, or sells. It is Caltech's burden to demonstrate what value that component has added to the product as a whole and to separate the value of the patented contribution from the value of other parts of the product that are not attributable to the patented invention. The ultimate combination of royalty base and royalty rate must reflect the value attributable to the allegedly infringing feature of the product, and no more.

It is up to you, based on the evidence, to decide what type of royalty is appropriate in this case.

In determining the amount of damages, you must determine when the damages began. In this case, if you find infringement of either the '710 patent or the '032 patent, damages should be calculated beginning on May 26, 2010. If you find only the '781 patent infringed, damages should be calculated as of the date the patent issued or the date the infringement began, whichever was first.

If you find only induced infringement, damages should be calculated as of the date the lawsuit was filed: May 26, 2016.

## IV. <u>Concluding Instructions</u>

Before you begin your deliberations, elect one member of the jury as your presiding juror. The presiding juror will preside over the deliberations and serve as the spokesperson for the jury in court.

You shall diligently strive to reach agreement with all of the other jurors if you can do so. Your verdict must be unanimous.

Each of you must decide the case for yourself, but you should do so only after you have considered all of the evidence, discussed it fully with the other jurors, and listened to their views.

It is important that you attempt to reach a unanimous verdict but, of course, only if each of you can do so after having made your own conscientious decision. Do not be unwilling to change your opinion if the discussion persuades you that you should. But do not come to a decision simply because other jurors think it is right, or change an honest belief about the weight and effect of the evidence simply to reach a verdict.

Because you must base your verdict only on the evidence received in the case and on these instructions, I remind you that you must not be exposed to any other information about the case or to the issues it involves. Except for discussing the case with your fellow jurors during your deliberations:

Do not communicate with anyone in any way and do not let anyone else communicate with you in any way about the merits of the case or anything to do with it. This includes discussing the case in person, in writing, by phone or electronic means, via email, via text messaging, or any internet chat room, blog, website or application, including but not limited to Facebook, YouTube, Twitter, Instagram, LinkedIn, Snapchat, or any other forms of social media. This applies to communicating with your family members, your employer, the media or press, and the people involved in the trial. If you are asked or approached in any way about your jury service or anything about this case, you must respond that you have been ordered not to discuss the matter and to report the contact to the court.

Do not read, watch, or listen to any news or media accounts or commentary about the case or anything to do with it; do not do any research, such as consulting dictionaries, searching the Internet, or using other reference materials; and do not make any investigation or in any other way try to learn about the case on your own. Do not visit or view any place discussed in this case, and do not use Internet programs or other devices to search for or view any place discussed during the trial. Also, do not do any research about this case, the law, or the people involved—including the parties, the witnesses or the lawyers—until you have been excused as jurors. If you happen to read or hear anything touching on this case in the media, turn away and report it to me as soon as possible.

These rules protect each party's right to have this case decided only on evidence that has been presented here in court. Witnesses here in court take an oath to tell the truth, and the accuracy of their testimony is tested through the trial process. If you do any research or investigation outside the courtroom, or gain any information through improper communications, then your verdict may be influenced by inaccurate, incomplete or misleading information that has not been tested by the trial process. Each of the parties is entitled to a fair trial by an impartial jury, and if you decide the case based on information not presented in court, you will have denied the parties a fair trial. Remember, you have taken an oath to follow the rules, and it is very important that you follow these rules.

A juror who violates these restrictions jeopardizes the fairness of these proceedings. If any juror is exposed to any outside information, please notify the court immediately.

If it becomes necessary during your deliberations to communicate with me, you may send a note through the bailiff, signed by your presiding juror or by one or more members of the jury. No member of the jury should ever attempt to communicate with me except by a signed writing; I will communicate with any member of the jury on anything concerning the case only in writing, or here in open court. If you send out a question, I will consult with the parties before answering it, which may take some time. You may continue your deliberations while waiting for the answer to any question. Remember that you are not to tell anyone – including me – how the jury stands, numerically or otherwise, until after you have reached a unanimous verdict or have been discharged. Do not disclose any vote count in any note to the court.

A verdict form will be prepared for you. Please follow the instructions on the form with care. After you have reached unanimous agreement on a verdict, your foreperson should complete the verdict form according to your deliberations, sign and date it, and advise the clerk or bailiff that you are ready to return to the courtroom.

FILED
CLERK, U.S. DISTRICT COURT
JAN 29 2020
CENTRAL DISTRICT OF CALIFORNIA
BY JG DEPUTY

# UNITED STATES DISTRICT COURT

# CENTRAL DISTRICT OF CALIFORNIA

| | |
|---|---|
| CALIFORNIA INSTITUTE OF TECHNOLOGY,<br><br>Plaintiff,<br><br>v.<br><br>BROADCOM LIMITED AND APPLE, INC.,<br><br>Defendants. | No. CV 16-3714-GW-AGRx<br><br>**JURY VERDICT** |

**CALIFORNIA INSTITUTE OF TECHNOLOGY v. BROADCOM LIMITED and APPLE, INC., Case No. 2:16-cv-3714-GW-(AGRx) – Verdict Form**

## I. INFRINGEMENT

**Question 1:** Has Caltech proven that it is more likely than not that one or both Defendants infringed Claim 20 of the '710 Patent?

As to Broadcom: ✓ YES ___ NO

As to Apple: ✓ YES ___ NO

**Question 2:** Has Caltech proven that it is more likely than not that one or both Defendants infringed Claim 22 of the '710 Patent?

As to Broadcom: ✓ YES ___ NO

As to Apple: ✓ YES ___ NO

**Question 3:** Has Caltech proven that it is more likely than not that one or both Defendants infringed Claim 11 of the '032 Patent?

As to Broadcom: ✓ YES ___ NO

As to Apple: ✓ YES ___ NO

**Question 4:** Has Caltech proven that it is more likely than not that one or both Defendants infringed Claim 18 of the '032 Patent?

As to Broadcom: ✓ YES ___ NO

As to Apple: ✓ YES ___ NO

**Question 5:** Has Caltech proven that it is more likely than not that one or both Defendants infringed Claim 13 of the '781 Patent?

As to Broadcom: ✓ YES ___ NO

As to Apple: ✓ YES ___ NO

**IF YOU ANSWERED "NO" TO QUESTIONS 1-5, THEN DO NOT ANSWER ANY FURTHER QUESTIONS. PLEASE TURN TO THE END OF THE VERDICT FORM, AND SIGN AND DATE THE FORM.**

**If you answered "yes" for Broadcom to any of Questions 1 through 5, please answer Questions 6.**

**Question 6:** Has Caltech proven that it is more likely than not that Broadcom willfully infringed any of the asserted claims of the '710, '032, or '781 Patents after this lawsuit was filed?

____ YES    ✓ NO

**If you answered "yes" for Apple to any of Questions 1 through 5, please answer Question 7.**

**Question 7:** Has Caltech proven that it is more likely than not that Apple willfully infringed any of the asserted claims of the '710, '032, or '781 Patents after this lawsuit was filed?

____ YES    ✓ NO

## II. DAMAGES

**If you answered "yes" for Broadcom to any of Questions 1 through 5, please answer Questions 8 and 9.**

**Question 8:** What amount of damages do you award Caltech for Broadcom's infringement?

Dollar Amount: $ 270,241,171

**Question 9:** Are your awarded damages for Broadcom's infringement based on a running royalty or a lump sum calculation of damages?

☑ Running royalty ***OR*** ☐ Lump sum

**If you answered "yes" for <u>Apple</u> to any of Questions 1 through 5, please answer Questions 10 and 11.**

**<u>Question 10</u>**: What amount of damages do you award Caltech for Apple's infringement?

Dollar Amount: $ 837,801,178

**<u>Question 11</u>**: Are your awarded damages for Apple's infringement based on a running royalty or a lump sum calculation of damages?

☑ Running royalty ***<u>OR</u>*** ☐ Lump sum

## III. <u>SIGNATURE</u>

You have now reached the end of the verdict form and should review it to ensure it accurately reflects your unanimous determinations. The Foreperson should then sign and date the verdict form in the spaces below and notify the Courtroom Deputy that you have reached a verdict. The Foreperson should retain possession of the verdict form and bring it when the jury is brought back into the courtroom.

**PLEASE SIGN AND DATE THIS FORM ON THE LINES PROVIDED BELOW**

01/29/2020 **REDACTED**

Date

# Appx194-240

## CONFIDENTIAL MATERIAL FILED UNDER SEAL REDACTED

# Appx241-251

## CONFIDENTIAL MATERIAL FILED UNDER SEAL REDACTED

JS-6

**UNITED STATES DISTRICT COURT**
**CENTRAL DISTRICT OF CALIFORNIA**

THE CALIFORNIA INSTITUTE OF TECHNOLOGY,

Plaintiff,

vs.

BROADCOM LIMITED, BROADCOM CORPORATION, AVAGO TECHNOLOGIES LIMITED, AND APPLE INC.,

Defendants.

BROADCOM LIMITED, BROADCOM CORPORATION, AVAGO TECHNOLOGIES LIMITED, AND APPLE INC.,

Counterclaim-Plaintiffs,

vs.

THE CALIFORNIA INSTITUTE OF TECHNOLOGY,

Counterclaim-Defendant.

NO. CV 16-3714-GW-AGRx

**JUDGMENT**

Hon. George H. Wu
United States District Judge

This action was tried to a jury beginning on January 14, 2020, in Courtroom 9D of the above-entitled Court, before the Honorable District Court Judge George H. Wu. On January 29, 2020, the jury returned a verdict in favor of Plaintiff the California Institute of Technology ("Caltech" or "Plaintiff") and against Defendants Broadcom Limited, Broadcom Corporation, Avago Technologies Limited (collectively, "Broadcom") and Apple Inc. ("Apple") on all questions except the question of willful infringement. Dkt. 2114 (redacted); Dkt. 2115 (sealed).

**NOW THEREFORE, IT IS ORDERED, ADJUDGED, AND DECREED THAT JUDGMENT IS HEREBY ENTERED IN THIS MATTER AS FOLLOWS:**

1. Broadcom has infringed Claims 20 and 22 of U.S. Patent No. 7,116,710 ("the '710 Patent"); Claims 11 and 18 of U.S. Patent No. 7,421,032 ("the '032 Patent"); and Claim 13 of U.S. Patent No. 7,916,781 ("the '781 Patent").

2. Broadcom has not willfully infringed Claims 20 and 22 of the '710 Patent; Claims 11 and 18 of the '032 Patent; or Claim 13 of the '781 Patent.

3. Apple has infringed Claims 20 and 22 of the '710 Patent; Claims 11 and 18 of the '032 Patent; and Claim 13 of the '781 Patent.

4. Apple has not willfully infringed Claims 20 and 22 of the '710 Patent; Claims 11 and 18 of the '032 Patent; or Claim 13 of the '781 Patent.

5. Claims 20 and 22 of the '710 Patent; Claims 11 and 18 of the '032 Patent; and Claim 13 of the '781 Patent are not invalid under 35 U.S.C. §103; 35 U.S.C. §102; 35 U.S.C. §112; or 35 U.S.C. §101.

6. Judgment is entered against Broadcom and Apple on their counterclaims and/or affirmative defenses of non-infringement; invalidity; laches, waiver, estoppel, unclean hands; inequitable conduct; preclusion; and failure to mark.

7. Caltech shall recover (1) $270,241,171.00 from Broadcom on the jury verdict; (2) $18,004,985.49 in pre-judgment interest on the jury's verdict from

Broadcom; (3) $837,801,178.00 from Apple on the jury verdict; (4) $47,640,650.64 in pre-judgment interest on the jury's verdict from Apple.

8. As provided in 28 U.S.C. § 1961, Caltech shall also recover post-judgment interest, running from the date of this Judgment until the Judgment is paid, on all amounts listed in paragraph 7 above, as well as on any supplemental damages, if awarded, at a rate equal to the weekly average one-year constant maturity Treasury yield as of the week preceding the date of this Judgment, compounded annually.

9. Caltech shall recover an ongoing royalty from both Apple and Broadcom at the rates set by the jury verdict. The Court will determine the products to which this ongoing royalty applies after the anticipated appeal in this action is resolved. Caltech shall also recover post-judgment interest on any ongoing royalties, running from the date of accrual until the Judgment is paid, at a rate equal to the weekly average one-year constant maturity Treasury yield as of the week preceding the date of this Judgment, compounded annually.

10. The Court will resolve the pending request for supplemental damages after the anticipated appeal in this action is resolved.

DATED: August 3, 2020

George H. Wu

HON. GEORGE H. WU
United States District Judge

US007116710B1

(12) **United States Patent**
**Jin et al.**

(10) **Patent No.: US 7,116,710 B1**
(45) **Date of Patent: Oct. 3, 2006**

(54) **SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES**

(75) Inventors: **Hui Jin**, Glen Gardner, NJ (US); **Aamod Khandekar**, Pasadena, CA (US); **Robert J. McEliece**, Pasadena, CA (US)

(73) Assignee: **California Institute of Technology**, Pasadena, CA (US)

( * ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 735 days.

(21) Appl. No.: **09/861,102**

(22) Filed: **May 18, 2001**

**Related U.S. Application Data**

(60) Provisional application No. 60/205,095, filed on May 18, 2000.

(51) **Int. Cl.**
***H04B 1/66*** (2006.01)

(52) **U.S. Cl.** ...................... **375/240**; 375/262; 375/265; 375/341; 341/51; 341/102; 714/752

(58) **Field of Classification Search** ................ 375/259, 375/262, 265, 285, 296, 341, 346, 348; 714/746, 714/752, 755, 756, 786, 792, 794, 795, 796; 341/51, 52, 56, 102, 103
See application file for complete search history.

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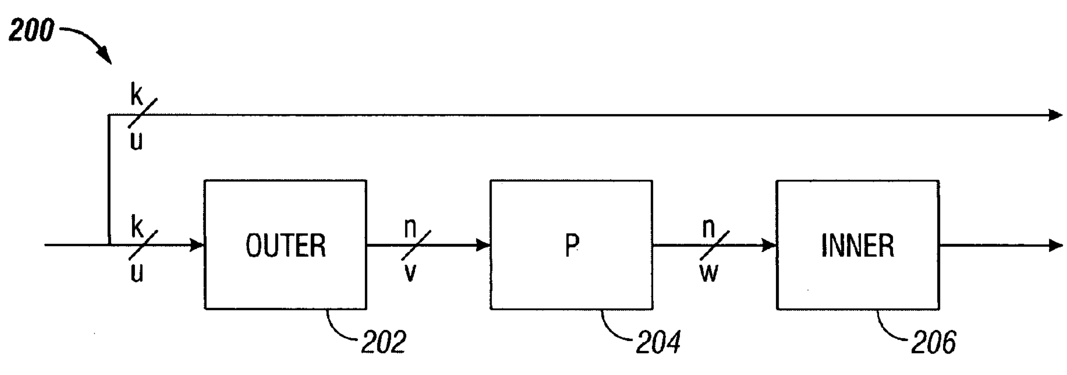
(Continued)


*Primary Examiner*—Dac V. Ha
(74) *Attorney, Agent, or Firm*—Fish & Richardson P.C.

(57) **ABSTRACT**

A serial concatenated coder includes an outer coder and an inner coder. The outer coder irregularly repeats bits in a data block according to a degree profile and scrambles the repeated bits. The scrambled and repeated bits are input to an inner coder, which has a rate substantially close to one.

**33 Claims, 5 Drawing Sheets**



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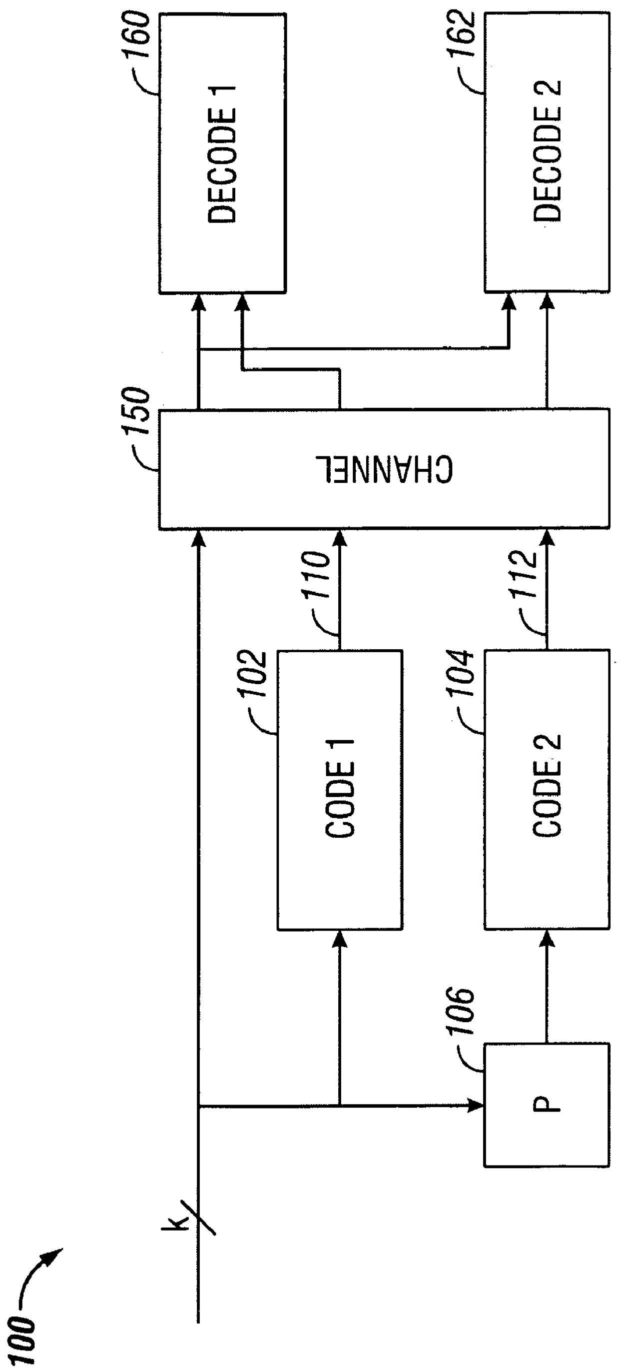


FIG. 1
(Prior Art)

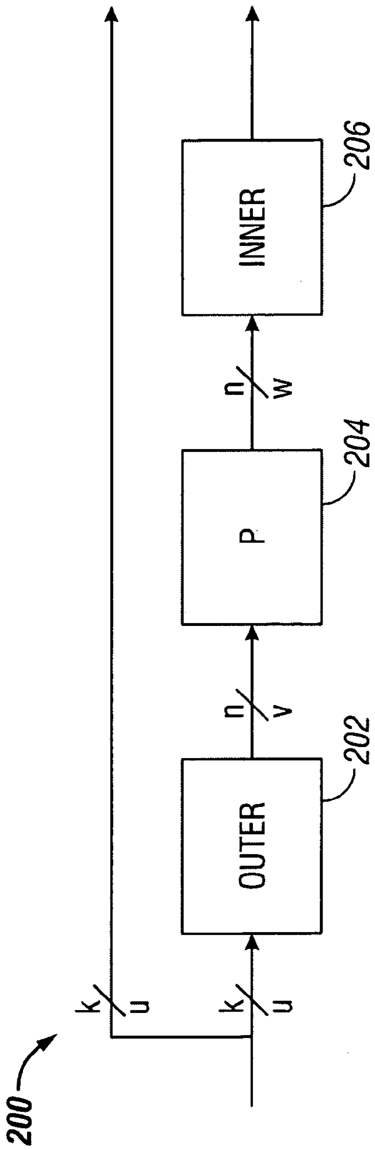


*FIG. 2*

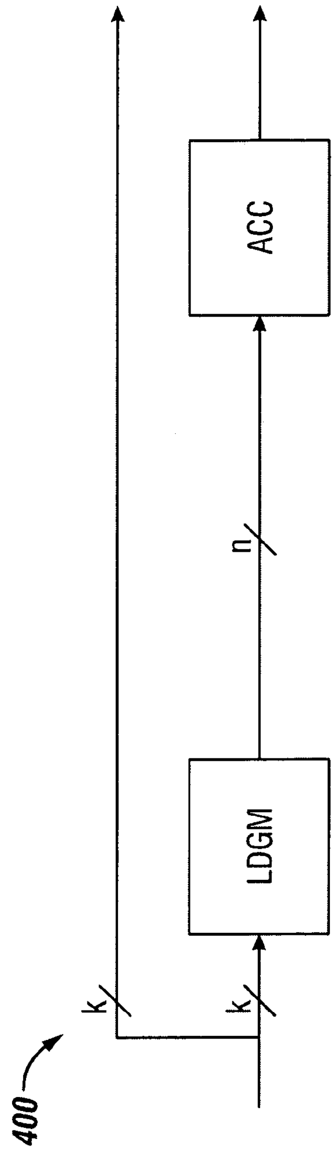


*FIG. 4*

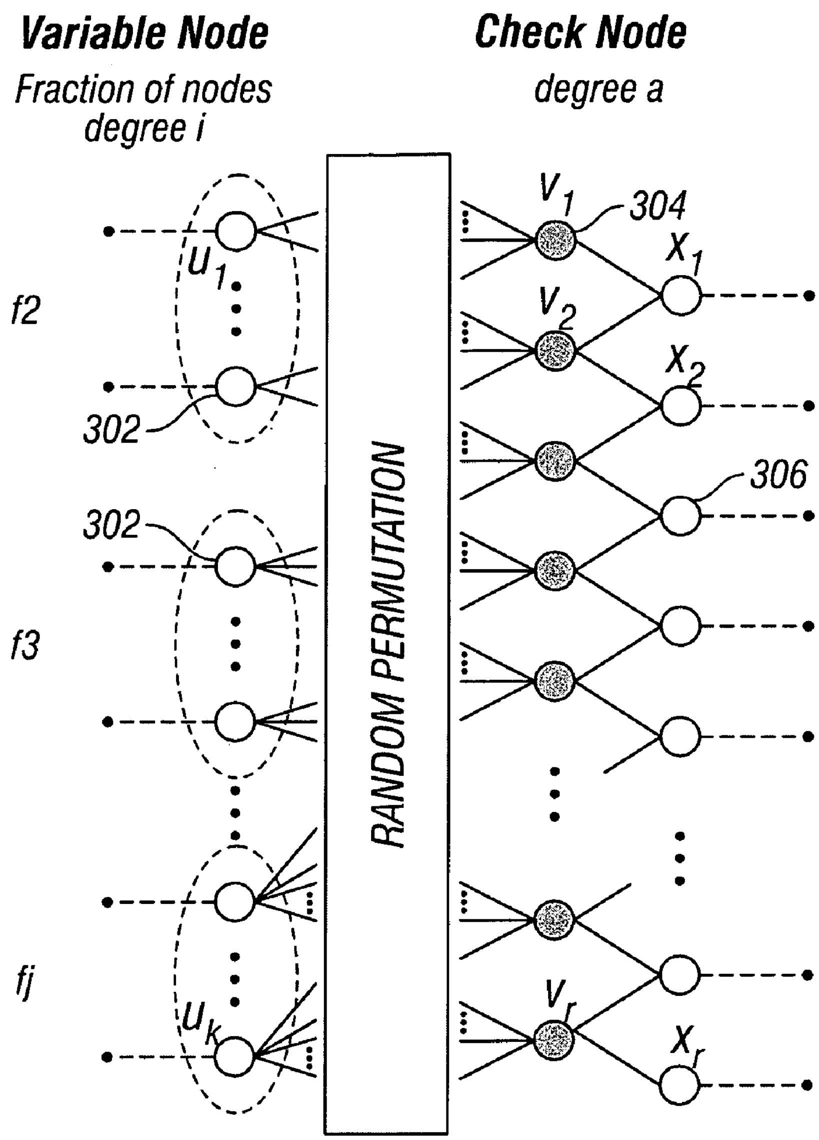
Variable Node
Fraction of nodes degree i
Check Node
degree a
RANDOM PERMUTATION
f2
f3
fj
$U_1$
$U_k$
302
302
$V_1$
304
$X_1$
$V_2$
$X_2$
306
$V_r$
$X_r$

FIG. 3

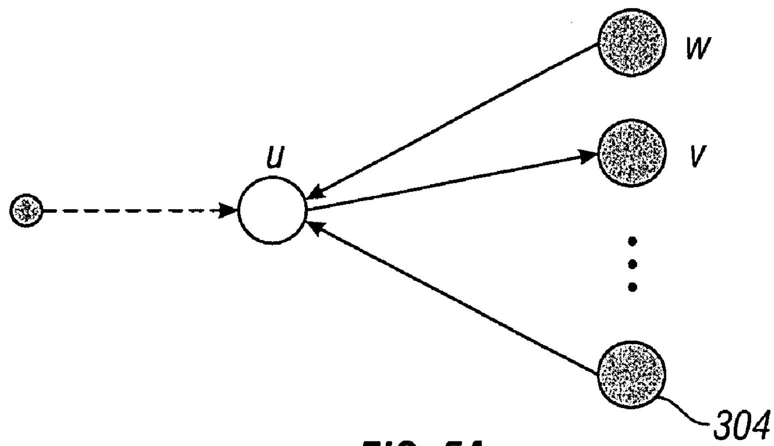


FIG. 5A

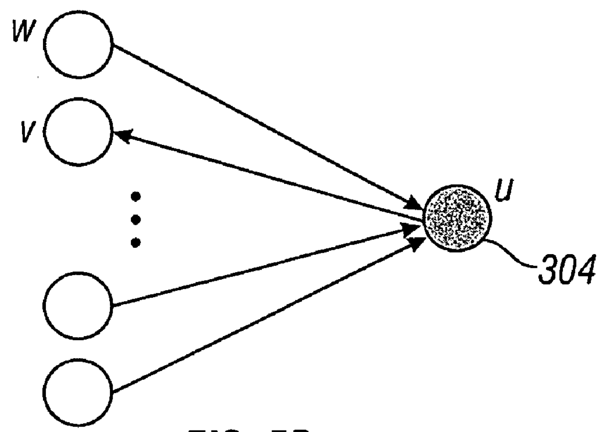


FIG. 5B

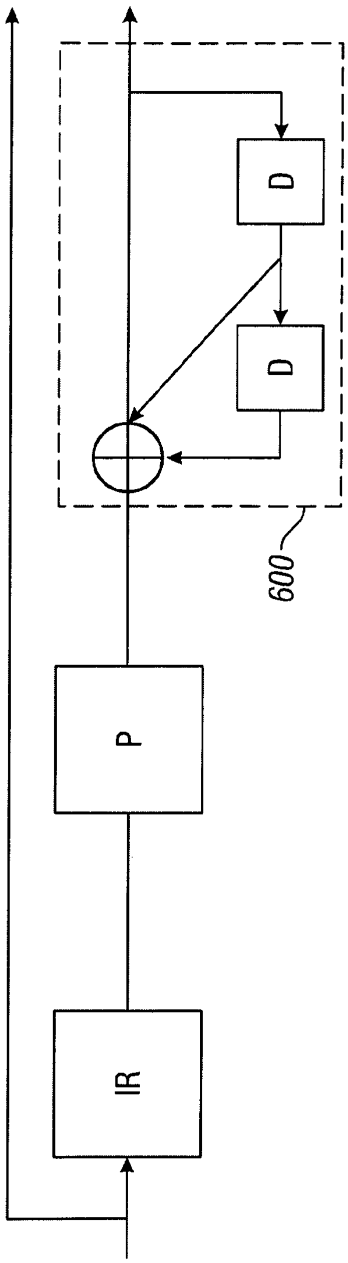


FIG. 6

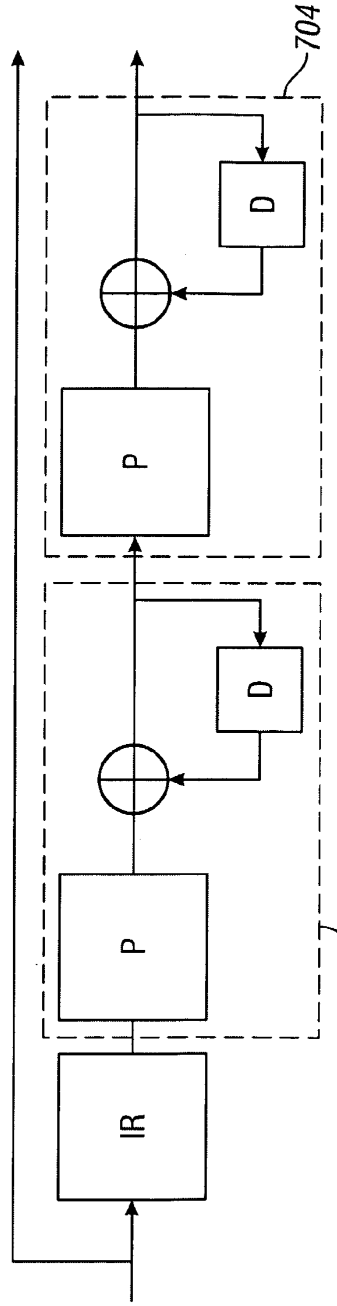


FIG. 7

# SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES

## CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims priority to U.S. Provisional Application Ser. No. 60/205,095, filed on May 18, 2000, and to U.S. application Ser. No. 09/922,852, filed on Aug. 18, 2000 and entitled Interleaved Serial Concatenation Forming Turbo-Like Codes.

## GOVERNMENT LICENSE RIGHTS

The U.S. Government has a paid-up license in this invention and the right in limited circumstances to require the patent owner to license others on reasonable terms as provided for by the terms of Grant No. CCR-9804793 awarded by the National Science Foundation.

## BACKGROUND

Properties of a channel affect the amount of data that can be handled by the channel. The so-called "Shannon limit" defines the theoretical limit of the amount of data that a channel can carry.

Different techniques have been used to increase the data rate that can be handled by a channel. "Near Shannon Limit Error-Correcting Coding and Decoding: Turbo Codes," by Berrou et al. ICC, pp 1064–1070, (1993), described a new "turbo code" technique that has revolutionized the field of error correcting codes. Turbo codes have sufficient randomness to allow reliable communication over the channel at a high data rate near capacity. However, they still retain sufficient structure to allow practical encoding and decoding algorithms. Still, the technique for encoding and decoding turbo codes can be relatively complex.

A standard turbo coder **100** is shown in FIG. **1**. 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.

## SUMMARY

A coding system according to an embodiment is configured to receive a portion of a signal to be encoded, for example, a data block including a fixed number of bits. The coding system includes an outer coder, which repeats and scrambles bits in the data block. The data block is apportioned into two or more sub-blocks, and bits in different sub-blocks are repeated a different number of times according to a selected degree profile. The outer coder may include a repeater with a variable rate and an interleaver. Alternatively, the outer coder may be a low-density generator matrix (LDGM) coder.



The repeated and scrambled bits are input to an inner coder that has a rate substantially close to one. The inner coder may include one or more accumulators that perform recursive modulo two addition operations on the input bit stream.

The encoded data output from the inner coder may be transmitted on a channel and decoded in linear time at a destination using iterative decoding techniques. The decoding techniques may be based on a Tanner graph representation of the code.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic diagram of a prior "turbo code" system.

FIG. **2** is a schematic diagram of a coder according to an embodiment.

FIG. **3** is a Tanner graph for an irregular repeat and accumulate (IRA) coder.

FIG. **4** is a schematic diagram of an IRA coder according to an embodiment.

FIG. **5**A illustrates a message from a variable node to a check node on the Tanner graph of FIG. **3**.

FIG. **5**B illustrates a message from a check node to a variable node on the Tanner graph of FIG. **3**.

FIG. **6** is a schematic diagram of a coder according to an alternate embodiment.

FIG. **7** is a schematic diagram of a coder according to another alternate embodiment.

## DETAILED DESCRIPTION

FIG. **2** illustrates a coder **200** according to an embodiment. The coder **200** may include an outer coder **202**, an interleaver **204**, and inner coder **206**. The coder may be used to format blocks of data for transmission, introducing redundancy into the stream of data to protect the data from loss due to transmission errors. The encoded data may then be decoded at a destination in linear time at rates that may approach the channel capacity.

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 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.

In an embodiment, the inner coder **206** is an accumulator, which produces outputs that are the modulo two (mod-2) partial sums of its inputs. The accumulator may be a truncated rate-1 recursive convolutional coder with the transfer function 1/(1+D). Such an accumulator may be considered a block coder whose input block $[x_1, \ldots, x_n]$ and output block $[y_1, \ldots, y_n]$ are related by the formula

$$y_1=x_1$$

$$y_2=x_1\oplus x_2$$

$$y_3=x_1\oplus x_2\oplus x_3$$

$$y_n=x_1\oplus x_2\oplus x_3\oplus \ldots \oplus x_n.$$

where "$\oplus$" denotes mod-2, or exclusive-OR (XOR), addition. An advantage of this system is that only mod-2 addition is necessary for the accumulator. The accumulator may be embodied using only XOR gates, which may simplify the design.

The bits output from the outer coder **202** are scrambled before they are input to the inner coder **206**. This scrambling may be performed by the interleaver **204**, which performs a pseudo-random permutation of an input block v, yielding an output block w having the same length as v.

The serial concatenation of the interleaved irregular repeat code and the accumulate code produces an irregular repeat and accumulate (IRA) code. An IRA code is a linear code, and as such, may be represented as a set of parity checks. The set of parity checks may be represented in a bipartite graph, called the Tanner graph, of the code. FIG. **3** shows a Tanner graph **300** of an IRA code with parameters $(f_1, \ldots, f_j; a)$, where $f_i \geqq 0$, $\Sigma_i f_i=1$ and "a" is a positive integer. The Tanner graph includes two kinds of nodes: variable nodes (open circles) and check nodes (filled circles). There are k variable nodes **302** on the left, called information nodes. There are r variable nodes **306** on the right, called parity nodes. There are $r=(k\Sigma_i if_i)/a$ check nodes **304** connected between the information nodes and the parity nodes. Each information node **302** is connected to a number of check nodes **304**. The fraction of information nodes connected to exactly i check nodes is $f_i$. For example, in the Tanner graph **300**, each of the $f_2$ information nodes are connected to two check nodes, corresponding to a repeat of q=2, and each of the $f_3$ information nodes are connected to three check nodes, corresponding to q=3.

Each check node **304** is connected to exactly "a" information nodes **302**. In FIG. **3**, a=3. These connections can be made in many ways, as indicated by the arbitrary permutation of the ra edges joining information nodes **302** and check nodes **304** in permutation block **310**. These connections correspond to the scrambling performed by the interleaver **204**.

In an alternate embodiment, the outer coder **202** may be a low-density generator matrix (LDGM) coder that performs an irregular repeat of the k bits in the block, as shown in FIG. **4**. As the name implies, an LDGM code has a sparse (low-density) generator matrix. The IRA code produced by the coder **400** is a serial concatenation of the LDGM code and the accumulator code. The interleaver **204** in FIG. **2** may be excluded due to the randomness already present in the structure of the LDGM code.

If the permutation performed in permutation block **310** is fixed, the Tanner graph represents a binary linear block code with k information bits $(u_1, \ldots, u_k)$ and r parity bits $(x_1, \ldots, x_r)$, as follows. Each of the information bits is associated with one of the information nodes **302**, and each of the parity bits is associated with one of the parity nodes **306**. The value of a parity bit is determined uniquely by the condition that the mod-2 sum of the values of the variable nodes connected to each of the check nodes **304** is zero. To see this, set $x_0=0$. Then if the values of the bits on the ra edges coming out the permutation box are $(v_1, \ldots, v_{ra})$, then we have the recursive formula

$$x_j = x_{j-1} + \sum_{i=1}^{\lambda} v_{(j-1)\lambda+i}$$

for j=1, 2, ..., r. This is in effect the encoding algorithm.

Two types of IRA codes are represented in FIG. **3**, a nonsystematic version and a systematic version. The nonsystematic version is an (r,k) code, in which the codeword corresponding to the information bits $(u_1, \ldots, u_k)$ is $(x_1, \ldots, x_r)$. The systematic version is a (k+r, k) code, in which the codeword is $(u_1, \ldots, u_k; x_1, \ldots, x_r)$.

The rate of the nonsystematic code is

$$R_{nsys} = \frac{a}{\sum_i if_i}$$

The rate of the systematic code is

$$R_{sys} = \frac{a}{a + \sum_i if_i}$$

For example, regular repeat and accumulate (RA) codes can be considered nonsystematic IRA codes with a=1 and exactly one $f_i$ equal to 1, say $f_q=1$, and the rest zero, in which case $R_{nsys}$ simplifies to R=1/q.

The IRA code may be represented using an alternate notation. Let $\lambda_i$ be the fraction of edges between the information nodes **302** and the check nodes **304** that are adjacent to an information node of degree i, and let $\rho_i$ be the fraction of such edges that are adjacent to a check node of degree i+2 (i.e., one that is adjacent to i information nodes). These edge fractions may be used to represent the IRA code rather than the corresponding node fractions. Define $\lambda(x)=\Sigma_i\lambda_i x^{i-1}$ and $\rho(x)=\Sigma_i\rho_i x^{i-1}$ to be the generating functions of these sequences. The pair $(\lambda, \rho)$ is called a degree distribution. For $L(x)=\Sigma_i f_i x_i$,

$$f_i = \frac{\lambda_i / i}{\sum_j \lambda_j / j}$$

$$L(x)=\int_0^x \lambda(t)dt / \int_0^1 \lambda(t)dt$$

The rate of the systematic IRA code given by the degree distribution is given by

$$\text{Rate} = \left(1 + \frac{\sum_j \rho_j / j}{\sum_j \lambda_j / j}\right)^{-1}$$

"Belief propagation" on the Tanner Graph realization may be used to decode IRA codes. Roughly speaking, the belief propagation decoding technique allows the messages passed on an edge to represent posterior densities on the bit associated with the variable node. A probability density on a bit is a pair of non-negative real numbers p(0), p(1) satisfying p(0)+p(1)=1, where p(0) denotes the probability of the bit being 0, p(1) the probability of it being 1. Such a pair can be represented by its log likelihood ratio, m=log(p(0)/p(1)). The outgoing message from a variable node u to a check node v represents information about u, and a message from a check node u to a variable node v represents information about u, as shown in FIGS. **5**A and **5**B, respectively.

The outgoing message from a node u to a node v depends on the incoming messages from all neighbors w of u except v. If u is a variable message node, this outgoing message is

$$m(u \to v) = \sum_{w \neq v} m(w \to u) + m_0(u)$$

where $m_0(u)$ is the log-likelihood message associated with u. If u is a check node, the corresponding formula is

$$\tanh\frac{m(u \to v)}{2} = \prod_{w \neq v} \tanh\frac{m(w \to u)}{2}$$

Before decoding, the messages m(w→u) and m(u→v) are initialized to be zero, and $m_0(u)$ is initialized to be the log-likelihood ratio based on the channel received information. If the channel is memoryless, i.e., each channel output only relies on its input, and y is the output of the channel code bit u, then $m_0(i)=\log(p(u=0|y)/p(u=1|y))$. After this initialization, the decoding process may run in a fully parallel and local manner. In each iteration, every variable/check node receives messages from its neighbors, and sends back updated messages. Decoding is terminated after a fixed number of iterations or detecting that all the constraints are satisfied. Upon termination, the decoder outputs a decoded sequence based on the messages $m(u)=\Sigma w_m(w \to u)$.

Thus, on various channels, iterative decoding only differs in the initial messages $m_0(u)$. For example, consider three memoryless channel models: a binary erasure channel (BEC); a binary symmetric channel (BSC); and an additive white Gaussian noise (AGWN) channel.

In the BEC, there are two inputs and three outputs. When 0 is transmitted, the receiver can receive either 0 or an erasure E. An erasure E output means that the receiver does not know how to demodulate the output. Similarly, when 1 is transmitted, the receiver can receive either 1 or E. Thus, for the BEC, y∈{0, E, 1}, and

$$m_0(u) = \begin{cases} +\infty & \text{if } y = 0 \\ 0 & \text{if } y = E \\ -\infty & \text{if } y = 1 \end{cases}$$

In the BSC, there are two possible inputs (0,1) and two possible outputs (0, 1). The BSC is characterized by a set of conditional probabilities relating all possible outputs to possible inputs. Thus, for the BSC y∈{0, 1},

$$m_0(u) = \begin{cases} \log\frac{1-p}{p} & \text{if } y = 0 \\ -\log\frac{1-p}{p} & \text{if } y = 1 \end{cases}$$

and

In the AWGN, the discrete-time input symbols X take their values in a finite alphabet while channel output symbols Y can take any values along the real line. There is assumed to be no distortion or other effects other than the addition of white Gaussian noise. In an AWGN with a Binary Phase Shift Keying (BPSK) signaling which maps 0 to the symbol with amplitude $\sqrt{Es}$ and 1 to the symbol with amplitude $-\sqrt{Es}$, output y∈R, then

$$m_0(u)=4y\sqrt{E_s}/N_0$$

where $N_0/2$ is the noise power spectral density.

The selection of a degree profile for use in a particular transmission channel is a design parameter, which may be affected by various attributes of the channel. The criteria for selecting a particular degree profile may include, for example, the type of channel and the data rate on the channel. For example, Table 1 shows degree profiles that have been found to produce good results for an AWGN channel model.

TABLE 1

| a | 2 | 3 | 4 |
|---|---|---|---|
| λ2 | 0.139025 | 0.078194 | 0.054485 |
| λ3 | 0.2221555 | 0.128085 | 0.104315 |
| λ5 | | 0.160813 | |
| λ6 | 0.638820 | 0.036178 | 0.126755 |
| λ10 | | | 0.229816 |
| λ11 | | | 0.016484 |
| λ12 | | 0.108828 | |
| λ13 | | 0.487902 | |
| λ14 | | | |
| λ16 | | | |
| λ27 | | | 0.450302 |
| λ28 | | | 0.017842 |
| Rate | 0.333364 | 0.333223 | 0.333218 |
| σGA | 1.1840 | 1.2415 | 1.2615 |
| σ* | 1.1981 | 1.2607 | 1.2780 |
| (Eb/N0) * (dB) | 0.190 | −0.250 | −0.371 |
| S.L. (dB) | −0.4953 | −0.4958 | −0.4958 |

Table 1 shows degree profiles yielding codes of rate approximately ⅓ for the AWGN channel and with a=2, 3, 4. For each sequence, the Gaussian approximation noise threshold, the actual sum-product decoding threshold and the corresponding energy per bit ($E_b$)-noise power ($N_0$) ratio in dB are given. Also listed is the Shannon limit (S.L.).

As the parameter "a" is increased, the performance improves. For example, for a=4, the best code found has an iterative decoding threshold of $E_b/N_0=-0.371$ dB, which is only 0.12 dB above the Shannon limit.

The accumulator component of the coder may be replaced by a "double accumulator" **600** as shown in FIG. **6**. The double accumulator can be viewed as a truncated rate 1 convolutional coder with transfer function $1/(1+D+D^2)$.

Alternatively, a pair of accumulators may be the added, as shown in FIG. **7**. There are three component codes: the "outer" code **700**, the "middle" code **702**, and the "inner" code **704**. The outer code is an irregular repetition code, and the middle and inner codes are both accumulators.

IRA codes may be implemented in a variety of channels, including memoryless channels, such as the BEC, BSC, and AWGN, as well as channels having non-binary input, non-symmetric and fading channels, and/or channels with memory.

A number of embodiments have been described. Nevertheless, it will be understood that various modifications may be made without departing from the spirit and scope of the invention. Accordingly, other embodiments are within the scope of the following claims.

The invention claimed is:

**1**. A method of encoding a signal, comprising:

obtaining a block of data in the signal to be encoded;

partitioning said data block into a plurality of sub-blocks, each sub-block including a plurality of data elements;

first encoding the data block to from a first encoded data block, said first encoding including repeating the data elements in different sub-blocks a different number of times;

interleaving the repeated data elements in the first encoded data block; and

second encoding said first encoded data block using an encoder that has a rate close to one.

**2**. The method of claim **1**, wherein said second encoding is via a rate 1 linear transformation.

**3**. The method of claim **1**, wherein said first encoding is carried out by a first coder with a variable rate less than one, and said second encoding is carried out by a second coder with a rate substantially close to one.

**4**. The method of claim **3**, wherein the second coder comprises an accumulator.

**5**. The method of claim **4**, wherein the data elements comprises bits.

**6**. The method of claim **5**, wherein the first coder comprises a repeater operable to repeat different sub-blocks a different number of times in response to a selected degree profile.

**7**. The method of claim **4**, wherein the first coder comprises a low-density generator matrix coder and the second coder comprises an accumulator.

**8**. The method of claim **1**, wherein the second encoding uses a transfer function of $1/(1+D)$.

**9**. The method of claim **1**, wherein the second encoding uses a transfer function of $1/(1+D+D^2)$.

**10**. The method of claim **1**, wherein said second encoding utilizes two accumulators.

**11**. A method of encoding a signal, comprising:

receiving a block of data in the signal to be encoded, the data block including a plurality of bits;

first encoding the data block such that each bit in the data block is repeated and two or more of said plurality of bits are repeated a different number of times in order to form a first encoded data block; and

second encoding the first encoded data block in such a way that bits in the first encoded data block are accumulated.

**12**. The method of claim **11**, wherein the said second encoding is via a rate 1 linear transformation.

**13**. The method of claim **11**, wherein the first encoding is via a low-density generator matrix transformation.

**14**. The method of claim **11**, wherein the signal to be encoded comprises a plurality of data blocks of fixed size.

**15**. A coder comprising:

a first coder having an input configured to receive a stream of bits, said first coder operative to repeat said stream of bits irregularly and scramble the repeated bits; and

a second coder operative to further encode bits output from the first coder at a rate within 10% of one.

**16**. The coder of claim **15**, wherein the stream of bits includes a data block, and wherein the first coder is operative to apportion said data block into a plurality of sub-blocks and to repeat bits in each sub-block a number of times, wherein bits in different sub-blocks are repeated a different number of times.

**17**. The coder of claim **16**, wherein the second coder comprises a recursive convolutional encoder with a transfer function of $1/(1+D)$.

**18**. The coder of claim **16**, wherein the second coder comprises a recursive convolutional encoder with a transfer function of $1/(1+D+D^2)$.

**19**. The coder of claim **15**, wherein the first coder comprises a repeater having a variable rate and an interleaver.

**20**. The coder of claim **15**, wherein the first coder comprises a low-density generator matrix coder.

**21**. The coder of claim **15**, wherein the second coder comprises a rate 1 linear encoder.

**22**. The coder of claim **21**, wherein the second coder comprises an accumulator.

**23**. The coder of claim **22**, wherein the second coder further comprises a second accumulator.

**24**. The coder of claim **15**, wherein the second coder comprises a coder operative to further encode bits output from the first coder at a rate within 1% of one.

**25**. A coding system comprising:

a first coder having an input configured to receive a stream of bits, said first coder operative to repeat said stream of bits irregularly and scramble the repeated bits;

a second coder operative to further encode bits output from the first coder at a rate within 10% of one in order to form an encoded data stream; and

a decoder operative to receive the encoded data stream and decode the encoded data stream using an iterative decoding technique.

**26**. The coding system of claim **25**, wherein the first coder comprises a repeater operative to receive a data block including a plurality of bits from said stream of bits and to repeat bits in the data block a different number of times according to a selected degree profile.

**27**. The coding system of claim **26**, wherein the first coder comprises an interleaver.

**28**. The coding system of claim **25**, wherein the first coder comprises a low-density generator matrix coder.

**29**. The coding system of claim **25**, wherein the second coder comprises a rate 1 accumulator.

**30**. The coding system of claim **25**, wherein the decoder is operative to decode the encoded data stream using a posterior decoding techniques.

**31**. The coding system of claim **25**, wherein the decoder is operative to decode the encoded data stream based on a Tanner graph representation.

**32**. The coding system of claim **25**, wherein the decoder is operative to decode the encoded data stream in linear time.

**33**. The coding system of claim **25**, wherein the second coder comprises a coder operative to further encode bits output from the first coder at a rate within 1% of one.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

# CERTIFICATE OF CORRECTION

PATENT NO. : 7,116,710 B1 Page 1 of 1
APPLICATION NO. : 09/861102
DATED : October 3, 2006
INVENTOR(S) : Hui Jin, Aamod Khandekar and Robert J. McEliece

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

At column **1**, line **8**, please amend the paragraph as follows:

This application claims the priority [[to]] of U.S. Provisional Application Ser. No. 60/205,095, filed on May 18, 2000, and [[to]] is a continuation-in-part of U.S. application Ser. No. 09/922,852, filed on Aug. 18, 2000 and entitled Interleaved Serial Concatenation Forming Turbo-Like Codes.

Signed and Sealed this

Twenty-second Day of July, 2008

Jon W. Dudas

JON W. DUDAS
*Director of the United States Patent and Trademark Office*

US007421032B2

(12) **United States Patent**
**Jin et al.**

(10) **Patent No.: US 7,421,032 B2**
(45) **Date of Patent: Sep. 2, 2008**

(54) **SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES**

(75) Inventors: **Hui Jin**, Glen Gardner, NJ (US); **Aamod Khandekar**, Pasadena, CA (US); **Robert J. McEliece**, Pasadena, CA (US)

(73) Assignee: **California Institute of Technology**, Pasadena, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **11/542,950**

(22) Filed: **Oct. 3, 2006**

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**Related U.S. Application Data**

(63) Continuation of application No. 09/861,102, filed on May 18, 2001, now Pat. No. 7,116,710, and a continuation-in-part of application No. 09/922,852, filed on Aug. 18, 2000, now Pat. No. 7,089,477.

(60) Provisional application No. 60/205,095, filed on May 18, 2000.

(51) **Int. Cl.**
*H04L 5/12* (2006.01)

(52) **U.S. Cl.** ...................... **375/262**; 375/265; 375/348; 714/755; 714/786; 714/792; 341/52; 341/102

(58) **Field of Classification Search** ................ 375/259, 375/262, 265, 285, 296, 341, 346, 348; 714/746, 714/752, 755, 756, 786, 792, 794–796; 341/51, 341/52, 56, 102, 103
See application file for complete search history.

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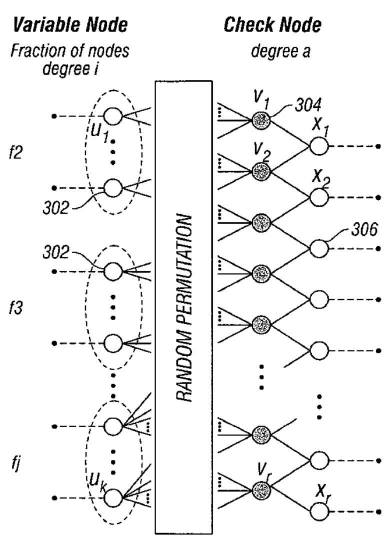
(57) **ABSTRACT**

A serial concatenated coder includes an outer coder and an inner coder. The outer coder irregularly repeats bits in a data block according to a degree profile and scrambles the repeated bits. The scrambled and repeated bits are input to an inner coder, which has a rate substantially close to one.

**23 Claims, 5 Drawing Sheets**



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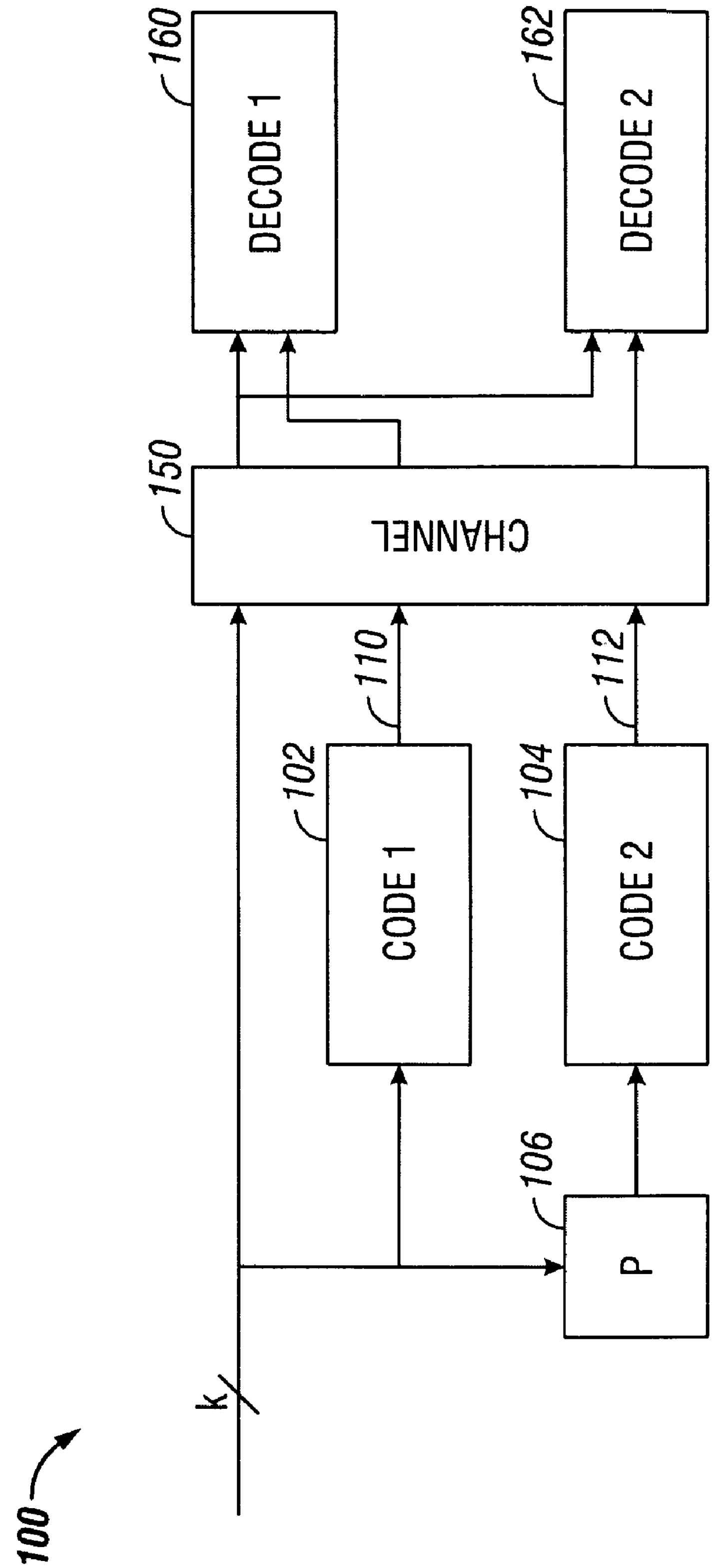



FIG. 1
(Prior Art)

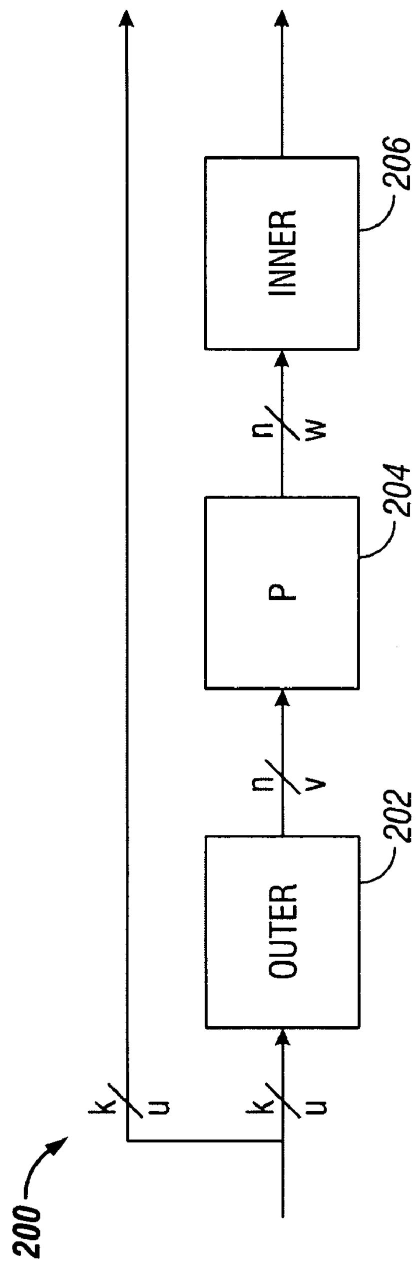



*FIG. 2*

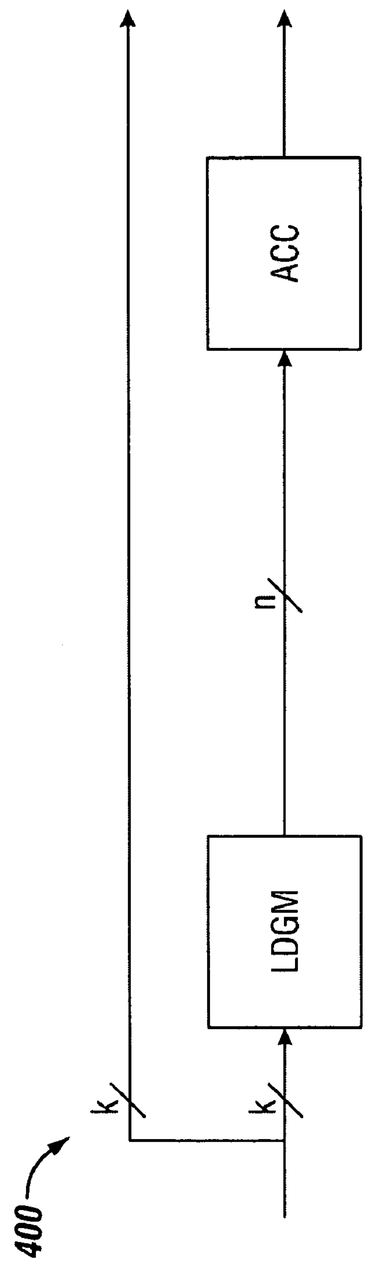



*FIG. 4*

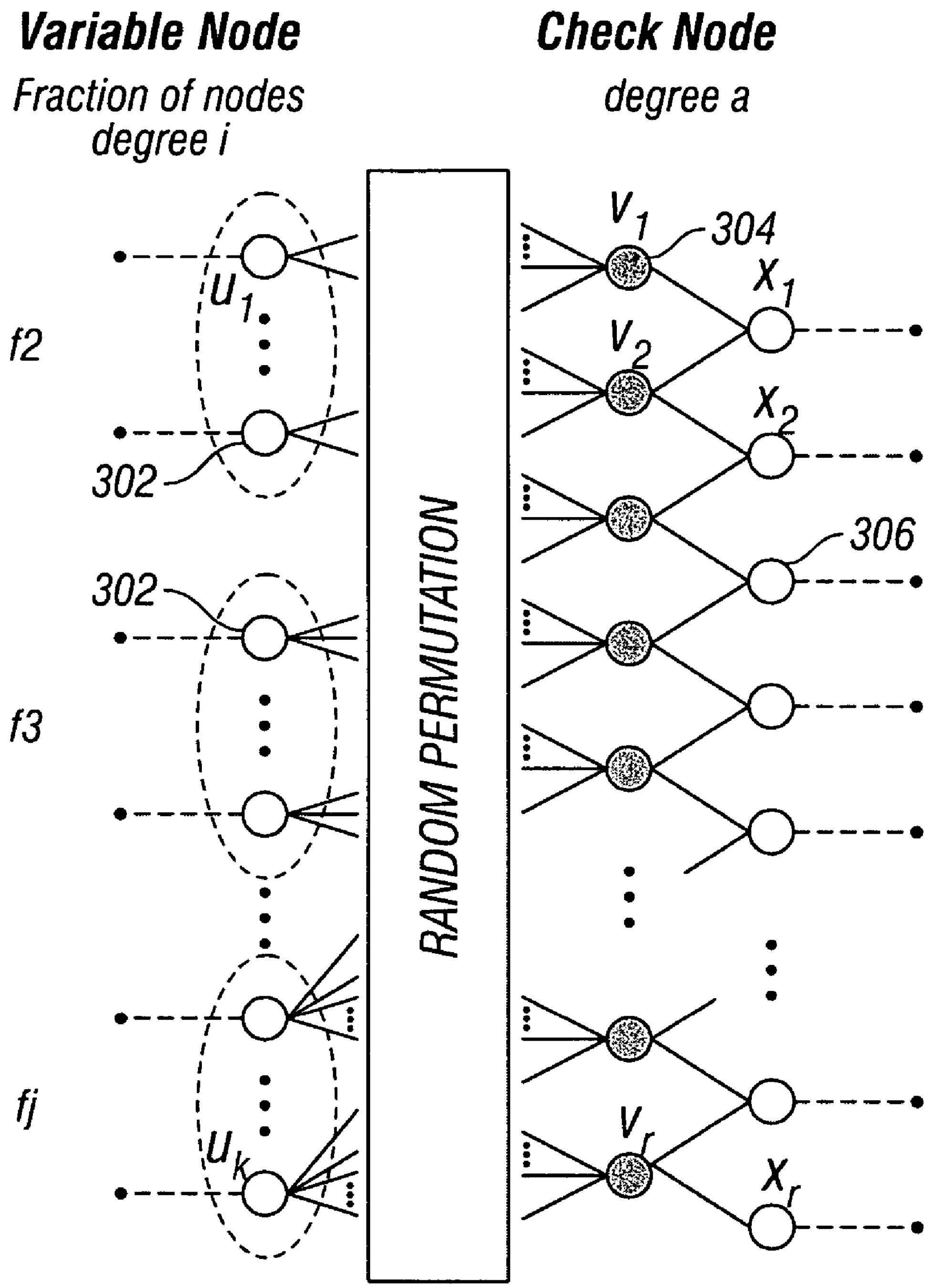

Variable Node
Fraction of nodes degree i
Check Node
degree a
f2
f3
fj
u1
uk
302
302
V1
V2
Vr
304
X1
X2
Xr
306
RANDOM PERMUTATION

FIG. 3

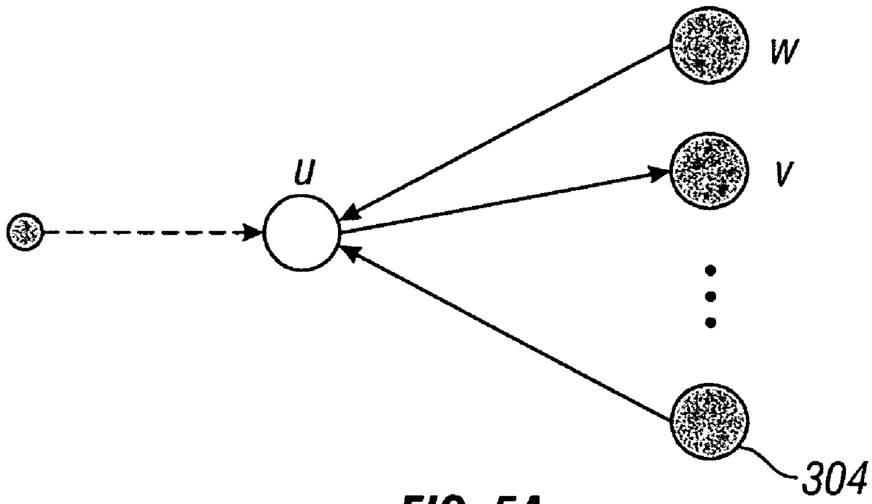



FIG. 5A

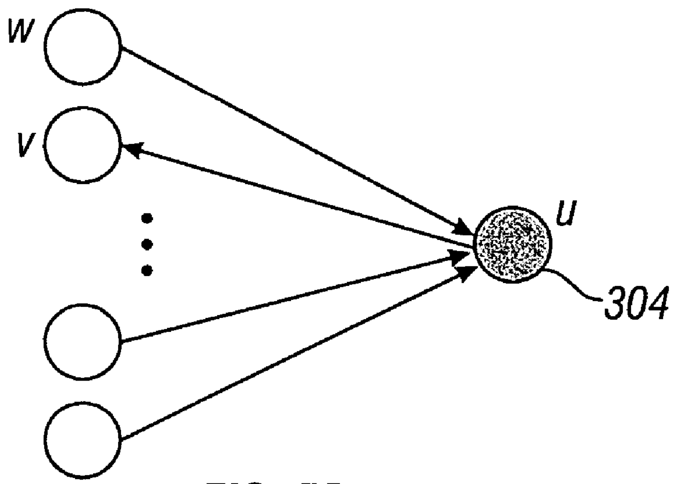



FIG. 5B

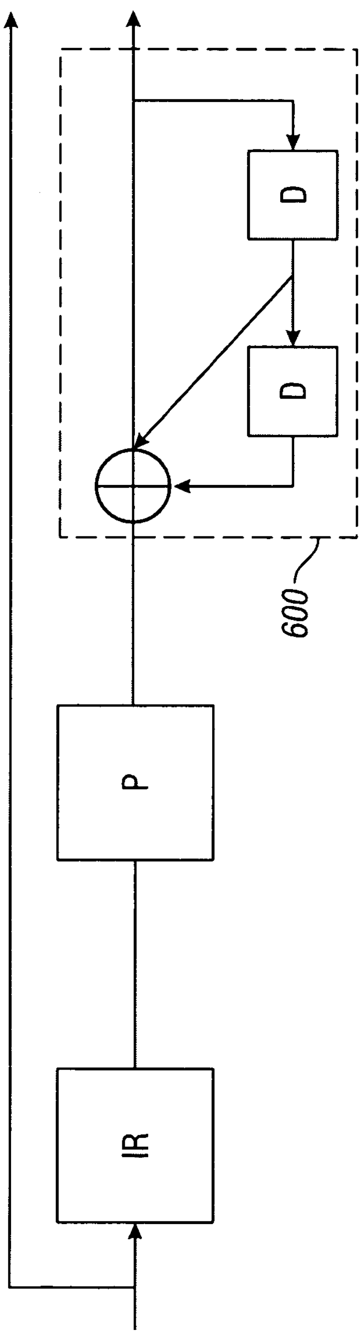



FIG. 6

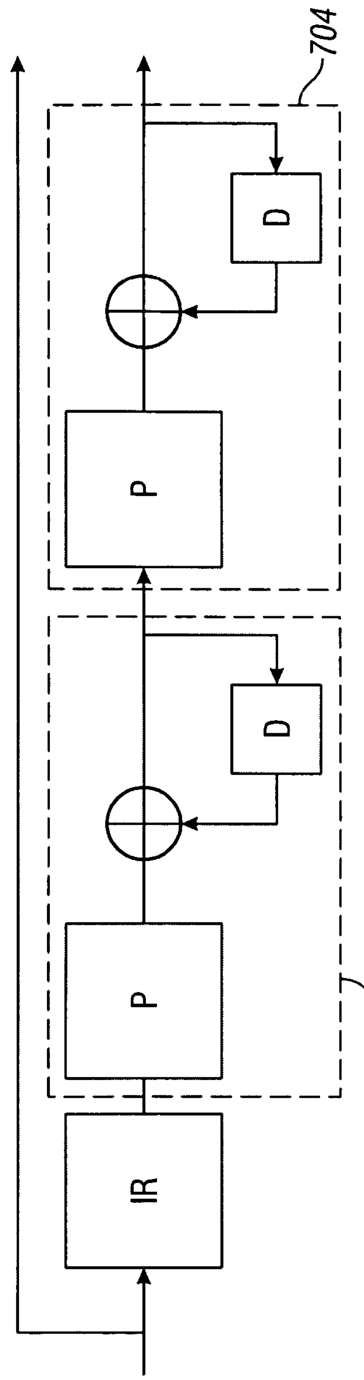



FIG. 7

# SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES

## CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. application Ser. No. 09/861,102, filed May 18, 2001, now U.S. Pat. No. 7,116,710, which claims the priority of U.S. provisional application Ser. No. 60/205,095, filed May 18, 2000, and is a continuation-in-part of U.S. application Ser. No. 09/922,852, filed Aug. 18, 2000, now U.S. Pat. No. 7,089,477.

## GOVERNMENT LICENSE RIGHTS

The U.S. Government has a paid-up license in this invention and the right in limited circumstances to require the patent owner to license others on reasonable terms as provided for by the terms of Grant No. CCR-9804793 awarded by the National Science Foundation.

## BACKGROUND

Properties of a channel affect the amount of data that can be handled by the channel. The so-called "Shannon limit" defines the theoretical limit of the amount of data that a channel can carry.

Different techniques have been used to increase the data rate that can be handled by a channel. "Near Shannon Limit Error-Correcting Coding and Decoding: Turbo Codes," by Berrou et al. ICC, pp 1064-1070, (1993), described a new "turbo code" technique that has revolutionized the field of error correcting codes. Turbo codes have sufficient randomness to allow reliable communication over the channel at a high data rate near capacity. However, they still retain sufficient structure to allow practical encoding and decoding algorithms. Still, the technique for encoding and decoding turbo codes can be relatively complex.

A standard turbo coder **100** is shown in FIG. **1**. 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.

## SUMMARY

A coding system according to an embodiment is configured to receive a portion of a signal to be encoded, for example, a data block including a fixed number of bits. The coding system includes an outer coder, which repeats and scrambles bits in the data block. The data block is apportioned into two or more sub-blocks, and bits in different sub-blocks are repeated a different number of times according to a selected degree profile. The outer coder may include a repeater with a variable rate and an interleaver. Alternatively, the outer coder may be a low-density generator matrix (LDGM) coder.

The repeated and scrambled bits are input to an inner coder that has a rate substantially close to one. The inner coder may include one or more accumulators that perform recursive modulo two addition operations on the input bit stream.

The encoded data output from the inner coder may be transmitted on a channel and decoded in linear time at a destination using iterative decoding techniques. The decoding techniques may be based on a Tanner graph representation of the code.



## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic diagram of a prior "turbo code" system.

FIG. **2** is a schematic diagram of a coder according to an embodiment.

FIG. **3** is a Tanner graph for an irregular repeat and accumulate (IRA) coder.

FIG. **4** is a schematic diagram of an IRA coder according to an embodiment.

FIG. **5**A illustrates a message from a variable node to a check node on the Tanner graph of FIG. **3**.

FIG. **5**B illustrates a message from a check node to a variable node on the Tanner graph of FIG. **3**.

FIG. **6** is a schematic diagram of a coder according to an alternate embodiment.

FIG. **7** is a schematic diagram of a coder according to another alternate embodiment.

## DETAILED DESCRIPTION

FIG. **2** illustrates a coder **200** according to an embodiment. The coder **200** may include an outer coder **202**, an interleaver **204**, and inner coder **206**. The coder may be used to format blocks of data for transmission, introducing redundancy into the stream of data to protect the data from loss due to transmission errors. The encoded data may then be decoded at a destination in linear time at rates that may approach the channel capacity.

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 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.

In an embodiment, the inner coder **206** is an accumulator, which produces outputs that are the modulo two (mod-2) partial sums of its inputs. The accumulator may be a truncated rate-1 recursive convolutional coder with the transfer function 1/(1+D). Such an accumulator may be considered a block coder whose input block $[x_1, \ldots, x_n]$ and output block $[y_1, \ldots, y_n]$ are related by the formula

$$y_1=x_1$$

$$y_2=x_1 \oplus x_2$$

$$y_3=x_1 \oplus x_2 \oplus x_3$$

$$\cdot$$

$$\cdot$$

$$\cdot$$

$$y_n=x_1 \oplus x_2 \oplus x_3 \oplus \ldots \oplus x_n.$$

where "⊕" denotes mod-2, or exclusive-OR (XOR), addition. An advantage of this system is that only mod-2 addition is necessary for the accumulator. The accumulator may be embodied using only XOR gates, which may simplify the design.

The bits output from the outer coder **202** are scrambled before they are input to the inner coder **206**. This scrambling may be performed by the interleaver **204**, which performs a pseudo-random permutation of an input block v, yielding an output block w having the same length as v.

The serial concatenation of the interleaved irregular repeat code and the accumulate code produces an irregular repeat and accumulate (IRA) code. An IRA code is a linear code, and as such, may be represented as a set of parity checks. The set of parity checks may be represented in a bipartite graph, called the Tanner graph, of the code. FIG. **3** shows a Tanner graph **300** of an IRA code with parameters $(f_1, \ldots, f_j; a)$, where $f_i \geqq 0$, $\Sigma_i f_i=1$ and "a" is a positive integer. The Tanner graph includes two kinds of nodes: variable nodes (open circles) and check nodes (filled circles). There are k variable nodes **302** on the left, called information nodes. There are r variable nodes **306** on the right, called parity nodes. There are $r=(k\Sigma_i if_i)/a$ check nodes **304** connected between the information nodes and the parity nodes. Each information node **302** is connected to a number of check nodes **304**. The fraction of information nodes connected to exactly i check nodes is $f_i$. For example, in the Tanner graph **300**, each of the $f_2$ information nodes are connected to two check nodes, corresponding to a repeat of q=2, and each of the $f_3$ information nodes are connected to three check nodes, corresponding to q=3.

Each check node **304** is connected to exactly "a" information nodes **302**. In FIG. **3**, a=3. These connections can be made in many ways, as indicated by the arbitrary permutation of the ra edges joining information nodes **302** and check nodes **304** in permutation block **310**. These connections correspond to the scrambling performed by the interleaver **204**.

In an alternate embodiment, the outer coder **202** may be a low-density generator matrix (LDGM) coder that performs an irregular repeat of the k bits in the block, as shown in FIG. **4**. As the name implies, an LDGM code has a sparse (low-density) generator matrix. The IRA code produced by the coder **400** is a serial concatenation of the LDGM code and the accumulator code. The interleaver **204** in FIG. **2** may be excluded due to the randomness already present in the structure of the LDGM code.

If the permutation performed in permutation block **310** is fixed, the Tanner graph represents a binary linear block code with k information bits $(u_1, \ldots, u_k)$ and r parity bits $(x_1, \ldots, x_r)$, as follows. Each of the information bits is associated with one of the information nodes **302**, and each of the parity bits is associated with one of the parity nodes **306**. The value of a parity bit is determined uniquely by the condition that the mod-2 sum of the values of the variable nodes connected to each of the check nodes **304** is zero. To see this, set $x_0=0$. Then if the values of the bits on the ra edges coming out the permutation box are $(v_1, \ldots, v_{ra})$, then we have the recursive formula

$$x_j = x_{j-1} + \sum_{i=1}^{\lambda} v_{(j-1)\lambda+i}$$

for j=1, 2, . . . , r. This is in effect the encoding algorithm.

Two types of IRA codes are represented in FIG. **3**, a nonsystematic version and a systematic version. The nonsystematic version is an (r,k) code, in which the codeword corresponding to the information bits $(u_1, \ldots, u_k)$ is $(x_1, \ldots, x_r)$. The systematic version is a (k+r, k) code, in which the codeword is $(u_1, \ldots, u_k; x_1, \ldots, x_r)$.

The rate of the nonsystematic code is

$$R_{nsys} = \frac{a}{\sum_i if_i}$$

The rate of the systematic code is

$$R_{sys} = \frac{a}{a + \sum_i if_i}$$

For example, regular repeat and accumulate (RA) codes can be considered nonsystematic IRA codes with a=1 and exactly one $f_i$ equal to 1, say $f_q=1$, and the rest zero, in which case $R_{nsys}$ simplifies to R=1/q.

The IRA code may be represented using an alternate notation. Let $\lambda_i$ be the fraction of edges between the information nodes **302** and the check nodes **304** that are adjacent to an information node of degree i, and let $\rho_i$ be the fraction of such edges that are adjacent to a check node of degree i+2 (i.e., one that is adjacent to i information nodes). These edge fractions may be used to represent the IRA code rather than the corresponding node fractions. Define $\lambda(x)=\Sigma_i\lambda_i x^{i-1}$ and $\rho(x)=\Sigma_i\rho_i x^{i-1}$ to be the generating functions of these sequences. The pair $(\lambda, \rho)$ is called a degree distribution. For $L(x)=\Sigma_i f_i x_i$,

$$f_i = \frac{\lambda_i / i}{\sum_j \lambda_j / j}$$

$$L(x) = \int_0^x \lambda(t)\,dt \Big/ \int_0^1 \lambda(t)\,dt$$

The rate of the systematic IRA code given by the degree distribution is given by

$$\text{Rate} = \left(1 + \frac{\sum_j \rho_j / j}{\sum_j \lambda_j / j}\right)^{-1}$$

"Belief propagation" on the Tanner Graph realization may be used to decode IRA codes. Roughly speaking, the belief propagation decoding technique allows the messages passed on an edge to represent posterior densities on the bit associated with the variable node. A probability density on a bit is a pair of non-negative real numbers p(0), p(1) satisfying p(0)+p(1)=1, where p(0) denotes the probability of the bit being 0, p(1) the probability of it being 1. Such a pair can be represented by its log likelihood ratio, m=log(p(0)/p(1)). The outgoing message from a variable node u to a check node v represents information about u, and a message from a check node u to a variable node v represents information about u, as shown in FIGS. **5**A and **5**B, respectively.

The outgoing message from a node u to a node v depends on the incoming messages from all neighbors w of u except v. If u is a variable message node, this outgoing message is

$$m(u \to v) = \sum_{w \neq v} m(w \to u) + m_0(u)$$

where $m_0(u)$ is the log-likelihood message associated with u. If u is a check node, the corresponding formula is

$$\tanh\frac{m(u \to v)}{2} = \prod_{w \neq v} \tanh\frac{m(w \to u)}{2}$$

Before decoding, the messages m(w→u) and m(u→v) are initialized to be zero, and $m_0(u)$ is initialized to be the log-likelihood ratio based on the channel received information. If the channel is memoryless, i.e., each channel output only relies on its input, and y is the output of the channel code bit u, then $m_0(u)=\log(p(u=0|y)/p(u=1|y))$. After this initialization, the decoding process may run in a fully parallel and local manner. In each iteration, every variable/check node receives messages from its neighbors, and sends back updated messages. Decoding is terminated after a fixed number of iterations or detecting that all the constraints are satisfied. Upon termination, the decoder outputs a decoded sequence based on the messages $m(u)=\Sigma w_m(w \to u)$.

Thus, on various channels, iterative decoding only differs in the initial messages $m_0(u)$. For example, consider three memoryless channel models: a binary erasure channel (BEC); a binary symmetric channel (BSC); and an additive white Gaussian noise (AGWN) channel.

In the BEC, there are two inputs and three outputs. When 0 is transmitted, the receiver can receive either 0 or an erasure E. An erasure E output means that the receiver does not know how to demodulate the output. Similarly, when 1 is transmitted, the receiver can receive either 1 or E. Thus, for the BEC, $y \in \{0, E, 1\}$, and

$$m_0(u) = \begin{cases} +\infty & \text{if } y = 0 \\ 0 & \text{if } y = E \\ -\infty & \text{if } y = 1 \end{cases}$$

In the BSC, there are two possible inputs (0,1) and two possible outputs (0, 1). The BSC is characterized by a set of conditional probabilities relating all possible outputs to possible inputs. Thus, for the BSC $y \in \{0, 1\}$,

$$m_0(u) = \begin{cases} \log\frac{1-p}{p} & \text{if } y = 0 \\ -\log\frac{1-p}{p} & \text{if } y = 1 \end{cases}$$

and

In the AWGN, the discrete-time input symbols X take their values in a finite alphabet while channel output symbols Y can take any values along the real line. There is assumed to be no distortion or other effects other than the addition of white Gaussian noise. In an AWGN with a Binary Phase Shift Keying (BPSK) signaling which maps 0 to the symbol with amplitude $\sqrt{Es}$ and 1 to the symbol with amplitude $-\sqrt{Es}$, output $y \in R$, then

$$m_0(u)=4y\sqrt{E_s}/N_0$$

where $N_0/2$ is the noise power spectral density.

The selection of a degree profile for use in a particular transmission channel is a design parameter, which may be affected by various attributes of the channel. The criteria for selecting a particular degree profile may include, for example, the type of channel and the data rate on the channel. For example, Table 1 shows degree profiles that have been found to produce good results for an AWGN channel model.

TABLE 1

| a | 2 | 3 | 4 |
|---|---|---|---|
| λ2 | 0.139025 | 0.078194 | 0.054485 |
| λ3 | 0.2221555 | 0.128085 | 0.104315 |
| λ5 | | 0.160813 | |
| λ6 | 0.638820 | 0.036178 | 0.126755 |
| λ10 | | | 0.229816 |
| λ11 | | | 0.016484 |
| λ12 | | 0.108828 | |
| λ13 | | 0.487902 | |
| λ14 | | | |
| λ16 | | | |
| λ27 | | | 0.450302 |
| λ28 | | | 0.017842 |
| Rate | 0.333364 | 0.333223 | 0.333218 |
| σGA | 1.1840 | 1.2415 | 1.2615 |
| σ* | 1.1981 | 1.2607 | 1.2780 |
| (Eb/N0) * (dB) | 0.190 | −0.250 | −0.371 |
| S.L. (dB) | −0.4953 | −0.4958 | −0.4958 |

Table 1 shows degree profiles yielding codes of rate approximately ⅓ for the AWGN channel and with a=2, 3, 4. For each sequence, the Gaussian approximation noise threshold, the actual sum-product decoding threshold and the corresponding energy per bit ($E_b$)-noise power ($N_0$) ratio in dB are given. Also listed is the Shannon limit (S.L.).

As the parameter "a" is increased, the performance improves. For example, for a=4, the best code found has an iterative decoding threshold of $E_b/N_0=-0.371$ dB, which is only 0.12 dB above the Shannon limit.

The accumulator component of the coder may be replaced by a "double accumulator" **600** as shown in FIG. **6**. The double accumulator can be viewed as a truncated rate 1 convolutional coder with transfer function $1/(1+D+D^2)$.

Alternatively, a pair of accumulators may be the added, as shown in FIG. **7**. There are three component codes: the "outer" code **700**, the "middle" code **702**, and the "inner" code **704**. The outer code is an irregular repetition code, and the middle and inner codes are both accumulators.

IRA codes may be implemented in a variety of channels, including memoryless channels, such as the BEC, BSC, and AWGN, as well as channels having non-binary input, non-symmetric and fading channels, and/or channels with memory.

A number of embodiments have been described. Nevertheless, it will be understood that various modifications may be made without departing from the spirit and scope of the invention. Accordingly, other embodiments are within the scope of the following claims.

The invention claimed is:

**1**. A method comprising:

receiving a collection of message bits having a first sequence in a source data stream;

generating a sequence of parity bits, wherein each parity bit "$x_j$" in the sequence is in accordance with the formula

$$x_j = x_{j-1} + \sum_{i=1}^{\lambda} v_{(j-1)\lambda+i},$$

where

"$x_{j-1}$" is the value of a parity bit "j−1," and

$$\text{“}\sum_{i=1}^{a} v_{(j-1)a+1}\text{”}$$

is the value of a sum of "a" randomly chosen irregular repeats of the message bits; and

making the sequence of parity bits available for transmission in a transmission data stream.

**2**. The method of claim **1**, wherein the sequence of parity bits is generated is in accordance with "a" being constant.

**3**. The method of claim **1**, wherein the sequence of parity bits is generated is in accordance with "a" varying for different parity bits.

**4**. The method of claim **1**, wherein generating the sequence of parity bits comprises performing recursive modulo two addition operations on the random sequence of bits.

**5**. The method of claim **1**, wherein generating the sequence of parity bits comprises:

generating a random sequence of bits that repeats each of the message bits one or more times with the repeats of the message bits being distributed in a random sequence, wherein different fractions of the message bits are each repeated a different number of times and the number of repeats for each message bit is irregular; and

XOR summing in linear sequential fashion a predecessor parity bit and "a" bits of the random sequence of bits.

**6**. The method of claim **5**, wherein generating the random sequence of bits comprises coding the collection of message bits using a low-density generator matrix (LDGM) coder.

**7**. The method of claim **5**, wherein generating the random sequence of bits comprises:

producing a block of data bits, wherein different message bits are each repeated a different number of times in a sequence that matches the first sequence; and

randomly permuting the different bits to generate the random sequence.

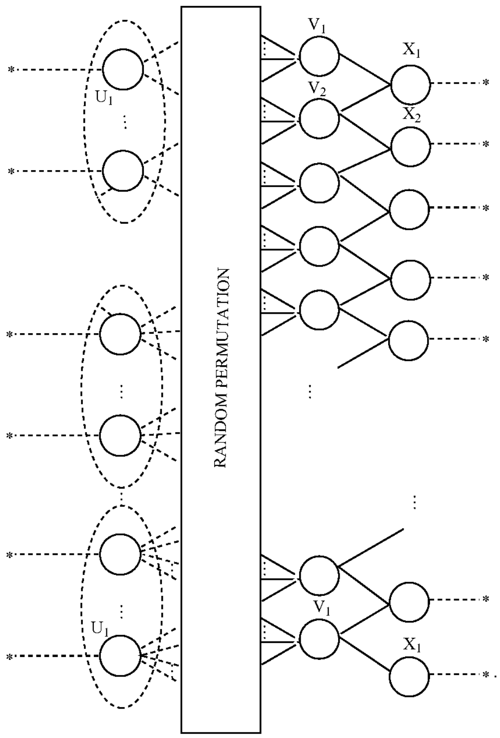
**8**. The method of claim **1**, further comprising transmitting the sequence of parity bits.

**9**. The method of claim **8**, wherein transmitting the sequence of parity bits comprises transmitting the sequence of parity bits as part of a nonsystematic code.

**10**. The method of claim **8**, wherein transmitting the sequence of parity bits comprises transmitting the sequence of parity bits as part of a systematic code.

**11**. A device comprising:

an encoder configured to receive a collection of message bits and encode the message bits to generate a collection of parity bits in accordance with the following Tanner graph:




12. The device of claim 11, wherein the encoder is configured to generate the collection of parity bits as if a number of inputs into nodes $v_i$ was not constant.

13. The device of claim 11, wherein the encoder comprises:

a low-density generator matrix (LDGM) coder configured to perform an irregular repeat on message bits having a first sequence in a source data stream to output a random sequence of repeats of the message bits; and

an accumulator configured to XOR sum in linear sequential fashion a predecessor parity bit and "a" bits of the random sequence of repeats of the message bits.

14. The device of claim 12, wherein the accumulator comprises a recursive convolutional coder.

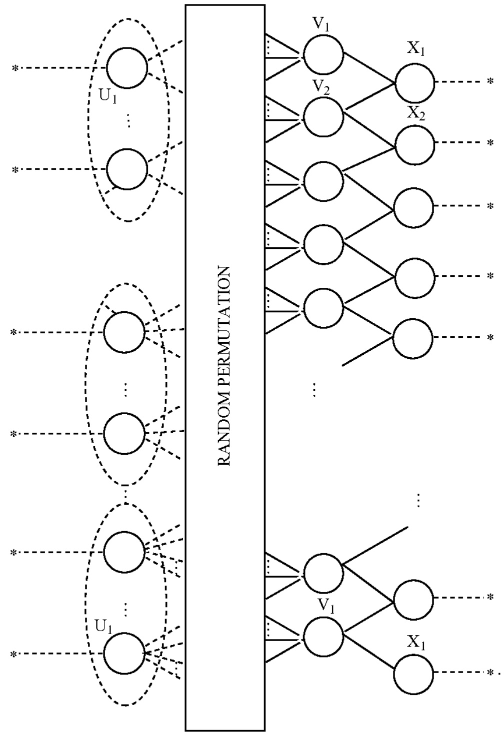
15. The device of claim 14, wherein the recursive convolutional coder comprises a truncated rate-1 recursive convolutional coder.

16. The device of claim 14, wherein the recursive convolutional coder has a transfer function of 1/(1+D).

17. The device of claim 12, further comprising a second accumulator configured to determine a second sequence of parity bits that defines a second condition that constrains the random sequence of repeats of the message bits.

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:




19. The device of claim 18, wherein the message passing decoder is configured to decode the received data stream that includes the message bits.

20. The device of claim 18, wherein the message passing decoder is configured to decode the received data stream as if a number of inputs into nodes $v_i$ was not constant.

21. The device of claim 18, wherein the message passing decoder is configured to decode in linear time at rates that approach a capacity of a channel.

22. The device of claim 18, wherein the message passing decoder comprises a belief propagation decoder.

23. The device of claim 18, wherein the message passing decoder is configured to decode the received data stream without the message bits.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

# CERTIFICATE OF CORRECTION

PATENT NO. : 7,421,032 B2 Page 1 of 1
APPLICATION NO. : 11/542950
DATED : September 2, 2008
INVENTOR(S) : Hui Jin, Aamod Khandekar and Robert J. McEliece

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Title Page, item [73] (Assignee), line 1, please delete "Callifornia" and insert --California--, therefor.

Claim 11, Column 9, line 28, delete "$V_1$" and insert --$V_r$--, therefor.

Claim 11, Column 9, line 29, delete "$U_1$" and insert --$U_k$--, therefor.

Claim 11, Column 9, line 29, delete "$X_1$" and insert --$X_r$--, therefor.

Claim 18, Column 10, line 35, delete "$V_1$" and insert --$V_r$--, therefor.

Claim 18, Column 10, line 36, delete "$U_1$" and insert --$U_k$--, therefor.

Claim 18, Column 10, line 37, delete "$X_1$" and insert --$X_r$--, therefor.

Signed and Sealed this

Seventeenth Day of February, 2009

John Doll

JOHN DOLL
*Acting Director of the United States Patent and Trademark Office*

UNITED STATES PATENT AND TRADEMARK OFFICE

# CERTIFICATE OF CORRECTION

PATENT NO. : 7,421,032 B2 Page 1 of 1
APPLICATION NO. : 11/542950
DATED : September 2, 2008
INVENTOR(S) : Hui Jin, Aamod Khandekar and Robert J. McEliece

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

At column 4, line 14, please delete " $x_j = x_{j-1} + \sum_{i=1}^{\lambda} v_{(j-1)\lambda+i}$ " and insert

-- $x_j = x_{j-1} + \sum_{i=1}^{a} v_{(j-1)a+i}$ --.

In claim 1, column 8, line 4, please delete " $x_j = x_{j-1} + \sum_{i=1}^{\lambda} v_{(j-1)\lambda+i}$ , " and insert

-- $x_j = x_{j-1} + \sum_{i=1}^{a} v_{(j-1)a+i}$ , --.

In claim 1, column 8, line 13, please delete " $\sum_{i=1}^{a} v_{(j-1)a+1}$ " and insert

-- $\sum_{i=1}^{a} v_{(j-1)a+i}$ --.

Signed and Sealed this

Twenty-seventh Day of July, 2010

David J. Kappos

David J. Kappos
*Director of the United States Patent and Trademark Office*

US007916781B2

(12) **United States Patent**
**Jin et al.**

(10) **Patent No.: US 7,916,781 B2**
(45) **Date of Patent: Mar. 29, 2011**

(54) **SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES**


(75) Inventors: **Hui Jin**, Glen Gardner, NJ (US); **Aamod Khandekar**, Pasadena, CA (US); **Robert J. McEliece**, Pasadena, CA (US)

(73) Assignee: **California Institute of Technology**, Pasadena, CA (US)



( * ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 424 days.

(21) Appl. No.: **12/165,606**

(22) Filed: **Jun. 30, 2008**

(65) **Prior Publication Data**

US 2008/0294964 A1 Nov. 27, 2008

**Related U.S. Application Data**

(63) Continuation of application No. 11/542,950, filed on Oct. 3, 2006, now Pat. No. 7,421,032, which is a continuation of application No. 09/861,102, filed on May 18, 2001, now Pat. No. 7,116,710, which is a continuation-in-part of application No. 09/922,852, filed on Aug. 18, 2000, now Pat. No. 7,089,477.

(60) Provisional application No. 60/205,095, filed on May 18, 2000.

(51) **Int. Cl.**
***H04B 1/66*** (2006.01)

(52) **U.S. Cl.** ........ **375/240**; 375/285; 375/296; 714/801; 714/804

(58) **Field of Classification Search** .................. 375/240, 375/240.24, 254, 285, 295, 296, 260; 714/755, 714/758, 800, 801, 804, 805
See application file for complete search history.



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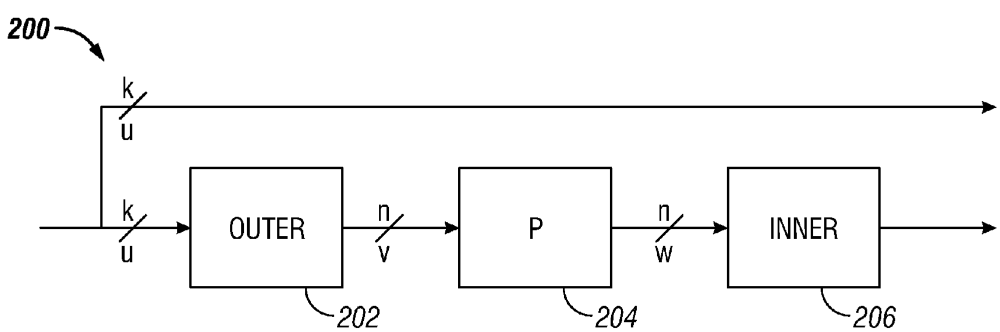
*Primary Examiner* — Dac V Ha
(74) *Attorney, Agent, or Firm* — Perkins Coie LLP

(57) **ABSTRACT**


A serial concatenated coder includes an outer coder and an inner coder. The outer coder irregularly repeats bits in a data block according to a degree profile and scrambles the repeated bits. The scrambled and repeated bits are input to an inner coder, which has a rate substantially close to one.


**22 Claims, 5 Drawing Sheets**



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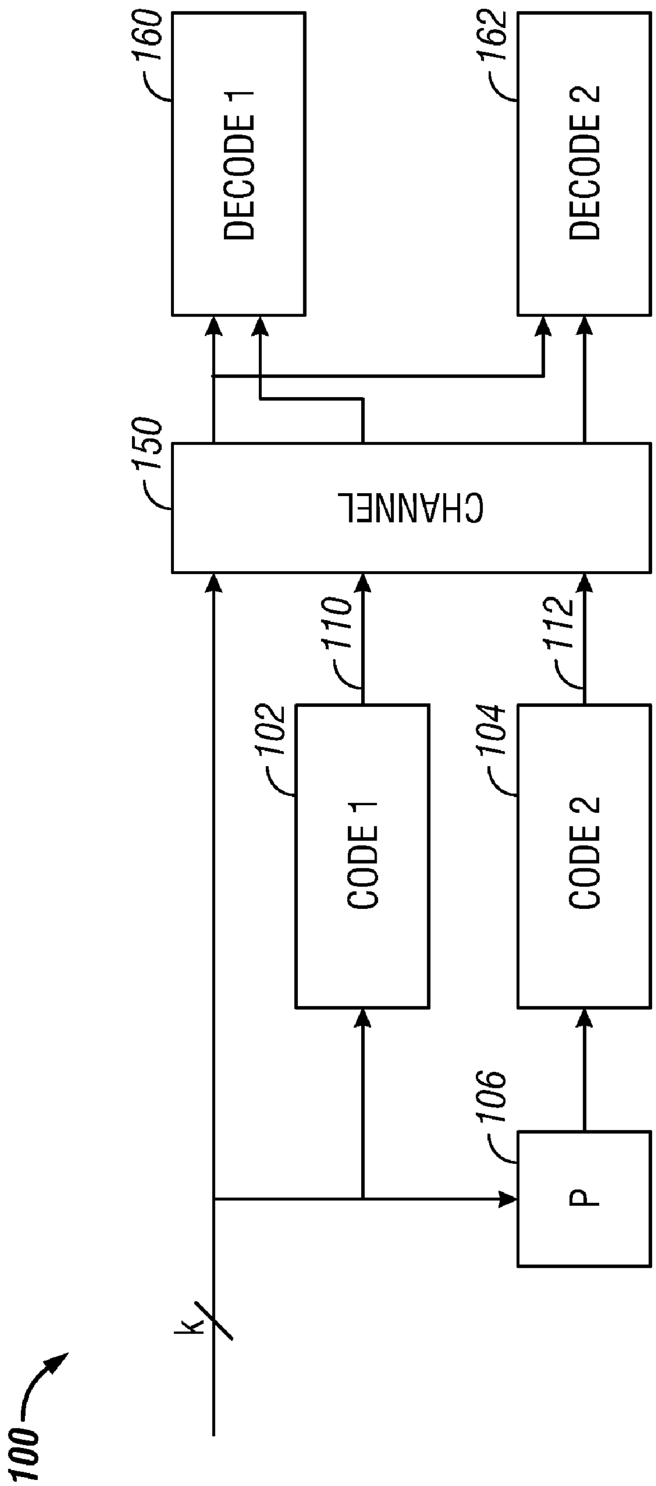


**FIG. 1**
**(Prior Art)**

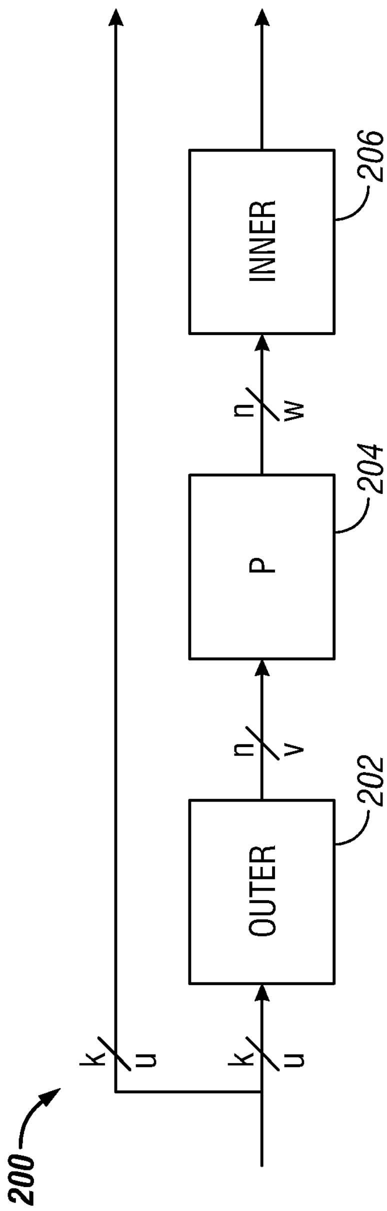


FIG. 2

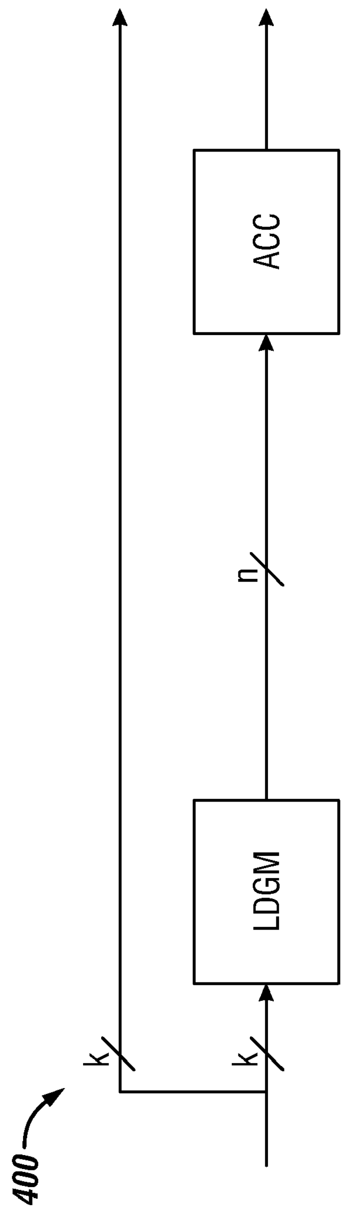


FIG. 4

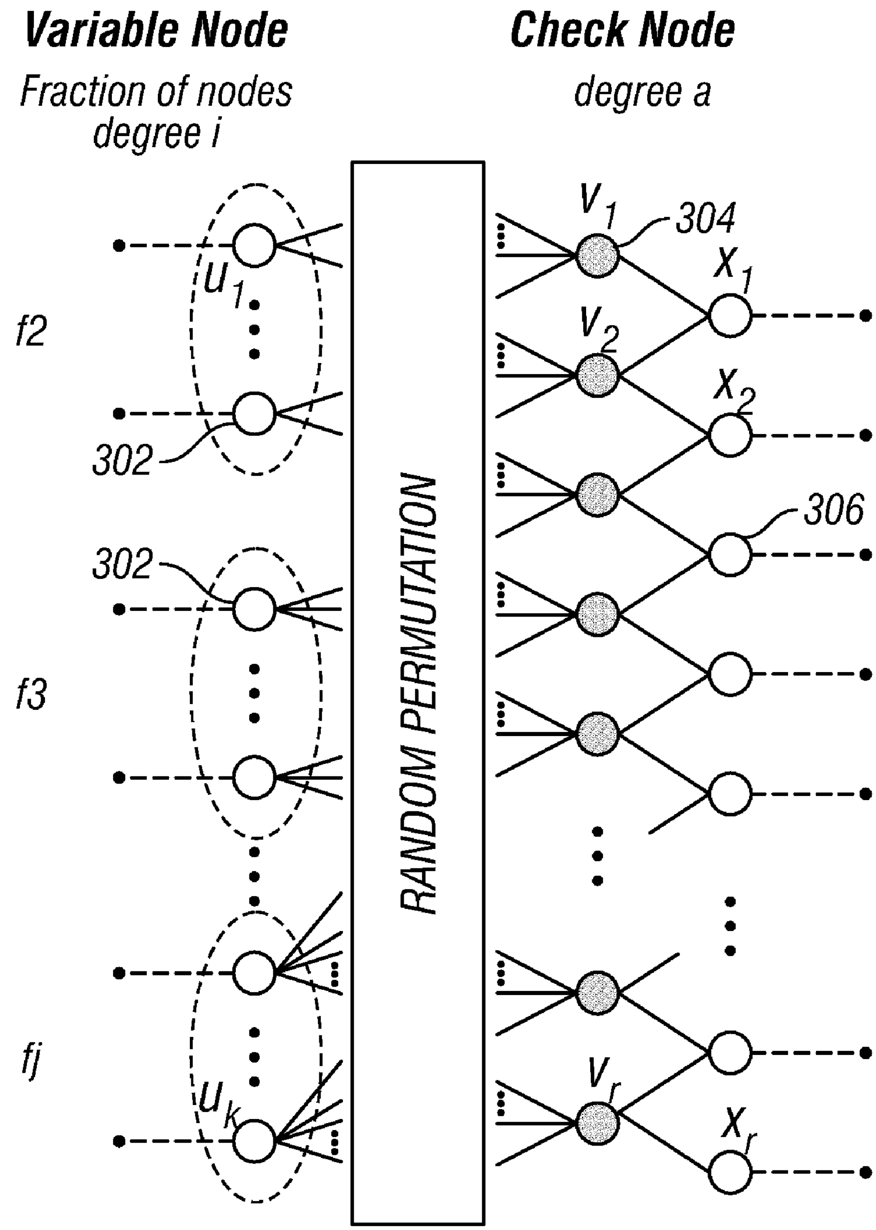
Variable Node
Fraction of nodes degree i
Check Node
degree a
f2
f3
fj
$u_1$
$u_k$
302
302
RANDOM PERMUTATION
$v_1$
$v_2$
$v_r$
304
$x_1$
$x_2$
$x_r$
306

FIG. 3

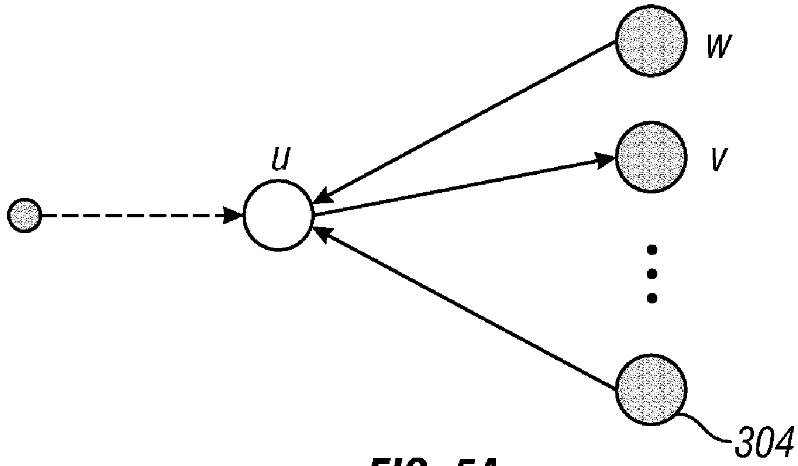


FIG. 5A

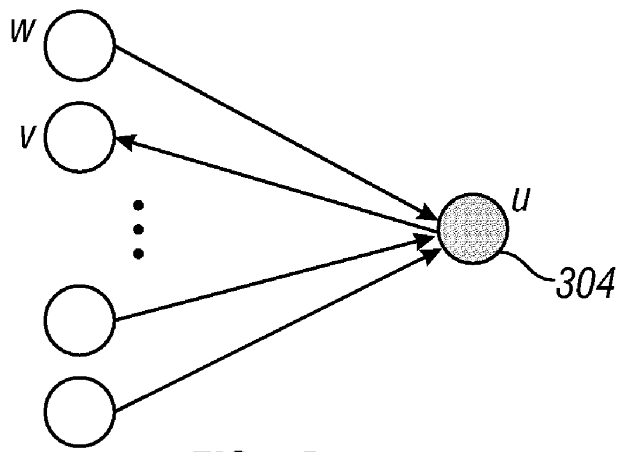


FIG. 5B

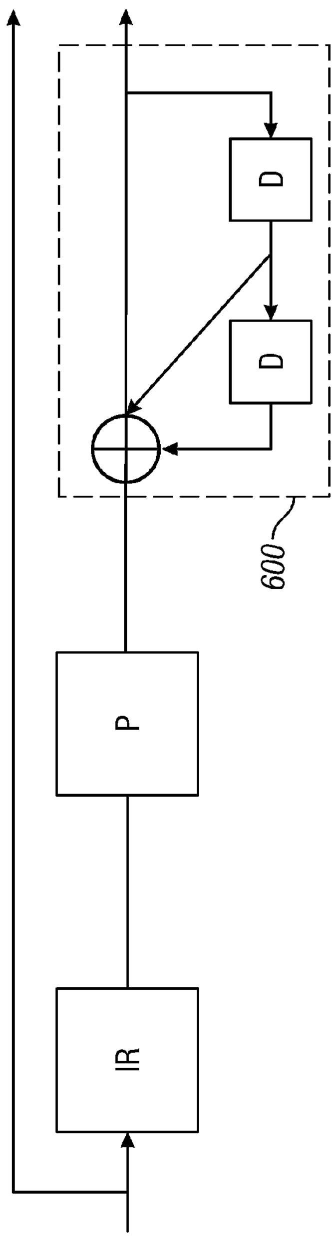


FIG. 6

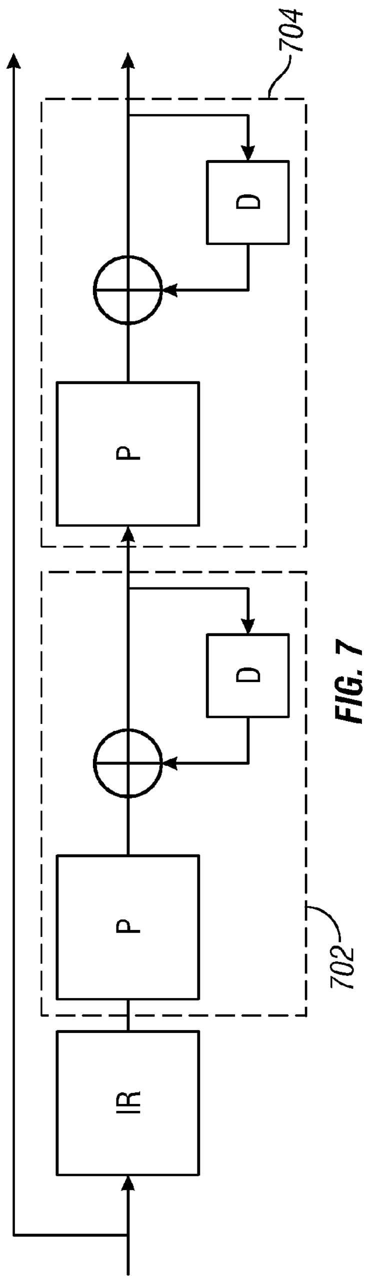


FIG. 7

# SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES

## CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. application Ser. No. 11/542,950, filed Oct. 3, 2006 now U.S. Pat. No. 7,421,032, which is a continuation of U.S. application Ser. No. 09/861,102, filed May 18, 2001, now U.S. Pat. No. 7,116,710, which claims the priority of U.S. Provisional Application Ser. No. 60/205,095, filed May 18, 2000, and is a continuation-in-part of U.S. application Ser. No. 09/922,852, filed Aug. 18, 2000, now U.S. Pat. No. 7,089,477. The disclosure of the prior applications are considered part of (and are incorporated by reference in) the disclosure of this application.

## GOVERNMENT LICENSE RIGHTS

The U.S. Government has a paid-up license in this invention and the right in limited circumstances to require the patent owner to license others on reasonable terms as provided for by the terms of Grant No. CCR-9804793 awarded by the National Science Foundation.

## BACKGROUND

Properties of a channel affect the amount of data that can be handled by the channel. The so-called "Shannon limit" defines the theoretical limit of the amount of data that a channel can carry.

Different techniques have been used to increase the data rate that can be handled by a channel. "Near Shannon Limit Error-Correcting Coding and Decoding: Turbo Codes," by Berrou et al. ICC, pp 1064-1070, (1993), described a new "turbo code" technique that has revolutionized the field of error correcting codes. Turbo codes have sufficient randomness to allow reliable communication over the channel at a high data rate near capacity. However, they still retain sufficient structure to allow practical encoding and decoding algorithms. Still, the technique for encoding and decoding turbo codes can be relatively complex.

A standard turbo coder **100** is shown in FIG. **1**. 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.

## SUMMARY

A coding system according to an embodiment is configured to receive a portion of a signal to be encoded, for example, a data block including a fixed number of bits. The coding system includes an outer coder, which repeats and scrambles bits in the data block. The data block is apportioned into two or more sub-blocks, and bits in different sub-blocks are repeated a different number of times according to a selected degree profile. The outer coder may include a repeater with a variable rate and an interleaver. Alternatively, the outer coder may be a low-density generator matrix (LDGM) coder.

The repeated and scrambled bits are input to an inner coder that has a rate substantially close to one. The inner coder may include one or more accumulators that perform recursive modulo two addition operations on the input bit stream.

The encoded data output from the inner coder may be transmitted on a channel and decoded in linear time at a destination using iterative decoding techniques. The decoding techniques may be based on a Tanner graph representation of the code.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic diagram of a prior "turbo code" system.

FIG. **2** is a schematic diagram of a coder according to an embodiment.

FIG. **3** is a Tanner graph for an irregular repeat and accumulate (IRA) coder.

FIG. **4** is a schematic diagram of an IRA coder according to an embodiment.

FIG. **5**A illustrates a message from a variable node to a check node on the Tanner graph of FIG. **3**.

FIG. **5**B illustrates a message from a check node to a variable node on the Tanner graph of FIG. **3**.

FIG. **6** is a schematic diagram of a coder according to an alternate embodiment.

FIG. **7** is a schematic diagram of a coder according to another alternate embodiment.

## DETAILED DESCRIPTION

FIG. **2** illustrates a coder **200** according to an embodiment. The coder **200** may include an outer coder **202**, an interleaver **204**, and inner coder **206**. The coder may be used to format blocks of data for transmission, introducing redundancy into the stream of data to protect the data from loss due to transmission errors. The encoded data may then be decoded at a destination in linear time at rates that may approach the channel capacity.

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 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.

In an embodiment, the inner coder **206** is an accumulator, which produces outputs that are the modulo two (mod-2) partial sums of its inputs. The accumulator may be a truncated rate-1 recursive convolutional coder with the transfer function 1/(1+D). Such an accumulator may be considered a block coder whose input block $[x_1, \ldots, x_n]$ and output block $[y_1, \ldots, y_n]$ are related by the formula

$$y_1=x_1$$

$$y_2=x_1 \oplus x_2$$

$$y_3=x_1 \oplus x_2 \oplus x_3$$

$$\vdots$$

$$y_n=x_1 \oplus x_2 \oplus x_3 \oplus \ldots \oplus x_n$$

where "⊕" denotes mod-2, or exclusive-OR (XOR), addition. An advantage of this system is that only mod-2 addition is necessary for the accumulator. The accumulator may be embodied using only XOR gates, which may simplify the design.

The bits output from the outer coder **202** are scrambled before they are input to the inner coder **206**. This scrambling may be performed by the interleaver **204**, which performs a pseudo-random permutation of an input block v, yielding an output block w having the same length as v.

The serial concatenation of the interleaved irregular repeat code and the accumulate code produces an irregular repeat and accumulate (IRA) code. An IRA code is a linear code, and as such, may be represented as a set of parity checks. The set of parity checks may be represented in a bipartite graph, called the Tanner graph, of the code. FIG. **3** shows a Tanner graph **300** of an IRA code with parameters $(f_1, \ldots, f_j; a)$, where $f_i \geqq 0$, $\Sigma_i f_i=1$ and "a" is a positive integer. The Tanner graph includes two kinds of nodes: variable nodes (open circles) and check nodes (filled circles). There are k variable nodes **302** on the left, called information nodes. There are r variable nodes **306** on the right, called parity nodes. There are $r=(k\Sigma_i if_i)/a$ check nodes **304** connected between the information nodes and the parity nodes. Each information node **302** is connected to a number of check nodes **304**. The fraction of information nodes connected to exactly i check nodes is $f_i$. For example, in the Tanner graph **300**, each of the $f_2$ information nodes are connected to two check nodes, corresponding to a repeat of q=2, and each of the $f_3$ information nodes are connected to three check nodes, corresponding to q=3.

Each check node **304** is connected to exactly "a" information nodes **302**. In FIG. **3**, a=3. These connections can be made in many ways, as indicated by the arbitrary permutation of the ra edges joining information nodes **302** and check nodes **304** in permutation block **310**. These connections correspond to the scrambling performed by the interleaver **204**.

In an alternate embodiment, the outer coder **202** may be a low-density generator matrix (LDGM) coder that performs an irregular repeat of the k bits in the block, as shown in FIG. **4**. As the name implies, an LDGM code has a sparse (low-density) generator matrix. The IRA code produced by the coder **400** is a serial concatenation of the LDGM code and the accumulator code. The interleaver **204** in FIG. **2** may be excluded due to the randomness already present in the structure of the LDGM code.

If the permutation performed in permutation block **310** is fixed, the Tanner graph represents a binary linear block code with k information bits $(u_1, \ldots, u_k)$ and r parity bits $(x_1, \ldots, x_r)$, as follows. Each of the information bits is associated with one of the information nodes **302**, and each of the parity bits is associated with one of the parity nodes **306**. The value of a parity bit is determined uniquely by the condition that the mod-2 sum of the values of the variable nodes connected to each of the check nodes **304** is zero. To see this, set $x_0=0$. Then if the values of the bits on the ra edges coming out the permutation box are

$$x_j = x_{j-1} + \sum_{i=1}^{a} v_{(j-1)a+i}$$

$(V_1, \ldots, v_{ra})$, then we have the recursive formula for j=1, 2, . . . , r. This is in effect the encoding algorithm.

Two types of IRA codes are represented in FIG. **3**, a nonsystematic version and a systematic version. The nonsystematic version is an (r,k) code, in which the codeword corresponding to the information bits $(u_1, \ldots, u_k)$ is $(x_1, \ldots, x_r)$. The systematic version is a (k+r, k) code, in which the codeword is $(u_1, \ldots, u_k; x_1, \ldots, x_4$.

The rate of the nonsystematic code is

$$R_{nsys} = \frac{a}{\sum_i if_i}$$

The rate of the systematic code is

$$R_{sys} = \frac{a}{a + \sum_i if_i}$$

For example, regular repeat and accumulate (RA) codes can be considered nonsystematic IRA codes with a=1 and exactly one $f_i$ equal to 1, say $f_q=1$, and the rest zero, in which case $R_{nsys}$ simplifies to R=1/q.

The IRA code may be represented using an alternate notation. Let $\lambda_i$ be the fraction of edges between the information nodes **302** and the check nodes **304** that are adjacent to an information node of degree i, and let $\rho_i$ be the fraction of such edges that are adjacent to a check node of degree i+2 (i.e., one that is adjacent to i information nodes). These edge fractions may be used to represent the IRA code rather than the corresponding node fractions. Define $\lambda(x)=\Sigma_i\lambda_i x^{i-1}$ and $\rho(x)=\Sigma_i\rho_i x^{i-1}$ to be

$$f_i = \frac{\lambda_i / i}{\sum_j \lambda_j / j}$$

the generating functions of these sequences. The pair $(\lambda, \rho)$ is called a degree distribution. For $L(x)=\Sigma_i f_i x_i$, The rate of the systematic IRA code given by the

$$L(x) = \int_0^x \lambda(t)\,dt \Big/ \int_0^1 \lambda(t)\,dt$$

$$\text{Rate} = \left(1 + \frac{\sum_j \rho_j / j}{\sum_j \lambda_j / j}\right)^{-1}$$

degree distribution is given by

"Belief propagation" on the Tanner Graph realization may be used to decode IRA codes. Roughly speaking, the belief propagation decoding technique allows the messages passed on an edge to represent posterior densities on the bit associated with the variable node. A probability density on a bit is a pair of non-negative real numbers p(0), p(1) satisfying p(0)+p(1)=1, where p(0) denotes the probability of the bit being 0, p(1) the probability of it being 1. Such a pair can be represented by its log likelihood ratio, m=log(p(0)/p(1)). The outgoing message from a variable node u to a check node v represents information about u, and a message from a check node u to a variable node v represents information about u, as shown in FIGS. **5**A and **5**B, respectively.

The outgoing message from a node u to a node v depends on the incoming messages from all neighbors w of u except v. If u is a variable message node, this outgoing message is

$$m(u \to v) = \sum_{w \neq v} m(w \to u) + m_0(u)$$

where $m_0(u)$ is the log-likelihood message associated with u. If u is a check node, the corresponding formula is

$$\tanh\frac{m(u \to v)}{2} = \prod_{w \neq v} \tanh\frac{m(w \to u)}{2}$$

Before decoding, the messages m(w→u) and m(u→v) are initialized to be zero, and $m_0(u)$ is initialized to be the log-likelihood ratio based on the channel received information. If the channel is memoryless, i.e., each channel output only relies on its input, and y is the output of the channel code bit u, then $m_0(u)=\log(p(u=0|y)/p(u=1|y))$. After this initialization, the decoding process may run in a fully parallel and local manner. In each iteration, every variable/check node receives messages from its neighbors, and sends back updated messages. Decoding is terminated after a fixed number of iterations or detecting that all the constraints are satisfied. Upon termination, the decoder outputs a decoded sequence based on the messages

$$m(u) = \sum w_m(w \to u).$$

Thus, on various channels, iterative decoding only differs in the initial messages $m_0(u)$. For example, consider three memoryless channel models: a binary erasure channel (BEC); a binary symmetric channel (BSC); and an additive white Gaussian noise (AGWN) channel.

In the BEC, there are two inputs and three outputs. When 0 is transmitted, the receiver can receive either 0 or an erasure E. An erasure E output means that the receiver does not know how to demodulate the output. Similarly, when 1 is transmitted, the receiver can receive either 1 or E. Thus, for the BEC, y∈{0, E, 1}, and

$$m_0(u) = \begin{cases} +\infty & \text{if } y = 0 \\ 0 & \text{if } y = E \\ -\infty & \text{if } y = 1 \end{cases}$$

In the BSC, there are two possible inputs (0,1) and two possible outputs (0, 1). The BSC is characterized by a set of conditional probabilities relating all possible outputs to possible inputs. Thus, for the BSC y∈{0, 1},

$$m_0(u) = \begin{cases} \log\frac{1-p}{p} & \text{if } y = 0 \\ -\log\frac{1-p}{p} & \text{if } y = 1 \end{cases}$$

In the AWGN, the discrete-time input symbols X take their values in a finite alphabet while channel output symbols Y can take any values along the real line. There is assumed to be no distortion or other effects other than the addition of white Gaussian noise. In an AWGN with a Binary Phase Shift Keying (BPSK) signaling which maps 0 to the symbol with amplitude $\sqrt{Es}$ and 1 to the symbol with amplitude $-\sqrt{Es}$, output y∈R, then

$$m_0(u)=4y\sqrt{E_s}/N_0$$

where $N_0/2$ is the noise power spectral density.

The selection of a degree profile for use in a particular transmission channel is a design parameter, which may be affected by various attributes of the channel. The criteria for selecting a particular degree profile may include, for example, the type of channel and the data rate on the channel. For example, Table 1 shows degree profiles that have been found to produce good results for an AWGN channel model.

TABLE 1

| a | 2 | 3 | 4 |
|---|---|---|---|
| λ2 | 0.139025 | 0.078194 | 0.054485 |
| λ3 | 0.2221555 | 0.128085 | 0.104315 |
| λ5 | | 0.160813 | |
| λ6 | 0.638820 | 0.036178 | 0.126755 |
| λ10 | | | 0.229816 |
| λ11 | | | 0.016484 |
| λ12 | | 0.108828 | |
| λ13 | | 0.487902 | |
| λ14 | | | |
| λ16 | | | |
| λ27 | | | 0.450302 |
| λ28 | | | 0.017842 |
| Rate | 0.333364 | 0.333223 | 0.333218 |
| σGA | 1.1840 | 1.2415 | 1.2615 |
| σ* | 1.1981 | 1.2607 | 1.2780 |
| (Eb/N0) * (dB) | 0.190 | −0.250 | −0.371 |
| S.L. (dB) | −0.4953 | −0.4958 | −0.4958 |

Table 1 shows degree profiles yielding codes of rate approximately 1/3 for the AWGN channel and with a=2, 3, 4. For each sequence, the Gaussian approximation noise threshold, the actual sum-product decoding threshold and the corresponding energy per bit ($E_b$)-noise power ($N_0$) ratio in dB are given. Also listed is the Shannon limit (S.L.).

As the parameter "a" is increased, the performance improves. For example, for a=4, the best code found has an iterative decoding threshold of $E_b/N_0=-0.371$ dB, which is only 0.12 dB above the Shannon limit.

The accumulator component of the coder may be replaced by a "double accumulator" **600** as shown in FIG. **6**. The double accumulator can be viewed as a truncated rate 1 convolutional coder with transfer function $1/(1+D+D^2)$.

Alternatively, a pair of accumulators may be the added, as shown in FIG. **7**. There are three component codes: the "outer" code **700**, the "middle" code **702**, and the "inner" code **704**. The outer code is an irregular repetition code, and the middle and inner codes are both accumulators.

IRA codes may be implemented in a variety of channels, including memoryless channels, such as the BEC, BSC, and AWGN, as well as channels having non-binary input, non-symmetric and fading channels, and/or channels with memory.

A number of embodiments have been described. Nevertheless, it will be understood that various modifications may be made without departing from the spirit and scope of the invention. Accordingly, other embodiments are within the scope of the following claims.

What is claimed is:

**1**. 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;

performing a first encoding operation on at least some of the information bits, the first encoding operation being a linear transform operation that generates L transformed bits; and

performing a second encoding operation using the L transformed bits as an input, the second encoding operation including an accumulation operation in which the L transformed bits generated by the first encoding operation are accumulated, said second encoding operation producing at least a portion of a codeword, wherein L is two or more.

**2**. The method of claim **1**, further comprising:

outputting the codeword, wherein the codeword comprises parity bits.

**3**. The method of claim **2**, wherein outputting the codeword comprises:

outputting the parity bits; and

outputting at least some of the information bits.

**4**. The method of claim **3**, wherein outputting the codeword comprises:

outputting the parity bits following the information bits.

**5**. The method of claim **2**, wherein performing the first encoding operation comprises transforming the at least some of the information bits via a low density generator matrix transformation.

**6**. The method of claim **5**, wherein generating each of the L transformed bits comprises mod-2 or exclusive-OR summing of bits in a subset of the information bits.

**7**. The method of claim **6**, wherein each of the subsets of the information bits includes a same number of the information bits.

**8**. The method of claim **6**, wherein at least two of the information bits appear in three subsets of the information bits.

**9**. The method of claim **6**, wherein the information bits appear in a variable number of subsets.

**10**. The method of claim **2**, wherein performing the second encoding operation comprises using a first of the parity bits in the accumulation operation to produce a second of the parity bits.

**11**. The method of claim **10**, wherein outputting the codeword comprises outputting the second of the parity bits immediately following the first of the parity bits.

**12**. The method of claim **2**, wherein performing the second encoding operation comprises performing one of a mod-2 addition and an exclusive-OR operation.

**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.

**14**. The method of claim **13**, further comprising:

outputting the codeword, wherein the codeword comprises parity bits.

**15**. The method of claim **14**, wherein outputting the codeword comprises:

outputting the parity bits; and

outputting at least some of the information bits.

**16**. The method of claim **15**, wherein the parity bits follow the information bits in the codeword.

**17**. The method of claim **13**, wherein each of the subsets of the information bits includes a constant number of the information bits.

**18**. The method of claim **13**, wherein performing the encoding operation further comprises:

performing one of the mod-2 addition and the exclusive-OR summing of the bits in the 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.

**20**. 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 performing the encoding operation comprises:

mod-2 or exclusive-OR adding a first subset of information bits in the collection to yield a first sum;

mod-2 or exclusive-OR adding a second subset of information bits in the collection and the first sum to yield a second sum.

**21**. A method comprising:

receiving a collection of information bits;

mod-2 or exclusive-OR adding a first subset of information bits in the collection to yield a first parity bit;

mod-2 or exclusive-OR adding a second subset of information bits in the collection and the first parity bit to yield a second parity bit; and

outputting a codeword that includes the first parity bit and the second parity bit.

**22**. The method of claim **21**, wherein:

the method further comprises mod-2 or exclusive-OR adding additional subsets of information bits in the collection and parity bits to yield additional parity bits; and the information bits in the collection appear in a variable number of subsets.

* * * * *

## CERTIFICATE OF SERVICE

I hereby certify that, on this 14th day of December, 2020, I filed the foregoing Non-Confidential Brief for Defendants-Appellants with the Clerk of the United States Court of Appeals for the Federal Circuit via the CM/ECF system, which will send notice of such filing to all registered CM/ECF users.

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