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Paper No. 8
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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

INTEL CORPORATION,
Petitioner,

v.

QUALCOMM INCORPORATED,
Patent Owner.

Case IPR2018-01328
Patent 9,608,675 B2

Before MICHELLE N. WORMMEESTER, AMANDA F. WIEKER, and SCOTT B. HOWARD, *Administrative Patent Judges*.

WORMMEESTER, *Administrative Patent Judge*.

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

I. INTRODUCTION

Intel Corporation[1] ("Petitioner") filed a Petition (Paper 2, "Pet.") requesting *inter partes* review of claims 1–3, 5, 7–15, 17–21, 23–25, and 27 of U.S. Patent No. 9,608,675 B2 (Ex. 1201, "the '675 patent"). Qualcomm Incorporated ("Patent Owner") filed a Preliminary Response (Paper 7, "Prelim. Resp."). We have jurisdiction under 35 U.S.C. § 314 and 37 C.F.R. § 42.4(a). Under 35 U.S.C. § 314(a), an *inter partes* review may not be instituted "unless . . . there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition." For the reasons that follow, we institute an *inter partes* review as to all the challenged claims of the '675 patent and all the grounds presented.

II. BACKGROUND

A. Related Proceedings

The parties identify a district court case in the Southern District of California in which Patent Owner has asserted the '675 patent against Apple. Pet. 2; Paper 4, 2. The parties also identify five other petitions for *inter partes* review involving the '675 patent that Petitioner has filed. Pet. 2; Paper 4, 2. In addition, Petitioner identifies an International Trade Commission (ITC) investigation in which Patent Owner asserted the '675 patent against Apple, but has since withdrawn that assertion. Pet. 2.

[1] Intel Corporation identifies itself and Apple Inc. ("Apple") as real parties in interest. Paper 2, 1.

B. The ’675 Patent

The ’675 patent describes power tracking for generating a power supply voltage for a circuit, such as an amplifier, that processes multiple transmit signals sent simultaneously. Ex. 1201, 1:8–10, 35–38. Figure 5, which is reproduced below, illustrates a transmit module with power tracking for all transmit signals according to the ’675 patent. *Id.* at 1:65–67.

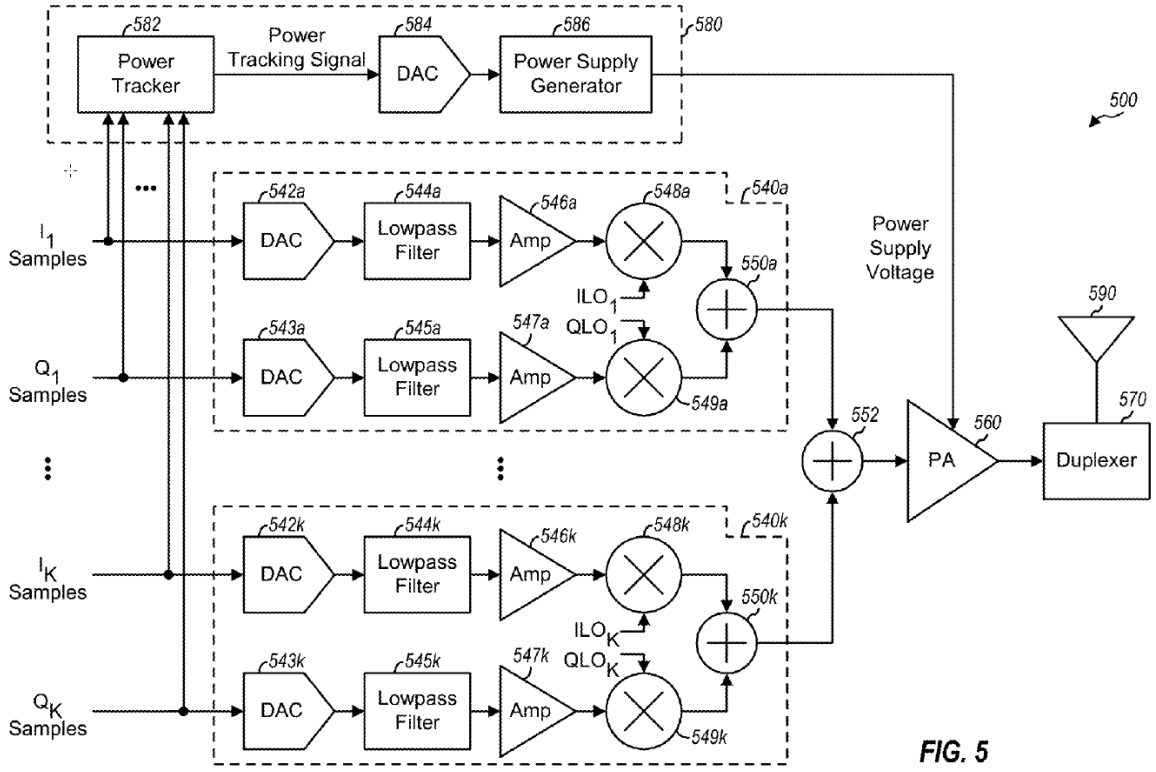

FIG. 5

In particular, Figure 5 shows transmit module 500, which includes K transmit circuits 540a to 540k that can simultaneously process K transmit signals, with each transmit circuit processing one transmit signal. *Id.* at 6:34–37. Transmit module 500 also includes summer 552, power amplifier (PA) 560, duplexer 570, and power tracking supply generator (or voltage generator) 580. *Id.* at 6:37–39.

Inphase (I) and quadrature (Q) samples for a transmit signal are provided to both a transmit circuit and voltage generator 580. *Id.* at 6:42–44. For example, transmit circuit 540a receives I_1 and Q_1 samples for a first transmit signal and generates a first upconverted radio frequency ("RF") signal for the first transmit signal. *Id.* at 6:40–42. Within transmit circuit 540a, the I_1 and Q_1 samples are converted to I and Q analog signals by digital-to-analog converters (DACs) 542a and 543a. *Id.* at 6:44–46. The I and Q analog signals are then filtered by lowpass filters 544a and 545a, amplified by amplifiers 546a and 547a, upconverted from baseband to RF by mixers 548a and 549a, and summed by summer 550a to generate the first upconverted RF signal. *Id.* at 6:46–50.

The other transmit circuits operate similarly. *Id.* at 6:54–57. Summer 552 receives all the upconverted RF signals from the transmit circuits, sums the upconverted RF signals, and provides a modulated RF signal to PA 560. *Id.* at 6:59–62.

Within voltage generator 580, power tracker 582 receives I_1 to I_K samples and Q_1 to Q_K samples for all transmit signals being sent simultaneously. *Id.* at 6:63–65. Power tracker 582 computes the overall power of all the transmit signals based on the I and Q samples and provides a digital power tracking signal to DAC 584. *Id.* at 6:65–7:1. DAC 584 converts the digital power tracking signal to analog and provides an analog power tracking signal for all the transmit signals to power supply generator 586. *Id.* at 7:1–4, Fig. 5. Power supply generator 586 then generates a power supply voltage for PA 560. *Id.* at 7:6–8.

Once PA 560 receives both the modulated RF signal from summer 552 and the power supply voltage from power supply

generator 586, PA 560 amplifies the modulated RF signal using the power supply voltage. *Id.* at 7:8–11. PA 560 then provides an output RF signal for all the transmit signals being sent simultaneously. *Id.* at 7:11–12. The output RF signal is routed through duplexer 570 and transmitted via antenna 590. *Id.* at 7:12–14.

C. Illustrative Claim

Petitioner challenges claims 1–3, 5, 7–15, 17–21, 23–25, and 27 of the '675 patent. Claims 1 and 18 are independent. Claim 1 is illustrative of the claims under challenge:

> 1. An apparatus comprising:
>
> a power tracker configured to determine a single power tracking signal based on a plurality of inphase (I) and quadrature (Q) components of a plurality of carrier aggregated transmit signals being sent simultaneously, wherein the power tracker receives the plurality of I and Q components corresponding to the plurality of carrier aggregated transmit signals and generates the single power tracking signal based on a combination of the plurality of I and Q components, wherein the plurality of carrier aggregated transmit signals comprise Orthogonal Frequency Division Multiplexing (OFDM) or Single Carrier Frequency Division Multiple Access (SC-FDMA) signals;
>
> a power supply generator configured to generate a single power supply voltage based on the single power tracking signal; and
>
> a power amplifier configured to receive the single power supply voltage and the plurality of carrier aggregated transmit signals being sent simultaneously to produce a single output radio frequency (RF) signal.

D. Asserted Grounds of Unpatentability

Petitioner challenges claims 1–3, 5, 7–15, 17–21, 23–25, and 27 of the '675 patent on the following grounds. Pet. 15–81.

References	Basis	Claim(s) Challenged
Chen[2] and Wang[3]	§ 103	1–3, 5, 7, 11, 17–21, and 27
Chen, Wang, and Eliezer[4]	§ 103	12
Chen, Wang, and Choi[5]	§ 103	8–10
Chen, Wang, and Dahlman[6]	§ 103	13–15 and 23–25

In support of its arguments, Petitioner relies on a Declaration of David Choi, Ph.D. (Exhibit 1203). *See id.*

III. DISCUSSION

A. Multiple Petitions

Patent Owner contends that we should exercise our discretion under 35 U.S.C. § 314(a) to deny institution of an *inter partes* review because Petitioner attempts to "sidestep" the Supreme Court's mandate in *SAS Institute, Inc. v. Iancu*, 138 S. Ct. 1348 (2018), by filing six petitions against the same patent. Prelim. Resp. 13–16. In *SAS*, the Supreme Court held that

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[2] W. Chen et al., *Hybrid Envelope Tracking for Efficiency Enhancement in Concurrent Dual-Band PAs*, 54 Microwave & Optical Tech. Letters 662 (2012) (Ex. 1212, "Chen").
[3] Feipeng Wang et al., *Design of Wide-Bandwidth Envelope-Tracking Power Amplifiers for OFDM Applications*, 53 IEEE Transactions on Microwave Theory & Techniques 1244 (2005) (Ex. 1205, "Wang").
[4] Eliezer, U.S. Publ'n No. 2009/0004981 A1, published Jan. 1, 2009 (Ex. 1211).
[5] Jinsung Choi et al., *Envelope Tracking Power Amplifier Robust to Battery Depletion*, 2010 IEEE MTT-S Int'l Microwave Symposium Digest 1074 (2010) (Ex. 1208, at Ex. A "Choi").
[6] Erik Dahlman et al., 4G LTE / LTE-ADVANCED FOR MOBILE BROADBAND (Elsevier Ltd. 2011) (Ex. 1206, "Dahlman").

a decision to institute under 35 U.S.C. § 314 may not institute on fewer than all claims challenged in the petition. 138 S. Ct. at 1358. Patent Owner asserts that the Board, however, has "cautioned that the presence of weak grounds in a petition could result in a complete denial of institution even if other unpatentability allegations met the threshold for institution." Prelim. Resp. 14. As such, Patent Owner further asserts that Petitioner "has divided its challenges to the '675 patent claims that would normally fit into one or two petitions (*i.e.*, two grounds challenging 31 claims) across *six* petitions, hoping to increase its odds of institution." *Id.* at 14–15. Patent Owner additionally asserts that "Petitioner provides no explanation for its convoluted filing strategy and why it requires 84,000 words (6 * 14,000) to make its case that 31 claims of the '675 patent are unpatentable based on two grounds." *Id.* at 16 (citing *Alere Inc. v. Rembrandt Diagnostics, LP*, Case IPR2017-01130, slip op. at 10 (PTAB Sept. 28, 2017) (Paper 10)); *see also id.* at 20 ("[T]he petition states that it contains 13,992 words, just 8 words shy of the limit."). According to Patent Owner, "such tactics unnecessarily multiply the amount of material that the Board and patent owner must traverse to assess the patentability of the '675 patent claims." *Id.* at 15.

We disagree with Patent Owner. There is nothing inherently improper with filing multiple petitions at the same time to avoid issues associated with the word limit. Petitioner's practice as described by Patent Owner is expressly permitted by the Board, which previously has provided guidance that petitioners should consider filing multiple petitions if concerned with exceeding word limits. *See* Rules of Practice for Trials Before the Patent Trial and Appeal Board and Judicial Review of Patent Trial and Appeal

Board Decisions, 77 Fed. Reg. 48,612, 48,635 (Aug. 14, 2012) ("Where a petitioner can demonstrate how a waiver of the page limit is in the interests of justice, a motion to waive the page limit should be considered. Alternatively, the filing of multiple petitions directed to subsets of related claims should be considered."). On this record, we find no reason to deny institution based on Petitioner's multiple filings.

B. Word Limit

Patent Owner also contends that we should deny the Petition for violating our rules on word limits and incorporation by reference. Prelim. Resp. 19–21. According to Patent Owner, "the petition states that it contains 13,992 words, just 8 words shy of the limit. . . . , [b]ut that total does not count the three full sections that the petition incorporates by reference from other documents." *Id.* at 20. In particular, Patent Owner asserts that the Petition incorporates by reference 4,116 words, including "the description of the technology," "the overview of the '675 patent," and "the description of the '675 patent's prosecution history" from Dr. Choi's declaration in this case and the petition in IPR2018-01326. *Id.* (citing Pet. 7–8). Patent Owner characterizes these instances of incorporation by reference as "improper" and "especially egregious" for "bring[ing] the petition length significantly beyond the 14,000 word limit." *Id.* at 20–21 (citing 37 C.F.R. §§ 42.6(a)(3), 42.24(a)(1)(i)).

This Decision does not rely on the portions of Dr. Choi's declaration and the petition in IPR2018-01326 that Patent Owner alleges are incorporated by reference improperly. Nevertheless, we disagree with Patent Owner. As Patent Owner acknowledges, our rules specify that

"[a]rguments must not be incorporated by reference from one document into another document," and that "combined documents are not permitted." Prelim. Resp. 20; 37 C.F.R. § 42.6(a)(3). Patent Owner does not allege or show that the instant Petition incorporates *arguments* by reference from another document. Mere descriptions or overviews of technologies, patents, and patent prosecution histories do not constitute arguments. Nor does Patent Owner allege or show that Petitioner has combined the instant Petition with another document. Accordingly, based on the record before us, we find that Petitioner has not violated our rules regarding word limits or incorporation by reference in this case.

C. Claim Interpretation

The claim construction standard applicable to this *inter partes* review proceeding is the broadest reasonable interpretation in light of the patent specification. *See* 37 C.F.R. § 42.100(b) (2017); *Cuozzo Speed Techs. LLC v. Lee*, 136 S. Ct. 2131, 2144–46 (2016) (upholding the use of the broadest reasonable interpretation standard).[7] Under this standard, claim terms generally are given their ordinary and customary meaning, as would be understood by one of ordinary skill in the art in the context of the entire

[7] The revised claim construction standard for interpreting claims in *inter partes* review proceedings as set forth in the final rule published October 11, 2018, does not apply to this proceeding because the new "rule is effective on November 13, 2018 and applies to all IPR, PGR and CBM petitions filed on or after the effective date." Changes to the Claim Construction Standard for Interpreting Claims in Trial Proceedings Before the Patent Trial and Appeal Board, 83 Fed. Reg. 51,340 (Oct. 11, 2018) (to be codified at 37 C.F.R. pt. 42).

disclosure. *See In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007).

Petitioner provides proposed interpretations of the claim terms "plurality of carrier aggregated transmit signals," "power tracker," and "single power tracking signal." Pet. 12–14. Patent Owner responds that "procedural defects in the petition warrant its denial," and "[t]hose defects can be ascertained without particular construction of any terms of the '675 patent." Prelim. Resp. 13. In light of the parties' arguments and evidence, we provide further discussion of the claim term "power tracker."

1. Satisfying 37 C.F.R. § 42.104(b)(3)

Petitioner indicates that Apple (a real party in interest in this proceeding) has argued in a related International Trade Commission (ITC) investigation that the recited "power tracker" is a means-plus-function limitation lacking sufficient corresponding structure. Pet. 13 n.3. Although Petitioner asserts that the challenged claims are invalid for indefiniteness under Apple's proposed means-plus-function construction, Petitioner directs us to the construction of "power tracker" determined by the Administrative Law Judge (ALJ) in the ITC investigation: "component in a voltage generator that computes the power requirement." *Id.* at 13 (citing Ex. 1218, 18–20),[8] 13 n.3. According to Petitioner, its "Petition shows the invalidity of the challenged claims under the ALJ's construction," as "indefiniteness is

[8] Although Petitioner cites pages 18 through 20 of Exhibit 1217, we believe that Petitioner intended to cite pages 18 through 20 of Exhibit 1218, which includes the ALJ's construction of "power tracker."

not an issue that can be considered in an [*inter partes* review proceeding]." *Id.*

In response, Patent Owner contends that we should deny the Petition because our "rules 'require a petition to identify, not only how the challenged claim is to be construed but also how the construed claim is unpatentable' under 'a claim construction that it consider[s] to be correct.'" Prelim. Resp. 18 (quoting *Hologic, Inc. v. Enzo Life Sciences, Inc.*, Case IPR2018-00019, slip op. at 8–9 (PTAB Apr. 18, 2018) (Paper 17)); *see* 37 C.F.R. § 42.104(b)(3) (a petitioner must identify "[h]ow the challenged claim is to be construed"). According to Patent Owner, "[i]n this case, petitioner believes that the term 'power tracker' is a means-plus-function term," but "advocates a different claim construction (*i.e.*, a non-[means-plus-function] claim construction)." Prelim. Resp. 18. Patent Owner also contends that, "[d]espite believing that 'power tracker' should be construed as a [means-plus-function] term, petitioner did not comply with 37 C.F.R. § 42.104(b)(3)[,] thereby providing another basis for denial of the petition." *Id.* at 19; *see* 37 C.F.R. § 42.104(b)(3) ("Where the claim to be construed contains a means-plus-function or step-plus-function limitation . . . , the [petitioner's] construction of the claim must identify the specific portions of the specification that describe the structure, material, or acts corresponding to each claimed function.").

We disagree with Patent Owner. A petitioner may satisfy 37 C.F.R. § 42.104(b)(3) "by identifying claim constructions it proposes as the basis for requesting review of the challenged claims," without "express[ing] its subjective agreement regarding correctness of its proffered claim constructions or [] tak[ing] ownership of those constructions." *Hologic, Inc.*

v. Enzo Life Sciences, Inc., Case IPR2018-00019, slip op. at 5 (PTAB Nov. 28, 2018) (Paper 21)[9] (quoting *Western Digital Corp. v. SPEX Techs., Inc.*, Case IPR2018-00084, slip op. at 11 (PTAB Apr. 25, 2018) (Paper 14)). In an *inter partes* review where the broadest reasonable interpretation applies, a petitioner may proffer a construction that the patent owner advocated in a different forum and may state that it disagrees that the construction is correct under the standard applied in the other forum but that it proposes the construction as the broadest reasonable interpretation of the term in question. *Id.* at 5, 8. Additionally, in a broadest reasonable interpretation case, a petitioner may argue that a claim is indefinite but still offer a construction for the claim. *Id.* at 5, 7. If a petitioner is concerned that the Board may not adopt what it believes to be the proper claim construction, the petitioner may offer alternative constructions and demonstrate unpatentability under each construction. *Id.* at 6.

As discussed above, we apply the broadest reasonable interpretation in this proceeding. By contrast, the ALJ in the related ITC investigation applied the *Phillips* standard. Ex. 1218, 3–5 (ITC claim construction order); *see also* Pet. 13 ("The ALJ's construction was based on the *Phillips* standard."). Here, Petitioner offers a construction for the claim term "power tracker," namely, the ALJ's construction in the ITC investigation, and expresses its belief that the challenged claims of the '675 patent are "also" invalid for indefiniteness under Apple's proposed means-plus-function construction of the term. Pet. 13, 13 n.3. We find this approach to be acceptable under 37 C.F.R. § 42.104(b)(3). This is not a situation like that

[9] This decision denied the motion for rehearing of the *Hologic* decision cited by Patent Owner.

presented in *Hologic*, where the *Phillips* standard was being applied and the petitioner offered constructions with which it expressly disagreed. *See Hologic*, slip op. at 7 (Paper 21).

2. Request for Proposed Constructions of "power tracker"

As discussed above, Patent Owner does not address the construction of "power tracker." At this stage of the proceeding, we have not reached a final decision regarding whether "power tracker" is a means-plus-function limitation under section 112, sixth paragraph, which requires identification of sufficient structure, material, or acts in the specification. *See In re Donaldson Co.*, 16 F.3d 1189, 1193 (Fed. Cir. 1994) (en banc). We are able to analyze Petitioner's asserted prior art ground for purposes of this Decision, however, without making such a determination. For purposes of this Decision, we adopt the ALJ's construction in the ITC investigation and construe "power tracker" to mean "component in a voltage generator that computes the power requirement." *See* Ex. 1218, 20. The preliminary evidence in favor of this construction passes the threshold sufficient to institute an *inter partes* review.

The parties are directed to address specifically in their subsequent briefing in this proceeding whether the recited "power tracker" invokes 35 U.S.C. § 112 ¶ 6. If it does invoke 35 U.S.C. § 112 ¶ 6, the parties are directed to identify the corresponding structure from the specification of the '675 patent. *See* 37 C.F.R. 42.104(b)(3). If not, the parties are directed to explain their reasoning and address the construction of the term under the broadest reasonable interpretation standard.

D. Obviousness over Chen and Wang

Petitioner asserts that claims 1–3, 5, 7, 11, 17–21, and 27 of the '675 patent would have been obvious over Chen and Wang. Pet. 15–59. For the reasons explained below, we are persuaded that Petitioner has demonstrated a reasonable likelihood of prevailing on this asserted ground.

1. Chen

Chen is a paper that proposes a hybrid envelope tracking scheme. Ex. 1212, 662. Figure 1 of Chen, which is reproduced below, illustrates the proposed scheme. *Id.*

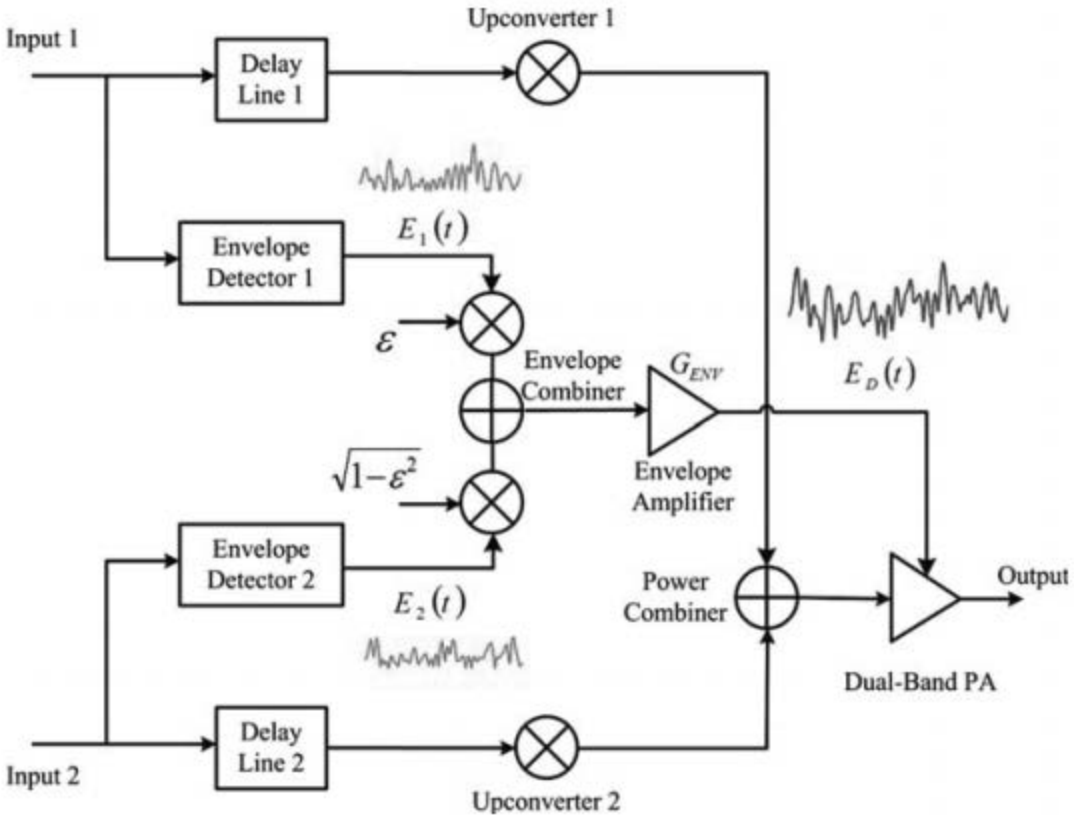


Figure 1 Proposed hybrid ET scheme for concurrent dual-band PAs.

In particular, Figure 1 of Chen shows the proposed hybrid envelope tracking architecture for concurrent dual-band power amplifiers. *Id.* Input signals 1 and 2 are provided at different frequencies (*id.* at 662), and each signal follows two paths (*see id.*, Fig. 1). Along one path, input signals 1 and 2 are fed separately to respective envelope detectors 1 and 2, where the envelopes of the signals are detected. *Id.* at 662, Fig. 1. The signals are then weighted using power weighting factor Ɛ. *Id.* Next, the signals are added together by the envelope combiner and injected into the envelope amplifier. *Id.* The output of the envelope amplifier is used to modulate the supply voltage of the target dual-band power amplifier (PA). *Id.* at 662. Chen indicates that $E_1(t)$ and $E_2(t)$ represent the signal envelopes in dual bands, and $E_D(t)$ represents the final modulated supply of the power amplifier. *Id.*

Along the other path, Figure 1 of Chen shows input signals 1 and 2 also being fed separately to respective delay lines 1 and 2. *See id.*, Fig. 1. The signals are then upconverted by upconverters 1 and 2 and added together by the power combiner. *See id.* The power combiner outputs a signal that is provided to the dual-band PA. *See id.*

After receiving signals from both the envelope amplifier and the power combiner, the dual-band PA generates an output signal. *See id.*

2. Wang

Wang describes an envelope-tracking power amplifier system. Ex. 1205, 1244 (Title, Abstract). In Wang, the input signal is a complex baseband signal whose amplitude is $A = (I^2 + Q^2)^{1/2}$, where I and Q are the real and imaginary parts of the complex baseband signal. *Id.* at 1245, Fig. 3.

3. Analysis

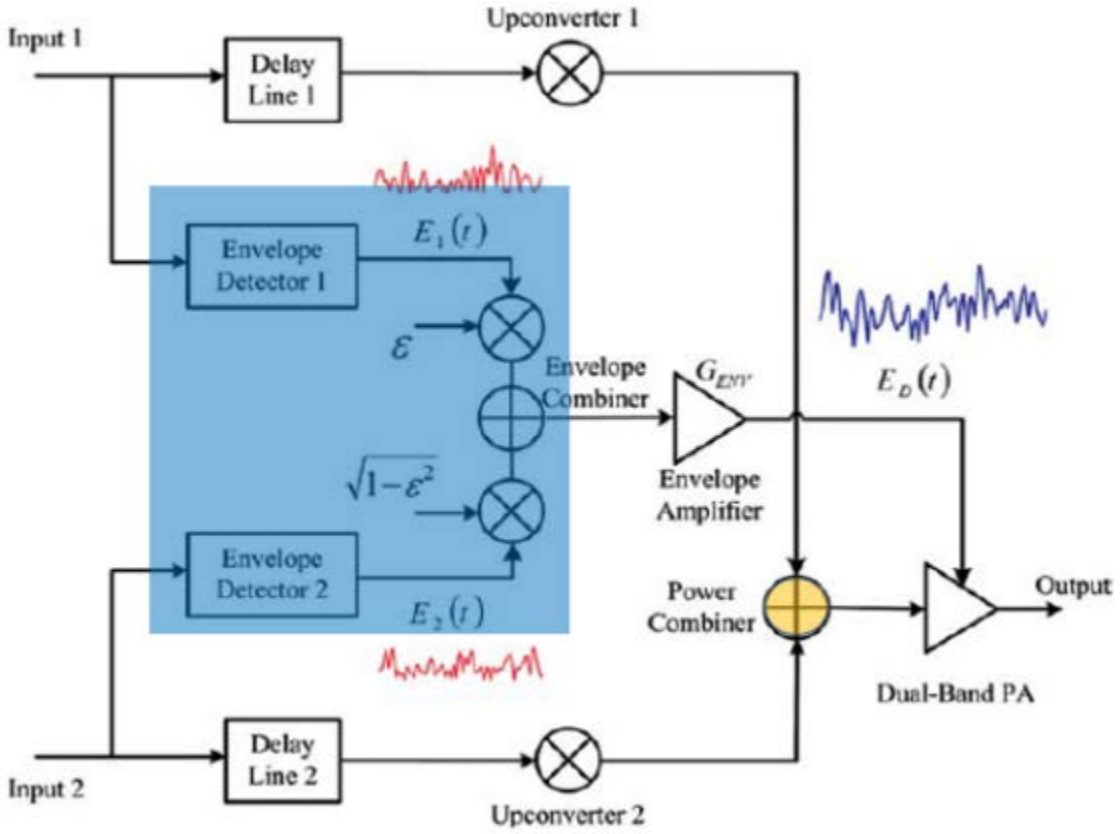
Independent claim 1 is directed to an apparatus, and independent claim 18 is directed to a corresponding method. Both claims recite similar limitations, and Petitioner analyzes the claims together (*see* Pet. 16–42). Accordingly, our analysis below regarding claim 1 also applies to claim 18.

a. "power tracker"

Claim 1 recites "a power tracker configured to determine a single power tracking signal based on a plurality of inphase (I) and quadrature (Q) components of a plurality of carrier aggregated transmit signals being sent simultaneously." Claim 1 requires that "the power tracker receives the plurality of I and Q components . . . and generates the single power tracking signal based on a combination of the plurality of I and Q components." Claim 1 also requires that "the plurality of carrier aggregated transmit signals comprise Orthogonal Frequency Division Multiplexing (OFDM) or Single Carrier Frequency Division Multiple Access (SC-FDMA) signals." As discussed above in the Claim Interpretation section, we construe "power tracker" to mean "component in a voltage generator that computes the power requirement."

For these limitations, Petitioner relies on both Chen and Wang. In particular, Petitioner identifies Chen's envelope detectors 1 and 2 together with Chen's envelope combiner as comprising a "power tracker." Pet. 18–19. Petitioner also identifies the output of Chen's envelope combiner as a "power tracking signal." *Id.* at 22. In addition, Petitioner identifies Chen's input signals 1 and 2 as "carrier aggregated transmit signals." *Id.* at 24. To

illustrate, Petitioner provides an annotated version of Figure 1 of Chen, which is reproduced below. *Id.* at 18.



As discussed above, Figure 1 of Chen illustrates the architecture for a hybrid envelope tracking scheme. Ex. 1212, 662. Chen's envelope detectors 1 and 2 as well as Chen's envelope combiner are highlighted in blue. Petitioner asserts that these components are in a voltage generator for the dual-band PA, and directs us to where Chen teaches that "$E_D(t)$ is the final modulated supply of the PA." *Id.* at 19 (citing Ex. 1212, 662); *see also* Ex. 1212, Fig. 3 (showing envelope waveforms E(t) measured in voltages). Petitioner also directs us to where Chen teaches that the envelopes of input signals 1 and 2 are detected by envelope detectors 1 and 2, weighted using power weighting

factor Ɛ, and then combined by the envelope combiner. *Id.* (citing Ex. 1212, 662). The envelope combiner outputs a signal that is fed to the envelope amplifier, which generates $E_D(t)$. Ex. 1212, 662. Petitioner further directs us to where Chen teaches that the detected envelope signals are represented by $E_1(t)$ and $E_2(t)$. Pet. 19 (citing Ex. 1212, 662). According to Petitioner, these envelope signals "are proxies for the power of each input signal," and the envelope combiner's output signal "is a proxy for the combined power of the two input signals." *Id.* at 20–21; *see also id.* at 22 ("[T]he use of a 'power weighting factor' to weight the envelope signals . . . confirms that the output of the Envelope Combiner represents the power requirement.") (citing Ex. 1203 ¶ 100).

With respect to Chen's input signals 1 and 2, Petitioner additionally directs us to where Chen describes the signals as "two single carrier wideband code division multiple access signals," which operate at different frequencies. Pet. 24 (citing Ex. 1212, 663). Petitioner contends that this teaching indicates that the signals "are from different (multiple) carriers," and that "aggregating multiple signals on different frequencies increases the bandwidth for a user, allowing more information to be transmitted per unit of time." *Id.* Petitioner relies on the declaration testimony of Dr. Choi. *Id.* (citing Ex. 1203 ¶ 103).

Petitioner submits, however, "Chen does not expressly mention I and Q components of the input signals, but [an ordinarily skilled artisan] would have understood that Input 1 and Input 2 are digital signals that each would have such I and Q components." Pet. 25. Petitioner directs us again to where Chen describes its input signals as wideband code division multiple access ("WCDMA") signals, and asserts that "WCDMA is the dominant

third-generation (UMTS) cellular technology and uses Quadrature Phase Shift Keying (QPSK) modulation." *Id.* at 25–26 (citing Ex. 1212, 663; Ex. 1206, 19, 205, 389). Relying on the declaration testimony of Dr. Choi, Petitioner contends that an ordinarily skilled artisan "would have known that QPSK modulation uses signals that have I and Q components." *Id.* at 26 (citing Ex. 1203 ¶ 105).

Alternatively, Petitioner points to Wang for teaching the recited I and Q components. *Id.* at 26. According to Petitioner, even if Chen does not disclose I and Q signals, "it would have been obvious to use Wang's I/Q signal processing in Chen." *Id.* Petitioner directs us to where Wang teaches receiving a "complex baseband signal," which Petitioner asserts "is generally understood to comprise I and Q components." *Id.* at 26–27 (citing Ex. 1205, Fig. 3; Ex. 1203 ¶ 107). Petitioner further draws our attention to Wang's teaching that "[t]he amplitude is $A = (I^2 + Q^2)^{1/2}$, where I and Q are the real and imaginary parts of the complex baseband signal." *Id.* at 27 (citing Ex. 1205, 1245). Petitioner contends that an ordinarily skilled artisan "would have been motivated to use Wang's I/Q signal processing in Chen to efficiently process and transmit the RF signals in Chen's system." *Id.* at 30. Petitioner asserts that "[c]omplex input signals (with I and Q components) allow the use of advanced modulation techniques such as quadrature phase-shift keying (QPSK), which doubles the data rate by increasing the number of bits per symbol that can be transmitted within the same bandwidth, compared with a method such as binary phase-shift keying (BPSK)." *Id.* at 31 (citing Ex. 1221, 308).

Petitioner also points to Wang for expressly teaching Orthogonal Frequency Division Multiplexing (OFDM) signals. *Id.* at 35 (citing

Ex. 1205, 1244 (title), 1253). According to Petitioner, an ordinarily skilled artisan "would have looked to Wang, a reference in the same field, to determine a modulation technique for Chen." *Id.* at 35. In addition, Petitioner contends that "OFDM had many advantages, including the ability to adapt to degraded channel conditions without complex equalization filters, and robustness against various forms of interference." *Id.* at 36 (citing Ex. 1222 ¶¶ 2–3). Petitioner relies on the declaration testimony of Dr. Choi. *Id.* (citing Ex. 1203 ¶ 117[10]).

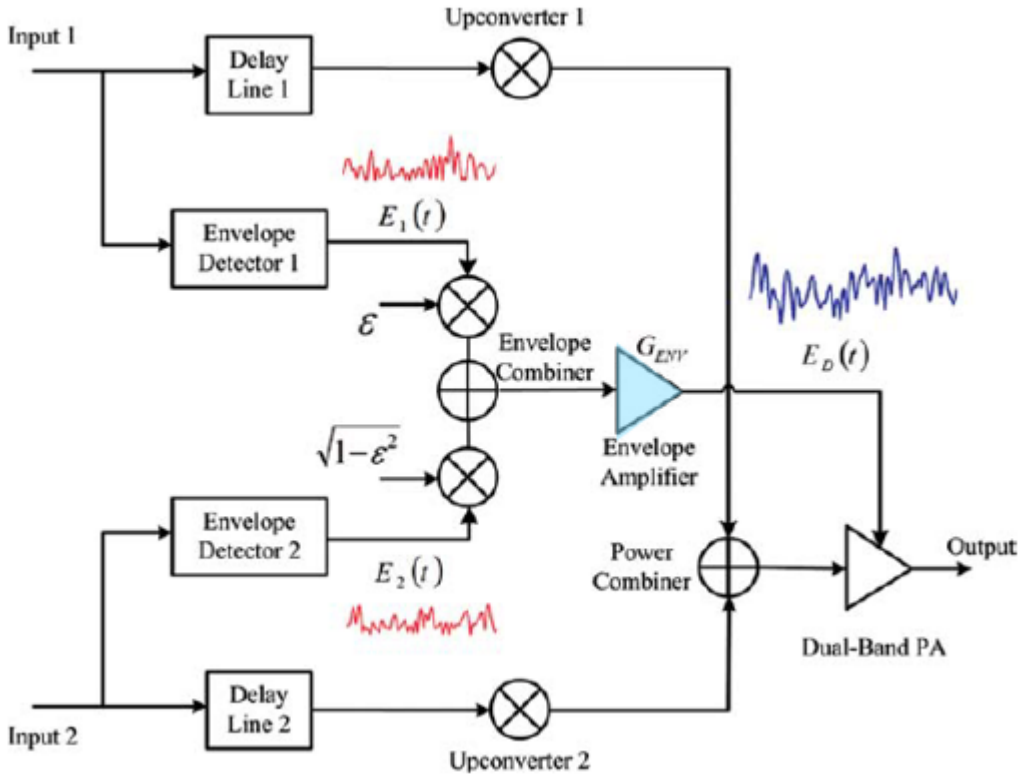
Based on the record before us, at this stage of the proceeding, we are persuaded that Petitioner has established sufficiently for purposes of this Decision that the combination of Chen and Wang teaches the recited "power tracker." We also are persuaded that Petitioner's proffered reasoning for modifying Chen to include Wang's baseband signal (comprising an OFDM signal with I and Q components) is sufficient to support the legal conclusion of obviousness. *See In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006) ("[T]here must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness."). Namely, we are persuaded that modifying Chen to include Wang's baseband signal would have provided a way to carry out Chen's signaling. *See* Pet. 31 ("Complex input signals (with I and Q components) allow the use of advanced modulation techniques such as quadrature phase-shift keying (QPSK)."); *id.* at 35 (an ordinarily skilled artisan "would have looked to

[10] Although Petitioner cites paragraph 118 of Exhibit 1203, we believe that Petitioner intended to cite paragraph 117 of Exhibit 1203, which includes the declaration testimony of Dr. Choi referred to in the Petition.

Wang, a reference in the same field, to determine a modulation technique for Chen").

b. "power supply generator"

Claim 1 further recites "a power supply generator configured to generate a single power supply voltage based on the single power tracking signal." For this limitation, Petitioner identifies Chen's envelope amplifier as a "power supply generator," and Chen's supply $E_D(t)$ as a "single power supply voltage." Pet. 38–39. To illustrate, Petitioner provides an annotated version of Figure 1 of Chen, which is reproduced below. *Id.* at 39.



As discussed above, Figure 1 of Chen shows the architecture for a hybrid envelope tracking scheme. Ex. 1212, 662. Petitioner directs us to where Chen teaches that "[t]he envelopes of the input signals at different frequencies are detected separately . . . and then added together in time domain and injected into the envelope amplifier, finally, the output of the

envelope amplifier is used to modulate the supply voltage of the target dual-band PA." Pet. 39 (citing Ex. 1212, 662). The annotated figure shows Chen's envelope amplifier with light blue shading receiving the envelope combiner's output signal (which Petitioner identifies as the "single power tracking signal") and generating supply $E_D(t)$. Based on the record before us, at this stage of the proceeding, we are persuaded that Petitioner has established sufficiently for purposes of this Decision that the combination of Chen and Wang discussed above teaches the recited "power supply generator."

c. "power amplifier"

Lastly, claim 1 recites "a power amplifier configured to receive the single power supply voltage and the plurality of carrier aggregated transmit signals being sent simultaneously to produce a single output radio frequency (RF) signal." For this limitation, Petitioner identifies Chen's dual-band PA as a "power amplifier." Pet. 40–41. To illustrate, Petitioner provides an annotated version of Figure 1 of Chen, which is reproduced below. *Id.* at 41.

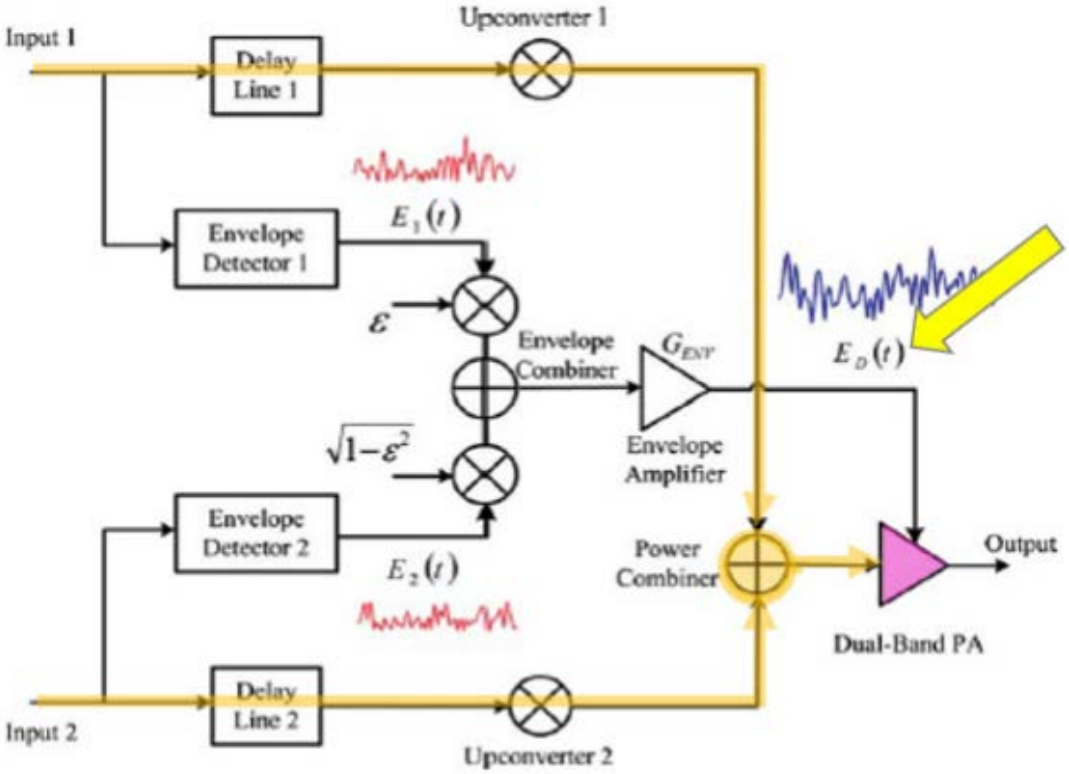


Figure 1 of Chen shows the architecture for a hybrid envelope tracking scheme. Ex. 1212, 662. Referring to its annotated Figure 1 of Chen, Petitioner contends that "the [dual-band] PA (highlighted in pink) receives the single power supply voltage $E_D(t)$ from the Envelope Amplifier, indicated at the yellow arrow." Pet. 40. Petitioner further contends that Chen's "[dual-band] PA also receives the plurality of carrier aggregated transmit signals (inputs 1 and 2) after they have been upconverted (by Upconverters 1 and 2 (mixers)) and summed (by the Power Combiner), as indicated . . . in gold, and produces a single output radio frequency signal such that the transmit signals are sent simultaneously." *Id.* We find that the signal generated by Chen's dual-band PA corresponds to the recited "single output radio frequency (RF) signal."

Based on the record before us, at this stage of the proceeding, we are persuaded that Petitioner has established sufficiently for purposes of this

Decision that the combination of Chen and Wang discussed above teaches the recited "power amplifier."

Patent Owner does not respond to Petitioner's arguments regarding claims 1 and 18. *See generally* Prelim. Resp. In view of the foregoing, we determine that Petitioner has demonstrated a reasonable likelihood of prevailing on its assertion that independent claims 1 and 18 would have been obvious over Chen and Wang. Having reviewed Petitioner's arguments asserting that dependent claims 2, 3, 5, 7, 11, 17, 19–21, and 27 would have been obvious over Chen and Wang (*see* Pet. 42–59), we also determine that Petitioner has demonstrated a reasonable likelihood of prevailing on its assertion as to these claims. Patent Owner does not respond to Petitioner's arguments regarding claims 2, 3, 5, 7, 11, 17, 19–21, and 27. *See generally* Prelim. Resp.

E. Obviousness over Chen, Wang, and Eliezer

Petitioner asserts that claim 12 of the '675 patent would have been obvious over Chen, Wang, and Eliezer. Pet. 59–65. For the reasons explained below, we are persuaded that Petitioner has demonstrated a reasonable likelihood of prevailing on this asserted ground.

We discussed Chen and Wang above.

1. Eliezer

Eliezer describes a power efficient digital transmitter, which incorporates a linear amplifier and a switched mode power supply (SMPS). Ex. 1211 ¶ 2. Figure 11 of Eliezer is reproduced below.

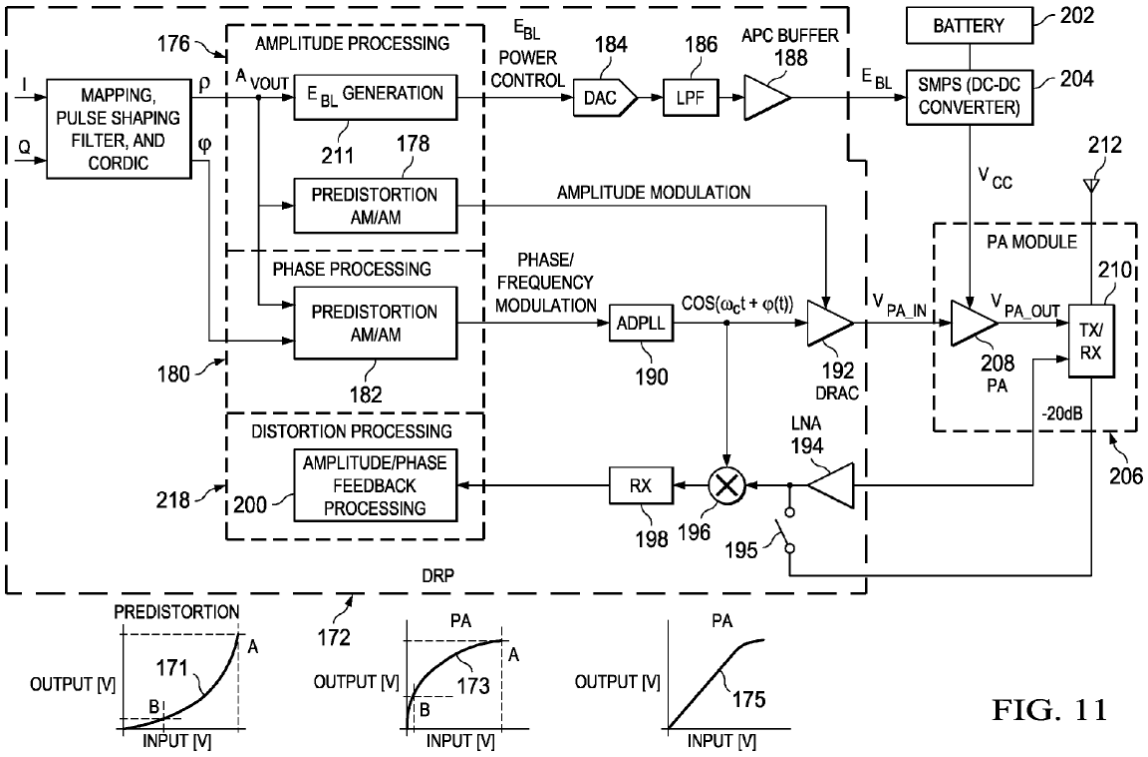


FIG. 11

Figure 11 is a block diagram of a power efficient digital transmitter. *Id.* ¶ 108. The transmitter includes power amplifier (PA) module 206 and SMPS 204. *Id.* PA module 206 includes power amplifier 208. *Id.*

Eliezer explains that one problem with using an SMPS is the degraded efficiency at high rates of switching, which is needed to accommodate wide bandwidth input signals. *Id.* ¶ 109. To address this problem, Eliezer's SMPS 204 is operative to follow a reduced-bandwidth form of the desired envelope signal A_{VOUT}. *Id.* ¶ 111. In particular, SMPS 204 is used to provide a slow form (i.e., reduced bandwidth) of envelope tracking based on a narrower bandwidth distorted version of the envelope waveform such that SMPS 204 can use a lower switching rate corresponding to the lower bandwidth, thereby obtaining high efficiency in the regulation. *Id.* ¶ 122. The reduced bandwidth form of signal A_{VOUT} is represented by E_{BL}. *Id.* ¶¶ 107, 110.

Reduced-bandwidth envelope signal E_{BL}, which is derived from signal A_{VOUT}, is generated by E_{BL} generation circuit 211. *Id.* ¶¶ 107, 124. Signal E_{BL} is converted to analog by DAC 184, passed through low pass filter 186, and input to buffer 188 before being fed to SMPS 204. *Id.* ¶ 124. SMPS 204 generates supply voltage V_{CC}, which is provided to linear power amplifier 208. *Id.*

2. Analysis

Claim 12 depends from claim 11, which depends from claim 1. For the reasons given above, we determine that Petitioner has demonstrated a reasonable likelihood of prevailing on its assertion that claims 1 and 11 would have been obvious over Chen and Wang. *See supra* Section III.D. Claim 11 recites that "the plurality of carrier aggregated transmit signals are sent on a plurality of carriers at different frequencies." As discussed above with respect to claim 1, Chen describes its input signals 1 and 2 as "two single carrier wideband code division multiple access signals," which operate at different frequencies. Ex. 1212, 663 (cited by Pet. 24).

Claim 12 recites that "the single power tracking signal has a bandwidth that is smaller than an overall bandwidth of the plurality of carriers." For this limitation, Petitioner relies on Eliezer. In particular, Petitioner identifies Eliezer's reduced-bandwidth envelope signal E_{BL} as a "single power tracking signal." Pet. 61. Petitioner contends that Eliezer teaches that the bandwidth of signal $E_{BL}$is narrower than the bandwidth of signal A_{VOUT}, which Petitioner asserts is the amplitude portion of the RF signal. *Id.* As support, Petitioner directs us to Figure 12 of Eliezer, which is reproduced below. *Id.* at 62.

FIG. 12

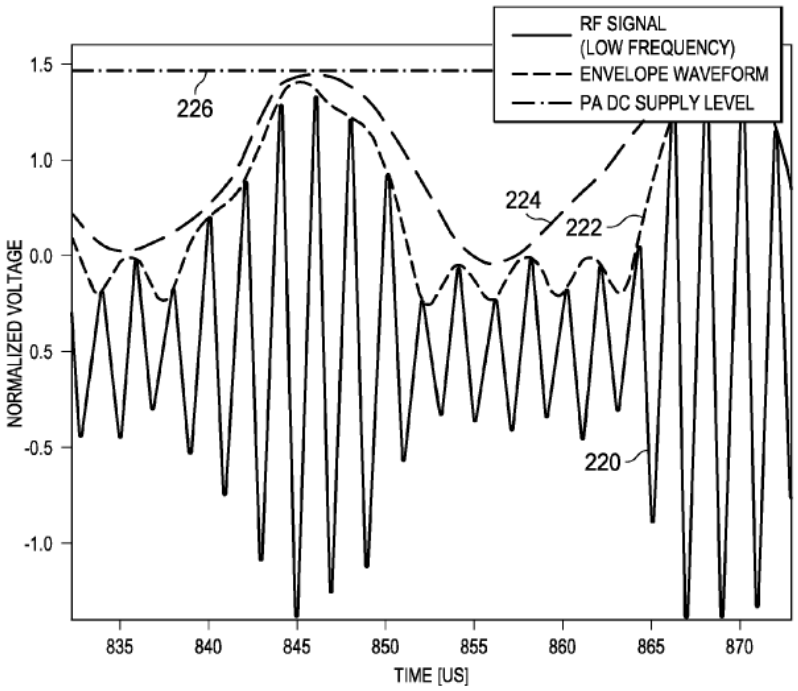


Figure 12 of Eliezer is a graph comparing an RF envelope generated by Eliezer's system and a "prior art" envelope. Ex. 1211 ¶ 128. Eliezer describes the graph as follows:

> The graph shows the normal DC supply voltage 226 to the power amplifier 208, the RF signal 220 (a low frequency version is shown for clarity sake), a high bandwidth envelope signal 222 that tightly hugs the RF signal and is suitable for regulating the voltage for a saturated PA and a reduced bandwidth envelope signal 224 (dashed trace) that maintains headroom for operation with a linear PA in accordance with the present invention. The reduced-bandwidth envelope signal is generated by the E_{BL} generation circuit 211 and in accordance with the present invention, is fed to the V_{CC} supply voltage input of the power amplifier 208. This band limited envelope signal 224 is significantly less demanding than signal 222, thus enabling the switching regulator [(SMPS)] to follow it much more easily.

Id. (cited by Pet. 62–63). According to Petitioner, "trace 224 is smoother (e.g., has less variation as a function of time) than trace 220," which "means

that the power tracking signal 224 has a lower bandwidth than the RF signal 220." Pet. 63. Petitioner relies on the declaration testimony of Dr. Choi. *Id.* (citing Ex. 1203 ¶ 162). Petitioner additionally directs us to where Eliezer teaches that its system maintains the condition $f_C < f_A$, where f_C represents the bandwidth of signal E_{BL} and f_A represents the bandwidth of A_{VOUT}. *Id.* (citing Ex. 1211 ¶ 120).

Petitioner further contends that an ordinarily skilled artisan would have been motivated to use Eliezer's signal processing to generate a band-limited envelope signal for a power supply generator in Chen in order to increase efficiency. *Id.* at 64. We note that Eliezer's signal processing addresses degraded power supply efficiency at high rates of switching, which is needed to accommodate wide bandwidth input signals. Ex. 1211 ¶ 109. Petitioner also asserts that "Wang specifically focuses on the importance of 'the time alignment between the envelope and RF paths in order to minimize the distortion and EVM [error vector magnitude],'" and contends that an ordinarily skilled artisan "would have understood that a reduced bandwidth envelope signal (such as that disclosed in Eliezer) would reduce the difficulty in accomplishing this task." Pet. 64 (citing Ex. 1205, 1245; Ex. 1203 ¶ 166).

Based on the record before us, at this stage of the proceeding, we are persuaded that Petitioner has established sufficiently for purposes of this Decision that the combination of Chen, Wang, and Eliezer teaches that the recited "single power tracking signal." We also are persuaded that Petitioner's proffered reasoning for further modifying the combination of Chen and Wang to include Eliezer's signal processing, namely, to increase

system efficiency, is sufficient to support the legal conclusion of obviousness. *See Kahn*, 441 F.3d at 988.

Patent Owner does not respond to Petitioner's arguments regarding claim 12. *See generally* Prelim. Resp. In view of the foregoing, we determine that Petitioner has demonstrated a reasonable likelihood of prevailing on its assertion that claim 12 would have been obvious over Chen, Wang, and Eliezer.

F. Obviousness over Chen, Wang, and Choi

Petitioner asserts that claims 8–10 of the '675 patent would have been obvious over Chen, Wang, and Choi. Pet. 65–73. For the reasons explained below, we are persuaded that Petitioner has demonstrated a reasonable likelihood of prevailing on this asserted ground.

We discussed Chen and Wang above.

1. Choi

Choi describes a supply modulator for envelope tracking. Ex. 1208, at Ex. A, at 1074. Figure 5 of Choi, which is reproduced below, illustrates such supply modulator.

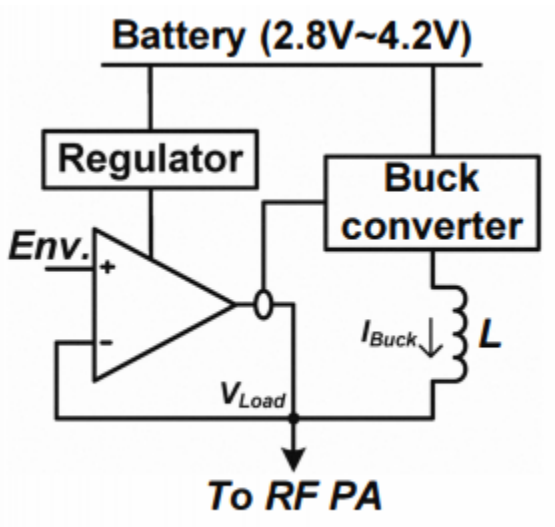


Fig. 5. Battery-to-5V boosting PA supply modulator.

In particular, Figure 5 of Choi shows the architecture of a power amplifier supply modulator that dynamically regulates a power amplifier. *Id.* The supply modulator employs a hybrid switching amplifier (HSA), which comprises the linear amplifier, regulator, and switching buck converter. *Id.* at 1074, Fig. 4. The linear amplifier receives an envelope signal designated as "Env." *See id.* at Fig. 5. The regulator operates as an independent voltage source, and the buck converter operates as a dependent current source, supplying most of the current needed at the output. *Id.* at 1075. A current sensing unit detects the current flowing from the linear amplifier to the output and changes the state of the switching amplifier according to the sensed current. *Id.* An additional boost converter, whose input range is from 2.8 V to 4.2 V, is coupled to the supply of the linear amplifier, which regulates the load voltage. *Id.*

2. Analysis

Claim 8 depends from claim 7, which depends from claim 1. For the reasons given above, we determine that Petitioner has demonstrated a

reasonable likelihood of prevailing on its assertion that claims 1 and 7 would have been obvious over Chen and Wang. *See supra* Section III.D. Claim 7 recites that the "power supply generator" comprises "a power tracking amplifier configured to receive the power tracking signal and generate the power supply voltage." As discussed above with respect to claim 1, Chen teaches that its envelope *amplifier* (which Petitioner identifies as the "power supply generator") receives the envelope combiner's output signal (which Petitioner identifies as the "power tracking signal") and generates signal ED(t) (which Petitioner identifies as the "power supply voltage"). Ex. 1212, Fig. 1; Pet. 22, 38–39.

Claim 8 recites that the "power supply generator" further comprises "a switcher configured to sense a first current from the power tracking amplifier and provide a second current for the power supply voltage based on the sensed first current." For this limitation, Petitioner relies on Choi. In particular, Petitioner identifies Choi's hybrid switching amplifier as a "power supply generator," Choi's linear amplifier as a "power tracking amplifier," and Choi's buck converter as a "switcher." Pet. 65–67. Referring to Figure 5 of Choi, Petitioner contends that "[t]he buck converter is shown as sensing the current from the linear amplifier . . . and providing a supply current (I_{Buck}) for the power supply voltage ('To RF PA') based on the sensed current, in order to assist the linear amplifier." *Id.* at 67 (citing Ex. 1208, at Ex. A, at 1075). Petitioner further contends that an ordinarily skilled artisan would have been motivated to further modify the combination of Chen and Wang discussed above to include Choi's hybrid switching amplifier in order to "reduce waste of power and increase efficiency" as well as to "obtain robustness against battery depletion" *Id.* at 69–70 (citing

Ex. 1208, at Ex. A, at 1074–1075). Petitioner relies on the declaration testimony of Dr. Choi. *Id.* (citing Ex. 1203 ¶¶ 176, 178).

Based on the record before us, at this stage of the proceeding, we are persuaded that Petitioner has established sufficiently for purposes of this Decision that the combination of Chen, Wang, and Choi teaches the recited "power supply generator." We also are persuaded that Petitioner's proffered reasoning for further modifying the combination of Chen and Wang to include Choi's hybrid switching amplifier is sufficient to support the legal conclusion of obviousness. *See Kahn*, 441 F.3d at 988.

Claim 9 depends from claim 7, which depends from claim 1, and recites that the "power supply generator" further comprises "a boost converter configured to receive a battery voltage and provide a boosted voltage for the power tracking amplifier." Claim 10 depends from claim 9 and recites that "the power tracking amplifier operates based on the boosted voltage or the battery voltage." For these limitations, Petitioner identifies Choi's additional boost converter as a "boost converter." As discussed above, Choi's additional boost converter, whose input range is from 2.8 V to 4.2 V, is coupled to the supply of the linear amplifier. Ex. 1208, at Ex. A, at 1075. Accordingly, based on the record before us, we are persuaded at this stage of the proceeding that Petitioner has established sufficiently for purposes of this Decision that the combination of Chen, Wang, and Choi discussed above teaches the recited "power supply generator" and the recited "power tracking amplifier."

Patent Owner does not respond to Petitioner's arguments regarding claims 8–10. *See generally* Prelim. Resp. In view of the foregoing, we determine that Petitioner has demonstrated a reasonable likelihood of

prevailing on its assertion that these claims would have been obvious over Chen, Wang, and Choi.

G. Obviousness over Chen, Wang, and Dahlman

Petitioner asserts that claims 13–15 and 23–25 of the '675 patent would have been obvious over Chen, Wang, and Dahlman. Pet.73–81. For the reasons explained below, we are persuaded that Petitioner has demonstrated a reasonable likelihood of prevailing on this asserted ground.

We discussed Chen and Wang above.

1. Dahlman

Dahlman is a book entitled "4G LTE / LTE-Advanced for Mobile Broadband." One of Dahlman's chapters describes carrier aggregation. Ex. 1206, 104. Figure 7.4 of Dahlman is reproduced below.

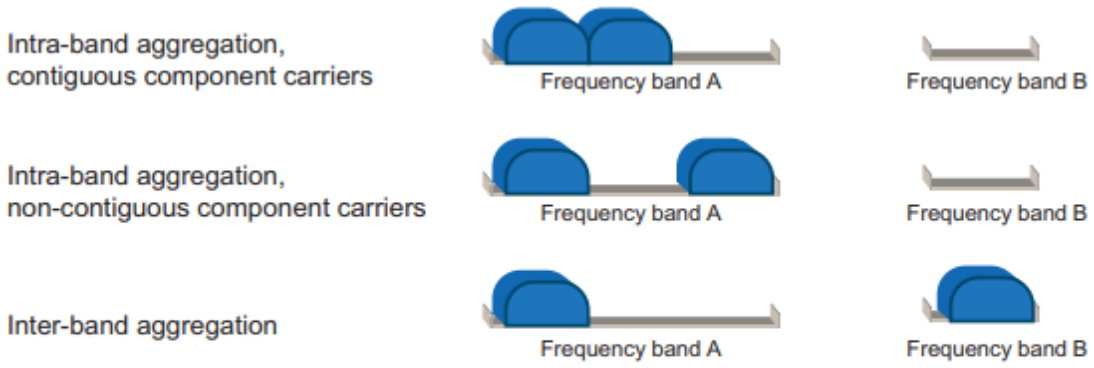


FIGURE 7.4

Carrier aggregation.

Figure 7.4 of Dahlman illustrates various types of carrier aggregation. *Id.* at Fig. 7.4. For example, the figure shows intra-band aggregation with

contiguous component carriers, intra-band aggregation with non-contiguous component carriers, and inter-band aggregation. *Id.*

2. Analysis

Claim 13 depends from claim 1 and recites that "the carrier aggregated transmit signals are intra-band carrier aggregated transmit signals." Claim 14, which depends from claim 13, recites that the "intra-band carrier aggregated transmit signals are contiguous." Claim 15, which also depends from claim 13, recites that the "intra-band carrier aggregated transmit signals are non-contiguous." Claims 23–25 recite similar limitations as claims 13–15, respectively, and Petitioner analyzes the claims together (*see* Pet. 74–81).

In particular, Petitioner relies on Dahlman, directing us to Figure 7.4 of Dahlman, which is reproduced above. Pet. 75, 79–80. As discussed above, the figure shows intra-band aggregation with contiguous component carriers and intra-band aggregation with non-contiguous component carriers. Ex. 1206, Fig. 7.4. Petitioner contends:

> A [person of ordinary skill in the art] . . . would have been motivated to combine Chen's architecture (as modified in view of Wang) with Dahlman's disclosure of the LTE and/or LTE-Advanced wireless communications standard in order to implement different and potentially better ways of aggregating carrier signals for transmission in the Chen architecture and so that it would comply with the LTE standard, which requires intra-band carrier aggregation.

Pet. 77. Petitioner relies on the declaration testimony of Dr. Choi. *Id.* (citing Ex. 1203 ¶ 194).

Based on the record before us, at this stage of the proceeding, we are persuaded that Petitioner has established sufficiently for purposes of this Decision that the combination of Chen, Wang, and Dahlman teaches the recited "carrier aggregated transmit signals." We also are persuaded that Petitioner's proffered reasoning for further modifying the combination of Chen and Wang to include Dahlman's aggregation schemes, namely, to provide a way to carry out Chen's signaling, is sufficient to support the legal conclusion of obviousness. *See Kahn*, 441 F.3d at 988.

Patent Owner does not respond to Petitioner's arguments regarding claims 13–15 and 23–25. *See generally* Prelim. Resp. In view of the foregoing, we determine that Petitioner has demonstrated a reasonable likelihood of prevailing on its assertion that these claims would have been obvious over Chen, Wang, and Dahlman.

IV. CONCLUSION

For the foregoing reasons, we are persuaded that Petitioner has demonstrated a reasonable likelihood that it will prevail in showing that claims 1–3, 5, 7–15, 17–21, 23–25, and 27 of the '675 patent are unpatentable. We have not made a final determination, however, with respect to the patentability of these claims.

V. ORDER

For the reasons given, it is

ORDERED that *inter partes* review is instituted as to all challenged claims of the '675 patent, namely, claims 1–3, 5, 7–15, 17–21, 23–25, and 27, based on all the grounds presented in the Petition:

A. Obviousness under 35 U.S.C. §103 of claims 1–3, 5, 7, 11, 17–21, and 27 over Chen and Wang;

B. Obviousness under 35 U.S.C. §103 of claim 12 over Chen, Wang, and Eliezer;

C. Obviousness under 35 U.S.C. §103 of claims 8–10 over Chen, Wang, and Choi; and

D. Obviousness under 35 U.S.C. §103 of claims 13–15 and 23–25 over Chen, Wang, and Dahlman;

FURTHER ORDERED that no other grounds of unpatentability are authorized for an *inter partes* review as to any claim of the ’675 patent; and

FURTHER ORDERED that, pursuant to 35 U.S.C. § 314(c) and 37 C.F.R. § 42.4, notice is hereby given of the institution of a trial; the trial will commence on the entry date of this Decision.

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