Trials@uspto.gov
571-272-7822

Paper 8
Entered: July 10, 2019

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

INTEL CORPORATION,
Petitioner

v.

QUALCOMM INCORPORATED,
Patent Owner.

Case IPR2019-00049
Patent 9,154,356 B2

Before DANIEL N. FISHMAN, MICHELLE N. WORMMEESTER, and AARON W. MOORE, *Administrative Patent Judges*.

MOORE, *Administrative Patent Judge*.

DECISION
Instituting *Inter Partes* Review
37 C.F.R. § 42.108

I. INTRODUCTION

Intel Corporation ("Petitioner") filed a Petition for *inter partes* review of claims 2–8 and 11 of U.S. Patent No. 9,154,356 B2 (Ex. 1201, "'356 patent").[1] Paper 3 ("Pet."). Qualcomm Incorporated ("Patent Owner") filed a Preliminary Response. Paper 7 ("Prelim. Resp.").

Institution of an *inter partes* review is authorized by statute when "the information presented in the petition . . . and any response . . . shows that there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition." 35 U.S.C. § 314(a); *see* 37 C.F.R. § 42.108.

Having considered the Petition, the Preliminary Response, and the evidence of record, we conclude there *is* a reasonable likelihood that Petitioner will prevail in establishing the unpatentability of at least one challenged claim of the '356 patent and, therefore, institute *inter partes* review.

A. Related Matters

Petitioner filed two petitions, IPR2019-00128 (the "'128 petition") and IPR2019-00129 (the "'129 petition"), seeking *inter partes* review of claims 1–8, 10, 11, 17, and 18 of the '356 patent based on prior art different than that presented in this petition. We instituted reviews in those petitions on May 29, 2019.

Petitioner filed another petition in IPR2019-00047 (the "'047 petition"), seeking *inter partes* review of claims 1, 7, 8, 10, 11, 17, and 18 of

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[1] Petitioner states that the real parties-in-interest are "Intel and Apple Inc." Pet. 1.

the '356 patent based on prior art different than that presented in this petition and the '128 and '129 petitions, and filed another petition, IPR2019-00048 (the "'048 petition"), seeking *inter partes* review of claims 1, 9, 10, 17, and 18 of the '356 patent based on the same prior art presented in this petition.

The Petition states that Patent Owner "has asserted the '356 patent against Apple in *Certain Mobile Electronic Devices and Radio Frequency and Processing Components Thereof*, Investigation No. 337-ITC-1093, currently pending before the International Trade Commission" and "also has asserted the '356 patent against Apple in another currently pending case, *Qualcomm Inc. v. Apple Inc.*, No. 3:17-cv-02398 (S.D. Cal.)." Pet. 1. In updated mandatory notices filed in IPR2019-00128 on May 24, 2019, Petitioner advised the Board that the private parties to the 1093 ITC investigation have moved to terminate, and that the 17-cv-02398 District Court litigation has been dismissed.

B. The '356 Patent

The '356 Patent is directed to "[l]ow noise amplifiers . . . supporting carrier aggregation." '356 Patent, Abstract. In the embodiment described in the Abstract, an "input RF signal includes transmissions sent on multiple carriers at different frequencies," a "first amplifier stage receives and amplifies [the input signal] and provides a first output RF signal to a first load circuit when the first amplifier stage is enabled," and a "second amplifier stage receives and amplifies the input RF signal and provides a second output RF signal to a second load circuit when the second amplifier stage is enabled." *Id*.

Figure 6A details an example of a low noise amplifier according to the '356 patent:

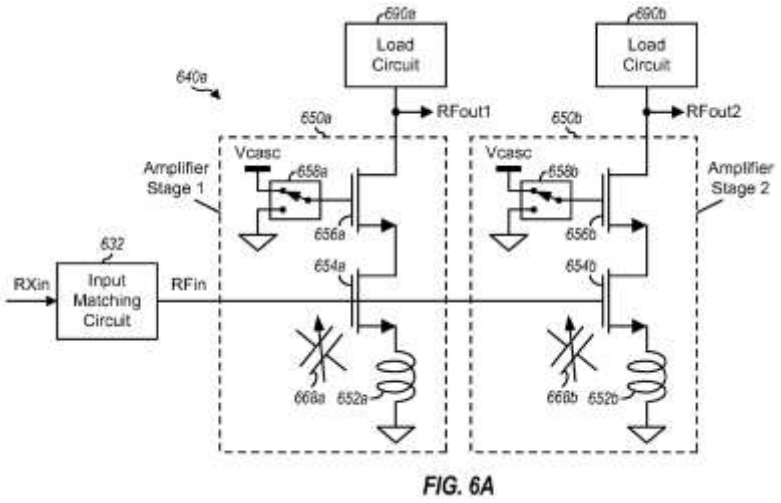

FIG. 6A

Figure 6A shows "an LNA with inductive degeneration and cascode shutoff." '356 Patent 1:54–55.

Amplifier stage 650a includes source degeneration inductor 652a, gain transistor 654a, cascode transistor 656a, and switch 658a. *See* '356 Patent 7:58–8:4. Similarly, amplifier stage 650b includes source degeneration inductor 652b, gain transistor 654b, cascode transistor 656b, and switch 658b. *See id.* at 8:4–9. Amplifier stages 650a and 650b are both coupled to common input matching circuit 632 and to respective load circuits 690a and 690b. *See id.* at 7:47–49.

In operation, matching circuit 632 receives receiver input signal RXin, performs input matching for low noise amplifier 640a, and provides input RF signal RFin to low noise amplifier 640a. *See* '356 Patent 7:49–52. Input RF signal RFin may include transmissions on one set of carriers or transmissions on two sets of carriers in the same band, with each set including one or more carriers. *See id.* at 7:55–57, 8:16–18, 8:30–32. An

RF signal with transmissions on multiple sets of carriers is called a carrier aggregated RF signal. *See id.* at 8:16–18.

Low noise amplifier 640a operates in either a non-carrier aggregation (non-CA) mode or a carrier aggregation (CA) mode, depending on the type of input RF signal it receives. *See* '356 Patent 8:24–32, 8:36–44. In the non-CA mode, low noise amplifier 640a receives transmissions on one set of carriers and provides one output RF signal to one load circuit. *See id.* at 8:30–32. Only one amplifier stage is enabled, while the other amplifier stage is disabled. *See id.* at 8:46–47. This is illustrated in Figure 6C:

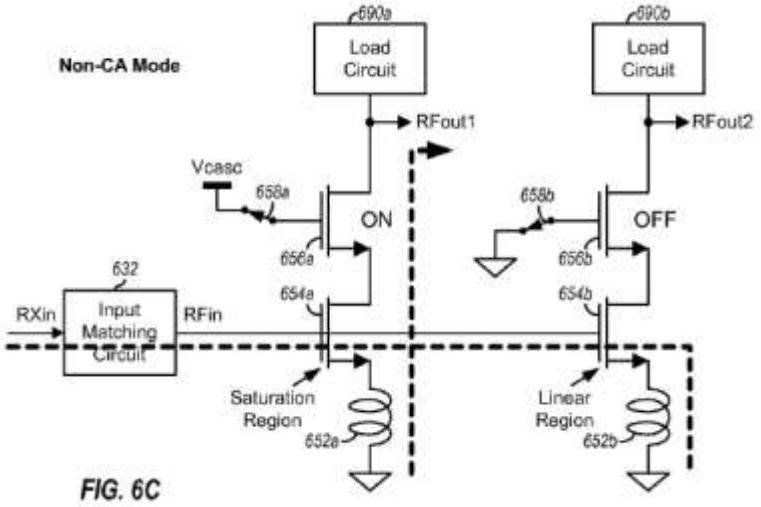

Figure 6C shows "an LNA with inductive degeneration and cascode shutoff." '356 Patent 1:54–55.

Amplifier stage 650a is enabled by connecting the gate of cascode transistor 656a to the Vcasc voltage via switch 658a, and amplifier stage 650b is disabled by shorting the gate of cascode transistor 656b to circuit ground via switch 658b. *See* '356 Patent 8:47–52. Amplifier stage 650a amplifies the input RF signal and provides an output RF signal to load circuit 690a. *See id.* at 8:52–54.

In the CA mode, low noise amplifier 640a receives transmissions on two sets of carriers and provides two output RF signals to two load circuits, one output RF signal for each set of carriers and both amplifier stages are enabled. *See* '356 Patent 8:32–38. This is shown in Figure 6B:

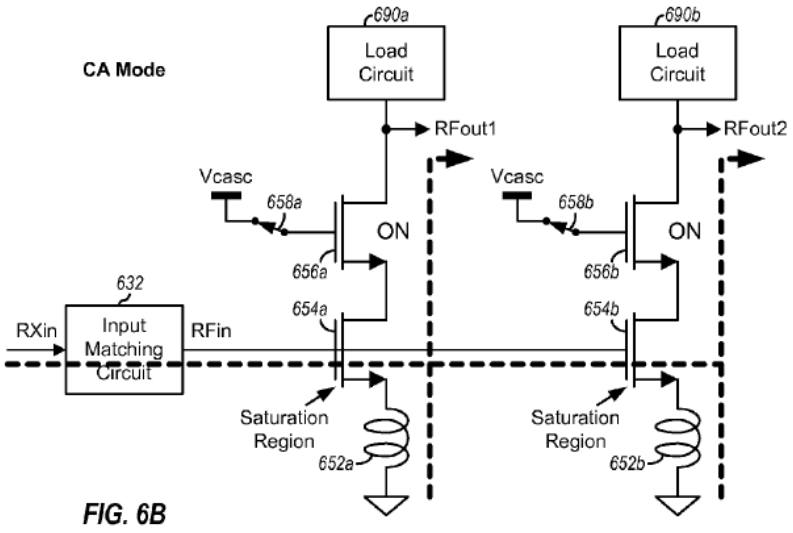

Figure 6B shows "an LNA with inductive degeneration and cascode shutoff." '356 Patent 1:54–55.

Amplifier stages 650a and 650b are enabled by connecting the gate of cascode transistor 656a to the Vcasc voltage via switch 658a and coupling the gate of cascode transistor 656b to the Vcasc voltage via switch 658b. *See* '356 Patent 8:37–40. The carrier aggregated RF signal splits at the input of low noise amplifier 640a, and then amplifier stages 650a and 650b amplify the carrier aggregated RF signal and provide two output RF signals to two separate downconverters in load circuits 690a and 690b. *See id.* at 8:21–28. Specifically, amplifier stage 650a amplifies the input RF signal and provides the first output RF signal to load circuit 690a. *See id.* at 8:41–42. Similarly, amplifier stage 650b amplifies the input RF signal and provides the second output RF signal to load circuit 690b. *See id.* at 8:42–44.

C. Illustrative Claim

All of the claims challenged in this Petition depend from claim 1, which is thus indicative of the subject matter addressed in this proceeding:

> 1. An apparatus comprising:
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> a first amplifier stage configured to be independently enabled or disabled, the first amplifier stage further configured to receive and amplify an input radio frequency (RF) signal and provide a first output RF signal to a first load circuit when the first amplifier stage is enabled, the input RF signal employing carrier aggregation comprising transmissions sent on multiple carriers at different frequencies to a wireless device, the first output RF signal including at least a first carrier of the multiple carriers; and
>
> a second amplifier stage configured to be independently enabled or disabled, the second amplifier stage further configured to receive and amplify the input RF signal and provide a second output RF signal to a second load circuit when the second amplifier stage is enabled, the second output RF signal including at least a second carrier of the multiple carriers different than the first carrier.

'356 Patent 20:43–61.

D. Asserted Grounds of Unpatentability

Petitioner asserts that claims 2–8 and 11 are unpatentable on the following grounds:

References	Basis	Claims
Jeon[2] and Xiong[3]	§ 103	2–8 and 11

[2] Jeon et al., *A Scalable 6-to-18 GHz Concurrent Dual-Band Quad-Beam Phased-Array Receiver in CMOS*, IEEE Journal of Solid-State Circuits, Vol. 43, No. 12, 2660–2673 (2008) (Ex. 1205).

[3] Xiong et al., US 2010/0237947 A1 (Ex. 1206).

References	Basis	Claims
Jeon, Xiong, and the Feasibility Study[4]	§ 103	2–8 and 11

Petitioner also relies on a Declaration of Patrick Fay, Ph.D., filed as Exhibit 1202.

II. DISCUSSION

A. 35 U.S.C. § 314(a)

Patent Owner argues that "Petitioner challenges overlapping claims with redundant references and arguments across two petitions" and "[t]he Board should exercise its discretion under 35 U.S.C. § 314(a) to deny Petitioner's serial attacks on the same claims of the '356 Patent." Prelim. Resp. 7. Patent Owner asserts that "Petitioner challenges dependent claims 2–6 in two separate petitions and four different invalidity grounds" and "Petitioner thus challenges nearly overlapping sets of claims with grounds that are substantially the same as each other and applied in the same manner." Prelim. Resp. 8–9. Patent Owner further argues that the combinations involving the Feasibility Study "are cumulative to one another." *Id.* at 9.

We first observe that these petitions were filed within days of each other and, thus, are not "serial" petitions, as Patent Owner argues. We also do not agree with Patent Owner that this petition is "redundant" or "cumulative" of the '129 petition. That petition alleges that the independent

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[4] *3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Feasibility Study for Further Advancements for E-UTRA (LTE-Advanced) (Release 9)*, 3GPP TR 36.912, v9.1.0 (December 2009) (Ex. 1204).

claims are unpatentable as anticipated by Lee or, if Lee is found not to disclose "carrier aggregation," then unpatentable in view of Lee and the Feasibility Study. *See* IPR 2019-00129, Paper 3, 41–79. That case thus presents what is primarily an anticipation argument, in which the main reference is alleged to show two amplifiers that are independently switchable. This case, on the other hand, alleges that one reference, Jeon, teaches the use of two amplifiers and that it would have been obvious in view of the teachings of another reference, Xiong, to make those amplifiers independently switchable. Because this case presents both different primary references and a fundamentally different theory of unpatentability—obviousness instead of anticipation—we decline to exercise our discretion to deny institution due to the '129 petition.

B. Level of Skill in the Art

The level of skill in the art is a factual determination that provides a primary guarantee of objectivity in an obviousness analysis. *See Al-Site Corp. v. VSI Int'l, Inc.*, 174 F.3d 1308, 1323 (Fed. Cir. 1999) (citing *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966)). The level of skill in the art also informs the claim construction analysis. *See Teva Pharm. USA, Inc. v. Sandoz, Inc.*, 135 S. Ct. 831, 841 (2015) (explaining that claim construction seeks the meaning "a skilled artisan would ascribe" to the claim term "in the context of the specific patent claim").

Petitioner asserts that a person of ordinary skill in the art "would have had at least an M.S. degree in electrical engineering (or equivalent experience) and would have had at least two years of experience with the structure and operation of RF transceivers and related structures (or the

equivalent)." Pet. 34 (citing Fay Decl. ¶ 57). Patent Owner does not address this issue in the Preliminary Response.

As Patent Owner does not dispute Petitioner's characterization of the level of skill in the art, we adopt it for purposes of this analysis.

C. Claim Construction

In *inter partes* reviews filed before November 13, 2018, such as this one, the Board construes claims in an unexpired patent according to their broadest reasonable construction in light of the specification of the patent in which they appear. *See Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 2131, 2144–46 (2016); 83 Fed. Reg. 51,340. The broadest reasonable construction is the "ordinary and customary meaning" to a person of ordinary skill in the art at the time of invention. *See In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007); *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–14 (Fed. Cir. 2005) (en banc).

Petitioner asserts that "carrier aggregation" should be construed as "simultaneous operation on multiple carriers." Pet. 30. Patent Owner "submits that no terms must be construed at this stage in the proceeding" but "reserves the right to put forth constructions of particular claim terms and to rebut constructions proffered in the petition as relevant to the patentability of the claims should trial be instituted." Prelim. Resp. 7.

Given the record before us, we do not find it necessary to engage in formal claim construction at this stage. *See Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co. Ltd.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (explaining that construction is needed only for terms that are in dispute, and only to the extent necessary to resolve the controversy).

D. Ground 1: Jeon and Xiong

Ground 1 alleges that dependent claims 2–8 and 11 are unpatentable under 35 U.S.C. § 103(a) in view of Jeon and Xiong. *See* Pet. 41–80.

1. Jeon

Jeon is a paper that describes a tunable concurrent amplifier ("TCA") for use in a concurrent dual-band receiver that receives an incoming RF signal that contains two frequencies, one in a low-band ("LB") and one in a high band ("HB"). *See* Jeon 2663. The TCA "amplifies, filters, and finally splits the RF signal into two separate outputs; one at LB and the other at HB." *Id*. These two signals go through "separate double down-conversion by subsequent RF and IF mixers." *Id*. Figure 6 of Jeon shows how the TCA receives an input signal ("RF Input") that includes the LB and HB frequencies, where LB and HB are amplified by separate cascode amplifiers "M1-M2" and "M3-M4":

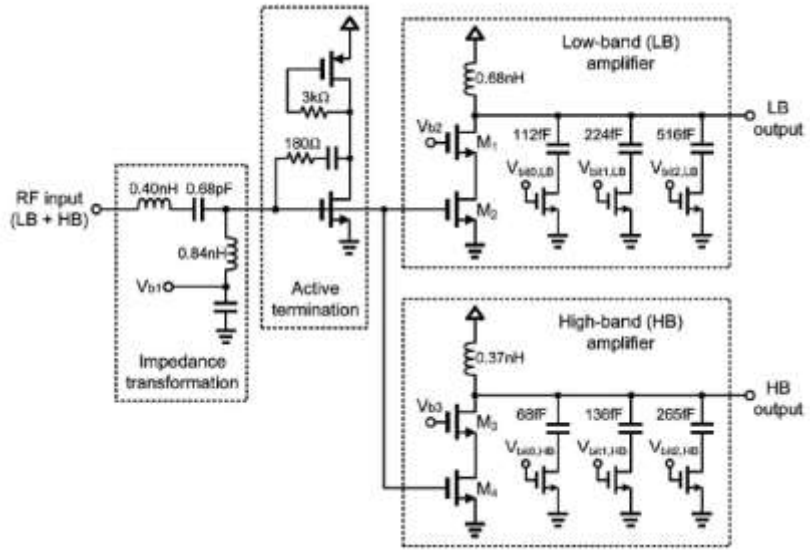

Figure 6 of Jeon is a "[s]chematic of [a] TCA with a single input and a dual output." Jeon 2664.

2. Xiong

Xiong is a patent application directed to "[t]echniques for designing a low-noise amplifier (LNA) for operation over a wide range of input power levels." Xiong, Abstract. The reference describes a low-noise ("LN") mode in which both gain paths (amplifiers) are enabled, and a high-linearity ("HL") mode, in which the only one gain path is enabled. *Id.* ¶ 29. It further explains that "the total gain provided to the input signal RF IN may advantageously be adjusted by selectively enabling or disabling the first and/or second gain paths." *Id.* ¶ 30. Figure 3 of Xiong shows switches SW1 335 and SW2 325 controlling gain paths 301 and 302:

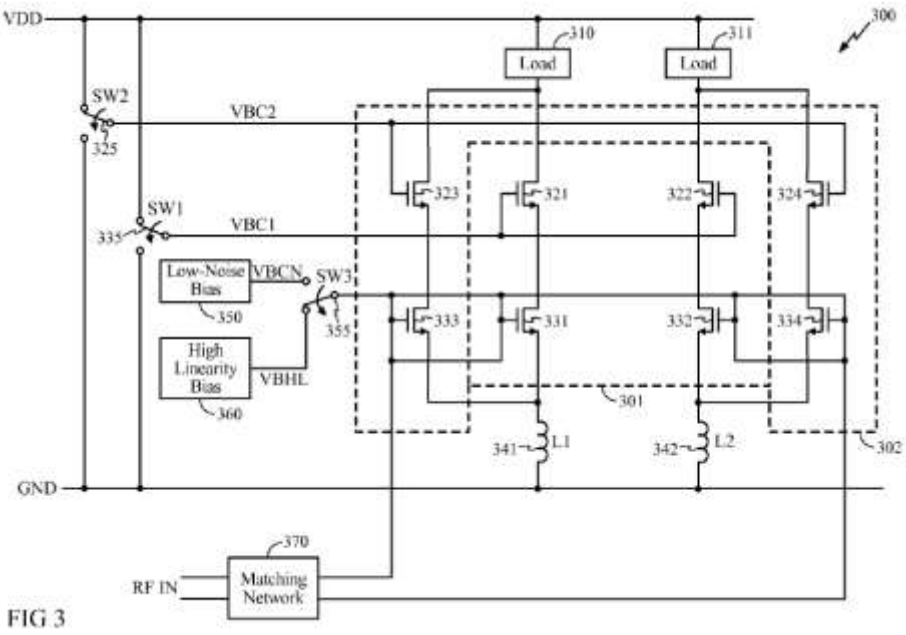

FIG 3

"FIG. 3 illustrates an implementation of an LNA that adopts a dual architecture." Xiong ¶ 9.

3. Mapping Claim 2 to Jeon and Xiong

Petitioner provides the following mapping of the limitations of challenged claim 2, including the limitations of claim 1 (which is not challenged), onto the combination of Jeon and Xiong. *See* Pet. 41–64.

a. First Amplifier Stage

Claim 1 recites "a first amplifier stage" that is "configured to be independently enabled or disabled" and "configured to receive and amplify an input radio frequency (RF) signal and provide a first output RF signal to a first load circuit when the first amplifier stage is enabled."

Petitioner asserts that "Jeon teaches a first amplifier stage," as it "states that '[t]he [tunable concurrent amplifier] is implemented in a parallel cascode configuration'" and describes how "[a]n incoming input RF signal is 'selectively amplified by two separate cascode amplifiers (M1-M2, M3-M4) that have tunable LC output loads.'" Pet. 43 (citing Jeon 2665; Fay Decl. ¶ 79).

Petitioner acknowledges that "Jeon does not teach whether the low-band amplifier is configured to be independently enabled or disabled," but asserts that "Xiong teaches a first amplifier stage that is independently enabled or disabled with switches." Pet. 44. Specifically, Petitioner argues that Figure 3 of Xiong "show[s] a switch being used to selectively enable and disable [a] first amplifier stage." *Id.* at 46.

Petitioner further argues that one would have been motivated to modify Jeon so as "to turn off unused circuitry to achieve lower power consumption during single-band operation." Pet. 48 (citing Xiong ¶ 34; Fay Decl. ¶ 85). Petitioner asserts that "[m]odifying Jeon in this way would have amounted to no more than combining the prior art elements of the

amplifiers of Jeon and switches of Xiong according to known methods to yield the predictable result of an amplifier that can operate in a concurrent dual-band mode or a single-band mode without consuming excess power" and that "[t]here would have been a reasonable expectation of success because the combinations could have been implemented with well-known circuit design and manufacturing techniques and would have produced predictable results." *Id*. at 48–49.

Regarding the RF signals, Petitioner asserts that "Figure 6 of Jeon shows the first amplifier stage (LB amplifier) configured to receive and amplify an input RF signal (RF input) and provide a first output RF signal (LB output) to a first load circuit, which Jeon explains goes to a mixer" and that "[t]he LB output is an output RF signal because it has not undergone downconversion until it reaches the RF and IF mixers." *Id*. at 48–50 (citing Fay Decl. ¶ 87). Petitioner argues that "[a] POSITA would have understood that [Jeon's] first amplifier stage amplifies the input RF signal and provides an output RF signal only when the first amplifier stage is enabled," and that, in the alternative, "[c]ombining Xiong's enabling/disabling capability with Jeon's amplifier stages results in an amplifier stage that amplifies and provides output 'when enabled.'" *Id*. at 49–50.

b. Input RF Signal and First Output RF Signal

Claim 1 next recites that "the input RF signal employ[s] carrier aggregation comprising transmissions sent on multiple carriers at different frequencies to a wireless device" and that "the first output RF signal includ[es] at least a first carrier of the multiple carriers."

Petitioner asserts that "[t]he input RF signal received by the tunable concurrent amplifier in Figure 6 of Jeon is "a dual-band signal containing

two different frequencies concurrently, one in the low band (LB) from 6 to 10.4 GHz and the other in the high band (HB) from 10.4 to 18 GHz." Pet. 51 (citing Jeon 2662). According to Petitioner, "[a] POSITA would have understood that 'low' and 'high band' refer to nonoverlapping frequency ranges that include different carriers" and that "that the (first) low-band frequency in Jeon was a different carrier at a different frequency than the (second) high-band frequency." *Id.* at 51–52.

Petitioner further argues that "Jeon [teaches] 'a dual-band signal containing two different frequencies concurrently," which teaches carrier aggregation under [Petitioner's] proposed construction, and that Jeon also includes "carrier aggregation" under a construction Patent Owner pursued in the ITC. *See* Pet. 52–53.

c. Second Amplifier Stage

Claim 1 further recites "a second amplifier stage" that is "configured to be independently enabled or disabled" and "configured to receive and amplify the input RF signal and provide a second output RF signal to a second load circuit when the second amplifier stage is enabled."

Petitioner argues that Figure 6 of Jeon "shows a second amplifier stage comprising the transistors M4 (gain transistor) coupled to M3 (cascode transistor)," and relies on Xiong for teaching "that the second amplifier stage is configured to be independently enabled or disabled," with analysis similar to that regarding the first amplifier. *See* Pet. 55–57.

d. Second Output RF Signal

Finally, claim 1 recites that the second output RF signal "includ[es] at least a second carrier of the multiple carriers different than the first carrier."

For this last limitation of claim 1, Petitioner argues that "the HB amplifier stage in Jeon 'receive[s] a dual-band signal containing two different frequencies concurrently, one in the low band (LB) from 6 to 10.4 GHz and the other in the high band (HB) from 10.4 to 18 GHz.'" Pet. 60 (citing Jeon 2662).

e. Gain Transistors

Claim 2 recites that the first amplifier stage comprises "a first gain transistor coupled to a first cascode transistor," that the second amplifier stage comprises "a second gain transistor coupled to a second cascode transistor, and that "the input RF signal [is] provided to both the first and second gain transistors."

Petitioner asserts that the LB amplifier in Jeon's Figure 6 "comprises the transconductance transistor M2 . . . coupled to the cascode transistor M1," that "a transconductance transistor is a gain transistor that converts voltage to current," and that Jeon thus "teaches a first amplifier stage comprising a first gain transistor coupled to a first cascode transistor." Pet. 62–63. Petitioner similarly identifies transconductance transistor M4 as the second gain transistor coupled to a second cascode transistor. *See id.* at 62–63. Petitioner then asserts that in Jeon "an incoming RF signal 'feeds a tunable concurrent amplifier (TCA),' which 'amplifies, filters, and finally splits the input RF signal into two separate outputs'" and "the input RF signal is provided to both M2 (the first gain transistor of the first amplifier stage) and M4 (the second gain transistor of the second amplifier stage)." *Id.* at 63 (citing Jeon 2663; Fay Decl. 102).

4. Ground 1 Conclusion

Patent Owner does not respond to Petitioner's analysis of claims 1 or 2 and, on the current record, we find Petitioner has sufficiently shown that the combination of Jeon and Xiong discloses the features of claim 2. With respect to a motivation to combine, we observe that Xiong differs from what is claimed in that it uses switches to apply variable levels of gain to a signal, not for purposes of selective power saving, and that paragraph 34 describes the inclusion of otherwise unnecessary switch 335 to turn off "the entire LNA," not just a portion of the LNA. Nevertheless, in view of the record as a whole, as developed to date, we find that Petitioner has sufficiently articulated a motivation to combine for purposes of institution.

For these reasons, we conclude that Petitioner has demonstrated a reasonable likelihood of prevailing on its assertion that claim 2 would have been obvious in view of Jeon and Xiong.

Patent Owner does not respond to Petitioner's analysis of claims 3–8 and 11 and, for the reasons stated in the Petition (*see* Pet. 64–80), we determine that Petitioner has also shown a reasonable likelihood of prevailing as to those claims.

5. Ground 2: Adding the Feasibility Study

Ground 2 is the same as ground 1, except that Petitioner adds the Feasibility Study. *See* Pet. 80–84. The Feasibility Study is a 3GPP (Third Generation Partnership Project) technical report that considers technology components for the evolution of E-UTRA (Evolved Universal Mobile Telecommunications System Terrestrial Radio Access). *See* Feasibility Study 6–8.

Petitioner contends that "[t]o the extent Patent Owner argues that Jeon in view of Xiong fails to teach an input RF signal employing carrier aggregation, . . . the Feasibility Study also discloses this element." Pet. 80–81. Petitioner argues that "[t]he Feasibility Study teaches that 'LTE-Advanced extends LTE release 8 with support for Carrier Aggregation, where two or more component carriers (CC) are aggregated in order to support wider transmission bandwidths up to 100MHz and for spectrum aggregation'" and that a "terminal may simultaneously receive one or multiple component carriers depending on its capabilities.'" *Id*. at 81–83 (citing Feasibility Study 8; Fay Decl. ¶ 133). Petitioner contends that one "would have been motivated to use the Feasibility Study's carrier-aggregated input RF signal with the Jeon/Xiong front-end architecture because of the benefits of carrier aggregation identified in the Feasibility Study" and that "[f]or example, the Feasibility Study teaches that carrier aggregation provides wider transmission bandwidths and spectrum aggregation and is supported by the LTE-Advanced standard." Pet. 82–83 (citing Feasibility Study, 8; Fay Decl. ¶¶ 128, 130).

On the record before us, we are persuaded that Petitioner has sufficiently shown that the Feasibility Study teaches an "input RF signal employing carrier aggregation" and that Petitioner's motivation to combine is sufficient to support the legal conclusion of obviousness.

For the remaining limitations of claim 2, as well as the limitations of claims 3–8 and 11, Petitioner relies on its arguments with respect to the combination of Jeon and Xiong. *See* Pet. 83–84. Because, as discussed above, we are persuaded by those arguments, we determine that Petitioner has demonstrated a reasonable likelihood of prevailing on its assertions that

claims 2–8 and 11 would have been obvious over Jeon, Xiong, and the Feasibility Study.

III. CONCLUSION

Petitioner demonstrates a reasonable likelihood of prevailing in showing the unpatentability of claims 2–8 and 11 of the '356 patent.

IV. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that, pursuant to 35 U.S.C. § 314(a), an *inter partes* review is hereby instituted as to all challenged claims 2–8 and 11 of the '356 patent, on all the grounds of unpatentability presented in the Petition:

References	Basis	Claims
Jeon and Xiong	§ 103	2–8 and 11
Jeon, Xiong, and the Feasibility Study	§ 103	2–8 and 11

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, which commences on the entry date of this Decision.

FOR PETITIONER:

David Cavanaugh
John Hobgood
Benjamin Fernandez
david.cavanaugh@wilmerhale.com
john.hobgood@wilmerhale.com
ben.fernandez@wilmerhale.com

FOR PATENT OWNER:

David B. Cochran
Matthew W. Johnson
Joseph M. Sauer
Joshua R. Nightingale
David M. Maiorana
dcochran@jonesday.com
mwjohnson@jonesday.com
jmsauer@jonesday.com
jrnightingale@jonesday.com
dmaiorana@jonesday.com