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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 IPR2019-00128

PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 9,154,356 CHALLENGING CLAIMS 1, 7, 8, 11, 17, and 18

TABLE OF CONTENTS

I. INTRODUCTION

Intel Corporation ("Intel" or "Petitioner") respectfully requests *Inter Partes* Review of claims 1, 7, 8, 11, 17, and 18 of U.S. Patent No. 9,154,356 (the "'356 patent") (EX1301-'356-Patent) pursuant to 35 U.S.C. §§311-19 and 37 C.F.R. §42.1 *et seq*.

II. MANDATORY NOTICES

A. Real Party-in-Interest

Intel and Apple Inc. ("Apple") are the real parties-in-interest.

B. Related Matters

Qualcomm Incorporated ("Qualcomm" or "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 ("ITC 1093 Investigation").

Qualcomm 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.) ("Related Matter No. 3:17-cv-02398").

Petitioner is filing the following other petitions for *inter partes* review of the '356 patent: IPR-2019-00047, IPR-2019-00048, IPR-2019-00049, and IPR-2019-00129.

Petitioner requests that these petitions be assigned to the same panel.

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Petitioner consents to email delivery on lead and backup counsel.

III. CERTIFICATION OF GROUNDS FOR STANDING

Petitioner certifies pursuant to Rule 42.104(a) that the patent for which review is sought is available for *inter partes* review and that Petitioner is not barred or estopped from requesting an *inter partes* review challenging the patent claims on the grounds identified in this Petition.

IV. OVERVIEW OF CHALLENGE AND RELIEF REQUESTED

Pursuant to Rules 42.22(a)(1) and 42.104(b)(1)-(2), Petitioner challenges claims 1, 7, 8, 11, 17, and 18 of the '356 patent.

A. Prior Art Patents and Printed Publications

The following references are pertinent to the grounds of unpatentability explained below:[1]

1. U.S. Patent Application Publication No. 2012/0056681 ("Lee" (EX1335-Lee)), filed on September 6, 2010, and published on March 8, 2012, is prior art under at least 35 U.S.C. §102(a) and §102(e).

2. 3GPP TR 36.912 V9.1.0; 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Feasibility study for Further Advancements for E-UTRA (LTE-Advanced) (Release 9) ("Feasibility Study" (EX1304-Study)), published on December 14, 2009, is prior art under at least 35 U.S.C. §102(a) and §102(b).[2]

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[1] The '356 patent issued from an application filed prior to enactment of the America Invents Act ("AIA"). Accordingly, the pre-AIA statutory framework applies.

[2] *See* Merias Decl. (EX1326); Rodermund Decl. (EX1327); TR 36.912 Webpage (EX1328).

Although the Patent Owner listed Lee in an Information Disclosure Statement more than a year before the introduction of the amendment that ultimately led to the allowance of the claims, Lee was not cited by the Examiner. The other reference was not before the Patent Office during prosecution.

B. Grounds for Challenge

Petitioner requests cancellation of claims 1, 7, 8, 11, 17, and 18 of the '356 patent as unpatentable under 35 U.S.C. §102 and §103. This Petition, supported by the declaration of Patrick Fay, Ph.D. (EX1302-Fay-Decl.), demonstrates that there is a reasonable likelihood that Petitioner will prevail with respect to cancellation of at least one challenged claim. *See* 35 U.S.C. §314(a). Petitioner respectfully requests institution on all challenged claims and on all the challenged grounds. *SAS Institute Inc. v. Iancu*, 138 S. Ct. 1348 (2018).

The '356 patent is asserted in both the ITC 1093 Investigation and Related Matter No. 3:17-cv-02398. The Board should not exercise its discretion and deny the petition based on 35 U.S.C. §314(a) or §325(d) for at least the following reasons (following the *General Plastic*[3] Factors): ***First***, the petitioner has not filed petitions other than those filed within days of the current petition. ***Second***, because

[3] *Gen. Plastic Indus. v. Canon Kabushiki Kaisha,* Case IPR2016-01357 et al., Paper 19 (Sept. 6, 2017).

there are no earlier petitions, Factors 2-5 do not apply. ***Third***, the presence of other disputes in different fora does not diminish the ability to provide a Final Written Decision not later than one year after the decision on Institution. Moreover, the ITC 1093 Investigation does not involve the same remedy, so even a finding of no violation in the ITC 1093 Investigation would not provide the same relief that Petitioner seeks in this proceeding. The district court case is not in an advanced stage and currently has a trial scheduled to start October 21, 2019. For each of these reasons, the Board should permit this *Inter Partes* Review proceeding move forward to trial.

V. BRIEF DESCRIPTION OF TECHNOLOGY

The '356 patent issued from U.S. Application No. 13/590,423, filed on August 21, 2012, and claims priority to U.S. Provisional Application No. 61/652,064, filed on May 25, 2012. In Related Matter No. 3:17-cv-02398, Patent Owner alleged a conception date of March 25, 2012 for the '356 patent ("Alleged Conception Date"). Petitioner disagrees that the '356 patent is entitled to a priority date earlier than May 25, 2012. However, even if entitled to a priority date of March 25, 2012, all challenged claims are unpatentable for the reasons set forth herein. *See* EX1302-Fay-Decl. ¶31, n.1.

The '356 patent relates to a low noise amplifier (LNA) within a radio frequency (RF) receiver configured to support carrier aggregation (CA). The

patent relies on prior art circuit components and well-known concepts related to the design of receivers for processing multi-frequency signals. This overview explains the basic operation and characteristics of such front-end receivers (i.e., the components between the antenna and the digital baseband system, including the filters, LNAs, and down conversion mixers that transform signals received at the antenna into baseband signals). These components were well-established background knowledge for those of ordinary skill in the art well before the Alleged Conception Date. EX1302-Fay-Decl. ¶31.

A. Basic Receiver Front End

A wireless communication system comprises a network of base stations and mobile devices. A mobile device, such as a cellular phone, has a receiver that receives radio frequency signals from multiple base stations, such as cell towers. The radio frequency signals sit within radio ***frequency bands*** of the electromagnetic spectrum. The FCC allocates radio frequency bands to specific applications, such as FM radio broadcasts. Within a frequency band, different ***carrier signals (or "carriers")*** carry different information. Each carrier occupies a certain frequency range when modulated to carry information. EX1302-Fay-Decl. ¶32.

The antenna of a receiver captures desired and undesired signals, including signals from frequency bands assigned to other applications and "interferer"

signals within the same band as the desired signals. The task of a receiver is to remove the undesired signals to extract only the carriers (frequencies) that carry the relevant information. The receiver does so by selectively filtering, amplifying, and down converting the signal. Figure 1 below shows a typical direct-conversion receiver (the type used in the '356 patent, EX1301-'356-Patent at Fig. 4B) where these steps are performed. EX1302-Fay-Decl. ¶33.

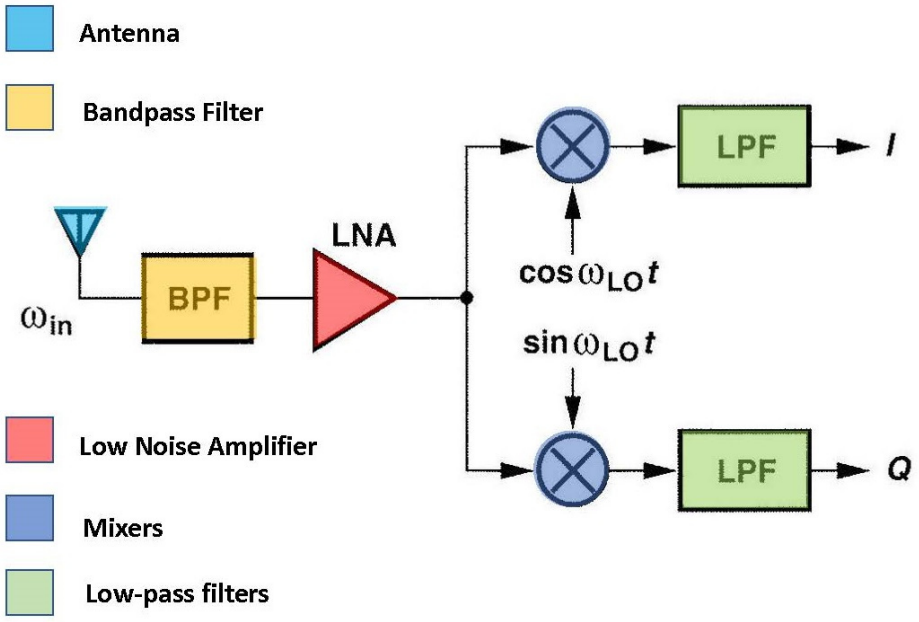


Figure 1. A direct-conversion receiver containing an antenna, a band-pass filter, a low noise amplifier, and two mixers coupled to low-pass filters.

The antenna in Figure 1 receives signals on desired and undesired frequencies. The band-pass filter (BPF) attenuates all frequencies that fall outside

the desired frequency band.[4] The low noise amplifier (LNA) increases the power of the remaining carriers by a gain factor.[5] Finally, the mixers down convert the frequencies to enable the low-pass filters (LPF) to select the specific carrier containing the relevant information. Figures 2-5 show a signal undergoing these various processing steps. EX1302-Fay-Decl. ¶34.

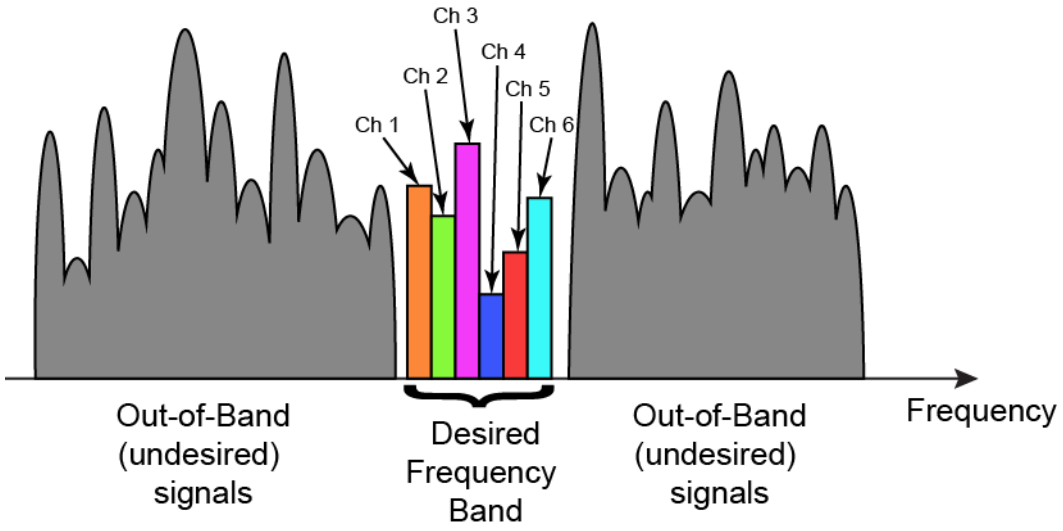


Figure 2. An input RF signal containing multiple frequencies as collected by the antenna.

[4] Attenuation is the opposite of amplifying. Although an amplifier increases the power, or amplitude, of a signal, resulting in a "gain," a filter decreases the amplitude of undesired frequencies. EX1302-Fay-Decl. ¶34, n.3.

[5] "Gain" is the measure of the increase in the amplitude, or power, of a signal as the result of the amplification. EX1302-Fay-Decl. ¶34, n.4.

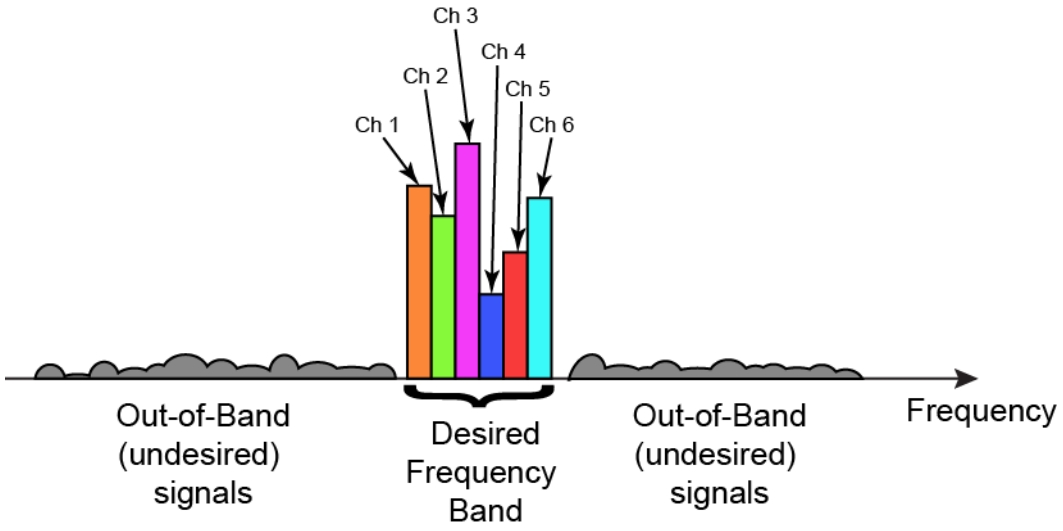


Figure 3. Frequencies in an input RF signal after the BPF attenuates out-of-band carriers and the LNA amplifies the remaining frequencies.

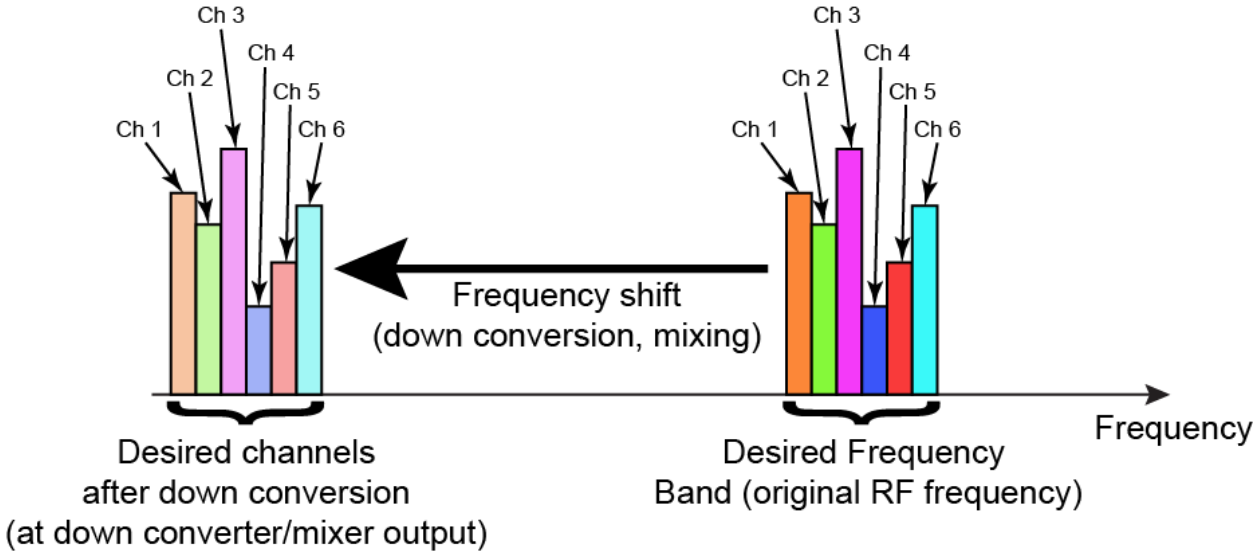


Figure 4. Frequencies in an input signal after the mixer down converts the carriers.

Figure 5. Frequencies in an input signal after the LPF attenuates all but one carrier.

The ’356 patent implements the same basic RF receiver structure—including an antenna, a low noise amplifier, mixers and filters—to process incoming RF signals, all of which were standard in wireless communication systems before the Alleged Conception Date. *See* EX1301-’356-Patent at Fig. 4B; EX1302-Fay-Decl. ¶34.

B. Low Noise Amplifiers

A low noise amplifier (“LNA”) is a long-known component of a front-end receiver used to increase the signal strength of a received radio signal. An LNA increases the amplitude, or power, of a signal. If the amplifier receives an input voltage and outputs a current proportional to the input voltage, it is called a “transconductance” amplifier. EX1302-Fay-Decl. ¶35.

1. *Cascode Configuration*

A cascode amplifier is a type of LNA. Modern cascode amplifiers include two transistors: (1) a common source "transconductance" transistor that receives an input voltage signal and converts it to current with an applied gain, and (2) a common gate "cascode" transistor that couples the current to the output signal. In Figure 6 below, Q1 is the ***transconductance*** transistor, while Q2 is the ***cascode*** transistor. EX1302-Fay-Decl. ¶36.

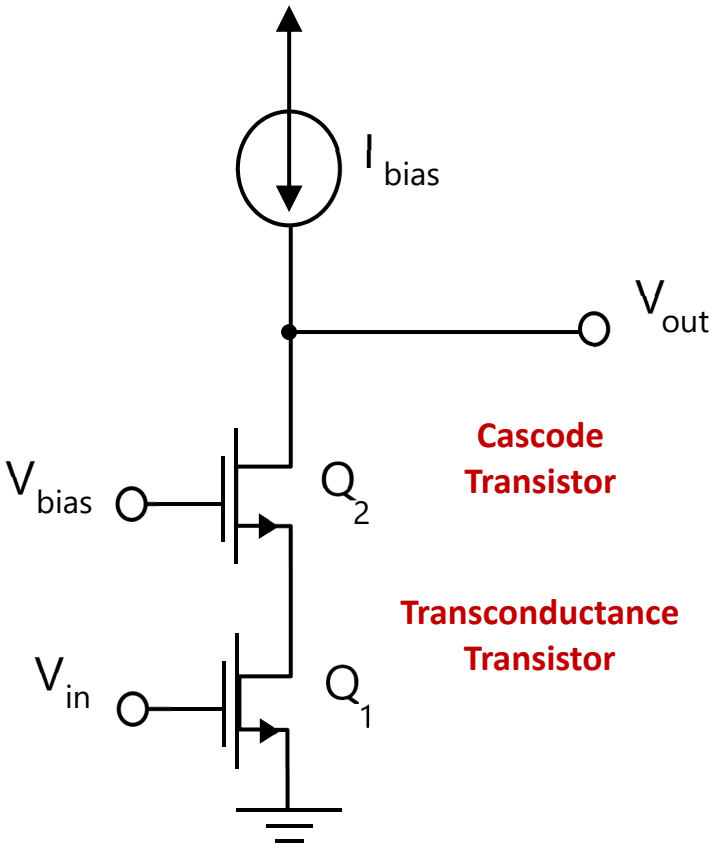


Figure 6. Cascode Amplifier: Q1 is the transconductance transistor and Q2 is the cascode transistor.

This amplifier amplifies the input RF signal (Vin) to produce a current signal (at Vout). Such amplification requires current to flow through the circuit, which depends on the voltage signals applied to the gates of ***both*** the transconductance transistor (Vin) and the cascode transistor (Vbias). If the voltage signal to the cascode transistor (Vbias) is too low—because, for example, the gate of the cascode transistor is coupled to ground—current will not flow through the amplifier stage, and the amplifier will be effectively disabled (even if the transconductance transistor continues to receive the RF input voltage signal). EX1302-Fay-Decl. ¶37.

The cascode configuration was known to provide benefits decades before the Alleged Conception Date—e.g., improved isolation between the input and output signals, higher gain, and higher bandwidth than single stage amplifiers—and had been a popular choice of radio circuit designers. The '356 patent uses the cascode configuration in the same way as it was typically used in RF communication systems before the Alleged Conception Date. *See* EX1301-'356-Patent at 7:58-8:9; EX1302-Fay-Decl. ¶38.

C. Carrier Aggregation

Carrier aggregation ("CA") is the transmission or reception of data on multiple carriers to or from a wireless device at the same time. Rather than transmitting or receiving data on a single carrier (i.e., a single base frequency that

occupies a particular frequency range), a signal employing carrier aggregation transmits related or unrelated data on multiple carriers (i.e., multiple different base frequencies occupying different frequency ranges) simultaneously. Transmitting data on multiple carriers can increase the data rate transmitted from a wireless transmitter to a wireless receiver by allowing information to be extracted from multiple carriers simultaneously. EX1302-Fay-Decl. ¶39.

A receiver enabled for carrier aggregation differs from non-carrier aggregation enabled receivers in that it can extract information from multiple signals transmitted on different carriers (and thus at different frequencies) simultaneously. The receiver does this by using multiple receive paths, where each receive path is configured to extract information from a single carrier frequency. In the example shown in the figure below, the receiver contains two receive paths containing two LNAs providing output to two sets of mixers for the extraction of two frequencies. EX1302-Fay-Decl. ¶42.

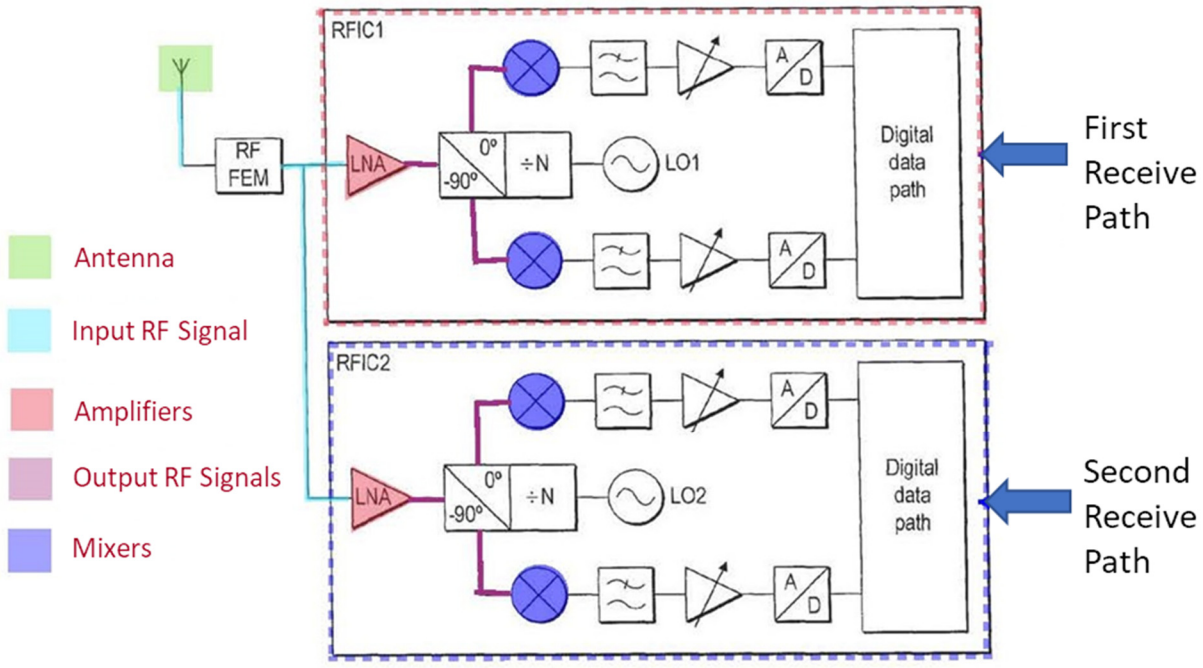


Figure 7. A carrier-aggregation enabled receiver with two receive paths. Source: Figure 15 of U.S. Patent No. 8,442,473 ("Kaukovuori" (EX1325-Kaukovuori))

Thus, the multiband receiver can process multiple frequencies at the same time. EX1302-Fay-Decl. ¶42.

The '356 patent follows this known technique of using multiple receive paths in a receiver to support carrier aggregation. The '356 patent includes multiple "amplifier stages," with each amplifier stage processing a different set of carriers. *See* EX1301-'356-Patent at 8:10-12 ("FIG. 6A shows CA LNA 640*a* including two amplifier stages 650*a* and 650*b* for two sets of carriers."); *id.* at 8:32-35 ("In the CA mode, CA LNA 640*a* 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."); EX1302-Fay-Decl. ¶42.

D. Optional Receiver Circuits

Before the Alleged Conception Date, a variety of circuits to address impedance matching and other problems in LNA design were well known. Several of the challenged dependent claims encompass these well-known circuits. These circuits and the issues they address are discussed below. EX1302-Fay-Decl. ¶43.

1. *Impedance Matching Circuits*

In addition to configuring the gain to particular input signal strengths, an LNA must address the problem of ***impedance matching***. Impedance is the effective resistance of a circuit to current flow when voltage is applied. If the impedance of the ***source*** (the electrical component that provides the signal power) is not equal to the impedance of the ***load*** (the electrical component that receives the signal) power transfer is not maximized, and some signal may be reflected back to the source. In the figure below, for example, the source and load impedances are mismatched with the line impedance, resulting in differences (discontinuities) in impedance along the transmission line and potentially causing the transmitted signal to be reflected back toward its origin. EX1302-Fay-Decl. ¶44.

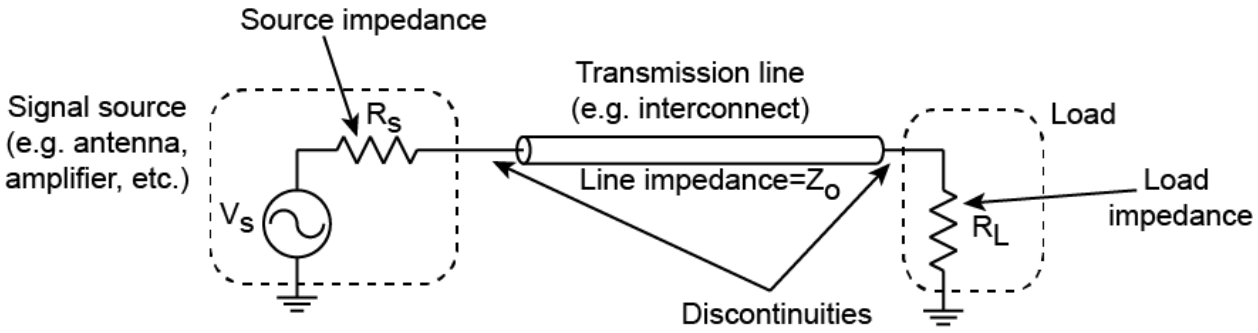


Figure 8. Impedance mismatch due to discontinuities, which may result in signal reflection.

Impedance matching seeks to maximize power transfer and/or minimize the amount of noise added to the signal. EX1302-Fay-Decl. ¶44.

An impedance matching circuit optimizes the impedance of a source and a load. When impedance matching takes place at the input stage, the circuit is called an input matching circuit or network. A variety of topologies have been developed for circuits that perform impedance matching. Figure 9 shows one topology. *Id.* ¶45.

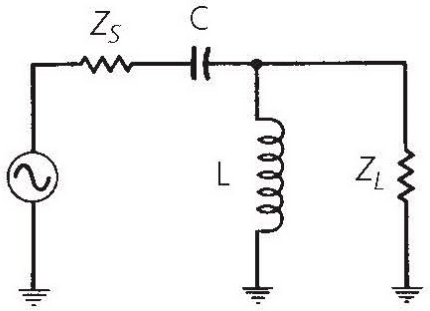


Figure 9. An L-network impedance matching circuit.

A simple matching circuit such as that shown in Figure 9 provides perfect impedance matching at one frequency. To achieve optimal impedance matching at different frequencies, a receiver front end can use a tunable matching circuit. A tunable matching circuit has components with variable electrical characteristics. Tunable impedance matching circuits were well known in the art prior to the '356 patent. EX1302-Fay-Decl. ¶46.

The '356 patent uses adjustable input matching circuits to provide better impedance matching across different modes, as was commonly done in the field of RF communication systems before the Alleged Conception Date. *See* EX1301-'356-Patent at 13:47-51 ("Matching circuit 932 may be adjusted based on the number of enabled amplifier stages and/or which amplifier stage(s) are enabled in order to obtain good noise/power match in both the CA modes and the non-CA modes."); EX1302-Fay-Decl. ¶46.

2. *Feedback Circuit*

A feedback circuit may be installed between the input and the output of an amplifier to enhance the stability of the amplifier. A feedback circuit functions by reducing the level of the input to an amplifier based on the level of the amplifier's output. Thus, as the output rises, for example, the feedback circuit will mitigate the increase. This reduces the gain of the signal, but it has the benefit of reducing the amplifier's sensitivity to transistor parameter variations. Also, the input and

output impedances can be better matched with feedback, and the bandwidth can be increased. Thus, overall circuit performance is improved at the expense of gain. EX1302-Fay-Decl. ¶47.

Feedback circuits were known to improve impedance matching long before the ’356 patent. The ’356 patent’s use of a feedback circuit to provide input power matching as an alternative to or in addition to inductors to yield the predictable result of better impedance matching was thus not novel at the time of the claimed invention. *See* EX1301-’356-Patent at 10:35-41; EX1302-Fay-Decl. ¶47.

3. *Inductors*

An inductor is an electrical component that stores electrical energy when current flows through it. Inductors add little noise and can be used as alternatives or additions to some of the circuits described above (such as with input matching circuits to help with impedance matching). Inductors used in this way can also be alternatives or additions to a feedback circuit because they improve the linearity of an LNA (i.e., the ability of the LNA to provide an output signal that is directly proportional to the input signal). EX1302-Fay-Decl. ¶48.

The ’356 patent uses inductors to provide impedance matching as an alternative to a feedback circuit, as was commonly done in the field of communication systems before the Alleged Conception Date. *See* EX1301-’356-Patent at 10:35-40 (“In an exemplary design, feedback circuit 660 may be

used/enabled for low-band to provide input power match. For mid-band and high-band, feedback circuit 660 may be disabled, and source degeneration inductors 652*a* and 652*b* may be used with matching circuit 632 for input power match"); EX1302-Fay-Decl. ¶48.

VI. OVERVIEW OF THE '356 PATENT

The purported invention of the '356 patent is an LNA that "support[s] carrier aggregation" with "better performance." EX1301-'356-Patent at 2:22-25. As described in the claims, specification, and prosecution history, the LNA of the '356 patent has multiple amplifier stages that receive a carrier aggregated signal, amplify it, and provide outputs to multiple load circuits. EX1301-'356-Patent at Abstract. The LNA of the '356 patent also supports non-carrier aggregated signals by disabling all but one of the amplifier stages. *Id*. at 8:45-54. *See generally* EX1302-Fay-Decl. ¶49.

A. Independent Claim 1

Claim 1 corresponds to the exemplary LNA embodiment shown in Figure 4B, as illustrated below.

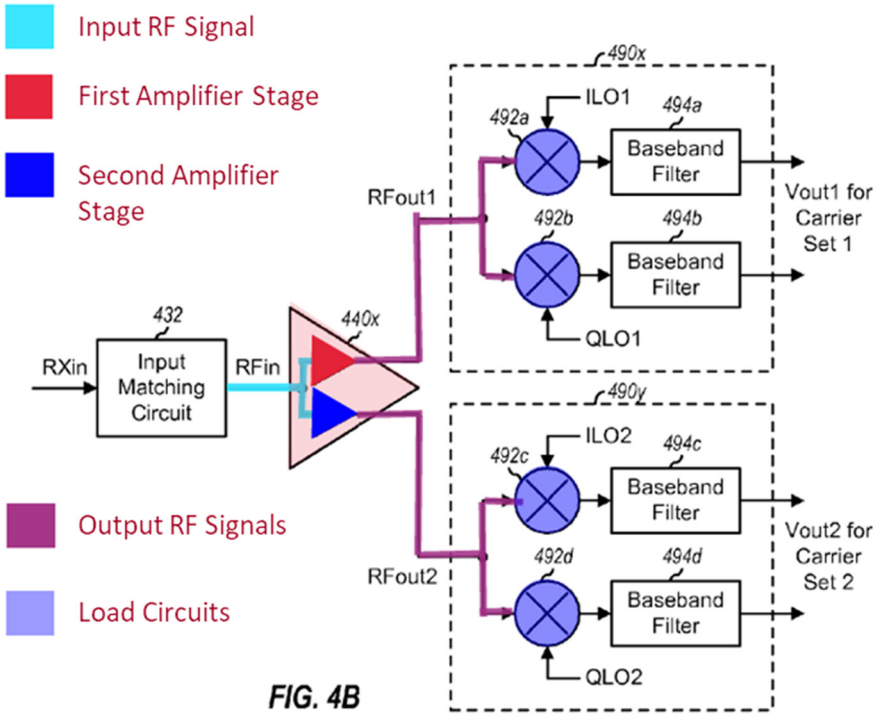


FIG. 4B

Claim 1 recites an apparatus (shown above as LNA 440x) having two amplifier stages (shown above as the red and blue triangles) to amplify an input radio frequency (RF) signal employing carrier aggregation. EX1301-'356-Patent at 20:43-61. The input RF signal includes transmissions sent on multiple carriers at different frequencies. *Id.* at 20:49-51. The first amplifier stage is configured to be independently enabled or disabled. *Id.* at 20:44-45. The first amplifier stage receives and amplifies an input RF signal (RFin) and provides a first output RF signal (RFout1) to a first load circuit (490x) when enabled. *Id.* at 20:44-48. Likewise, the second amplifier stage is configured to be independently enabled or disabled. *Id.* at 20:54-55. The second amplifier stage receives and amplifies the input RF signal (RFin) and provides a second output RF signal (RFout2) to a

second load circuit (490y) when enabled. *Id.* at 20:54-58. The first output RF signal (RFout1) includes a first carrier of the multiple carriers, and the second output RF signal (RFout2) includes a second carrier of the multiple carriers different from the first carrier. *Id.* at 20:51-53, 20:58-61; EX1302-Fay-Decl. ¶50.

Figure 6A shows the internal structure of an exemplary LNA 640a.

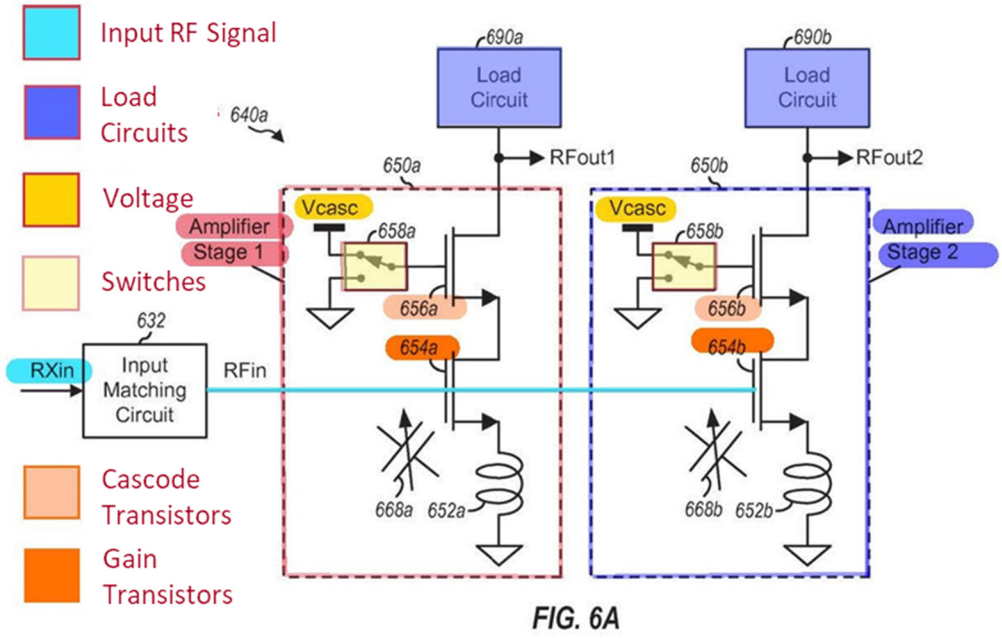


FIG. 6A

An input matching circuit 632 receives a receiver input signal, RXin, and provides an input RF signal, RFin, to LNA 640a. EX1301-'356-Patent at 7:47-52. LNA 640a "includes two amplifier stages 650*a* and 650*b*" (outlined in red and blue). *Id.* at 7:47-48; EX1302-Fay-Decl. ¶¶51-54.

The first amplifier stage 650a (outlined in red) includes a gain transistor 654a (i.e., a transconductance transistor)[6] coupled to a cascode transistor 656a. EX1301-'356-Patent at 7:58-60. The gate of gain transistor 654a receives the input RF signal (RFin) while its source is coupled to ground via a source degeneration inductor 652a. *Id.* at 7:49-52, 7:63-66. As discussed in Section V.B.1, the transistor arrangement of the first amplifier stage 650a is a "cascode amplifier," which was known before the Alleged Conception Date. EX1302-Fay-Decl. ¶¶51-54.

The drain of the gain transistor 654a is coupled to the source of the cascode transistor 656a, and the drain of cascode transistor 656a is coupled to a first load circuit 690a. EX1301-'356-Patent at 7:66-8:01. A switch 658a selectively couples the gate of cascode transistor 656a to either a bias voltage, Vcasc, or to circuit ground. *Id*. at 8:01-04. When the switch 658a couples the gate of the cascode transistor 656a to the bias voltage (Vcasc), current can flow through the first amplifier stage 650a, thereby enabling the first amplifier stage 650a. *See id.* at 8:01-04, 8:12-13, 8:37-42. The gain transistor 654a amplifies the input RF voltage signal, which passes through cascode transistor 656a to the first load circuit, 690a.

[6] The '356 patent refers to the transconductance transistors in a cascode as "gain" transistors. EX1302-Fay-Decl. ¶47, n.8.

See id. at 8:52-54. However, when the switch 658a couples the gate of the cascode transistor 656a to circuit ground, current is unable to flow through the first amplifier stage 650a, thereby disabling the first amplifier stage 650a. *See id*. at 8:04-09, 8:47-57. This design allows the LNA of the '356 patent to support both carrier aggregation and non-carrier aggregation operation in different modes. EX1302-Fay-Decl. ¶¶51-54.

LNA 640a has a second amplifier stage 650b (outlined in blue) that also receives the input RF signal (RFin) and is coupled to a second load circuit 690b. EX1301-'356-Patent at 8:4-9, 8:24-28. Switch 658b enables and disables the second amplifier stage 650b, independently. *See id*. at 8:04-09, 8:12-13, 8:36-59; EX1302-Fay-Decl. ¶¶51-54.

B. Independent Claim 17

Independent claim 17 recites a method that has elements similar to those of claim 1. Claim 17 differs from claim 1 in that claim 17 permits amplifying the first input RF signal ***or a second input RF signal*** with a second amplifier stage to obtain a second output RF signal. EX1301-'356-Patent at 22:21-23. Claim 17 also omits the requirement that the first and second output RF signals be provided to first and second load circuits, respectively. EX1302-Fay-Decl. ¶55.

C. Summary of the Prosecution History

The '356 patent issued from U.S. Application No. 13/590,423 ("'423 Application" (EX1311)). The original independent claims of the '423 Application were directed to a low noise amplifier with two amplifier stages that receive an input RF signal comprising transmissions sent on multiple carriers at different frequencies. EX1311 at 30-33 (Aug. 21, 2012, U.S. Application No. 13/590,423 as filed).

The Patent Office rejected variations of the claims four times, leading to three amendments by Patent Owner. The Examiner ultimately allowed the claims because "the cited references … cannot teach or suggest '<u>a first amplifier stage configured to be independently enabled or disabled</u>' and '<u>a second amplifier stage configured to be independently enabled or disabled'</u>." EX1322 at 4-5 (May 29, 2015 Notice of Allowability) (emphasis in original).

As described below, Lee teaches this very limitation as well as the other limitations of the challenged claims.

1. *First Office Action*

In the first office action, the Examiner rejected the independent claims under 35 U.S.C. §103(a) as obvious over U.S. Patent No. 7,751,513, to Eisenhut ("Eisenhut" (EX1323-Eisenhut)). EX1312 at 3 (Nov. 14, 2013 Office Action); EX1323-Eisenhut. The Examiner explained that Eisenhut discloses first and

second amplifier stages receiving an input RF signal and providing two separate output signals to two different load circuits. EX1312 at 3.

Patent Owner amended the independent claims 1 and 17 to specify that "the first output RF signal includ[es] at least a first carrier of the multiple carriers" and "the second output RF signal includ[es] at least a second carrier of the multiple carriers different from the first carrier." EX1313 at 2 (Feb. 6, 2014 Resp. to Office Action).

2. *Second Office Action*

In the second office action, the Examiner rejected the independent claims under 35 U.S.C. §§102(b) and 103(a) as both anticipated and rendered obvious by U.S. Patent No. 7,317,894 to Hirose ("Hirose" (EX1324-Hirose)). EX1314 at 3 (Apr. 18, 2014 Office Action); EX1324-Hirose. The Examiner explained that Hirose discloses the claimed amplifier stages of claims 1 and 17, the "input RF signal comprising transmissions sent on multiple carriers at different frequencies," and the newly-added limitations concerning carriers in the first and second output RF signals. EX1314 at 5-6.

In response, Patent Owner amended the independent claims to require that the input RF signal "employ[] carrier aggregation," and argued Hirose does not disclose carrier aggregation because it describes receiving "redundant data" over multiple carriers, which Patent Owner contended does not result in an "increased

aggregated data rate." EX1315 at 7 (June 6, 2014 Resp. to Office Action). Thus, when Patent Owner added "the input RF signal employing carrier aggregation" to distinguish the Hirose reference, Patent Owner's point of distinction was that Hirose does not employ "carrier aggregation" because it discloses redundant data transmissions. *See id*. Patent Owner did not argue that "carrier aggregation" required anything more than non-redundant data transmissions. *See id*.

3. *Third Office Action*

In the third office action, the Examiner rejected the independent claims under 35 U.S.C. §§102(e) and 103(a) as both anticipated and rendered obvious by U.S. Patent No. 8,442,473 to Kaukovuori ("Kaukovuori" (EX1025-Kaukovuori)). EX1316 at 3 (Aug. 1, 2014 Office Action); EX1325-Kaukovuori. EX1316 at 3.

The Patent Owner responded that Kaukovuori does not teach "amplifying . . . *when the [] amplifier stage is enabled*" because it teaches "nonselective amplifiers that continuously amplify." EX1317 at 7-8 (Oct. 30, 2014 Resp. to Office Action) (emphasis in original).

4. *Fourth Office Action*

The Examiner found Patent Owner's argument regarding Kaukovuori unpersuasive and maintained the rejection over Kaukovuori. EX1318 at 2 (Dec. 26, 2014 Office Action). In response, Patent Owner had a telephonic interview with the Examiner. In the Interview Summary, the Examiner stated, "the Examiner

suggested Applicants' Representative to include the allowable features 'amplifier stages 650a and 650b may be independently enabled or disabled via switches 658a and 658b, respectively.'" EX1319 at 2 (Feb. 26, 2015 Applicant-Initiated Interview Summary). Patent Owner amended independent claims 1 and 17 to require each of the first and second amplifier stages to be "configured to be independently enabled or disabled." EX1320 at 2 (Feb. 25, 2015 Resp. to Office Action).

The Patent Office allowed claims 1-20. The Examiner stated that the claims were allowed because "the cited references … cannot teach or suggest 'a first amplifier stage configured to be independently enabled or disabled' and 'a second amplifier stage configured to be independently enabled or disabled.'" EX1321 at 5 (Mar. 5, 2015 Notice of Allowability); EX1322 at 4-5 (May 29, 2015 Notice of Allowability).

As set forth in detail below, Lee teaches all other elements of the challenged independent claims, including a first amplifier stage configured to be independently enabled or disabled and a second amplifier stage configured to be independently enabled or disabled. As detailed below, Patent Owner's expert admitted this in the 1093 Investigation, and argued solely that Lee does not disclose the "carrier aggregation" limitation of the independent claims.

VII. CLAIM CONSTRUCTION

A claim of an unexpired patent in *inter partes* review is given the "broadest reasonable construction in light of the specification" ("BRI standard"). 37 C.F.R. §42.100(b); *see Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 2131, 2142 (2016). Any claim term that lacks a definition in the specification is therefore also given a broad interpretation. *In re ICON Health & Fitness, Inc.*, 496 F.3d 1374, 1379 (Fed. Cir. 2007). Petitioner submits a claim construction that should apply under the BRI standard below.

A. "carrier aggregation"

The term "carrier aggregation" appears in challenged claims 1 and 17 in the phrase "input RF signal employing carrier aggregation." EX1301-'356-Patent at 20:49, 22:17-18. "Carrier aggregation" should be construed as "simultaneous operation on multiple carriers." This construction comes directly from the specification, which defines the term. *See* EX1301-'356-Patent at 1:32-33 ("A wireless device may support ***carrier aggregation, which is simultaneous operation on multiple carriers***.")[7]; *id.* at 2:53-54 ("Wireless device 110 may support ***carrier aggregation, which is operation on multiple carriers***."); *id.* at 2:54-55 ("Carrier aggregation may also be referred to as multi-carrier operation.");

[7] Emphasis in quotations is added unless stated otherwise.

see also id. at 1:33-35 ("A carrier may refer to a ***range of frequencies*** used for communication and may be associated with certain characteristics."). Given the clear guidance in the specification, "carrier aggregation" should be construed as "simultaneous operation on multiple carriers" under the BRI standard. *See Apple Inc. v. Immersion Corp*., IPR2016-01372, 2017 WL 376909, at *3 (P.T.A.B. Jan. 11, 2017) ("use of the word 'is' in the specification may 'signify that a patentee is serving as its own lexicographer'" and applying express definition under BRI); *see also In re Imes*, 778 F.3d 1250, 1252-53 (Fed. Cir. 2015) (where the specification "expressly and unambiguously defines" a term, construction of the term is "straightforward"). *See* EX1302-Fay-Decl. ¶59. This meaning is consistent with the understanding of the term by a person having ordinary skill in the art ("POSITA"). *Id*. ¶60.

In the ITC 1093 Investigation, Patent Owner agreed with Petitioner that "carrier aggregation" includes "simultaneous operation on multiple carriers" but argued that "carrier aggregation" also requires additional elements: increased bandwidth for a user, and/or increased "aggregated" data rate. Patent Owner relied, in part, on the following statements made during prosecution to overcome Hirose. *See* Section VI.C.2.

> **Regarding amended independent claims 1 and 17**, Applicant's amended independent claims 1 and 17 recite, *inter alia*, "the [] input RF signal employing ***carrier aggregation***," which is **not** disclosed in Hirose. Generally,

> Applicant's claimed invention recites "carrier aggregation" which results in an ***increased aggregated*** data rate. In contrast, Hirose transmits the same signals over different paths which results in ***redundant*** data at a ***common*** data rate.

EX1315 at 7 (June 6, 2014 Resp. to Office Action) (emphasis in original).

Thus, Patent Owner argued that Hirose does not disclose carrier aggregation because it describes receiving "redundant data" over multiple carriers, which Patent Owner contended does not result in an "increased aggregated data rate." *Id*. Patent Owner did not argue during prosecution that carrier aggregation required anything more than non-redundant data transmissions. *See id*.

The prosecution history does not justify limiting "carrier aggregation" to certain narrow uses (increasing bandwidth for a user, increasing aggregated data rate, etc.) as Patent Owner proposed in the ITC 1093 Investigation. ***First***, limiting a term in an apparatus claim to a particular use is contrary to well-settled law. *Paragon Solutions, LLC v. Timex Corp.*, 566 F.3d 1075, 1090-91 (Fed. Cir. 2009) (rejecting claim construction that "injects a use limitation into a claim written in structural terms"). ***Second,*** as explained above, the specification specifically defines carrier aggregation as Petitioner proposes. By contrast, the specification never even uses the terms "bandwidth" or "data rate." Adding either phrase to the construction, as Patent Owner proposed, would therefore improperly limit the term to a specific use not even mentioned in the specification. ***Third*****,** Patent Owner's

statement during prosecution is not the "clear and unequivocal evidence" required to show a disclaimer. *See Poly-America, L.P. v. API Indus.*, 839 F.3d 1131, 1136 (Fed. Cir. 2016). Patent Owner's disclaimer of redundant data transmissions did not clearly and unequivocally disclaim all uses of carrier aggregation that do not increase bandwidth or data rate: e.g., enabling a mobile network operator to more efficiently make use of "fragmented spectrum" or enhancing "wireless backhaul" communications between back-end nodes in a communication network. *See* EX1302-Fay-Decl. ¶¶59-61. Prosecution disclaimer therefore does not apply. *See,* e.g., *Computer Docking Station Corp. v. Dell, Inc.*, 519 F.3d 1366, 1375 (Fed. Cir. 2008) ("[I]f the specification expressly defines a claim term and remarks made to distinguish claims from the prior art are broader than necessary to distinguish the prior art, the full breadth of the remark is not a clear and unambiguous disavowal of claim scope as required to depart from the meaning of the term provided in the written description.") (citations omitted).

Indeed, in the ITC 1093 Investigation, the Administrative Law Judge construed "carrier aggregation" as Petitioner proposes here—"simultaneous operation on multiple carriers"—despite Patent Owner's arguments. EX1336 at 17 (Inv. No. 337-ITC-1093, Order No. 38); *see also id.*, App'x A at 30 ("[F]ree from artificial limitations, the proper construction of 'carrier aggregation' comes straight from the specification of the '356 patent."). If, however, the Board were to apply a

construction requiring increased bandwidth and/or data rate, the invalidity analysis remains the same: the challenged claims are unpatentable for the reasons given below. *See* EX1302-Fay-Decl. ¶61.

VIII. LEVEL OF ORDINARY SKILL IN THE ART

A POSITA at the time of the alleged invention 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). EX1302-Fay-Decl. ¶56.

IX. OVERVIEW OF PRIOR ART

A. U.S. Patent Application Publication 2012/0056681 ("Lee")

As Patent Owner admitted in the ITC 1093 Investigation, Lee discloses the key limitations—a first amplifier stage configured to be independently enabled or disabled and a second amplifier stage configured to be independently enabled or disabled—that the Examiner believed were missing from the prior art and that were the basis for the decision to allow the '356 patent. EX1337-ITC at 2190:8-25. Patent Owner also admitted that Lee discloses every limitation of the challenged independent claims other than the "carrier aggregation" limitation. EX1337-ITC at 2174:9-24, 2190:8-25. As explained, below, Lee also teaches carrier aggregation. While Lee is listed as a cited reference on the '356 patent, along with 350 other references, it was not applied by the Examiner during prosecution.

Lee teaches LNAs (referred to as "signal amplification circuits") that can "support several different kinds of radio connections," such as Bluetooth and WiFi. EX1335-Lee ¶¶2-3. Lee teaches using one LNA shared between different radio connections to "reduce the hardware cost and the chip size of the multi-radio device." *Id.* ¶2. Lee thus teaches an LNA that "can receive/transmit signals according to one input." *Id.*

Figure 2 of Lee shows a signal amplification circuit capable of supporting multiple simultaneous radio connections. The signal amplification circuit 200 "includes a plurality of amplifier blocks 202_1-202_N" which are outlined below in red and blue in an annotated version of Figure 2. *Id.* ¶26.

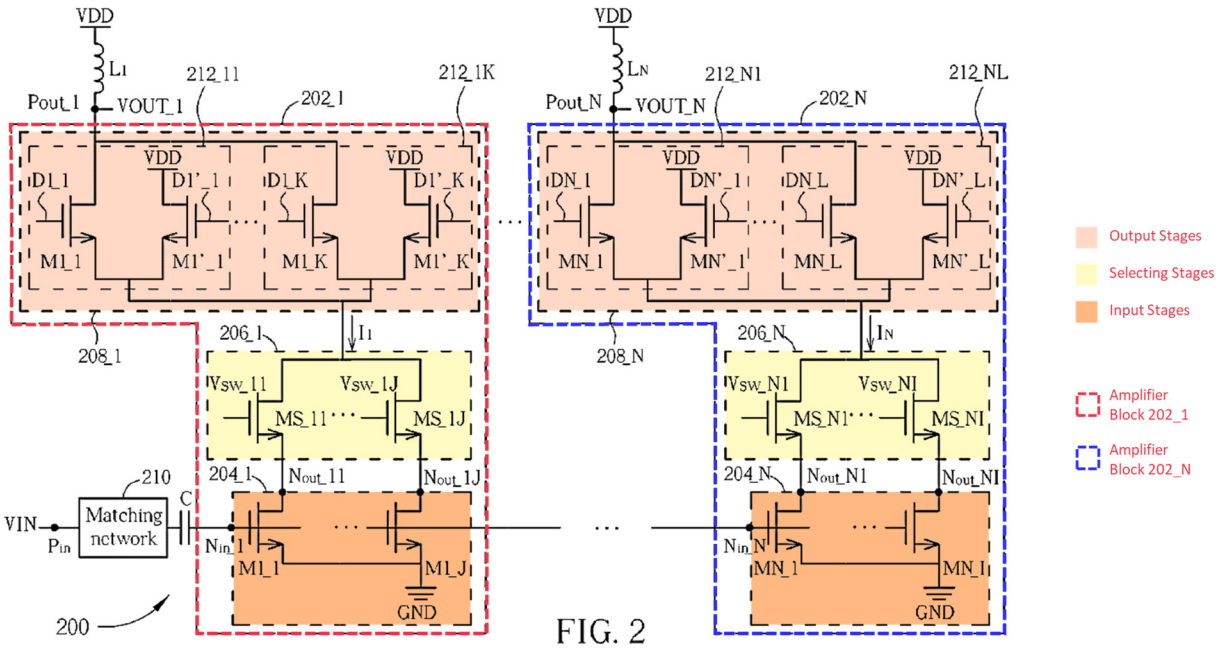


FIG. 2

Each amplifier block includes (1) an "input stage" 204 (highlighted in dark orange), (2) a "selecting stage" 206 (highlighted in yellow), and (3) multiple

"output stages" 208 (highlighted in light orange).[8] *Id*. The input stage receives "an input signal VIN" on its input node, Nin. *Id*. The selecting stage "selectively couple[s] the input stage . . . to the output stage." *Id*. ¶27. The output stages "are coupled to a plurality of output ports Pout_1-Pout_N" and "generate a plurality of processed signals VOUT_1-VOUT_N, respectively" for corresponding output ports. *Id*. ¶¶28, 35.

Each amplifier block supports a different type of radio connection by providing output to a different radio signal processing system. *Id*. ¶29. For example, in Figure 2, "the output port Pout_1 is coupled to a first radio signal processing system (e.g., a WiFi receiver/transmitter) and the output port Pout_N is coupled to a second radio signal processing system (e.g., a Bluetooth receiver/transmitter)," so that amplifier block 202_1 supports a WiFi connection, while amplifier block 202_N supports a Bluetooth connection. *Id.*

The amplification circuit can operate in different modes depending on the number of signals on the input VIN. In a "shared" mode, the input VIN contains

[8] Lee refers to each stage with reference to the amplifier block in which it is found. For instance, Lee refers to input stage "204_1" to designate the input stage of amplifier block 1, and input stage "204_N" to designate the input stage of amplifier block N. *See* EX1335-Lee ¶26.

only one radio signal, so only one of the amplifier blocks 202_1-202_N is enabled, while the others are disabled. For example, "when only the WiFi function of the multi-radio device is required to be active . . . , the output stage 208_1 is enabled" for "generating the corresponding processed signal VOUT_1," while "the output stages in the remaining amplifier blocks are disabled." EX1335-Lee ¶33. Similarly, "when only the Bluetooth function of the multi-radio device is required to be active . . . , the output stage 208_N is turned on, whereas all of the output stages in the remaining amplifier blocks are disabled." *Id.* However, in a "combo mode," the input VIN contains both a WiFi and Bluetooth signal, such that "both of the WiFi function and Bluetooth function of the multi-radio device are required to be active," and "the output stages 208_1 and 208_N are both enabled at the same time." *Id.*

The signal amplification circuit 200 of Lee effectuates the different modes by independently enabling or disabling the output stages. EX1335-Lee ¶33. For example, if output stage 208_1 is required for generating the corresponding processed signal VOUT_1, "the output stage 208_1 is enabled by making each of the transistor element pairs 212_11-212_1K have one turned on transistor element and one turned-off transistor element." *Id*. On the other hand, if output stage 208_1 is not required to be enabled for generating the signal VOUT_1, "the output stage 208_1 is disabled by turning off both of the first transistor element and the

second transistor element included in each of the transistor element pairs 212_11-212_1K." *Id*. The transistor elements can be turned off using control signals D1 (e.g., for amplifier block 202_1) to DN (e.g., for amplifier block 202_N). *Id*.

An annotated version of Lee Figure 2, below, illustrates the "shared" mode in which the first amplifier block 202_1 is enabled, while the second amplifier block 202_N is disabled, using the output stages 208_1 and 208_N, respectively. EX1302-Fay-Decl. ¶¶62-68.

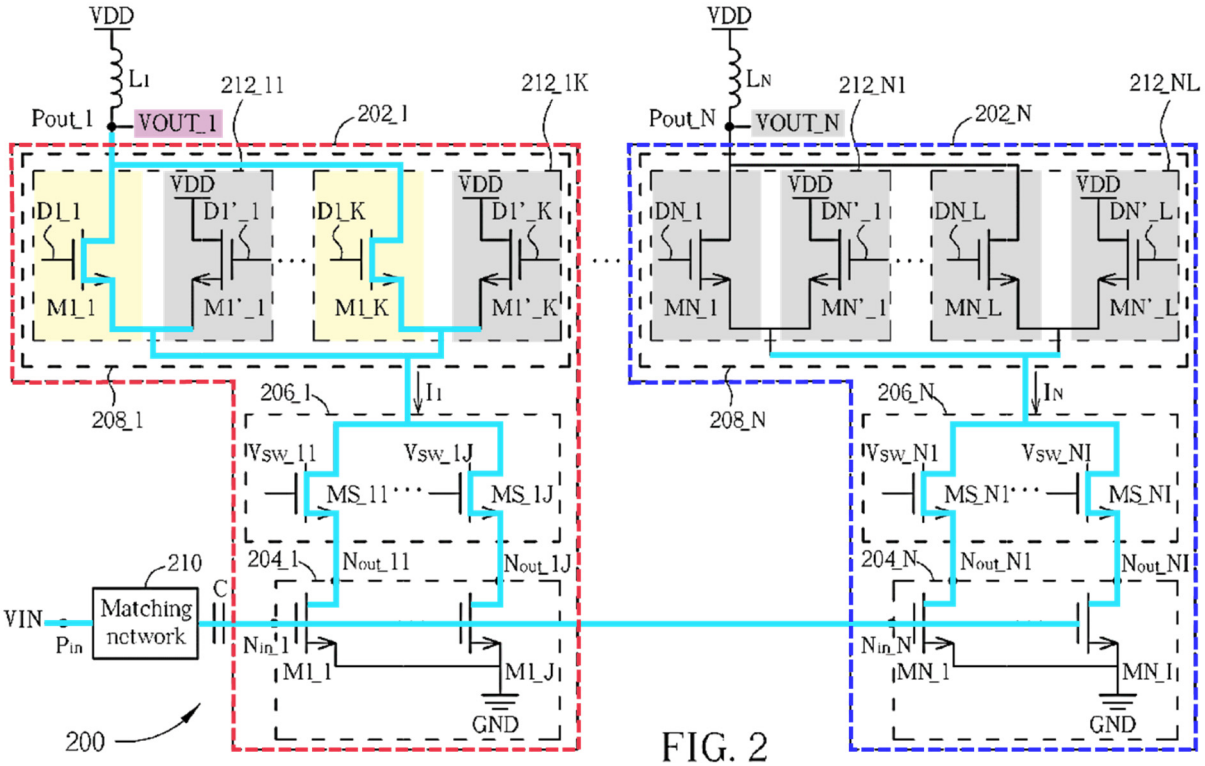


FIG. 2

As noted above, Petitioner challenged the validity of claims 1 and 17 in the ITC 1093 Investigation, referred to in Section II.B, *supra*. In that proceeding, Patent Owner agreed that Lee teaches every limitation of claims 1 and 17 except

for limitations 1.d and 17.d reciting "carrier aggregation." EX1337-ITC at 2174:9-24, 2190:8-25. As explained in Sections X.A.1.d and X.A.5.d, *infra*, Lee teaches this limitation, and even if it did not teach "carrier aggregation," as described in Section X.C, *infra*, Lee in view of Feasibility Study renders this limitation obvious.

B. 3GPP TR 36.912 Feasibility study for Further Advancements for E-UTRA (LTE-Advanced) (Release 9) ("Feasibility Study")

As explained above, carrier aggregation was well known before the Alleged Conception Date. The Feasibility Study is a technical report by the standard-setting body Third Generation Partnership Project ("3GPP"). See EX1304-Study at 7. The Feasibility Study discusses design and implementation details of extending LTE Release 8 "with support for Carrier Aggregation, where two or more component carriers (CCs) are aggregated in order to support wider transmission bandwidths up to 100MHz and for spectrum aggregation." *Id.* at 8. (emphasis in original). The Feasibility Study discloses support for both contiguous and non-contiguous component carrier aggregation.[9] *See id.* at 9; EX1302-Fay-Decl. ¶69.

[9] Intra-band contiguous carrier aggregation occurs when the carriers being aggregated are next to each other within the same frequency band. Intra-band non-contiguous carrier aggregation occurs when the aggregated carriers are not next to each other but are in the same frequency band. EX1302-Fay-Decl. ¶41.

The Feasibility Study states, "It is possible to configure a UE [user equipment] to aggregate a different number of component carriers originating from the same eNB [base station] and of possibly different bandwidths in the UL [uplink] and the DL [downlink]." EX1304-Study at 9. The Feasibility Study discusses "Receiver characteristics" for equipment supporting carrier aggregation, including illustrative receiver architectures. *Id*. at 25-26. The Feasibility Study suggests that multiple separate RF front ends are preferable over a single wideband-capable RF front end for certain kinds of carrier aggregation. *See id*.; EX1302-Fay-Decl. ¶70.

The Feasibility Study was not considered by the Examiner during prosecution of the application leading to the '356 patent. The Feasibility Study also differs from the 3GPP TS 36.101 specification identified in the '356 patent ("3GPP TS 36.101"). *See* EX1301-'356-Patent at 2:65. The 3GPP TS 36.101 reference lacks the illustrative receiver architectures disclosed in the Feasibility Study for use with carrier aggregation. *See* EX1302-Fay-Decl. ¶71.

X. SPECIFIC GROUNDS FOR PETITION

Pursuant to Rule 42.104(b)(4)-(5), the following sections (as confirmed in EX1302-Fay-Decl.) demonstrate how the prior art discloses every limitation of claims 1, 7, 8, 11, 17, and 18 of the '356 patent, and how those claims are anticipated and/or rendered obvious by the prior art. Indeed, Patent Owner

previously acknowledged that Lee discloses the key limitations—a first amplifier stage configured to be independently enabled or disabled and a second amplifier stage configured to be independently enabled or disabled—that the Examiner believed were missing from the prior art and that were the basis for the decision to allow the '356 patent, as well as nearly all other limitations of the challenged independent claims.

A. Ground I: Claims 1, 7, 8, 11, 17, and 18 Are Anticipated by Lee

1. *Claim 1*

a) *"An apparatus comprising"*

Lee discloses an apparatus, namely amplification circuits. EX1335-Lee ¶1; EX1302-Fay-Decl. ¶73; EX1337-ITC at 2190:8-21 (Patent Owner in the ITC 1093 Investigation did not dispute that Lee discloses this limitation).

b) *"a first amplifier stage configured to be independently enabled or disabled"*

Lee teaches a first amplifier stage (e.g., amplifier block 202_1) configured to be independently enabled or disabled (e.g., by independently enabling or disabling output stage 208_1). An "amplifier stage" in the '356 patent may comprise (1) a gain transistor,[10] and (2) a cascode transistor arranged in a cascode configuration.

[10] "Gain" is the generic measurement of amplification. Any transistor that amplifies is a "gain" transistor. EX1302-Fay-Decl. ¶74, n.13.

EX1301-'356-Patent at 17:58-18:1; Fig. 6A. Figure 2 of Lee shows amplifier block 202_1, which includes an input stage 204_1, a selecting stage 206_1, and an output stage 208_1. EX1335-Lee ¶26. Amplifier block 202_1 is the first amplifier stage, as shown in annotated Figure 2 below.

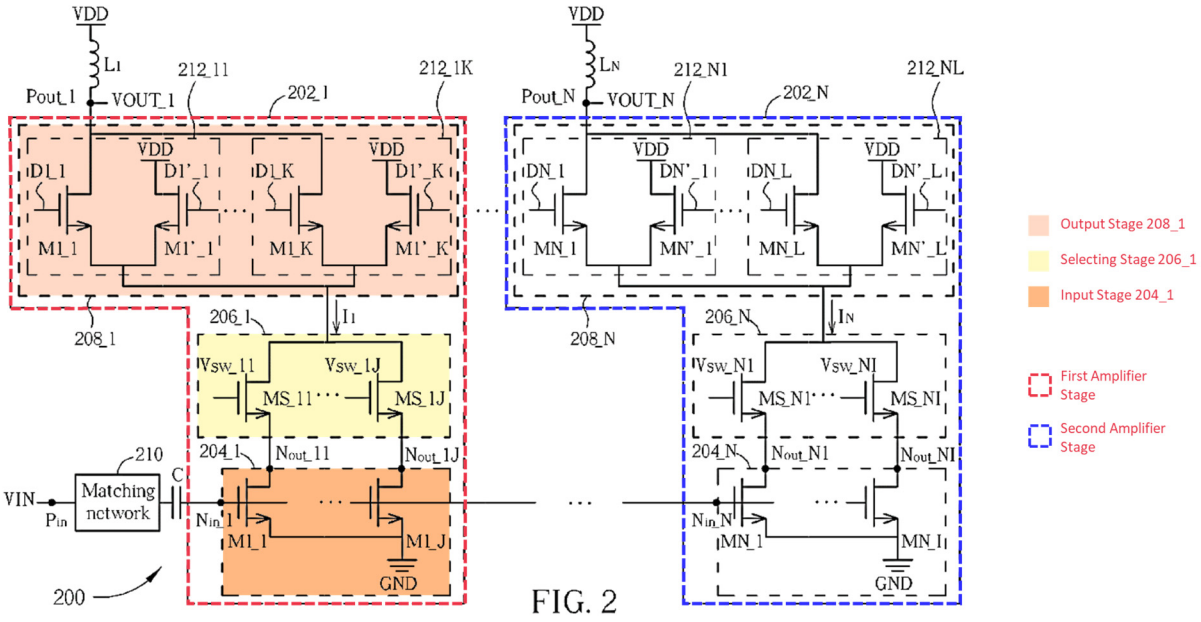


FIG. 2

Lee teaches that the first amplifier stage is configured to be independently enabled or disabled using its output stage 208_1.[11] When the first amplifier stage

[11] Lee teaches two different configurations for independently enabling or disabling the amplifier stages, using either the "selecting" stages 206 or the "output" stages 208 in each amplifier block. EX1335-Lee ¶¶29, 33. For simplicity, this petition focuses on the configuration using the output stages 208. EX1302-Fay-Decl. ¶75, n.14.

202_1 is required to be active, such as to process a WiFi signal, "the output stage 208_1 is enabled by making each of the transistor element pairs 212_11-212_1K have one turned-on transistor element and one turned-off transistor element." EX1335-Lee ¶33. At the same time, if the amplifier stage "is not required to be enabled for generating the corresponding processed signal VOUT_1, the output stage 208_1 is disabled by turning off both of the first transistor element and the second transistor element included in each of the transistor element pairs 212_11-212_1K." *Id.* The transistor element pairs in output stage 208_1 can be turned on and off using control signals D1_1-D1_K and D1'_1-D1'_K.[12] *Id.* An annotated version of Figure 2 shows the first amplifier stage independently enabled using the output stage 208_1, while the second amplifier stage is disabled using the corresponding output stage 208_N, below. *See also* EX1302-Fay ¶¶74-75; EX1337-ITC at 2190:8-21 (Patent Owner in the ITC 1093 Investigation did not dispute that Lee discloses this limitation).

[12] Control signals D1_1 to D1_K control the first transistor element of transistor pairs 1 through K, while control signals D1'_1 to D1'_K control the second transistor element in 1 through K transistor pairs. *See* EX1335-Lee at Fig. 2; EX1302-Fay-Decl. ¶75, n.15.

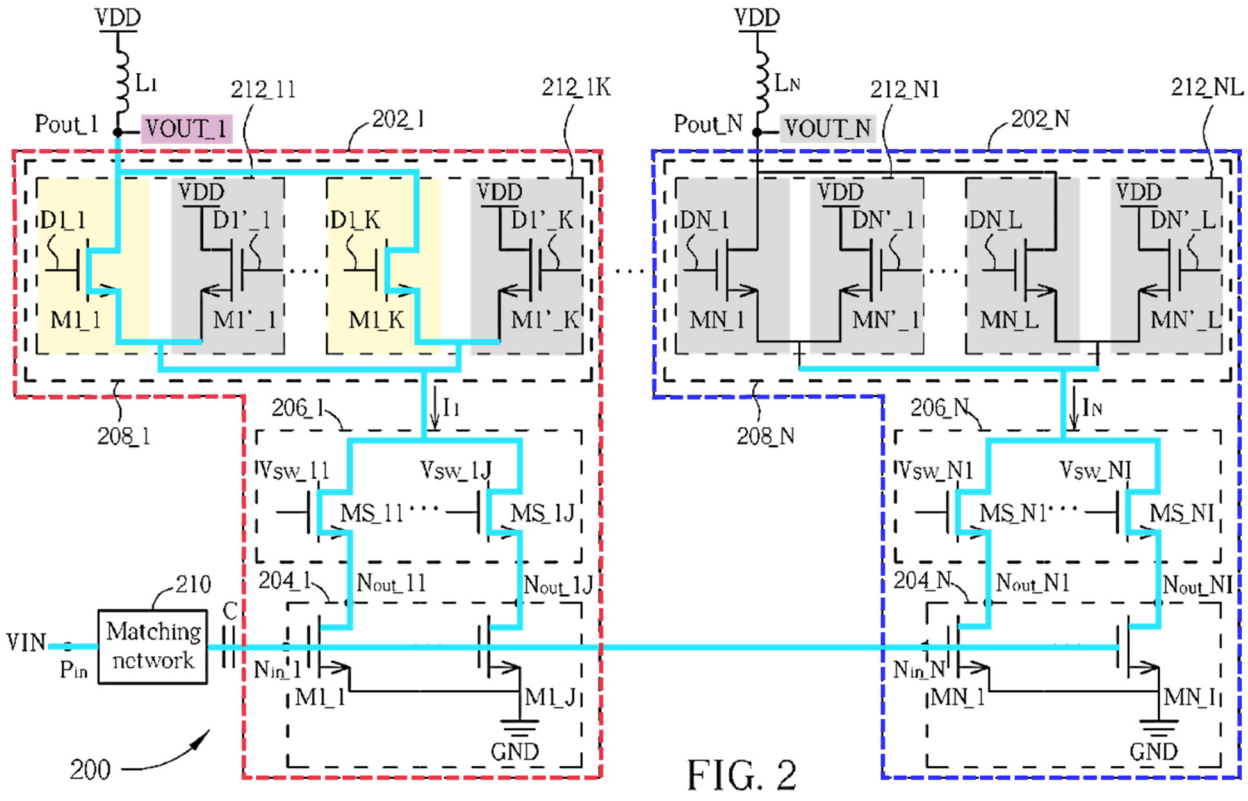


FIG. 2

c) *"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"*

Lee teaches this limitation. Lee teaches the first amplifier stage (e.g., amplifier block 202_1) configured to receive and amplify an input radio frequency (RF) signal (e.g., VIN) and provide a first output RF signal (e.g., VOUT_1) to a first load circuit (e.g., a WiFi receiver/transmitter, or inductive load L_1) when the first amplifier stage is enabled (e.g., "when enabled"). As explained above, amplifier block 202_1 (comprising the input stage 204_1, the selecting stage 206_1, and the output stage 208_1) is the first amplifier stage. Lee explains that an "input signal VIN is transmitted to the input nodes Nin_1-Nin_N of the input

stages 204_1-204_N," including the input stage 204_1 of the first amplifier stage. EX1335-Lee ¶26. The "selecting stage 206_1 selectively couples the input stage 204_1 to the output stage 208_1," *id*. ¶27, and the output stage 208_1 "generat[es] the corresponding processed signal (e.g., VOUT_1 . . .) to the corresponding output port (e.g., Pout_1 . . .) according to a gain." *Id*. ¶28. "[T]he output port Pout_1 is coupled to a first radio signal processing system (e.g., a WiFi receiver/transmitter)," which is a load circuit.[13] *Id*. ¶29; EX1302-Fay ¶76.

As shown in Figure 2, below, the first amplifier stage in Lee is configured to receive and amplify an input RF signal (VIN) and provide a first output RF signal (VOUT_1) to a first load circuit (e.g., a WiFi receiver/transmitter) via output port Pout_1. VIN is a radio frequency (RF) signal because it "may include a plurality of radio-frequency signals." EX1335-Lee ¶17. VOUT_1 is an RF signal because

[13] The '356 patent states that a load circuit "may include one or more inductors, capacitors, transistors, mixers, etc." EX1301-'356-Patent at 5:3-5. A receiver includes one or more of these components and is therefore a load circuit. EX1302-Fay-Decl. ¶76, n16. Moreover, Lee teaches that the output stage 208_1 is coupled to an inductive "load (e.g., the inductor L_1)," which is also a load circuit. *Id*.; EX1335-Lee ¶28.

it is one of "a plurality of received signals corresponding to the radio-frequency signals . . . generated as outputs" prior to downconversion. EX1335-Lee ¶17; EX1302-Fay ¶77; EX1337-ITC at 2190:8-21 (Patent Owner in the ITC 1093 Investigation did not dispute that Lee discloses this limitation).

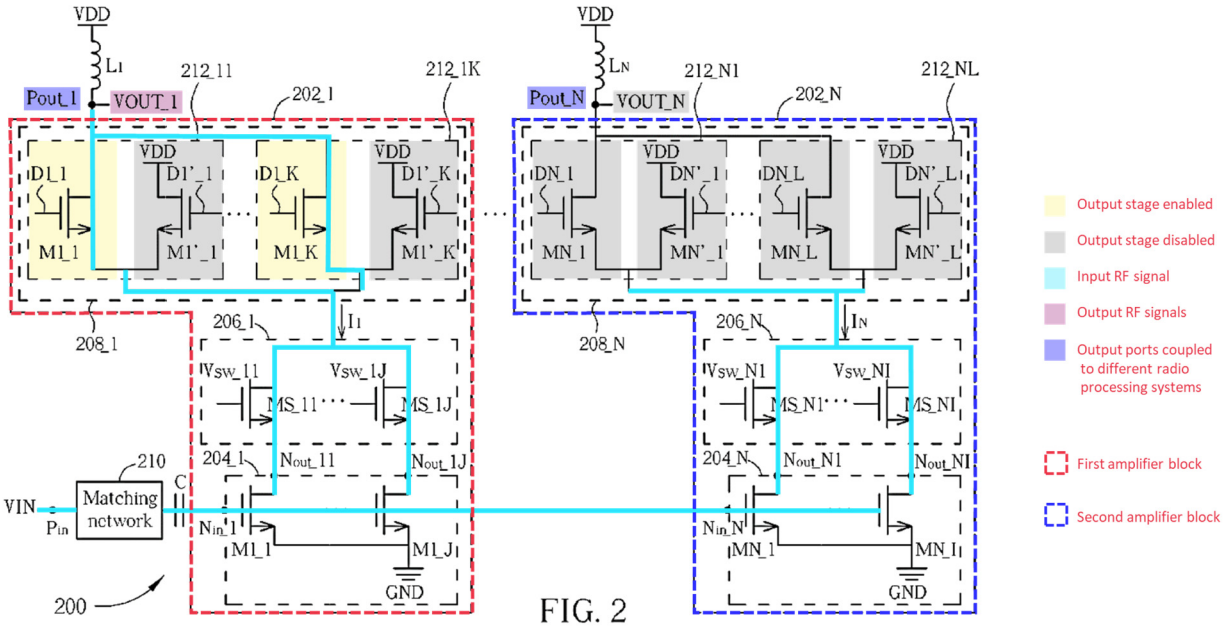


FIG. 2

Lee further teaches that the first amplifier stage performs this function only "when . . . enabled." Lee states that "[e]ach of the output stages generates a corresponding processed signal to a corresponding output port according to a gain . . . when enabled." EX1335-Lee ¶4; *see also id.* ¶28. Thus, "if the output stage 208_1 is required to be enabled for generating the corresponding processed signal VOUT_1, the output stage is enabled," but "if the output stage 208_1 is not required to be enabled for generating the corresponding processed signal VOUT_1, the output stage 208_1 is disabled." *Id.* ¶33; EX1302-Fay ¶78; EX1337-ITC at

2190:8-21 (Patent Owner in the ITC 1093 Investigation did not dispute that Lee discloses this limitation).

d) *"the input RF signal employing carrier aggregation comprising transmissions sent on multiple carriers at different frequencies to a wireless device"*

Lee teaches this limitation. Lee teaches the input RF signal (e.g., VIN) employing carrier aggregation comprising transmissions sent on multiple carriers at different frequencies (e.g., "plurality of radio frequency signals (e.g., a Bluetooth signal and a WiFi signal) received by a single antenna") to a wireless device (e.g., a "mobile device"). First, Lee teaches an input RF signal comprising transmissions sent on multiple carriers at different frequencies to a wireless device. It discloses that "the input signal VIN may include a plurality of radio frequency signals (e.g., a Bluetooth signal and a WiFi signal) received by a single antenna." EX1335-Lee ¶17. Bluetooth and WiFi signals are transmitted on different carriers.[14] *Cf.* EX1337-ITC at 2196:18-2197:4. Moreover, Lee teaches that the amplifier can be used in a "mobile device," and therefore describes a wireless device. EX1335-Lee ¶2. Thus, Lee teaches an input RF signal (VIN) comprising

[14] Using frequency hopping, Bluetooth and WiFi signals will be transmitted over different carriers to avoid interference. EX1302-Fay-Decl. ¶79, n17.

transmissions sent on multiple carriers at different frequencies to a wireless device. EX1302-Fay-Decl. ¶79.

Lee further teaches that the input RF signal employs carrier aggregation. Carrier aggregation is "simultaneous operation on multiple carriers." *See* Section VII.A; EX1301-'356-Patent at 1:32-35, 2:53-55. Lee discloses that in the "combo" mode, "when both of the WiFi function and Bluetooth function of the multi-radio device are required to be active," "the output stages 208_1 and 208_N are ***both enabled at the same time***" in order to process both a WiFi signal and a Bluetooth signal at the same time. EX1335-Lee ¶33. Lee therefore teaches simultaneous operation on multiple carriers—it teaches receiving and processing data on multiple carriers at the same time in a single input RF signal, VIN. *See also* EX1337-ITC at 2205:12-18 (Patent Owner's expert in the ITC 1093 Investigation testified that "Lee is capable of receiving both a Wi-Fi signal and a Bluetooth signal at the same time."); EX1302-Fay-Decl. ¶80.

Furthermore, even if carrier aggregation were construed as simultaneous operation on multiple carriers that increases bandwidth for a wireless device, Lee also teaches this result. Specifically, carriers occupy bandwidth, and transmitting or receiving data on multiple carriers increases bandwidth to the sum of the carriers' frequency ranges. For example, receiving data over two 20 MHz carriers increases bandwidth to 40 MHz, as shown in Figure 10 below:

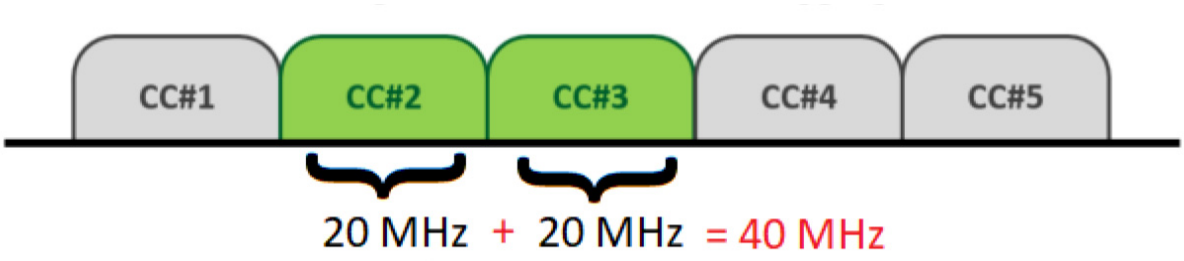
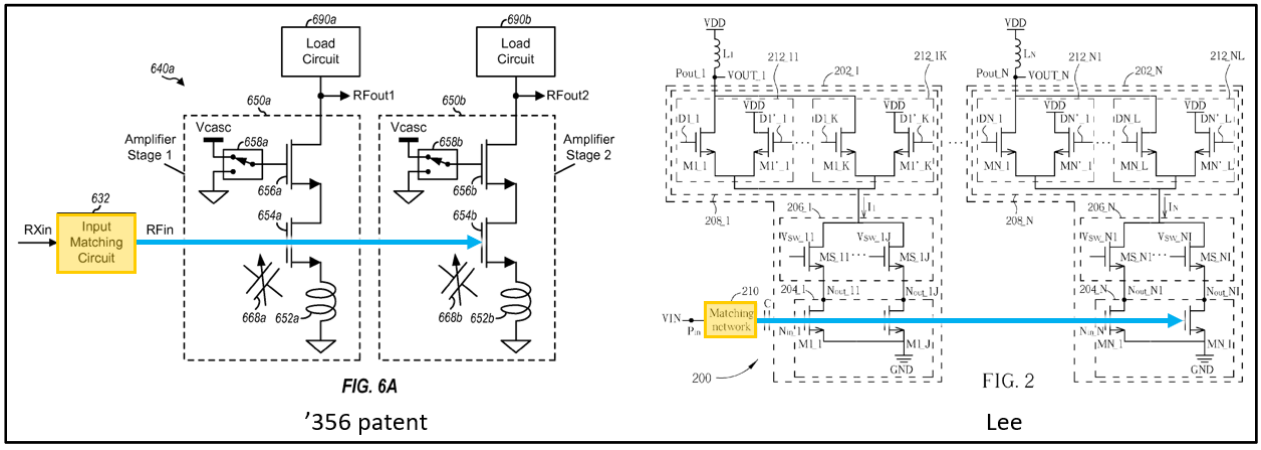


Figure 10. Transmitting data over two 20 MHz carriers increases available bandwidth to 40 MHz (the sum of the carriers' bandwidths).

Lee therefore teaches carrier aggregation. EX1302-Fay-Decl. ¶81.

In the related ITC 1093 Investigation, Patent Owner argued that Lee does not teach a single "input RF signal" because the input signal VIN includes "a plurality of radio frequency signals." EX1335-Lee ¶17; EX1337-ITC at 2205:19-22. But the disclosure of Lee is no different than the disclosure of the '356 patent. As shown below by a comparison of Figure 2 of Lee and Figure 6A of the '356 patent, both Lee and the '356 patent disclose a single input RF signal that is provided from an input matching circuit to the amplifier stages.



See EX1301-'356-Patent at 7:49-52 ("Matching circuit 632 receives a receiver input signal, RXin, . . . , and provides an input RF signal RFin."), Abstract ("first amplifier stage receives and amplifies an input radio frequency (RF) signal and provides a first output RF signal to a first load circuit"), *id.* at 17:52-54 ("input RF signal may comprise transmissions sent carriers at different frequencies to a wireless device"), *id.* at Fig. 6A (showing "RXin" and "RFin");[15] EX1335-Lee ¶17 ("input signal VIN is transmitted to the input nodes" of the amplifier blocks via the input matching circuit). EX1302-Fay-Decl. ¶82.

Patent Owner also argued in the same investigation that Lee does not teach "carrier aggregation" because it does not describe "increased aggregated data rate." EX1337-ITC at 2170:3-19. But even assuming carrier aggregation were construed to require an "increased aggregated data rate," Lee teaches carrier aggregation. Receiving data on two or more carriers carrying non-redundant data simultaneously increases the data rate to the sum of the two carriers' data rates.

[15] The '356 patent states that "antenna 410 receives transmissions on multiple carriers in the same band and provides a received RF signal," which is "provided as a receiver input signal, RXin, to an input matching circuit." EX1301-'356-Patent at 4:56-60. The matching circuit then "provides an input RF signal, RFin, to CA LNA 440." *Id*. at 4:63-65. EX1302-Fay-Decl. ¶82, n18.

For example, if the first carrier transmits data at 50 megabits per second and the second carrier transmits data at 25 megabits per second, transmitting data over both of those carriers at the same time increases the aggregated data rate to 75 megabits per second. This is consistent with the prosecution history and its discussion of "increased aggregated data rate." Patent Owner distinguished the prior art reference Hirose on the grounds that it described sending ***redundant*** data over three different carriers and therefore did not lead to an "increased aggregated data rate." *See* Section V.C, *supra*. Lee, however, is different from Hirose: Lee uses multiple carriers to send different data, not redundant data, and Lee therefore does teach an "increased aggregated data rate." EX1302-Fay-Decl. ¶83.

e) *"the first output RF signal including at least a first carrier of the multiple carriers"*

Lee teaches this limitation. Lee teaches the first output RF signal (e.g., VOUT_1) including at least a first carrier of the multiple carriers (e.g., a WiFi carrier). Lee teaches that "the input signal VIN may include a plurality of radio frequency signals," and that "a plurality of received signals corresponding to the radio-frequency signals [in VIN] are ***generated as outputs*** of the signal amplification circuit." EX1335-Lee ¶17. As described above, Bluetooth and WiFi are sent over different carriers. The first output RF signal VOUT_1 is one of the "generated outputs" of the amplification circuit. *See id.* ¶28 ("a plurality of processed signals VOUT_1-VOUT_N"). VOUT_1 includes a WiFi carrier, for

example. *See id.* ¶¶29, 33. Thus, the first output RF signal VOUT_1 includes at least a first carrier of the multiple carriers because it corresponds to at least one of the radio-frequency signals within VIN. EX1302-Fay-Decl. ¶84; EX1337-ITC at 2190:8-21 (Patent Owner in the ITC 1093 Investigation did not dispute that Lee discloses this limitation).

f) *"a second amplifier stage configured to be independently enabled or disabled"*

Lee teaches this limitation. Lee teaches a second amplifier stage (e.g., amplifier block 202_N) configured to be independently enabled or disabled (e.g., by independently enabling or disabling output stage 208_N). Figure 2 shows amplifier block 202_N, which includes an input stage 204_N, a selecting stage 206_N, and output stage 208_N. EX1335-Lee ¶26. Amplifier block 202_N is the second amplifier stage, as shown in annotated Figure 2 below.

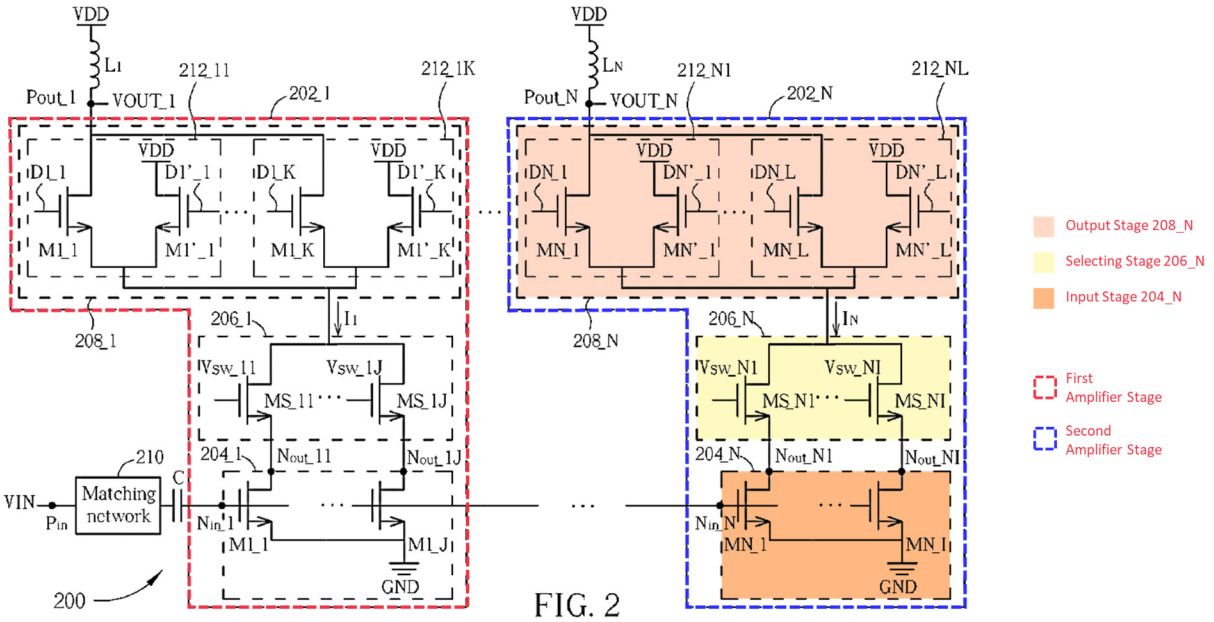


FIG. 2

Lee teaches that the second amplifier stage is configured to be independently enabled or disabled via its output stage 208_N. When the second amplifier stage is required to provide output, such as "when only the Bluetooth function of the multi-radio device is required to be active, . . . the output stage 208_N is turned on" by enabling one transistor element in each pair 212_N1-212_NL using control signals DN_1-DN_L and DN'_1-DN'_L, similarly to the first amplifier stage. EX1335-Lee ¶33. However, if the second amplifier stage is not required to be active, then output stage 208_N is disabled. *Id*. An annotated version of Figure 2, below, shows the second amplifier stage 202_N enabled using the output stage 208_N, while the first amplifier stage 202_1 is disabled. EX1302-Fay-Decl. ¶¶85-86; EX1337-ITC at 2190:8-21 (Patent Owner in the ITC 1093 Investigation did not dispute that Lee discloses this limitation).

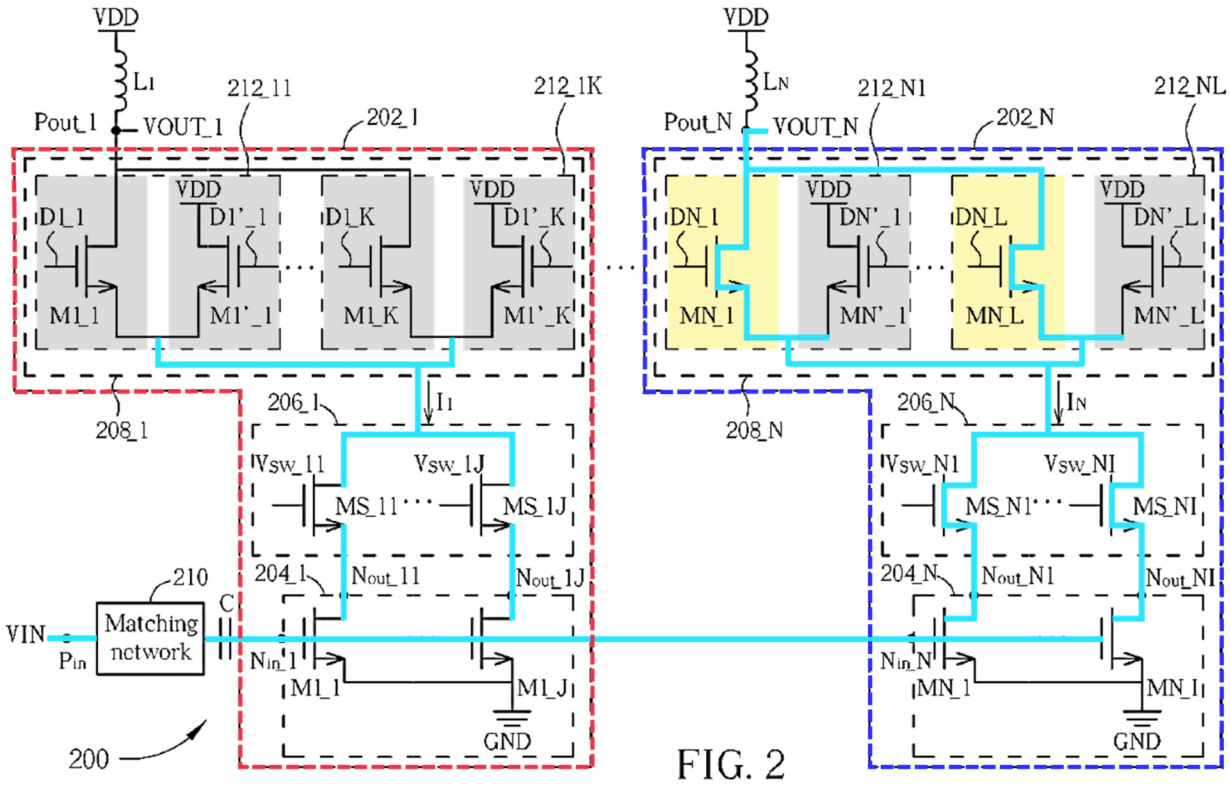


FIG. 2

g) *"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"*

Lee teaches this limitation. Lee teaches the second amplifier stage (e.g., 202_N) further configured to receive and amplify the input RF signal (e.g., VIN) and provide a second output RF signal (e.g., VOUT_N) to a second load circuit (e.g., a Bluetooth receiver/transmitter, or inductive load L_N) when the second amplifier stage is enabled (e.g., "when enabled"). As described above, amplifier block 202_N, comprising the input stage 204_N, the selecting stage 206_N, and the output stage 208_N, is the second amplifier stage. Lee discloses that "input signal VIN is transmitted to the input nodes Nin_1-Nin_N of the input stages

204_1-204_N via matching network 210," including the input stage 204_N of the second amplifier stage. EX1335-Lee ¶26. The second amplifier block is arranged in substantially the same way as the first amplifier block, with the selecting stage 206_N coupling the input stage 204_N to the output stage 208_N, and the output stage 208_N generating a corresponding output signal VOUT_N to the corresponding output port Pout_N. *See id*. ¶28. The second amplifier block receives and amplifies the input RF signal VIN. *Id.* ¶¶4, 28 (describing generation of "a corresponding processed signal to a corresponding output port according to a gain"). Moreover, Lee explains that "the output port Pout_N is coupled to a second radio signal processing system (e.g., a Bluetooth receiver/transmitter)," which is another load circuit.[16] *Id*. ¶29. Lee therefore teaches a second amplifier stage configured to receive and amplify an input RF signal (VIN) via its input stage 204_N and provide a second output RF signal (VOUT_N) to a second load

[16] The '356 patent states that a load circuit "may include one or more inductors, capacitors, transistors, mixers, etc.," and a receiver includes one or more of these components. EX1301-'356-Patent at 5:3-5; EX1302-Fay-Decl. ¶87, n.19. Moreover, Lee teaches that the output stage 208_N is coupled to an inductive "load (e.g., the inductor L_N)," which is a load circuit. EX1335-Lee ¶28; EX1302-Fay-Decl. ¶87, n.19.

circuit (e.g., a Bluetooth receiver/transmitter) via output port Pout_N, as shown in Figure 2, below. EX1302-Fay-Decl. ¶87; EX1337-ITC at 2190:8-21 (Patent Owner in the ITC 1093 Investigation did not dispute that Lee discloses this limitation).

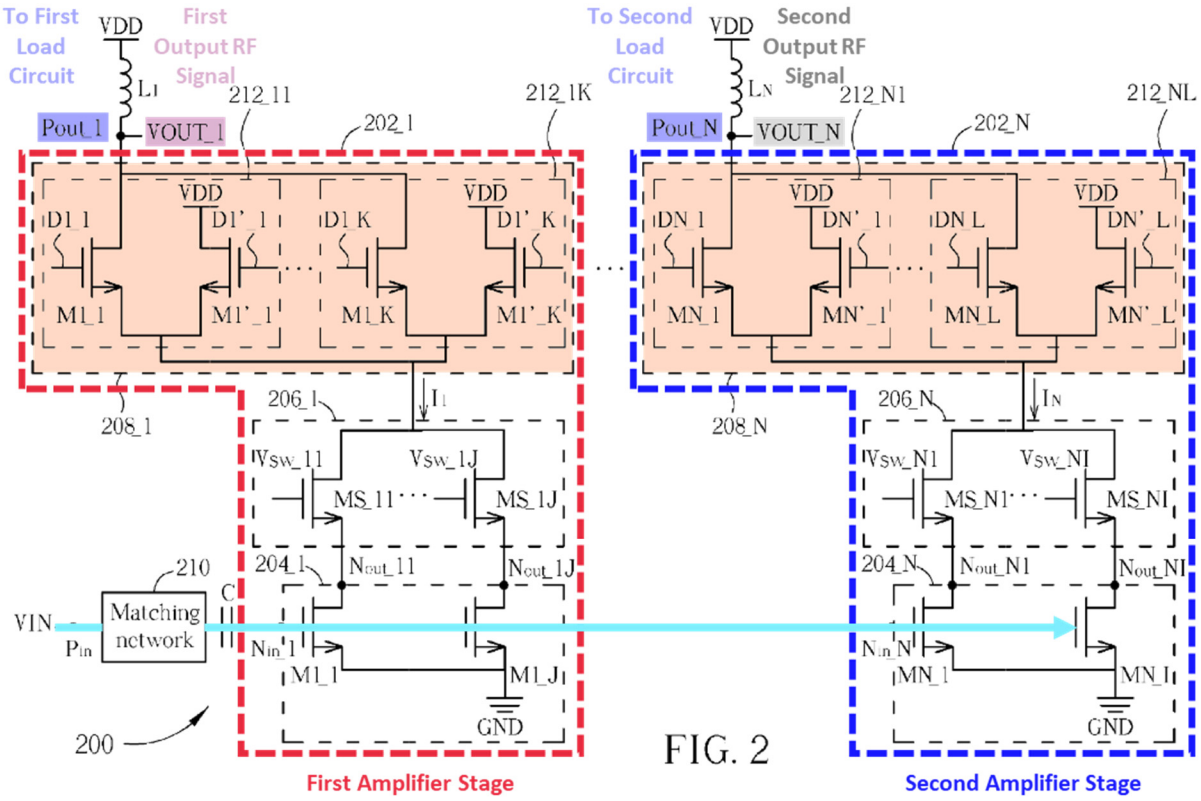


FIG. 2

Moreover, as described above, Lee teaches that the second amplifier stage is configured to perform this function "when . . . enabled." *See* EX1356-Lee ¶28 ("the output stage is . . . implemented for generating a corresponding processed signal (e.g., . . . VOUT_N) to the corresponding output port (e.g., . . . Pout_N) according to a gain . . . of the input stage when enabled."); *id.* ¶4 ("Each of the output stages generates a corresponding processed signal to a corresponding output

port according to a gain . . . when enabled."); *id.* ¶33 ("when only the Bluetooth function of the multi-radio device is required to be active . . . the output stage 208_N is turned on"). EX1302-Fay-Decl. ¶88; EX1337-ITC at 2190:8-21 (Patent Owner in the ITC 1093 Investigation did not dispute that Lee discloses this limitation).

h) *"the second output RF signal including at least a second carrier of the multiple carriers different than the first carrier."*

Lee teaches this limitation. Lee teaches the second output RF signal (e.g., VOUT_N) including at least a second carrier of the multiple carriers (e.g., a Bluetooth carrier) different than the first carrier (e.g., a WiFi carrier). Lee explains that "the input signal VIN may include a plurality of radio-frequency signals (e.g., a Bluetooth signal and a WiFi signal) received by a single antenna," and that "a plurality of received signals corresponding to the radio-frequency signals [in the input signal VIN] are ***generated as outputs*** of the signal amplification circuit." EX1335-Lee ¶17. As described above, Bluetooth and WiFi are sent over different carriers. *Cf.* EX1337-ITC at 22196:18-2197:4. The second output RF signal VOUT_N is one of the "generated outputs" of the amplification circuit. *See* EX1335-Lee ¶28 ("a plurality of processed signals VOUT_1-VOUT_N"). VOUT_N includes a Bluetooth carrier, for example. *See id.* ¶¶29, 33. Thus, the second output RF signal VOUT_N includes at least a second carrier of the multiple

carriers because it corresponds to at least one of the radio-frequency signals in VIN. EX1302-Fay-Decl. ¶89; EX1337-ITC at 2190:8-21 (Patent Owner in the ITC 1093 Investigation did not dispute that Lee discloses this limitation).

Accordingly, claim 1 is invalid under 35 U.S.C. §102 as anticipated by Lee. EX1302-Fay-Decl. ¶90.

2. *Claim 7*

a) *"The apparatus of claim 1, further comprising:"*

As discussed in Section X.A.1, Lee's Figure 2 and its accompanying disclosure teach the apparatus of claim 1. As described below, Lee's Figure 4 and its accompanying disclosure also teach the apparatus of claim 1.[17] EX1302-Fay-Decl. ¶91.

Claims 1[a] and 1[b]: *"An apparatus comprising a first amplifier stage configured to be independently enabled or disabled"***:** As illustrated in the annotated Lee Figure 4, below, Lee discloses an apparatus (e.g., amplification circuit 400) comprising a first amplifier stage (e.g., transistor M'_1 and output stage 304_1, shown in red below). EX1335-Lee ¶¶34, 35, 38, Fig. 4. This first amplifier stage is configured to be independently enabled or disabled. EX1335-

[17] The amplifier circuit 400 "is similar to that of the exemplary signal amplification circuit 300." EX1335-Lee ¶38; EX1302-Fay-Decl. ¶91, n.20.

Lee ¶37 ("When only the WiFi function of the multi-radio device is required to be active, the output stage 304_1 is enabled, whereas the remaining output stages in the signal amplification circuit . . . are disabled. . . . Similarly, when only the Bluetooth function of the multi-radio device is required to be active, the output stage 304_N is turned on, whereas the remaining output stages in the signal amplification circuit . . . are disabled."). Amplification circuit 400 may also operate in combo mode, in which both stages are enabled. *See* EX1335-Lee ¶¶41-42, 33; EX1302-Fay-Decl. ¶92.

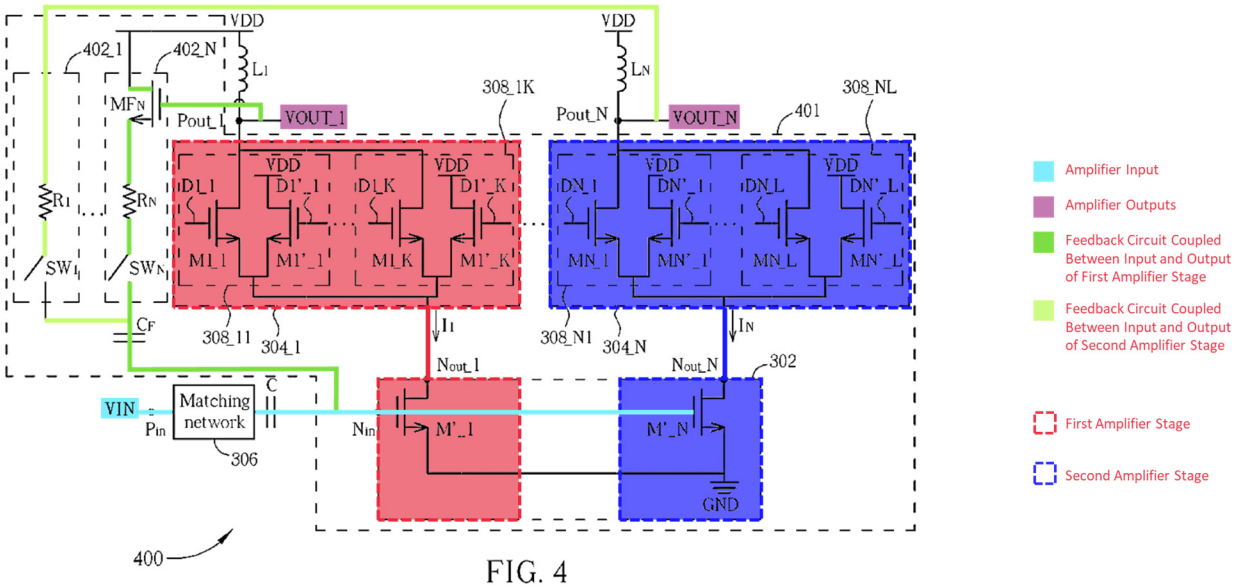


FIG. 4

Claim 1[c]: *"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 first amplifier stage in Lee Figure 4 (e.g., the transistor M'_1 and output stage 304_1) is configured to receive and amplify an input radio frequency (RF) signal (e.g.,

receive the VIN and generate "a corresponding output according to a gain") and provide a first output RF signal (e.g., VOUT_1) to a first load circuit (e.g., a "WiFi receiver/transmitter" or "inductive load" L_1) when the first amplifier stage is enabled (e.g., if "the output stages 304_1 and 304_N are enabled alternately under the mode, the signal amplification circuit . . . refers the input signal VIN to generate the processed signal VOUT_1 for WiFi connection and the other processed signal VOUT_N for Bluetooth connection alternately."). EX1335-Lee ¶¶34-37; EX1302-Fay-Decl. ¶93.

Claim 1[d]: *"the input RF signal employing carrier aggregation comprising transmissions sent on multiple carriers at different frequencies to a wireless device,"*: The input RF signal VIN of Lee Figure 4 employs carrier aggregation as recited in claim 1[d] for the reasons identified above in Section X.A.1.d. EX1302-Fay-Decl. ¶94.

Claim 1[e]: *"the first output RF signal including at least a first carrier of the multiple carriers"*: Lee teaches this limitation for similar reasons as explained above in Section X.A.1.e. *See also* EX1335-Lee ¶¶37-38 ("Pout_1 is coupled to a first radio signal processing system (e.g., a WiFi receiver / transmitter)"); EX1302-Fay-Decl. ¶95.

Claim 1[f]: *"a second amplifier stage configured to be independently enabled or disabled"*: Lee discloses a second amplifier stage (e.g., transistor M'_N

and output stage 304_N, shown in blue, above). EX1335-Lee ¶¶38, 34-35, Fig. 4. This second amplifier stage is configured to be independently enabled or disabled. EX1335-Lee ¶37 ("When only the WiFi function of the multi-radio device is required to be active, the output stage 304_1 is enabled, whereas the remaining output stages in the signal amplification circuit . . . are disabled. . . . Similarly, when only the Bluetooth function of the multi-radio device is required to be active, the output stage 304_N is turned on, whereas the remaining output stages in the signal amplification circuit . . . are disabled."). Amplification circuit 400 may also operate in combo mode, in which both stages are enabled. *See* EX1335-Lee ¶¶42, 33, 41; EX1302-Fay-Decl. ¶96.

Claim 1[g]: *"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 amplifier stage in Lee Figure 4 (e.g., the transistor M'_N and output stage 304_N) is configured to receive and amplify an input radio frequency (RF) signal (e.g., receive the VIN and generate "a corresponding output according to a gain") and provide a second output RF signal (e.g., VOUT_N) to a second load circuit (e.g., a "Bluetooth receiver/transmitter" or "inductive load" L_N) when the second amplifier stage is enabled (e.g., if "the output stages 304_1 and 304_N are enabled alternately under the mode, the signal amplification circuit . . . refers the input

signal VIN to generate the processed signal VOUT_1 for WiFi connection and the other processed signal VOUT_N for Bluetooth connection alternately."). EX1335-Lee ¶¶34-37; EX1302-Fay-Decl. ¶97.

Claim 1[h]: *"the second output RF signal including at least a second carrier of the multiple carriers different than the first carrier."*: Lee teaches this limitation for similar reasons as explained above in Section X.A.1.h. *See also* EX1335-Lee ¶¶37-38 ("Pout_N is coupled to a second radio signal processing system (e.g., a Bluetooth receiver / transmitter)"); EX1302-Fay-Decl. ¶98.

Lee Figure 4, and its accompanying disclosure, therefore also teaches the apparatus of claim 1. EX1302-Fay-Decl. ¶99.

b) *"a feedback circuit coupled between an output and an input of at least one of the first and second amplifier stages."*

Lee teaches this limitation of claim 7. Lee teaches a feedback circuit (e.g., feedback elements 402_1-402_N and/or AC coupling capacitor C_F) coupled between an output (e.g., VOUT_1 and/or VOUT_N) and an input (e.g., input node N_{in}) of at least one of the first and second amplifier stages. Figure 4 shows a signal amplification circuit that "includes a plurality of feedback elements coupled to the output ports VOUT_1-VOUT_N, respectively." EX1335-Lee ¶38. "[E]ach of the feedback elements is coupled between a specific output port and the input node Nin of the input stage 302," and is "used for feeding a specific processed signal

generated at the specific output port to the input node . . . when . . . enabled." *Id*. Each feedback element may be adjusted to the particular application (e.g., WiFi vs. Bluetooth) and may be switched on when that amplifier stage is enabled in a shared mode. *Id.* Lee therefore teaches a feedback circuit coupled between an output and an input of at least one of the first and second amplifier stages, as shown in annotated Figure 4 of Lee, above. EX1302-Fay-Decl. ¶100.

Accordingly, claim 7 is invalid under 35 U.S.C. §102 as anticipated by Lee. EX1302-Fay-Decl. ¶101.

3. *Claim 8*

a) *"The apparatus of claim 7"*

As described in Section X.A.2, claim 7 is invalid under 35 U.S.C. §102 as anticipated by Lee. EX1302-Fay-Decl. ¶102.

b) *"the feedback circuit comprising a resistor, or a capacitor, or both a resistor and a capacitor."*

Lee teaches this limitation. Lee explains that the feedback circuit in Figure 4 may be "implemented by an active feedback element or a resistive feedback element." EX1335-Lee ¶38. In an active feedback configuration, the feedback element "includ[es] a transistor element MF_N, a ***resistor*** R_N, and a switch SW_N." *Id*. In a passive feedback configuration, the feedback element "include[s] a ***resistor*** R1 and a switch SW1." *Id*. Lee therefore teaches the feedback circuit comprising a resistor in both configurations. In addition to the feedback elements,

Lee teaches that "an AC coupling capacitor C_F is placed between the input stage 302 and the feedback elements 401_1-402_N." *Id*. The feedback circuit in Lee thus comprises a resistor, or a capacitor, or both a resistor and a capacitor, as shown in annotated Lee Figure 4, below. EX1302-Fay-Decl. ¶103.

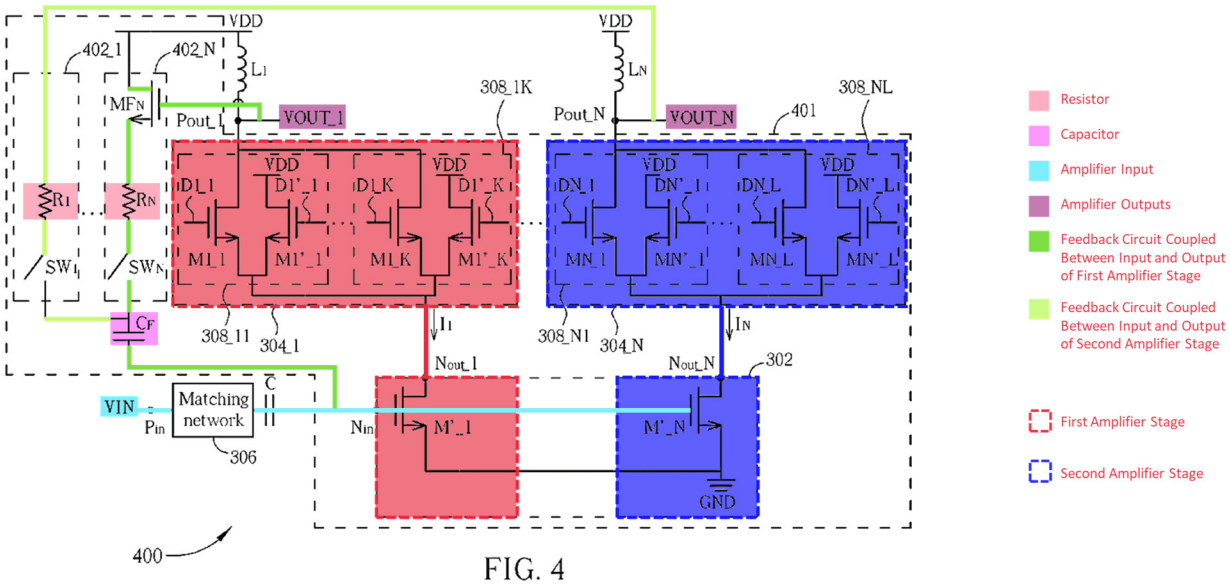


FIG. 4

Accordingly, claim 8 is invalid under 35 U.S.C. §102 as anticipated by Lee. EX1302-Fay-Decl. ¶104.

4. *Claim 11*

a) *"The apparatus of claim 1, further comprising:"*

As described in Section X.A.1, Lee teaches the apparatus of claim 1. EX1302-Fay-Decl. ¶105.

b) *"an input matching circuit coupled to the first and second amplifier stages and configured to receive a receiver input signal and provide the input RF signal."*

Lee teaches this limitation. Lee teaches an input matching circuit (e.g., matching network 210) coupled to the first (e.g., 202_1) and second (e.g., 202_N) amplifier stages and configured to receive a receiver input signal (e.g., VIN) and provide the input RF signal (e.g., the signal leaving matching network 210, to which Lee also refers as "VIN"). Lee explains that "the input signal VIN may include a plurality of radio frequency signals (e.g., a Bluetooth signal and a WiFi signal) ***received by a single antenna***." EX1335-Lee ¶17. Lee further explains that "[t]he input signal VIN is transmitted to the input nodes Nin_1-Nin_N of the input stages 204_1-204_N ***via the matching network 210*** and an AC coupling capacitor C." EX1335-Lee ¶26. Input stage 204_1 is part of the first amplifier stage 202_1 and input stage 204_N is part of the second amplifier stage 202_N. EX1135-Lee ¶¶26, 27. The matching network 210 provides "desired impedance matching" and is "designed to meet the impedance matching requirements." *Id*. Lee therefore teaches an input matching circuit coupled to the first and second amplifier stages (through their input stages 204_1 and 204_N) and configured to provide the input RF signal (e.g., the signal leaving matching network 210, to which Lee also refers as "VIN"), as shown in annotated Lee Figure 2, below. EX1302-Fay-Decl. ¶106.

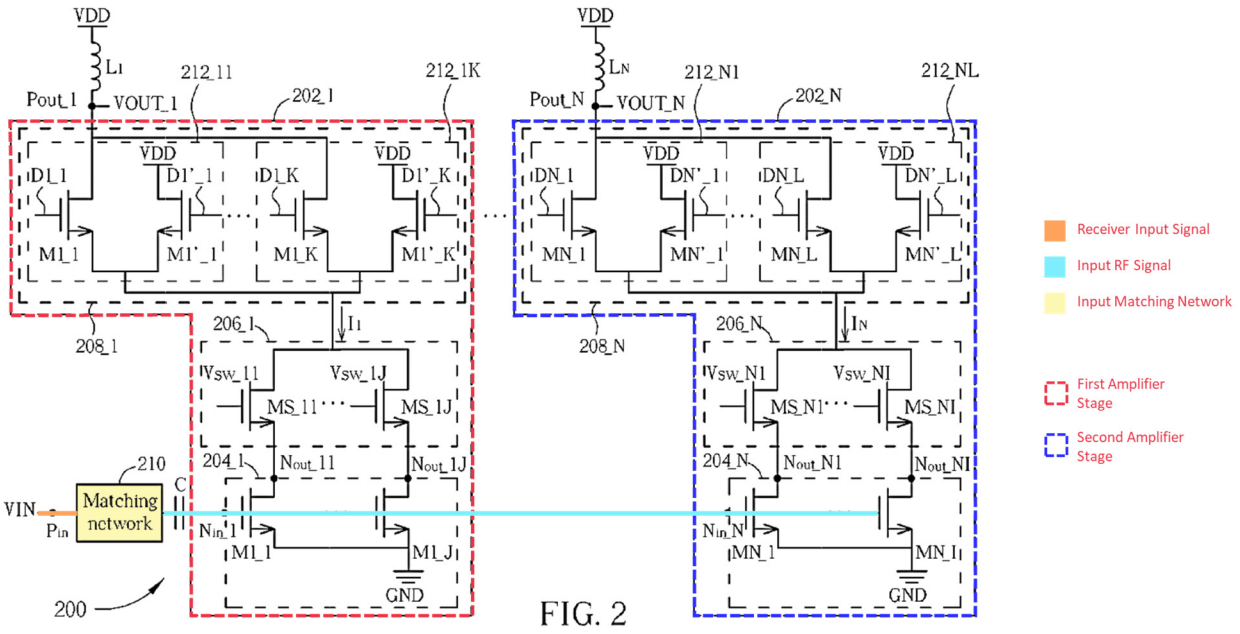


FIG. 2

Moreover, Lee teaches that the input matching network is configured to receive the receiver input signal. The receiver input signal in the '356 patent is the signal provided to the input matching network after the antenna. *See* EX1302-'356-Patent at 4:56-65 ("[A]ntenna 410 receives transmissions on multiple carriers in the same band and provides a received RF signal. The received RF signal is routed through switches/duplexers 424 and provided as a receiver input signal, RXin, to an input matching circuit 432. Matching circuit . . . provides an input RF signal, RFin, to CA LNA 440.") In Lee, "the input signal VIN may include a plurality of radio-frequency signals . . . received by a single antenna" and provided to the matching network. EX1335-Lee ¶¶17, 26. Lee therefore teaches that the matching network is configured to receive the receiver input signal. EX1302-Fay-Decl. ¶107.

Accordingly, claim 11 is invalid under 35 U.S.C. §102 as anticipated by Lee. EX1302-Fay-Decl. ¶108.

5. *Claim 17*

a) *"A method comprising"*

As explained in further detail, below, Lee discloses a method for amplifying input RF signals in a receiver that supports carrier aggregation. EX1302-Fay-Decl. ¶109.

b) *"amplifying a first input radio frequency (RF) signal with a first amplifier stage to obtain a first output RF signal when the first amplifier stage is enabled,"*

Lee teaches this limitation of claim 17 for the same reasons described in Sections X.A.1.b and X.A.1.c (limitations 1.b and 1.c). EX1302-Fay-Decl. ¶110.

c) *"the first amplifier stage configured to be independently enabled or disabled,"*

Lee teaches this limitation of claim 17 for the same reasons described in Section X.A.1.b (limitation 1.b). EX1302-Fay-Decl. ¶111.

d) *"the first input RF signal employing carrier aggregation comprising transmissions sent on multiple carriers at different frequencies to a wireless device,"*

Lee teaches this limitation of claim 17 for the same reasons described in Section X.A.1.d (limitation 1.d). EX1302-Fay-Decl. ¶112.

e) *"the first output RF signal including at least a first carrier of the multiple carriers"*

Lee teaches this limitation of claim 17 for the same reasons described in Section X.A.1.e (limitation 1.e). EX1302-Fay-Decl. ¶113.

f) *"amplifying the first input RF signal or a second input RF signal with a second amplifier stage to obtain a second output RF signal when the second amplifier stage is enabled,"*

This limitation requires amplifying an input RF signal with a second amplifier stage to obtain a second output RF signal when the second amplifier stage is enabled. The input RF signal that must be amplified is recited in the alternative – it can be either "the first input RF signal" or "a second input RF signal." *See* EX1301-'356-Patent at 22:21-22. As described in Sections X.A.1.f. and X.A.1.g (limitations 1.f and 1.g), Lee teaches amplifying ***the first input RF signal*** with a second amplifier stage to obtain a second output RF signal when the second amplifier stage is enabled. Lee therefore teaches this limitation. EX1302-Fay-Decl. ¶114.

g) *"the second amplifier stage configured to be independently enabled or disabled,"*

Lee teaches this limitation of claim 17 for the same reasons described in Section X.A.1.f (limitation 1.f). EX1302-Fay-Decl. ¶115.

h) *"the second output RF signal including at least a second carrier of the multiple carriers different than the first carrier."*

Lee teaches this limitation of claim 17 for the same reasons described in Section X.A.1.h (limitation 1.h). Accordingly, claim 17 is invalid under 35 U.S.C. §102 as anticipated by Lee. EX1302-Fay-Decl. ¶116.

Accordingly, claim 17 is invalid under 35 U.S.C. §102 as anticipated by Lee. EX1302-Fay-Decl. ¶117.

6. *Claim 18*

a) *"The method of claim 17, further comprising:"*

As described in Section X.A.5, Lee teaches the method of claim 17. EX1302-Fay-Decl. ¶118.

b) *"enabling the first and second amplifier stages in a first mode to obtain the first and second output RF signals"*

Lee teaches this limitation. As explained in Section X.A.1, Lee teaches a first "combo" mode where "both of the WiFi function and Bluetooth function of the multi-radio device are required to be active" and "the output stages 208_1 and 208_N are ***both enabled at the same time***." EX1335-Lee ¶33. Each output stage is "enabled for generating the corresponding processed signal," and therefore both the first output RF signal VOUT_1 and the second output RF signal VOUT_N are generated in the combo mode. *Id.* ("[E]ach of the output stages 208_1-208_N is further arranged to determine if a processed signal is allowed to be generated at a corresponding output port."); EX1302-Fay-Decl. ¶119.

c) *enabling the first amplifier stage and disabling the second amplifier stage in a second mode to obtain the first output RF signal but not the second output RF signal."*

Lee teaches this limitation. As explained in Section X.A.1, Lee teaches a second "shared" mode where "only the WiFi function of the multi-radio device is required to be active" and "the output stage 208_1 is enabled, whereas all of the output stages in the remaining amplifier blocks are disabled." EX1335-Lee ¶33. Further, because "each of the output stages 208_1-208_N is further arranged to determine if a processed signal is allowed to be generated at a corresponding output port," disabling the second output stage 208_N in the second mode means that the second output RF signal VOUT_N is not provided. *Id*. Lee therefore teaches enabling the first amplifier stage and disabling the second amplifier stage in a second mode, so as to obtain the first output RF signal but not the second output RF signal. EX1302-Fay-Decl. ¶120.

Accordingly, claim 18 is invalid under 35 U.S.C. §102 as anticipated by Lee. EX1302-Fay-Decl. ¶121.

B. Ground II: Claims 7 and 8 Are Obvious Over Lee

1. *Claim 7*

a) *"The apparatus of claim 1, further comprising:"*

As described in Section X.A.1, Lee teaches the apparatus of claim 1. EX1302-Fay-Decl. ¶123.

b) *"a feedback circuit coupled between an output and an input of at least one of the first and second amplifier stages."*

Lee teaches this limitation. Figure 4 shows a signal amplification circuit that "includes a plurality of feedback elements coupled to the output ports VOUT_1-VOUT_N, respectively." EX1335-Lee ¶38. "[E]ach of the feedback elements is coupled between a specific output port and the input node Nin of the input stage 302," and is "used for feeding a specific processed signal generated at the specific output port to the input node . . . when . . . enabled." *Id.* Each feedback element may be adjusted to the particular application (e.g., WiFi vs. Bluetooth) and may be switched on when that amplifier stage is enabled in a shared mode. *Id.* Lee therefore teaches a feedback circuit coupled between an output and an input of at least one of the first and second amplifier stages, as shown in annotated Figure 4 of Lee below. EX1302-Fay-Decl. ¶124.

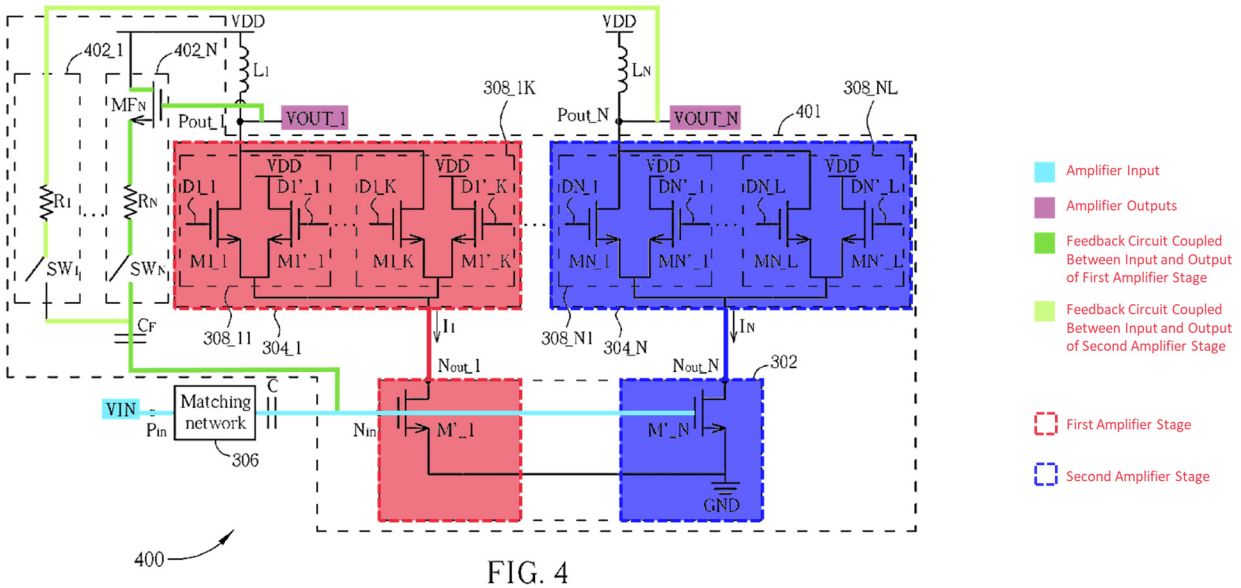


FIG. 4

It would have been obvious to one of ordinary skill in the art to combine the feedback circuit of Lee Figure 4 with the amplification circuit of Lee Figure 2. Lee explains that "[w]ith the feedback elements implemented in the signal amplification circuit 400, the input matching performance can be improved greatly" and that, for example, "a wider input frequency range can be covered by the signal amplification circuit 400." EX1335-Lee ¶39. This combination would have involved nothing more than combining prior art elements (the feedback elements 402_1 and/or 402_N of Figure 4 and the amplification circuit 200 of Figure 2) according to known methods (coupling feedback elements 402_1 and/or 402_N at one end to the input signal between the matching network and the input node Nin, and at the other end to the output signal VOUT_1 and/or VOUT_N, as shown and described with respect to Lee Figure 4), to yield predictable results (to "improv[e] greatly" the "input matching performance" and "cover[]" a "wider input frequency range"). *See id.*; EX1302-Fay-Decl. ¶125.

A POSITA would have understood the feedback circuit in Figure 4 as a known technique for improving input matching performance. EX1335-Lee ¶39 ("input matching performance can be improved greatly" and "wider input frequency range can be covered"). Lee already describes input matching with respect to the amplification circuit 200 of Figure 2, stating that the "matching network . . . 210 should be properly designed to meet the impedance matching

requirements." *Id.* ¶26. A POSITA would have recognized the amplification circuit 200 of Figure 2 as a known circuit ready for improvement (i.e. that "should be properly designed to meet the impedance matching requirements") to yield the predictable result of the improved input matching performance and wider input frequency range described with respect to Lee Figure 4. EX1302-Fay-Decl. ¶126.

Finally, a POSITA would have found this combination obvious to try. Lee suggests fluidity of components among its described embodiments: "[t]his document does not intend to distinguish between components that differ in name but not function." EX1335-Lee ¶16. Lee also notes that "[t]hose skilled in the art will readily observe that numerous modifications and alterations of the device and method may be made while retaining the teachings of the invention." EX1335-Lee ¶45. Given how Lee describes the amplification circuits 200 and 400 from Figure 2 and Figure 4 using similar terms and with similar functionality, and describes a finite number of embodiments of "similar" amplification circuits 100, 200, 300, 400, 600, a POSITA would have found the addition of the feedback circuit of Figure 4 to the amplification circuit of Figure 2 obvious to try. EX1335-Lee ¶¶16, 33, 39; EX1302-Fay-Decl. ¶127.

Accordingly, claim 7 is invalid under 35 U.S.C. §103 as obvious over Lee. EX1302-Fay-Decl. ¶128.

2. *Claim 8*

a) *"The apparatus of claim 7,"*

As described in Section X.B.1, Lee renders obvious the apparatus of claim 7. EX1302-Fay-Decl. ¶129.

b) *"the feedback circuit comprising a resistor, or a capacitor, or both a resistor and a capacitor."*

Lee teaches this limitation of claim 8 for the same reasons described in Section X.A.3.b (limitation 8.b). For the reasons stated above in Section X.B.1, one of ordinary skill in the art would have combined the feedback circuit of Lee Figure 4 with the amplification circuit of Lee Figure 2. EX1302-Fay-Decl. ¶130.

Accordingly, claim 8 is invalid under 35 U.S.C. §103 as obvious over Lee. EX1302-Fay-Decl. ¶131.

C. Ground III: Claims 1, 7, 8, 11, 17, and 18 Are Obvious Over Lee in View of the Feasibility Study

To the extent Patent Owner argues that Lee fails to teach an input RF signal employing carrier aggregation, as recited in limitations 1.d and 17.d (*see* Sections X.A.1.d and X.A.5.d), the Feasibility Study also discloses this element. The '356 patent discloses the use of carrier aggregation in LTE. *See* EX1301-'356-Patent at 2:53-67. The 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." EX1304-Study at 22. It further teaches

that a "terminal may simultaneously receive one or multiple component carriers depending on its capabilities." *Id*.; EX1302-Fay-Decl. ¶133.

A POSITA would have found it obvious to turn to the amplification circuit of Lee in order to process the carrier aggregated input RF signal of the Feasibility Study and would have been motivated to combine those references. The Feasibility Study recognizes that wireless mobile devices can be configured to operate with input RF signals employing carrier aggregation. *See* EX1304-Study at 9 ("It is possible to configure a UE [user equipment][18] to aggregate a different number of component carriers originating from the same eNB [base station] and of possibly different bandwidths in the UL [uplink] and the DL [downlink]."). The Feasibility Study further suggests that an ideal receiver for noncontiguous intra-band and inter-band carrier aggregation[19] would have multiple RF front-ends. *See id*. at 26 (describing "Option B" with "multiple" Rx architecture for non-contiguous carrier aggregation). The Feasibility Study characterizes an "RF front end" as having its own gain control (amplifier), mixer, and analog-to-digital

[18] "User equipment" is and was understood by those skilled in the art to include wireless mobile devices such as cellular telephones. EX1302-Fay-Decl. ¶134, n. 21.

[19] *See* EX1302-Fay-Decl. ¶41.

conversion. *See id.* ("RF front end (i.e., mixer, AGC [Automatic Gain Control], ADC [Analog to Digital Conversion)"). Lee teaches multiple amplifier blocks providing output to different receivers. *See* EX1335-Lee ¶29. Lee thus teaches the exact type of receiver that the Feasibility Study recognizes would work with signals employing carrier aggregation. The motivation to combine Lee with the teachings of the Feasibility Study arises from the references themselves and requires nothing more than substitution of the "plurality of radio frequency signals" of Lee for the "Carrier Aggregation" signals described in the Feasibility Study. EX1302-Fay-Decl. ¶134.

A POSITA would have been motivated to use the carrier aggregated input RF signal of the Feasibility Study with the amplification blocks of Lee. The Feasibility Study teaches that carrier aggregation may provide benefits, such as wider transmission bandwidths and spectrum aggregation. *See* EX1304-Study at 8. The Feasibility Study further teaches that carrier aggregation is supported by LTE-Advanced. *Id*. A POSITA would have been motivated to use the input RF signal employing carrier aggregation of the Feasibility Study with the amplification blocks of Lee in order to achieve these benefits and unlock the features of LTE-Advanced. EX1302-Fay-Decl. ¶135.

A POSITA would have had a reasonable expectation of success in using the carrier aggregated input RF signals as described in the Feasibility Study with the

amplification blocks of Lee. The Feasibility Study teaches that a receiver front-end with multiple processing paths can successfully support carrier aggregation. EX1304-Study at 26. The circuitry of Lee is capable of receiving and processing the types of signals described in Feasibility Study, and any further modifications that would have been made to Lee to accept the input RF signal of the Feasibility Study would have involved nothing more than well-known receiver tuning and filtering techniques. EX1302-Fay-Decl. ¶136.

Lee teaches all of the remaining limitations of claims 1, 7, 8, 11, 17, and 18 for the same reasons described in Section X.A.1 – X.A.6 and Lee renders claims 7 and 8 unpatentable under 35 U.S.C. §103(a) for the same reasons described in Sections X.B.1 – X.B.2. Accordingly, Lee in view of the Feasibility Study renders claims 1, 7, 8, 11, 17, and 18 unpatentable under 35 U.S.C. §103(a). EX1302-Fay-Decl. ¶137.

XI. CONCLUSION

Based on the foregoing, claims 1, 7, 8, 11, 17, and 18 of the ’356 patent are unpatentable. *See* EX1302-Fay-Decl. ¶72. The Petitioner requests institution of an *inter partes* review to cancel these claims.

Respectfully Submitted,

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Table of Exhibits for U.S. Patent 9,154,356 Petition for *Inter Partes* Review

Exhibit	Description
1301	U.S. Patent No 9,154,356 ("'356 patent")
1302	Declaration of Dr. Patrick Fay ("Fay-Decl.")
1303	RESERVED
1304	3GPP Technical Report 36.912 V9.1.0, 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Feasibility study for Further Advancements for E-UTRA (LTE-Advanced) (Release 9) ("Feasibility Study")
1305	RESERVED
1306	RESERVED
1307	RESERVED
1308	RESERVED
1309	RESERVED
1310	RESERVED
1311	August 21, 2012, U.S. Application No. 13/590,423 as filed
1312	November 14, 2013 Office Action, U.S. Application No. 13/590,423

Exhibit	Description
1313	Patent Owner's February 6, 2014 Response to Office Action Dated November 14, 2013, U.S. Application No. 13/590,423
1314	April 18, 2014 Office Action, U.S. Application No. 13/590,423
1315	Patent Owner's June 6, 2014 Response to Office Action Dated April 18, 2014, U.S. Application No. 13/590,423
1316	August 1, 2014 Office Action, U.S. Application No. 13/590,423
1317	Patent Owner's October 30, 2014 Response to Office Action Dated August 1, 2014, U.S. Application No. 13/590,423
1318	December 26, 2014 Office Action, U.S. Application No. 13/590,423
1319	February 26, 2015 Applicant-Initiated Interview Summary, U.S. Application No. 13/590,423
1320	Patent Owner's February 25, 2015 Response to Office Action Dated December 26, 2014, U.S. Application No. 13/590,423
1321	March 5, 2015 Notice of Allowability, U.S. Application No. 13/590,423
1322	May 29, 2015 Notice of Allowability, U.S. Application No. 13/590,423

Exhibit	Description
1323	U.S. Patent No. 7,751,513 ("Eisenhut")
1324	U.S. Patent No. 7,317,894 ("Hirose")
1325	U.S. Patent No. 8,442,473 ("Kaukovuori")
1326	Declaration of Patrick Merias ("Merias Decl.")
1327	Declaration of Friedhelm Rodermund ("Rodermund Decl.")
1328	RAN1 TR 36.912 Documents ("TR 36.912 Webpage") http://www.3gpp.org/ftp/Specs/archive/36_series/36.912/
1329	RESERVED
1330	RESERVED
1331	RESERVED
1332	RESERVED
1333	RESERVED
1334	RESERVED
1335	U.S. Patent Application Publication 2012/0056681 ("Lee")
1336	Inv. No. 337-TA-1093 Order No. 38: Construing Certain Terms of the Asserted Claims of the Patents at Issue (*Markman* Claim Construction), August 28, 2018, Public Version, pgs. cover, 1-

Exhibit	Description
	19, App'x A 1, 3-9, 11, 12, 14, 15, 17-20, 23-25, 27, 30-41, 43-46, Chart 2, Cert. of Service
1337	Inv. No. 337-TA-1093, "Open Sessions," Public Hearing Transcript, (cover, pages 1953, 2170, 2174, 2189-2216, 2246, & 2270), Sep. 25, 2018 ("ITC")

CERTIFICATE OF SERVICE

I hereby certify that on November 9, 2018, I caused a true and correct copy of the foregoing materials:

- Petition for *Inter Partes* Review of U.S. Patent No. 9,154,356 Under 35 U.S.C. §312 and 37 C.F.R. §42.104
- Certificate of Compliance Regarding Word Count
- Table of Exhibits for Petition for *Inter Partes* Review of U.S. Patent No. 9,154,356 (EX1301-1337)
- Exhibits 1301, 1302, 1304, 1311-1328, 1335-1337
- Intel Corporation Power of Attorney
- Fee Authorization

to be served via Express Mail on the following attorney of record as listed on PAIR:

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WORD COUNT CERTIFICATE OF COMPLIANCE

I hereby certify that the foregoing, Petition for *Inter Partes* Review of U.S. Patent No. 9,154,356, contains 13,520 words as measured by the word processing software used to prepare the document, in compliance with 37 C.F.R. §42.24 (d).

Respectfully submitted,

Dated: November 9, 2018

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