Intel Corporation
v.
Qualcomm Incorporated

IPR2019-00128
IPR2019-00129

U.S. Patent No. 9,154,356

Patent Owner's Demonstrative Exhibits

U.S. Patent No. 9,154,356

(12) **United States Patent**
Tasic et al.

(10) **Patent No.: US 9,154,356 B2**
(45) **Date of Patent: Oct. 6, 2015**

(54) **LOW NOISE AMPLIFIERS FOR CARRIER AGGREGATION**

(75) Inventors: **Aleksandar Miodrag Tasic**, San Diego, CA (US); **Anosh Bomi Davierwalla**, San Diego, CA (US)

(73) Assignee: **QUALCOMM Incorporated**, San Diego, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **13/590,423**

(22) Filed: **Aug. 21, 2012**

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,911,364 A
4,035,728 A

FOREIC

CN 152
CN 192

OT

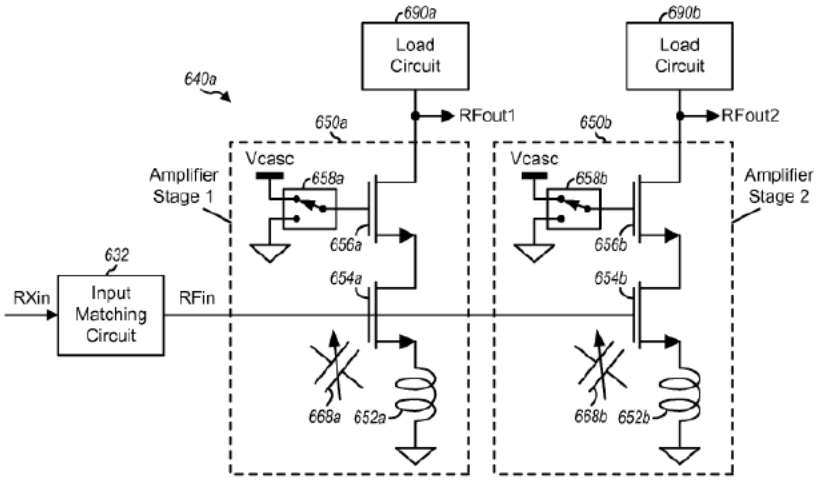


FIG. 6A

Intel 1301, Fig. 6A*

* All Citations are to IPR2019-00128, unless otherwise noted.

Instituted Grounds

- Ground I (IPR2019-00128): Claims 1, 7, 8, 11, 17 and 18 as Anticipated by Lee
- Ground II (IPR2019-00128): Claims 7 and 8 as Obvious over Lee
- Ground III (IPR2019-00128): Claims 1, 7, 8, 11, 17 and 18 as Obvious over Lee and Feasibility Study
- Ground I (IPR2019-00129): Claims 2, 3, 4, 5 and 6 as Anticipated by Lee
- Ground II (IPR2019-00129): Claim 10 as Obvious over Lee and Youssef
- Ground III (IPR2019-00129): Claims 2, 3, 4, 5 and 6 as Obvious over Lee and Feasibility Study
- Ground IV (IPR2019-00129): Claim 10 as Obvious over Lee, Feasibility Study and Youssef

IPR2019-00128, Institution Decision, p. 32
IPR 2019-00129, Institution Decision, p. 36

Patentability

1) The Petition Relies on an Overly Broad Interpretation of "Carrier Aggregation"
2) Lee is Unrelated to Carrier Aggregation
3) The POSA Would Not Combine Lee with the Feasibility Study
4) Petitioner Relies Improperly on Two Different Lee Embodiments for Claim 7

Patent Owner Response, pp. 11-29, 32-37, 40-47

Patentability

1) Petition Relies on an Overly Broad Interpretation of "Carrier Aggregation"

2) Lee is Unrelated to Carrier Aggregation

3) The POSA Would Not Combine Lee with the Feasibility Study

4) Petitioner Relies Improperly on Two Different Lee Embodiments for Claim 7

Patent Owner Response, pp. 11-29;
Patent Owner Sur-Reply, pp. 2-18

Claim Construction – "Carrier Aggregation"

1. An apparatus comprising:

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

a second amplifier stage configured to be independently enabled or disabled, the second amplifier stage further configured to receive and amplify the input RF signal and provide a second output RF signal to a second load circuit when the second amplifier stage is enabled, the second output RF signal including at least a second carrier of the multiple carriers different than the first carrier.

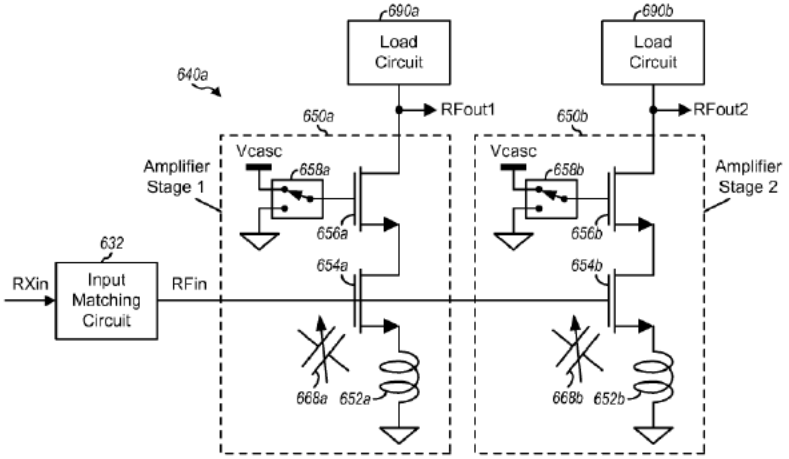


FIG. 6A

Intel 1301, 20:43-61, Fig. 6

Claim Construction – "Carrier Aggregation"

Patent Owner's Proposed Construction	Petitioner's Proposed Construction
"simultaneous operation on multiple carriers that are combined as a single virtual channel to provide higher bandwidth"	"simultaneous operation on multiple carriers"

Patent Owner Response, p. 11

Claim Construction – "Carrier Aggregation"

- Petitioner's Construction Reads "Carrier Aggregation" Out of the Claims
- Petitioner's Construction Contradicts the Written Description
- Petitioner's Construction Violates the Doctrine of Prosecution History Disclaimer
- Patent Owner Did Not Redefine "Carrier Aggregation"
- "Carrier Aggregation" Has a Well Understood Meaning

Patent Owner Response, pp. 28-29;
Patent Owner Sur-Reply, pp. 15-16

Petitioner's Construction Reads "Carrier Aggregation" Out of the Claims

1. An apparatus comprising:

a first amplifier stage configured to be independently enabled or disabled, the first amplifier stage further configured to receive and amplify an input radio frequency (RF) signal and provide a first output RF signal to a first load circuit when the first amplifier stage is enabled, the input RF signal employing ~~carrier aggregation~~ [simultaneous operation on multiple carriers] comprising transmissions sent on multiple carriers at different frequencies to a wireless device, the first output RF signal including at least a first carrier of the multiple carriers; and

Patent Owner Response, p. 29

Petitioner's Construction Reads "Carrier Aggregation" Out of the Claims

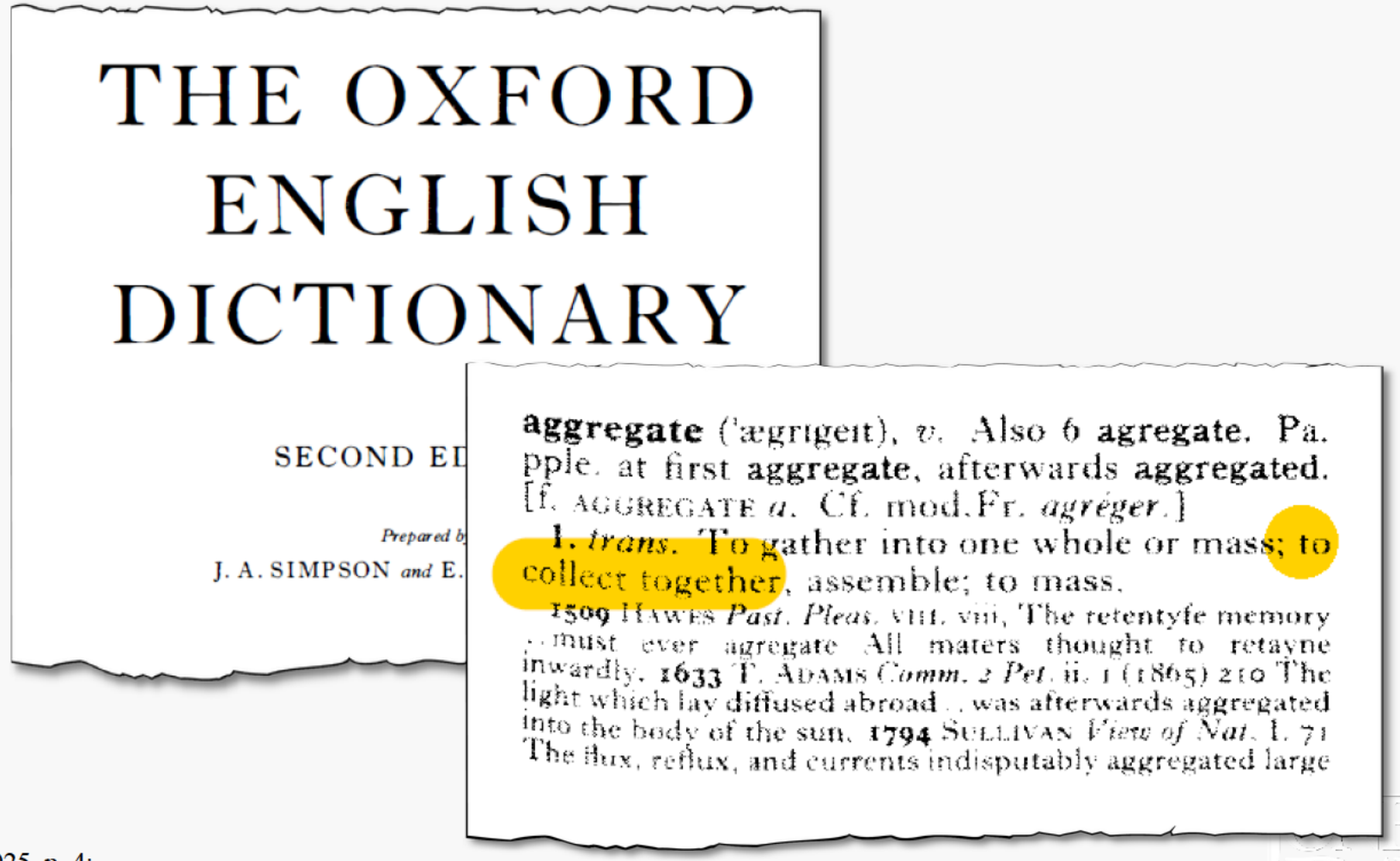
1. (Currently amended) An apparatus comprising:

a first amplifier stage configured to receive and amplify an input radio frequency (RF) signal and provide a first output RF signal to a first load circuit when the first amplifier stage is enabled, the input RF signal employing carrier aggregation comprising transmissions sent on multiple carriers at different frequencies to a wireless device, the first output RF signal including at least a first carrier of the multiple carriers; and

a second amplifier stage configured to receive and amplify the input RF signal and provide a second output RF signal to a second load circuit when the second amplifier stage is enabled, the second output RF signal including at least a second carrier of the multiple carriers different than the first carrier.

Intel Ex. 1315 (Amendment) at 2;
Patent Owner Response, p. 25

Petitioner's Construction Reads "Carrier Aggregation" Out of the Claims



THE OXFORD ENGLISH DICTIONARY

SECOND ED

Prepared by

J. A. SIMPSON *and* E.

aggregate ('ægrigeit), *v.* Also 6 **agregate**. Pa. pple. at first **aggregate**, afterwards **aggregated**. [f. AGGREGATE *a.* Cf. mod.Fr. *agréger*.]

1. *trans.* To gather into one whole or mass; to collect together, assemble; to mass.

1509 HAWES *Past. Pleas.* VIII. viii, The retentyfe memory ..must ever agregate All maters thought to retayne inwardly. **1633** T. ADAMS *Comm. 2 Pet.* ii. 1 (1865) 210 The light which lay diffused abroad .. was afterwards aggregated into the body of the sun. **1794** SULLIVAN *View of Nat.* I. 71 The flux, reflux, and currents indisputably aggregated large

Ex. 2025, p. 4;
Patent Owner Response, p. 29

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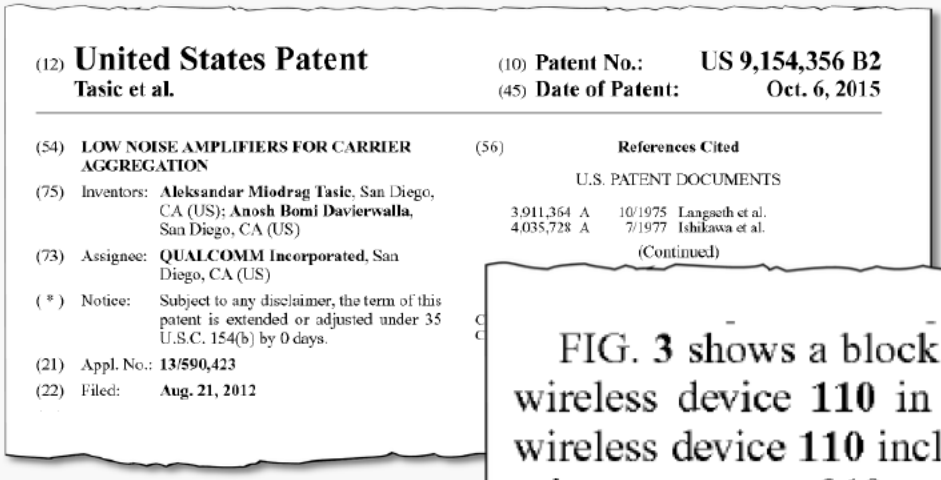
Patent Owner Response, pp. 12-14, 29;

Petitioner's Construction Contradicts the Written Description



(12) **United States Patent**
Tasic et al.

(10) **Patent No.: US 9,154,356 B2**
(45) **Date of Patent: Oct. 6, 2015**

(54) **LOW NOISE AMPLIFIERS FOR CARRIER AGGREGATION**

(75) Inventors: **Aleksandar Miodrag Tasic**, San Diego, CA (US); **Anosh Bomi Davierwalla**, San Diego, CA (US)

(73) Assignee: **QUALCOMM Incorporated**, San Diego, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **13/590,423**

(22) Filed: **Aug. 21, 2012**

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,911,364 A 10/1975 Langseth et al.
4,035,728 A 7/1977 Ishikawa et al.

(Continued)

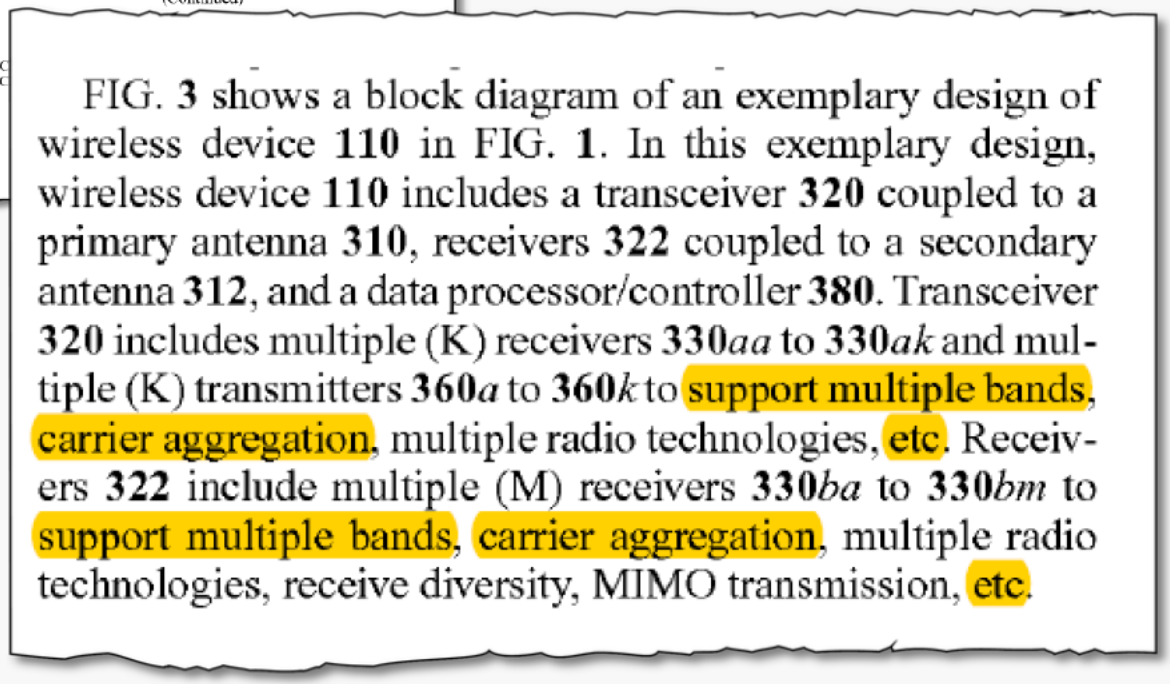


FIG. **3** shows a block diagram of an exemplary design of wireless device **110** in FIG. **1**. In this exemplary design, wireless device **110** includes a transceiver **320** coupled to a primary antenna **310**, receivers **322** coupled to a secondary antenna **312**, and a data processor/controller **380**. Transceiver **320** includes multiple (K) receivers **330***aa* to **330***ak* and multiple (K) transmitters **360***a* to **360***k* to support multiple bands, carrier aggregation, multiple radio technologies, etc. Receivers **322** include multiple (M) receivers **330***ba* to **330***bm* to support multiple bands, carrier aggregation, multiple radio technologies, receive diversity, MIMO transmission, etc.

Intel Ex. 1301, 3:39-49;
Patent Owner Response, p. 29

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Patent Owner Response, pp. 24-27;
Patent Owner Sur-Reply, pp. 12-15

Patent Owner Narrowed Claims to Overcome Hirose

Application/Control Number: 13/590,423 Page 3
Art Unit: 2631

Regarding claim 1, Hirose discloses an apparatus (FIG. 6 digital broadcast receiver) comprising:

a first amplifier stage 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 (variable gain amplifier 15, corresponding to the claimed first amplifier stage, receiving input RF signal (e.g. satellite wave signal and ground wave signal) and providing an output to intermediate frequency demodulation stage (for ground wave), which corresponds to the claimed first load circuit (see column 5 lines 1-30 and FIG. 6) ;

the input RF signal comprising transmissions sent on multiple carriers at different frequencies to a wireless device, the first output RF signal including at least a first carrier of the multiple carriers (as recited above, the input RF signal comprising satellite wave signal and ground wave signal (column 5 lines 1-4) and the output to intermediate frequency demodulation stage for ground wave, corresponding to the claimed first carrier of the multiple carriers);

Intel Ex. 1314 (Office Action) at 4;
Patent Owner Response, p. 25

1. (Currently amended) An apparatus comprising:

a first amplifier stage configured to receive and amplify an input radio frequency (RF) signal and provide a first output RF signal to a first load circuit when the first amplifier stage is enabled, the input RF signal employing carrier aggregation comprising transmissions sent on multiple carriers at different frequencies to a wireless device, the first output RF signal including at least a first carrier of the multiple carriers; and

a second amplifier stage configured to receive and amplify the input RF signal and provide a second output RF signal to a second load circuit when the second amplifier stage is enabled, the second output RF signal including at least a second carrier of the multiple carriers different than the first carrier.

Intel Ex. 1315 (Amendment) at 2;
Patent Owner Response, p. 25

Patent Owner Narrowed Claims to Overcome Hirose

Office Action alleges:

> Hirose discloses … receiving ***input RF signal*** (e.g. ***satellite wave signal and ground wave signal***) …. (Office Action, p. 3; emphasis added)

Applicant respectfully asserts that Hirose's "satellite wave signal and ground wave signal" do not result in "carrier aggregation" as claimed by Applicant in amended independent claims 1 and 17. As stated, Applicant's amended independent claims 1 and 17 recite, *inter alia*, "the [] input RF signal employing ***carrier aggregation***," while Hirose discloses ***redundant*** data at a ***common*** data rate. Specifically, Hirose discloses:

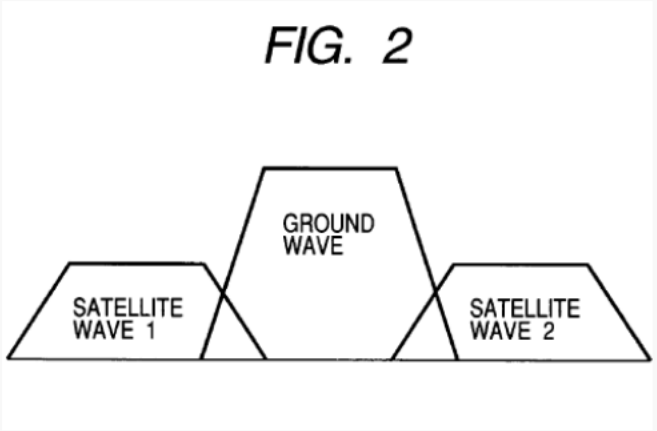
> In an area where it is difficult to receive a radio wave from an elliptical orbit satellite or in an urban area where it is difficult to receive a satellite broadcast radio wave, a radio broadcast receiver receives in some cases a ***radio wave (ground wave) from a ground repeater*** which is controlled by a Geo stationary orbit satellite. Therefore, the ***satellite radio broadcast receiver receives three radio waves in total, two satellite waves and one ground wave, at the same time*** at its wide band RF amplifier. FIG. 2 shows the spectrum of radio waves to be received by the receiver. The center frequency of this spectrum is approximately 2.3 GHz, and the satellite wave and ground wave have both the band width of about 4 MHz. Although the ***satellite wave #1 and the ground wave are received at the same timing, the satellite wave #2 is received at the timing delayed by several seconds***, and so time diversity is presented ….

Intel Ex. 1315 (Amendment) at 8;
Patent Owner Response, p. 26

Petitioner's Proposed Construction Reads on Hirose

Petitioner Construction

"carrier aggregation" means "simultaneous operation on multiple carriers"



In an area where it is difficult to receive a radio wave from an elliptical orbit satellite or in an urban area where it is difficult to receive a satellite broadcast radio wave, a radio broadcast receiver receives in some cases a radio wave (ground wave) from a ground repeater which is controlled by a Geo stationary orbit satellite. Therefore, the satellite radio broadcast receiver receives three radio waves in total, two satellite waves and one ground wave, at the same time at its wide band RF amplifier. FIG. **2** shows the spectrum of radio waves to be received by the receiver. The center frequency of this spectrum is approximately 2.3 GHz, and the satellite wave and ground wave have both the band width of about 4 MHz. Although the satellite wave #1 and the ground wave are received at the same timing, the satellite wave #2 is received at the timing delayed by several seconds, and so time diversity is presented. Of three satellite

Intel 1325 (Hirose), 1: 26-42, Fig. 2
Intel Ex. 1315 (Amendment) at 8;
Patent Owner Response, p. 25

Petitioner's Construction Violates the Doctrine of Prosecution History Disclaimer

"[C]laims that have been narrowed in order to obtain the issuance of a patent by distinguishing the prior art cannot be sustained to cover that which was previously by limitation eliminated from the patent." *Graham v. John Deere Co. of Kansas City,* 383 U.S. 1, 33 (1966)

"[A]n amendment that clearly narrows the scope of a claim, such as by the addition of a new claim limitation, constitutes a disclaimer of any claim interpretation that would effectively eliminate the limitation or that would otherwise recapture the claim's original scope." *Schindler Elevator Corp. v. Otis Elevator Co.,* 593 F.3d 1275, 1285 (Fed. Cir. 2010)

Patent Owner Response, p. 24
Patent Owner Sur-Reply, p. 13

Claim Construction – "Carrier Aggregation"

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Patent Owner Response, pp. 11-22;
Patent Owner Sur-Reply, pp. 2-6, 16-17

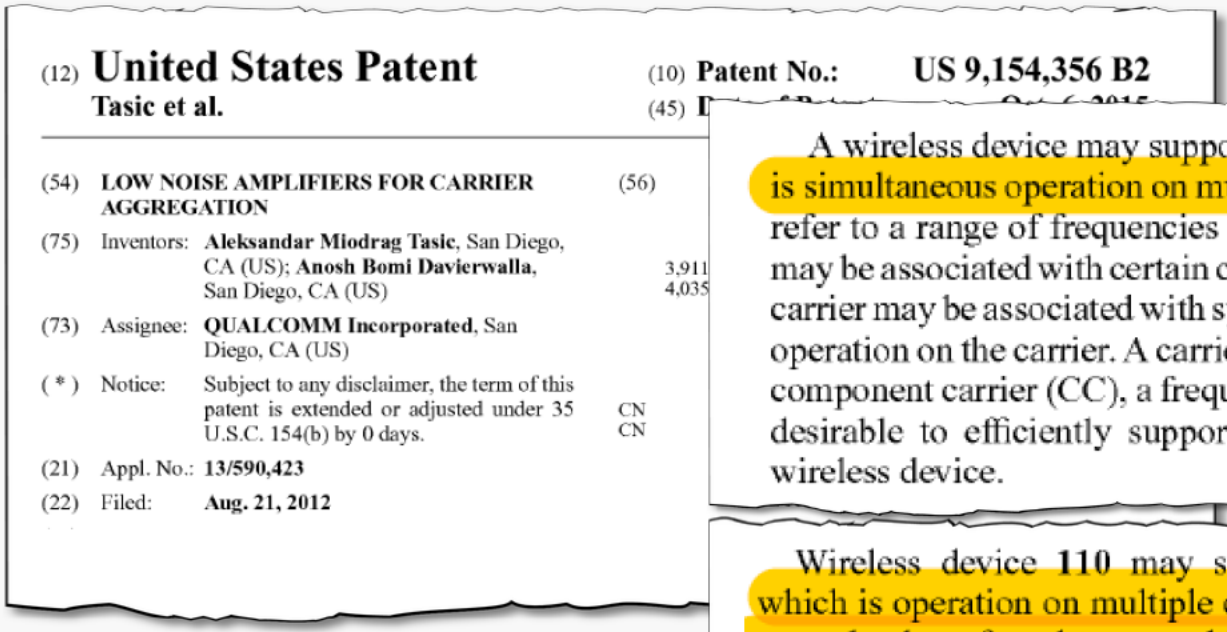
Patent Owner Did Not Redefine "Carrier Aggregation"

"[A] claim term is only given a special definition different from the term's plain and ordinary meaning if the 'patentee… clearly set[s] forth a definition of the disputed claim term other than its plain and ordinary meaning." *Akamai Techs., Inc. v. Limelight Networks, Inc.*, 805 F.3d 1368, 1375 (Fed. Cir. 2015)

"When a patent acts as his own lexicographer in redefining the meaning of particular claim terms away from their ordinary meaning, he must clearly express that intent in the written description. We have repeatedly emphasized that the statement in the specification must have sufficient clarity to put one reasonably skilled in the art on notice that the inventor intended to redefine the claim term." *Merck & Co., Inc. v. Teva Pharm. USA, Inc.*, 395 F.3d 1364, 1370 (Fed. Cir. 2005)

Patent Owner Sur-Reply, p. 3

Patent Owner Did Not Redefine "Carrier Aggregation"



(12) **United States Patent**
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(10) **Patent No.: US 9,154,356 B2**
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(54) **LOW NOISE AMPLIFIERS FOR CARRIER AGGREGATION**

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(21) Appl. No.: **13/590,423**

(22) Filed: **Aug. 21, 2012**

3,911
4,035

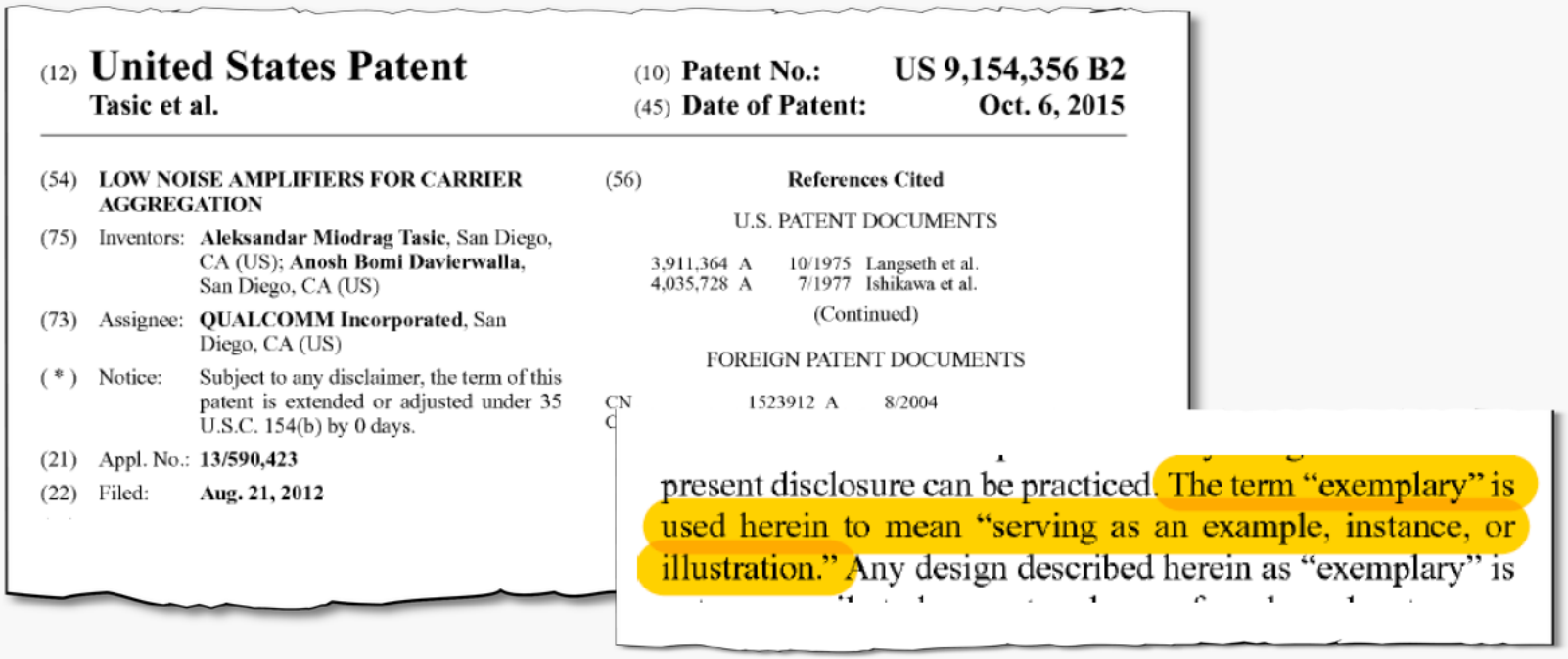
CN
CN

A wireless device may support carrier aggregation, which is simultaneous operation on multiple carriers. A carrier may refer to a range of frequencies used for communication and may be associated with certain characteristics. For example, a carrier may be associated with system information describing operation on the carrier. A carrier may also be referred to as a component carrier (CC), a frequency channel, a cell, etc. It is desirable to efficiently support carrier aggregation by the wireless device.

Wireless device **110** may support carrier aggregation, which is operation on multiple carriers. Carrier aggregation may also be referred to as multi-carrier operation. Wireless device **110** may be able to operate in low-band from 698 to 960 megahertz (MHz), mid-band from 1475 to 2170 MHz, and/or high-band from 2300 to 2690 and 3400 to 3800 MHz. Low-band, mid-band, and high-band refer to three groups of bands (or band groups), with each band group including a number of frequency bands (or simply, "bands"). Each band may cover up to 200 MHz and may include one or more carriers. Each carrier may cover up to 20 MHz in LTE. LTE Release 11 supports 35 bands, which are referred to as LTE/UMTS bands and are listed in 3GPP TS 36.101. Wireless device **110** may be configured with up to 5 carriers in one or two bands in LTE Release 11.

Intel 1301,1:32-40; 2:53-67

Patent Owner Employed a Distinctive Format for Defining Terms



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4,035,728 A 7/1977 Ishikawa et al.

(Continued)

FOREIGN PATENT DOCUMENTS

CN 1523912 A 8/2004

present disclosure can be practiced. The term "exemplary" is used herein to mean "serving as an example, instance, or illustration." Any design described herein as "exemplary" is

Intel 1301,2:9-11;
Patent Owner Sur-Reply, p. 4

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- "Carrier Aggregation" Has a Well Understood Meaning

Patent Owner Response, pp. 15-22, 27-29;
Patent Owner Sur-Reply, pp. 6-12

"Carrier Aggregation" Has a Well Understood Meaning

- Supported by the Intrinsic Record
  - The Specification Supports the Patent Owner's Construction
  - The File History Supports the Patent Owner's Construction
- Supported by Extrinsic Evidence
  - Intel Patents Support Patent Owner's Construction
  - The Feasibility Study Supports Patent Owner's Construction
  - Industry Publications Support Patent Owner's Construction

Patent Owner Response, pp. 11-22, 27-29;

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Patent Owner Response, pp. 11-22, 27-29;

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Intel Ex. 1301, 1:32-40, 2:53-67
Patent Owner Response, pp. 12-14

The Specification Supports Patent Owner's Construction

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5.1 General

LTE-Advanced extends LTE Rel.-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.

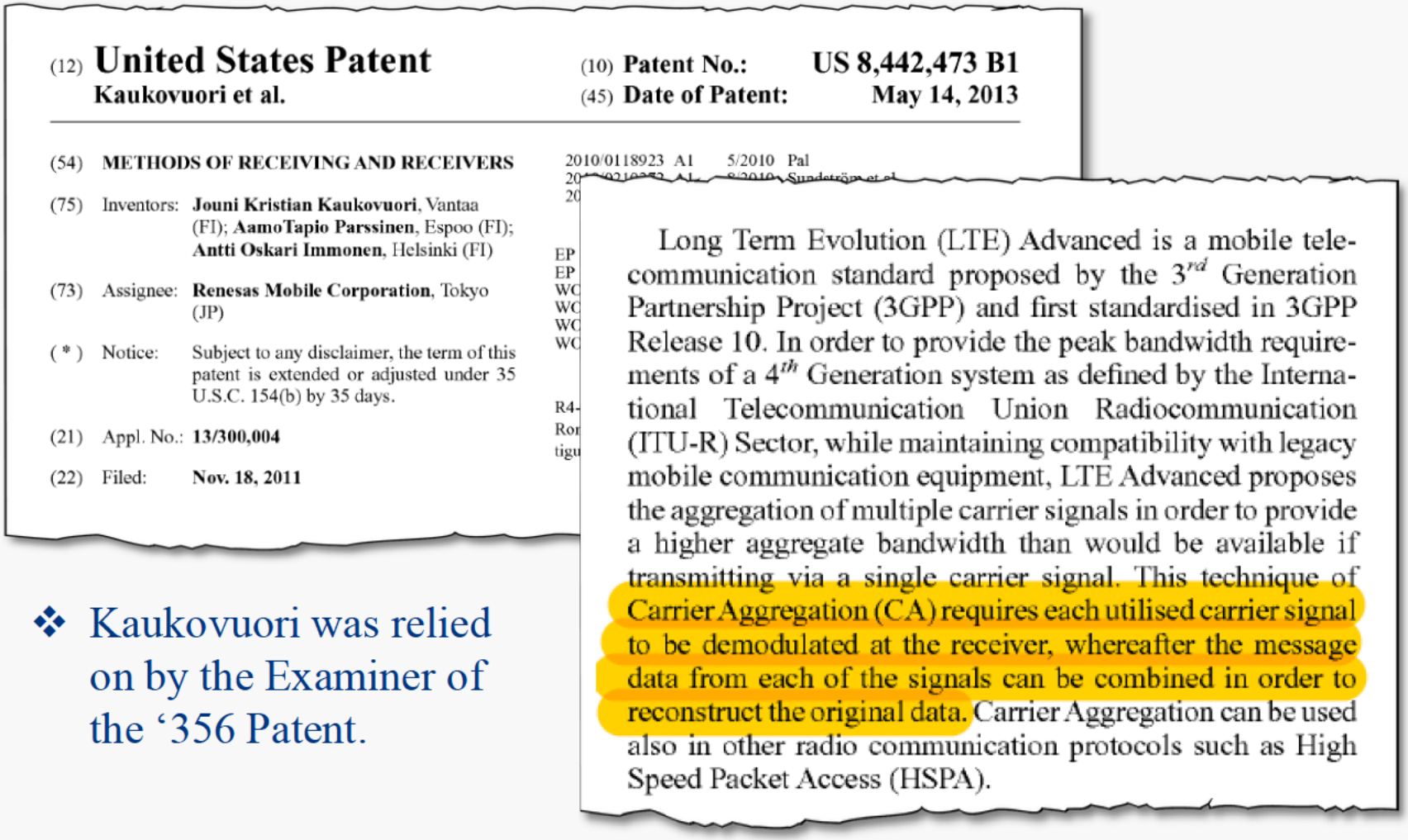
Intel Ex. 1301, 2:53-67;
Ex. 1304 ("Feasibility Study"), ¶ 5.1
Patent Owner Response, pp. 12-14

The File History Supports Patent Owner's Construction

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. Specifically, the

Patent Owner Response, pp. 15-16; Intel Ex. 1315 at 7.

The File History Supports Patent Owner's Construction



(12) **United States Patent**
Kaukovuori et al.

(10) **Patent No.: US 8,442,473 B1**
(45) **Date of Patent: May 14, 2013**

(54) **METHODS OF RECEIVING AND RECEIVERS**

(75) Inventors: **Jouni Kristian Kaukovuori**, Vantaa (FI); **AamoTapio Parssinen**, Espoo (FI); **Antti Oskari Immonen**, Helsinki (FI)

(73) Assignee: **Renesas Mobile Corporation**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 35 days.

(21) Appl. No.: **13/300,004**

(22) Filed: **Nov. 18, 2011**

2010/0118923 A1 5/2010 Pal

Long Term Evolution (LTE) Advanced is a mobile telecommunication standard proposed by the 3rd Generation Partnership Project (3GPP) and first standardised in 3GPP Release 10. In order to provide the peak bandwidth requirements of a 4th Generation system as defined by the International Telecommunication Union Radiocommunication (ITU-R) Sector, while maintaining compatibility with legacy mobile communication equipment, LTE Advanced proposes the aggregation of multiple carrier signals in order to provide a higher aggregate bandwidth than would be available if transmitting via a single carrier signal. This technique of Carrier Aggregation (CA) requires each utilised carrier signal to be demodulated at the receiver, whereafter the message data from each of the signals can be combined in order to reconstruct the original data. Carrier Aggregation can be used also in other radio communication protocols such as High Speed Packet Access (HSPA).

- Kaukovuori was relied on by the Examiner of the '356 Patent.

Patent Owner Response, pp. 15-16;
Intel Ex. 1325 at 1:19-35.

JONES DAY

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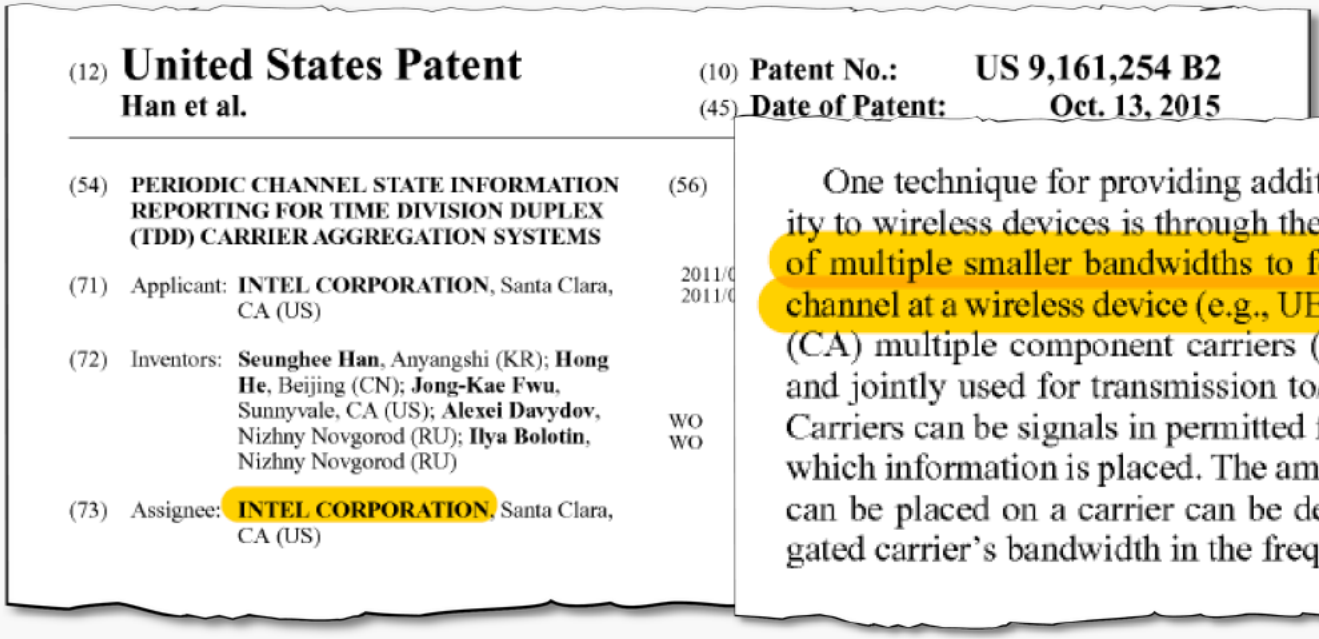
Patent Owner Response, pp. 11-22, 27-29;

"Carrier Aggregation" Has a Well Understood Meaning



(12) **United States Patent**
Han et al.

(10) **Patent No.: US 9,161,254 B2**
(45) **Date of Patent: Oct. 13, 2015**

(54) **PERIODIC CHANNEL STATE INFORMATION REPORTING FOR TIME DIVISION DUPLEX (TDD) CARRIER AGGREGATION SYSTEMS**

(56)

(71) Applicant: **INTEL CORPORATION**, Santa Clara, CA (US)

(72) Inventors: **Seunghee Han**, Anyangshi (KR); **Hong He**, Beijing (CN); **Jong-Kae Fwu**, Sunnyvale, CA (US); **Alexei Davydov**, Nizhny Novgorod (RU); **Ilya Bolotin**, Nizhny Novgorod (RU)

(73) Assignee: **INTEL CORPORATION**, Santa Clara, CA (US)

2011/0
2011/0

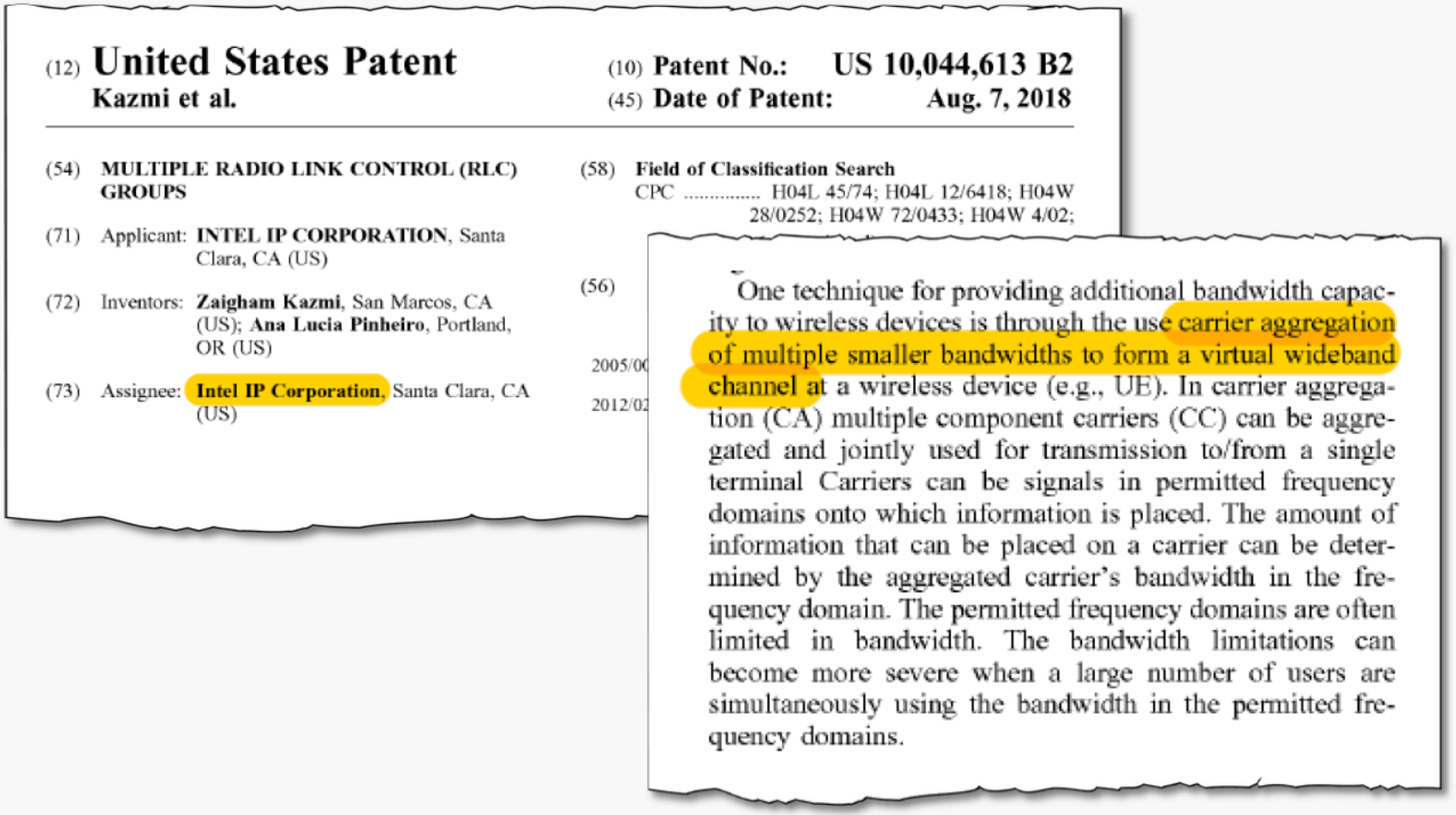
WO
WO

One technique for providing additional bandwidth capacity to wireless devices is through the use carrier aggregation of multiple smaller bandwidths to form a virtual wideband channel at a wireless device (e.g., UE). In carrier aggregation (CA) multiple component carriers (CC) can be aggregated and jointly used for transmission to/from a single terminal. Carriers can be signals in permitted frequency domains onto which information is placed. The amount of information that can be placed on a carrier can be determined by the aggregated carrier's bandwidth in the frequency domain. The per-

Carrier aggregation (CA) enables multiple carrier signals to be simultaneously communicated between a user's wireless device and a node. Multiple different carriers can be used. In some instances, the carriers may be from different permitted frequency domains. Carrier aggregation provides a broader choice to the wireless devices, enabling more bandwidth to be obtained. The greater bandwidth can be used to communicate bandwidth intensive operations, such as streaming video or communicating large data files.

Patent Owner Response, p. 18;
Ex. 2013, 3:19-28, 45-53

"Carrier Aggregation" Has a Well Understood Meaning



(12) **United States Patent**
Kazmi et al.

(10) **Patent No.: US 10,044,613 B2**
(45) **Date of Patent: Aug. 7, 2018**

(54) **MULTIPLE RADIO LINK CONTROL (RLC) GROUPS**

(71) Applicant: **INTEL IP CORPORATION**, Santa Clara, CA (US)

(72) Inventors: **Zaigham Kazmi**, San Marcos, CA (US); **Ana Lucia Pinheiro**, Portland, OR (US)

(73) Assignee: **Intel IP Corporation**, Santa Clara, CA (US)

(58) **Field of Classification Search**
CPC H04L 45/74; H04L 12/6418; H04W 28/0252; H04W 72/0433; H04W 4/02;

(56)

2005/00
2012/02

One technique for providing additional bandwidth capacity to wireless devices is through the use carrier aggregation of multiple smaller bandwidths to form a virtual wideband channel at a wireless device (e.g., UE). In carrier aggregation (CA) multiple component carriers (CC) can be aggregated and jointly used for transmission to/from a single terminal Carriers can be signals in permitted frequency domains onto which information is placed. The amount of information that can be placed on a carrier can be determined by the aggregated carrier's bandwidth in the frequency domain. The permitted frequency domains are often limited in bandwidth. The bandwidth limitations can become more severe when a large number of users are simultaneously using the bandwidth in the permitted frequency domains.

Patent Owner Response, p. 18;
Ex. 2018, 3:27-41

"Carrier Aggregation" Has a Well Understood Meaning

3GPP TR 36.912 V9.1.0 (2009-12)

Technical Report

3rd Generation Partnership Project;
Technical Specification Group Radio Access Network;
Feasibility study for
Further Advancements for E-UTRA (LTE-Advanced)
(Release 9)

5.1 General

LTE-Advanced extends LTE Rel.-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.

Patent Owner Response, p. 19;
Ex. 1304 ("Feasibility Study"), ¶ 5.1

"Carrier Aggregation" Has a Well Understood Meaning

QUALCOMM

Qualcomm, Inc.

Strategies to win in LTE and evolve to LTE Advanced

September 2013

3.1 Carrier aggregation and its evolution

Carrier aggregation, as the name suggests, combines multiple carriers (a.k.a. channels) at the device to provide a bigger data pipe to the user. A bigger data pipe means higher data rates, both peak data rates (as high as over 1 Gbps) and, more importantly, higher user date rates across the cell coverage area. The higher data rates can be traded off to get increased capacity for bursty applications such as browsing, social media apps, smartphone usage and more.

As a first step, the commercial launch supported aggregation of two 10 MHz carriers, enabling a 150 Mbps peak data rate (Cat 4 terminals). This also doubles the user data rates across the cell, whether the user is close to the cell or at the cell edge. As mentioned before, this higher data rate can also be traded off to provide twice (or more) the capacity for bursty apps, under typical loading conditions.

Carrier aggregation continues to evolve to utilize all spectrum resources that operators have access to. There could be aggregation across more carriers (up to five defined in LTE Advanced) and more band combinations (more than 45 being defined in 3GPP). There will be many different types

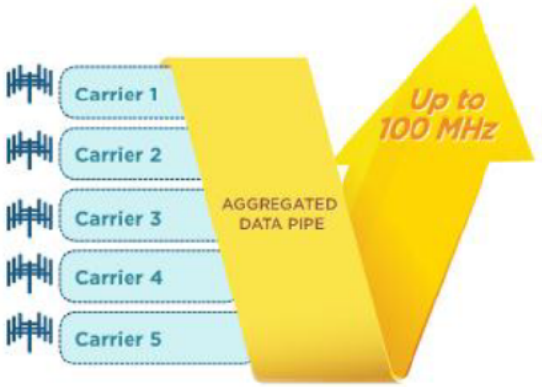
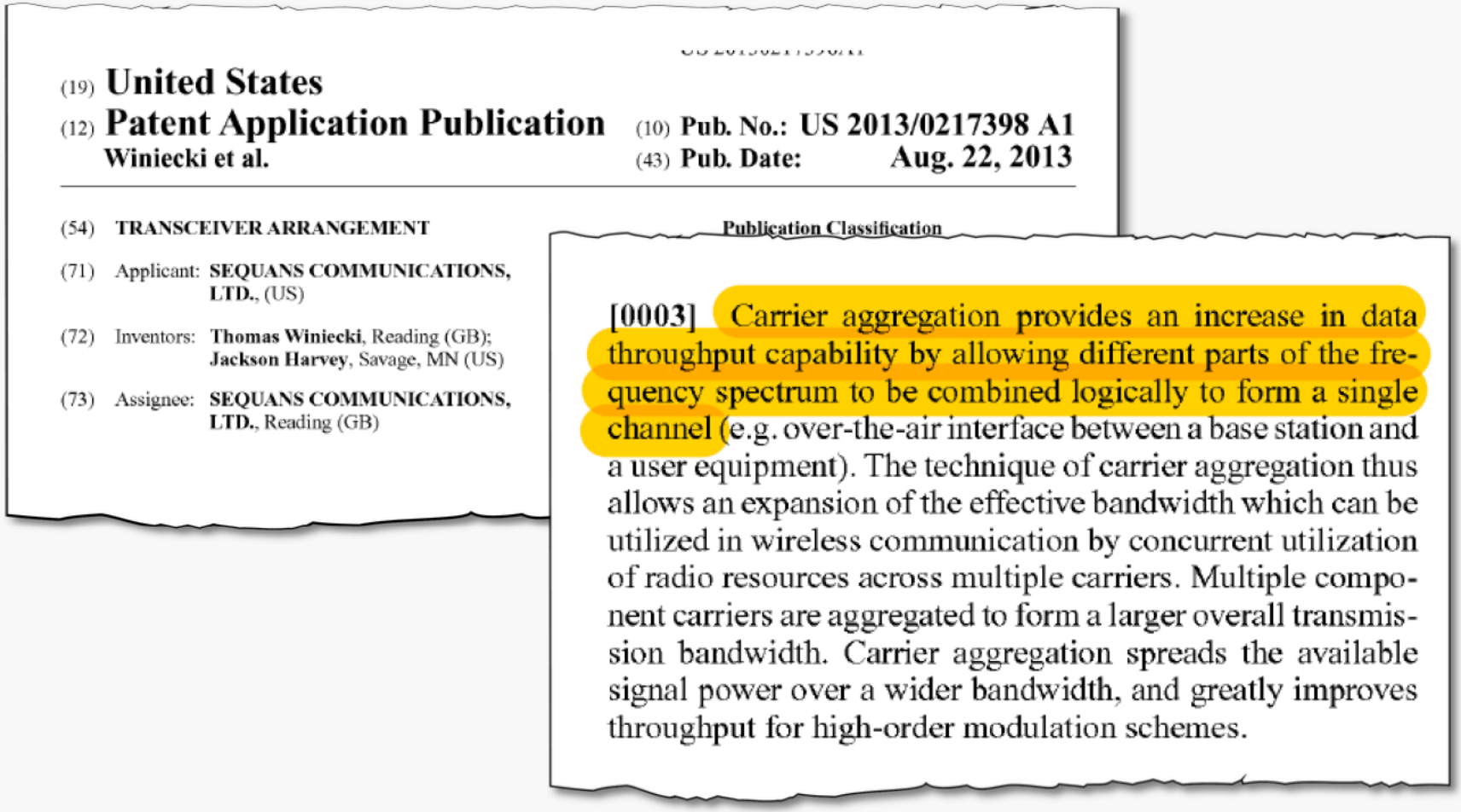


Fig. 3.2: LTE Advanced supports carrier aggregation of up to 5 carriers (100 MHz)

Patent Owner Response, p. 18;
Ex. 2019, p. 6

"Carrier Aggregation" Has a Well Understood Meaning



(19) **United States**
(12) **Patent Application Publication**
Winiecki et al.

(10) **Pub. No.: US 2013/0217398 A1**
(43) **Pub. Date: Aug. 22, 2013**

(54) **TRANSCEIVER ARRANGEMENT**

(71) Applicant: **SEQUANS COMMUNICATIONS, LTD.**, (US)

(72) Inventors: **Thomas Winiecki**, Reading (GB); **Jackson Harvey**, Savage, MN (US)

(73) Assignee: **SEQUANS COMMUNICATIONS, LTD.**, Reading (GB)

Publication Classification

[0003] Carrier aggregation provides an increase in data throughput capability by allowing different parts of the frequency spectrum to be combined logically to form a single channel (e.g. over-the-air interface between a base station and a user equipment). The technique of carrier aggregation thus allows an expansion of the effective bandwidth which can be utilized in wireless communication by concurrent utilization of radio resources across multiple carriers. Multiple component carriers are aggregated to form a larger overall transmission bandwidth. Carrier aggregation spreads the available signal power over a wider bandwidth, and greatly improves throughput for high-order modulation schemes.

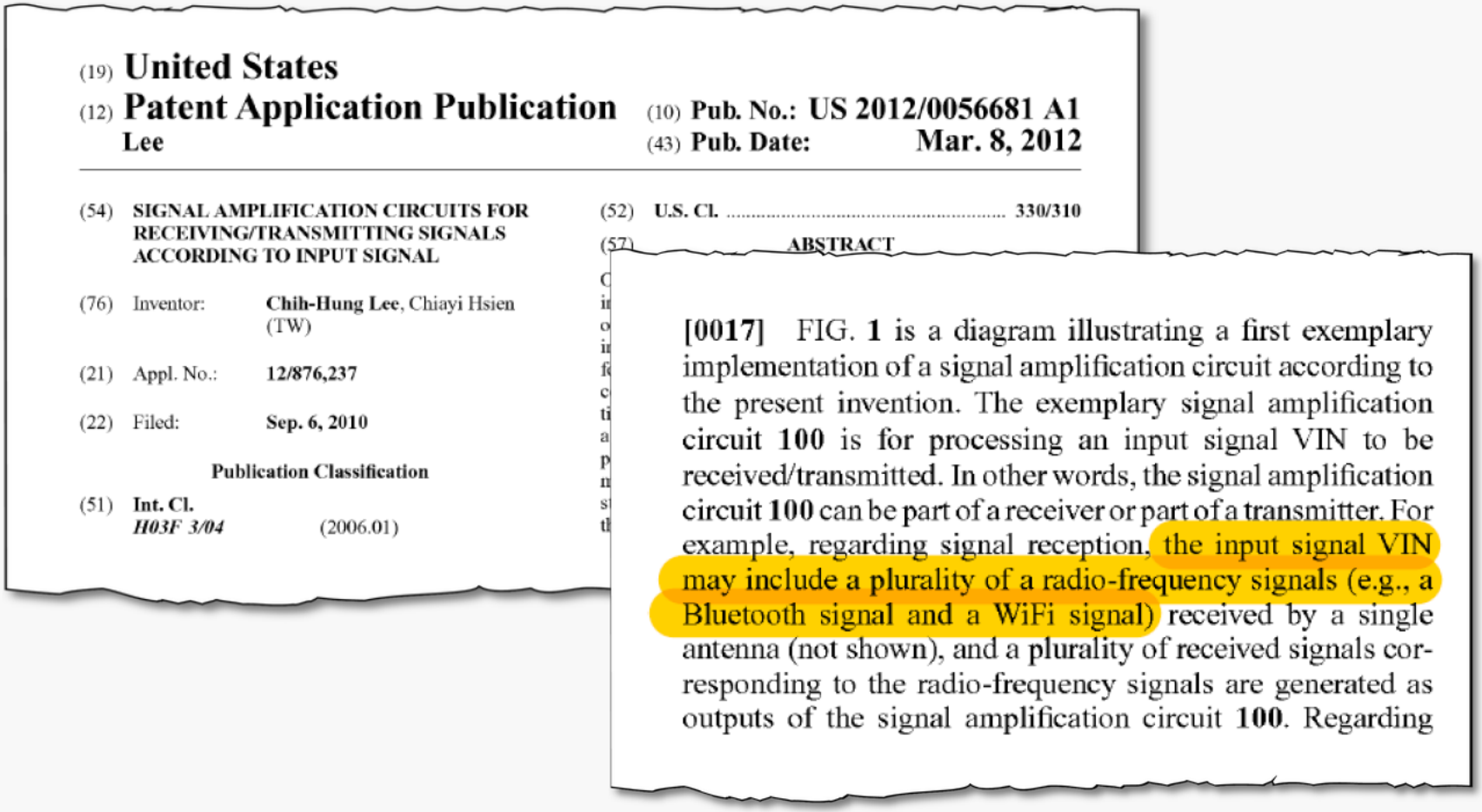
Patent Owner Response, p. 18;
Ex. 2020, ¶ [0003]

Patentability

1) Petition Relies on an Overly Broad Interpretation of "Carrier Aggregation"
2) Lee is Unrelated to Carrier Aggregation
3) The POSA Would Not Combine Lee with the Feasibility Study
4) Petitioner Relies Improperly on Two Different Lee Embodiments for Claim 7

Patent Owner Response, pp. 32-35

Lee is Unrelated to Carrier Aggregation



(19) **United States**
(12) **Patent Application Publication**
Lee

(10) **Pub. No.: US 2012/0056681 A1**
(43) **Pub. Date: Mar. 8, 2012**

(54) **SIGNAL AMPLIFICATION CIRCUITS FOR RECEIVING/TRANSMITTING SIGNALS ACCORDING TO INPUT SIGNAL**

(76) Inventor: **Chih-Hung Lee**, Chiayi Hsien (TW)

(21) Appl. No.: **12/876,237**

(22) Filed: **Sep. 6, 2010**

Publication Classification

(51) **Int. Cl.**
H03F 3/04 (2006.01)

(52) **U.S. Cl.** **330/310**

(57) **ABSTRACT**

[0017] FIG. **1** is a diagram illustrating a first exemplary implementation of a signal amplification circuit according to the present invention. The exemplary signal amplification circuit **100** is for processing an input signal VIN to be received/transmitted. In other words, the signal amplification circuit **100** can be part of a receiver or part of a transmitter. For example, regarding signal reception, the input signal VIN may include a plurality of a radio-frequency signals (e.g., a Bluetooth signal and a WiFi signal) received by a single antenna (not shown), and a plurality of received signals corresponding to the radio-frequency signals are generated as outputs of the signal amplification circuit **100**. Regarding

Patent Owner Response, pp. 32-34;
Intel Ex. 1335 (Lee), ¶[0017].

Lee is Unrelated to Carrier Aggregation

"Lee never describes the VIN signal (or anything else) as 'employing carrier aggregation.' Instead, Lee consistently refers throughout to two separate and distinct input signals '(e.g., a Bluetooth signal and a WiFi signal) received by a single antenna).'… In fact, Lee is clear that a key goal of his invention is to provide outputs of the WiFi and Bluetooth inputs that are kept separate."

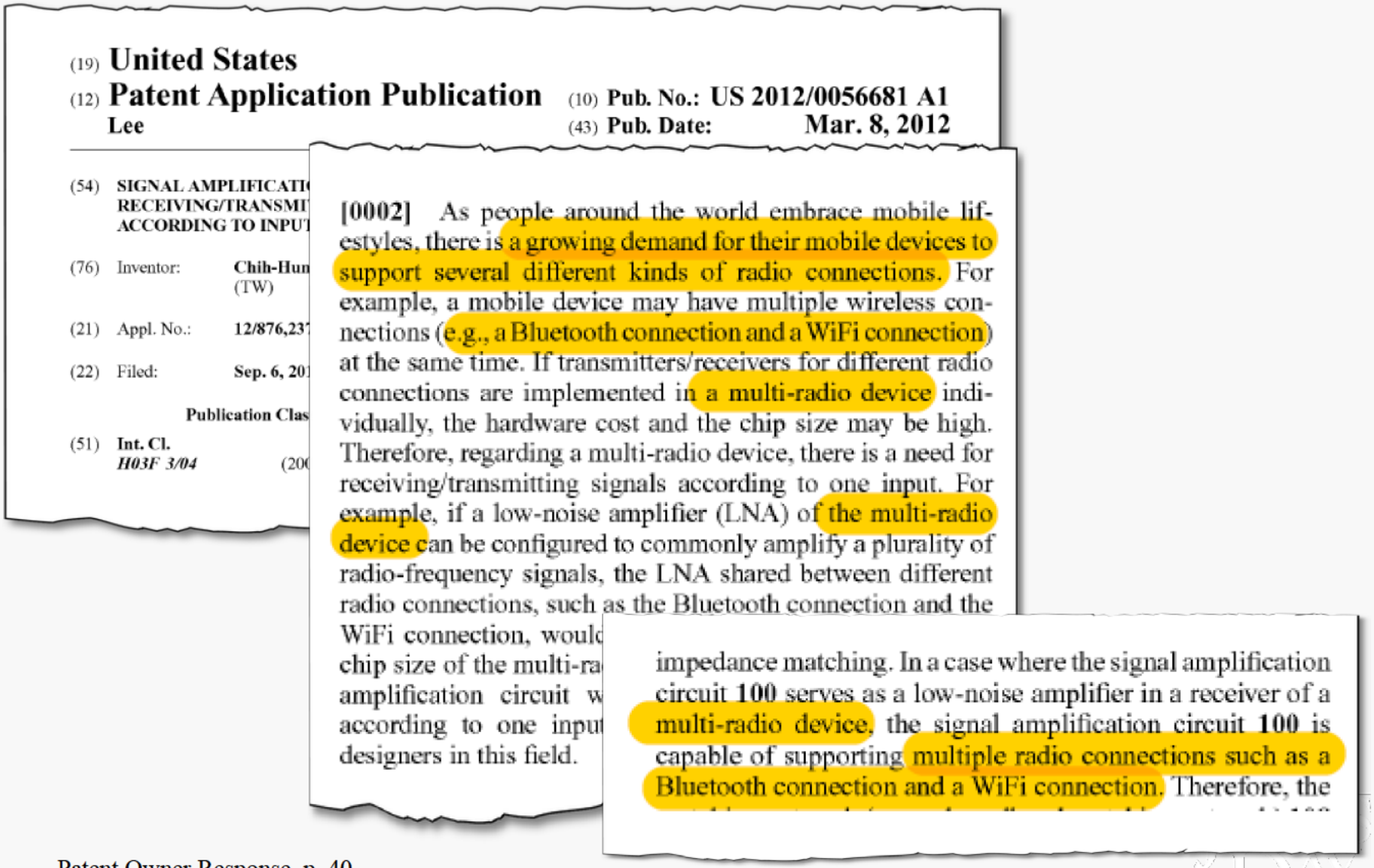
Ex. 2024 (Declaration of Dr. Foty), ¶139.
Patent Owner Response, p. 32

Patentability

1) Petition Relies on an Overly Broad Interpretation of "Carrier Aggregation"
2) Lee is Unrelated to Carrier Aggregation
3) The POSA Would Not Combine Lee with the Feasibility Study
4) Petitioner Relies Improperly on Two Different Lee Embodiments for Claim 7

Patent Owner Response, pp. 40-47

Lee Describes a Multi-Radio Device



(19) **United States**
(12) **Patent Application Publication**
Lee

(10) **Pub. No.: US 2012/0056681 A1**
(43) **Pub. Date: Mar. 8, 2012**

(54) **SIGNAL AMPLIFICATI**
RECEIVING/TRANSMI
ACCORDING TO INPU

(76) Inventor: **Chih-Hun**
(TW)

(21) Appl. No.: **12/876,23**

(22) Filed: **Sep. 6, 20**

Publication Clas

(51) **Int. Cl.**
H03F 3/04 (20

[0002] As people around the world embrace mobile lifestyles, there is a growing demand for their mobile devices to support several different kinds of radio connections. For example, a mobile device may have multiple wireless connections (e.g., a Bluetooth connection and a WiFi connection) at the same time. If transmitters/receivers for different radio connections are implemented in a multi-radio device individually, the hardware cost and the chip size may be high. Therefore, regarding a multi-radio device, there is a need for receiving/transmitting signals according to one input. For example, if a low-noise amplifier (LNA) of the multi-radio device can be configured to commonly amplify a plurality of radio-frequency signals, the LNA shared between different radio connections, such as the Bluetooth connection and the WiFi connection, would
chip size of the multi-ra
amplification circuit w
according to one input
designers in this field.

impedance matching. In a case where the signal amplification circuit **100** serves as a low-noise amplifier in a receiver of a multi-radio device, the signal amplification circuit **100** is capable of supporting multiple radio connections such as a Bluetooth connection and a WiFi connection. Therefore, the

Patent Owner Response, p. 40
Intel Ex. 1335, ¶ ¶ [0002], [0017]

The Feasibility Study Relates to Single Radio Technology

3GPP TR 36.912 V9.1.0 (2009-12)

Technical Report

3rd Generation Partnership Project:

Technical Specifi

Further Advan

1 Scope

This document is related to the technical report for the study item "Further advancements for E-UTRA" [1].

This activity involves the Radio Access work area of the 3GPP studies and has impacts both on the Mobile Equipment and Access Network of the 3GPP systems.

This document is intended to gather all technical outcome of the study item, and draw a conclusion on way forward.

In addition this document includes the results of the work supporting the3GPP submission of "*LTE Release 10 & beyond (LTE-Advanced)*"to the ITU-R as a candidate technology for the IMT-Advanced.

5.1 General

LTE-Advanced extends LTE Rel.-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.

Patent Owner Response, p. 40
Intel Ex. 1304, ¶¶ 1, 5.1

Petitioner Has Provided No Reasoned Motivation to Combine

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 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.

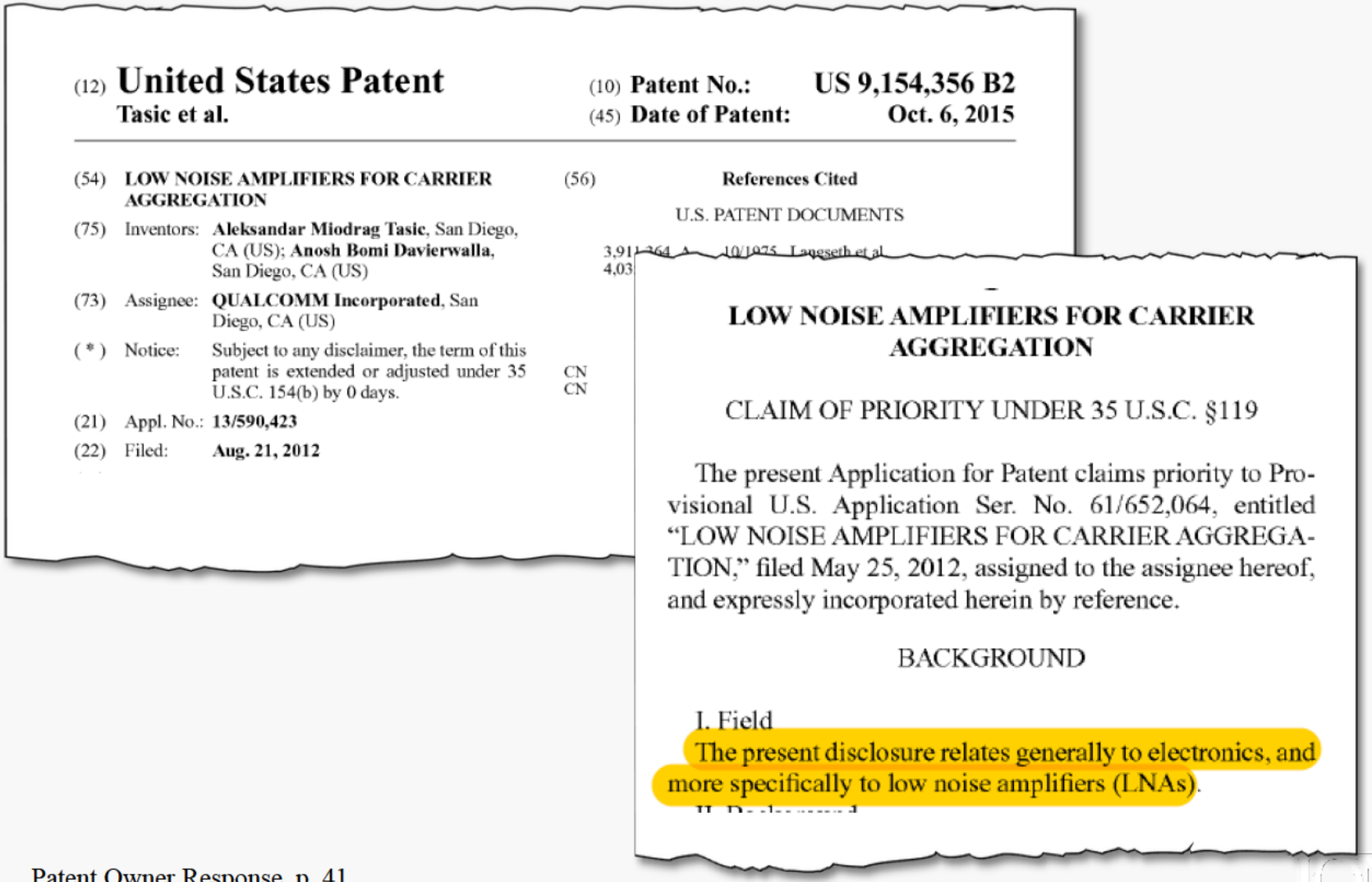
Petition, pp. 73-74

Petitioner Has Provided No Reasoned Motivation to Combine

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.

Petition, p. 74

The Feasibility Study is Non-Analogous Art



(12) **United States Patent**
Tasic et al.

(10) **Patent No.: US 9,154,356 B2**
(45) **Date of Patent: Oct. 6, 2015**

(54) **LOW NOISE AMPLIFIERS FOR CARRIER AGGREGATION**

(75) Inventors: **Aleksandar Miodrag Tasic**, San Diego, CA (US); **Anosh Bomi Davierwalla**, San Diego, CA (US)

(73) Assignee: **QUALCOMM Incorporated**, San Diego, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **13/590,423**

(22) Filed: **Aug. 21, 2012**

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,91[illegible] 10/1975 Langseth et al.
4,03[illegible]

CN
CN

LOW NOISE AMPLIFIERS FOR CARRIER AGGREGATION

CLAIM OF PRIORITY UNDER 35 U.S.C. §119

The present Application for Patent claims priority to Provisional U.S. Application Ser. No. 61/652,064, entitled "LOW NOISE AMPLIFIERS FOR CARRIER AGGREGATION," filed May 25, 2012, assigned to the assignee hereof, and expressly incorporated herein by reference.

BACKGROUND

I. Field

The present disclosure relates generally to electronics, and more specifically to low noise amplifiers (LNAs).

Patent Owner Response, p. 41
Patent Owner Sur-Reply, p. 22-24
Intel Ex. 1301, 1:16-17

The Feasibility Study is Non-Analogous Art

3GPP TR 36.912 V9.1.0 (2009-12)

Technical Report

Technical Specifica

Further Advance

11.3.3.1 Receiver architecture

Table 11.3.3-1 illustrates various Rx architectures options for the three scenarios

Table 11.3.3.1-1: Possible UE Architecture for the three aggregation scenarios

Rx Characteristics				
Option	Description (Rx architecture)	Intra Band aggregation		Inter Band aggregation
		Contiguous (CC)	Non contiguous (CC)	Non contiguous (CC)
A	Single (RF + FFT + baseband) with BW>20MHz	Yes		
B	Multiple (RF + FFT + baseband) with BW≤20MHz	Yes	Yes	Yes

Option A

- UE may adopt a single wideband-capable (i.e., >20MHz) RF front end (i.e., mixer, AGC, ADC) and a single FFT, or alternatively multiple "legacy" RF front ends (<=20MHz) and FFT engines. The choice between single or multiple transceivers comes down to the comparison of power consumption, cost, size, and flexibility to support other aggregation types.

Option B

- In this case, using a single wideband-capable RF front end is undesirable in the case of Intra band non contiguous CC due to the unknown nature of the signal on the "unusable" portion of the band. In the case non adjacent Inter band separate RF front end are necessary.

Patent Owner Sur-Reply, p. 23-24
Intel Ex. 1304, ¶ 11.3.3.1

Patentability

1) Petition Relies on an Overly Broad Interpretation of "Carrier Aggregation"
2) Lee is Unrelated to Carrier Aggregation
3) The POSA Would Not Combine Lee with the Feasibility Study
4) Petitioner Relies Improperly on Two Different Lee Embodiments for Claim 7

Patent Owner Response, pp. 35-37

‘356 Patent – Claim 7

1. An apparatus comprising:

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

a second amplifier stage configured to be independently enabled or disabled, the second amplifier stage further configured to receive and amplify the input RF signal and provide a second output RF signal to a second load circuit when the second amplifier stage is enabled, the second output RF signal including at least a second carrier of the multiple carriers different than the first carrier.

7. The apparatus of claim 1, further comprising:

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

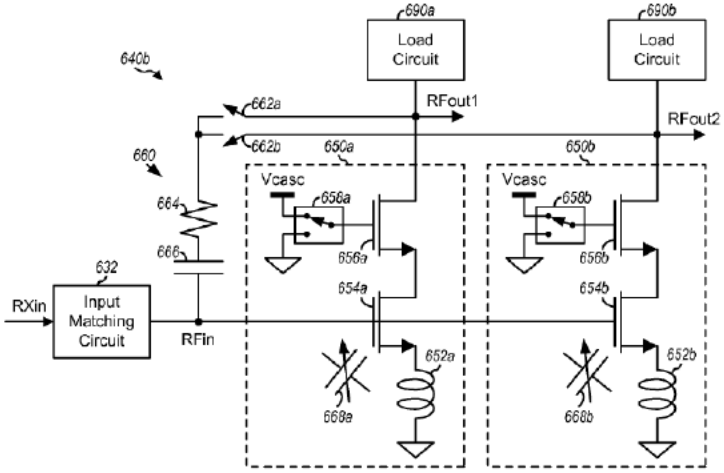


FIG. 7

Intel 1301, 20:43-61, 21:21-23, Fig. 7

Petitioner Relies Improperly on Two Separate Lee Embodiments for Claim 7

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-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.

Petition, pp. 56-57

Petitioner Relies Improperly on Two Separate Lee Embodiments for Claim 7

[0036] In addition to setting the gain applied to a signal passing therethrough, each of the output stages **304_1-304_N** is arranged to further control if a processed signal is allowed to be generated at a corresponding output port, and therefore control whether the output stage should be enabled. That is, the output stages **304_1-304_N** also control the operation of the signal amplification circuit **100** under the shared mode. More specifically, a plurality of specific output stages included in the output stages **304_1-304_N** are enabled in a time-division manner. Taking the output stage **304_1** for

[0037]

requirements. If the output stages **304_1** and **304_N** are enabled alternately under the mode, the signal amplification circuit **300** refers to 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.

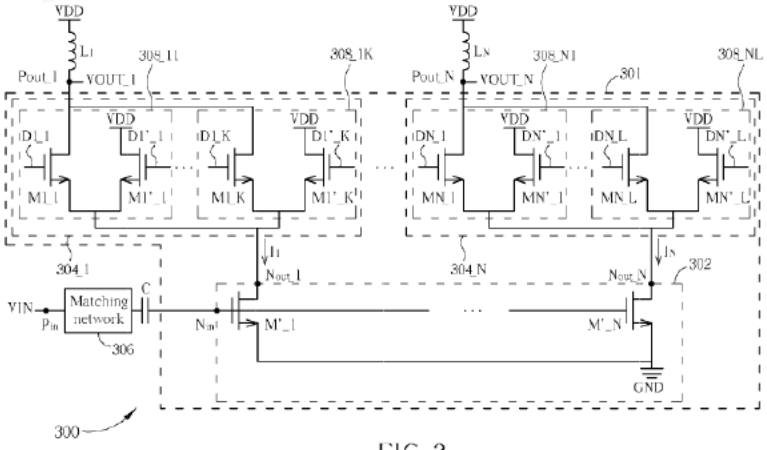


FIG. 3

[0041] As mentioned above, each of the feedback elements **402_1-402_N** can be properly designed to adjust the input matching. In an alternative design, the signal amplification circuit **400** shown in FIG. **4** may operate under a combo mode due to the implemented feedback elements **402_1-402_N**. For example, the input matching is constant no matter how many output stages are enabled concurrently. In this way, the signal amplification circuit **400** has a low noise figure.

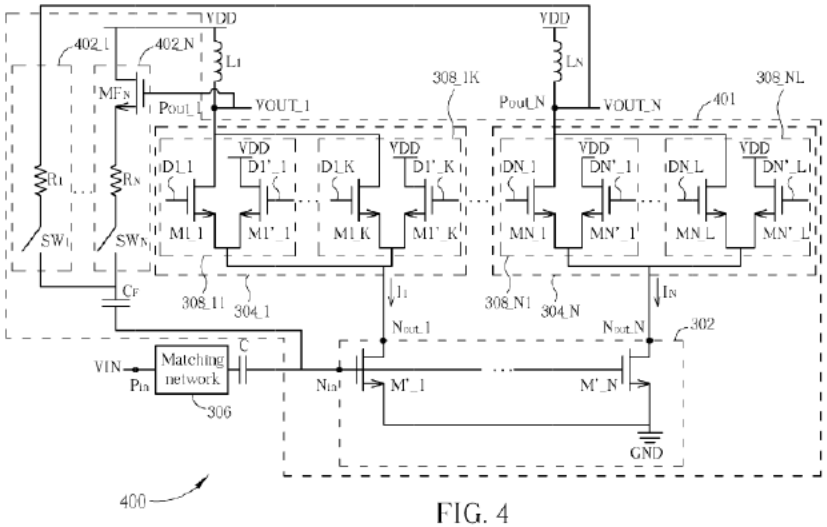


FIG. 4

Patent Owner Response, pp. 35-38

Intel 1335, paras. [0036], [0037], [0041], Figs. 3, 4

CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. § 42.6(e), the undersigned certifies that on February 18, 2020, a complete and entire copy of PATENT OWNER'S DEMONSTRATIVE EXHIBITS have been served in their entirety by e-mail on the following addresses of record for Petitioner:

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Dated: February 18, 2020

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