



US009161254B2

(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**

(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)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 147 days.

(21) Appl. No.: **13/886,795**

(22) Filed: **May 3, 2013**

(65) **Prior Publication Data**

US 2014/0092787 A1 Apr. 3, 2014

Related U.S. Application Data

(60) Provisional application No. 61/707,784, filed on Sep. 28, 2012.

(51) **Int. Cl.**
H04W 24/10 (2009.01)
H04W 48/14 (2009.01)

(Continued)

(52) **U.S. Cl.**
CPC **H04W 24/10** (2013.01); **H04W 48/14** (2013.01); **H04W 52/0209** (2013.01); **H04W 52/0212** (2013.01); **H04W 36/08** (2013.01);
(Continued)

(58) **Field of Classification Search**
None
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2011/0242982 A1* 10/2011 Lunttila et al. 370/241
2011/0244847 A1 10/2011 Mallik et al.

(Continued)

FOREIGN PATENT DOCUMENTS

WO WO 2012/008815 1/2012
WO WO2012/011718 * 1/2012

(Continued)

OTHER PUBLICATIONS

International Search Report and Written Opinion received for PCT Patent Application No. PCT/US2013/060020, mailed on Dec. 19, 2013, 12 Pages.

Primary Examiner — Ayaz Sheikh

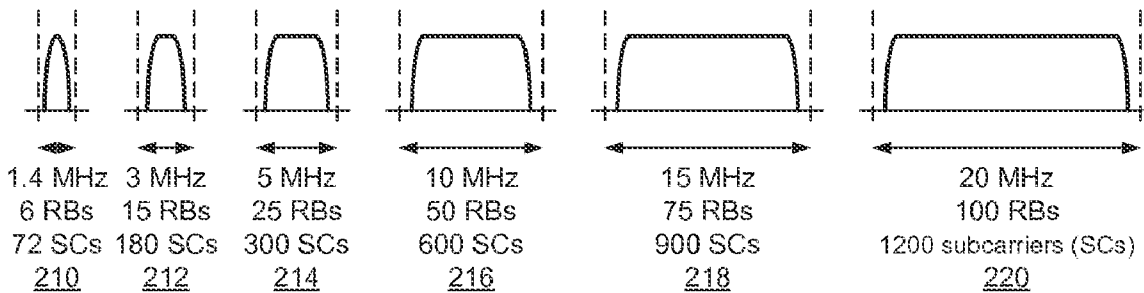
Assistant Examiner — Peter Chau

(74) *Attorney, Agent, or Firm* — Thorpe North & Western LLP

(57) **ABSTRACT**

Technology for periodic channel state information (CSI) reporting is disclosed. One method can include a user equipment (UE) identifying a configured CSI reporting instance for a secondary cell to report the periodic CSI to a node based on a CSI reporting configuration of the secondary cell. The UE can determine that the configured CSI reporting instance of the secondary cell used to report the periodic CSI does not correspond with an uplink (UL) subframe of a primary cell. The UE can transmit the periodic CSI report for the secondary cell, to the node, using a physical uplink shared channel (PUSCH) on the secondary cell when the periodic CSI reporting instance for the secondary cell does not correspond with the UL subframe of the primary cell and an UL-SCH (Uplink Shared Channel) is available in a subframe that corresponds to the periodic CSI reporting instance of the secondary cell.

7 Claims, 12 Drawing Sheets



(51)	Int. Cl. <i>H04W 52/02</i> (2009.01) <i>H04W 36/08</i> (2009.01) <i>H04W 48/18</i> (2009.01)	2012/0257524 A1* 10/2012 2012/0281601 A1* 11/2012 2013/0021980 A1* 1/2013 2013/0028205 A1 1/2013 2013/0039231 A1* 2/2013 2013/0064211 A1 3/2013 2013/0114455 A1* 5/2013 2013/0114554 A1 5/2013 2013/0148613 A1* 6/2013 2013/0188591 A1* 7/2013 2013/0286904 A1 10/2013 2014/0016714 A1 1/2014 2014/0169300 A1 6/2014 2014/0247798 A1* 9/2014 2014/0286296 A1* 9/2014	Chen et al. 370/252 Kuo et al. 370/280 Yang et al. 370/328 Dajnjanovic et al. Wang 370/280 Tanaka Yoo et al. 370/252 Yang et al. Han et al. 370/329 Ko et al. 370/329 Xu et al. Chen et al. Kim et al. Lunttila et al. 370/329 Tiirola et al. 370/329
(52)	U.S. Cl. CPC <i>H04W 48/18</i> (2013.01); <i>H04W 52/0261</i> (2013.01); <i>Y02B 60/50</i> (2013.01)		
(56)	References Cited U.S. PATENT DOCUMENTS 2011/0268045 A1* 11/2011 Heo et al. 370/329 2012/0002568 A1 1/2012 Tiirola et al. 2012/0076028 A1* 3/2012 Ko et al. 370/252 2012/0106511 A1* 5/2012 Wu 370/331 2012/0127869 A1* 5/2012 Yin et al. 370/252 2012/0134275 A1 5/2012 Choi et al. 2012/0140649 A1* 6/2012 Choudhury et al. 370/252 2012/0140708 A1* 6/2012 Choudhury et al. 370/328 2012/0182910 A1* 7/2012 Nakashima et al. 370/281 2012/0201154 A1* 8/2012 Chandrasekhar et al. 370/252		FOREIGN PATENT DOCUMENTS WO 2012/091342 A2 7/2012 WO 2012/099369 A2 7/2012 WO 2014/052084 A1 4/2014

* cited by examiner

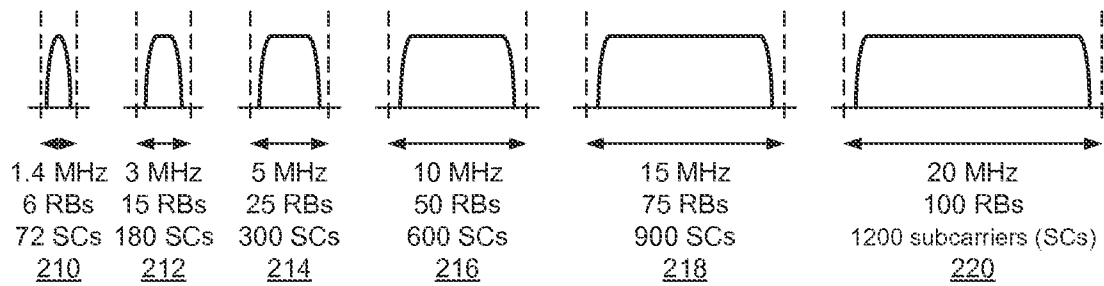


FIG. 1

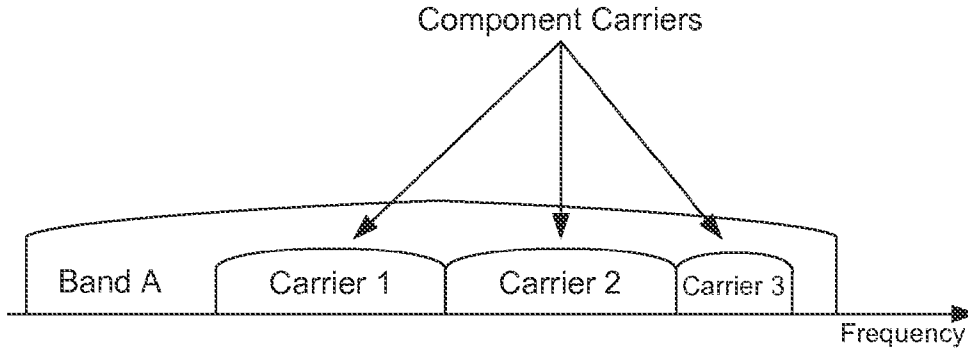


FIG. 2A

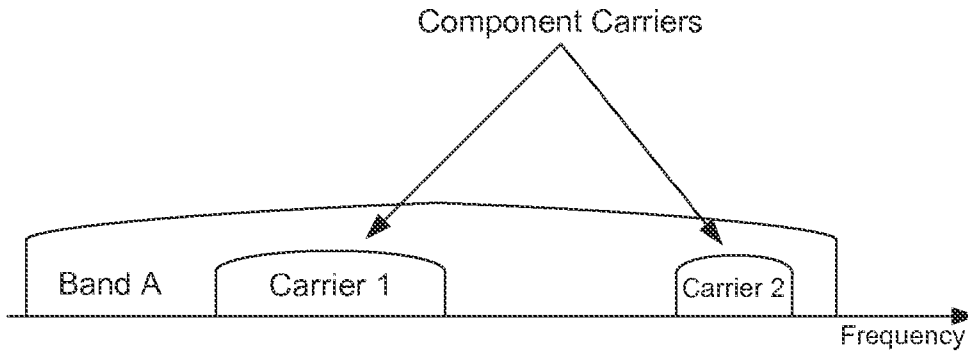


FIG. 2B

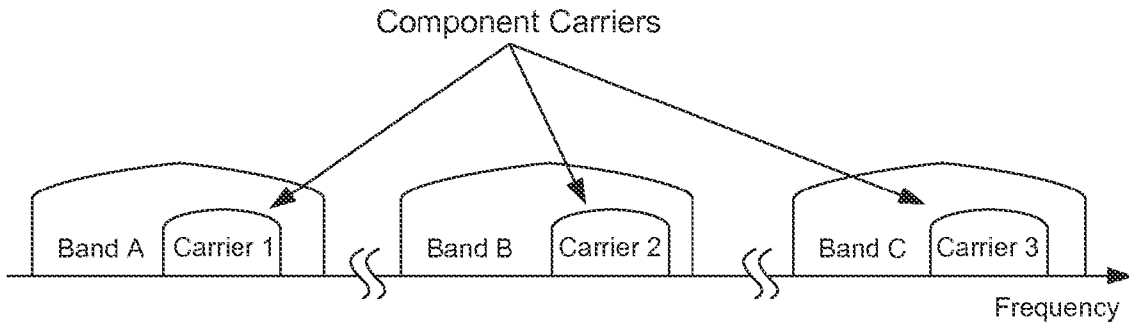


FIG. 2C

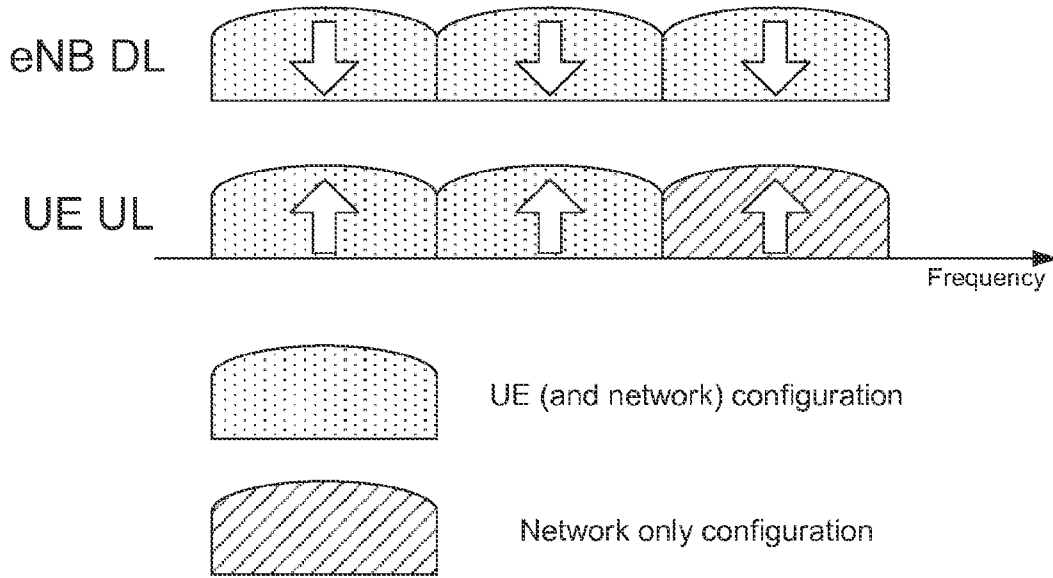


FIG. 3A

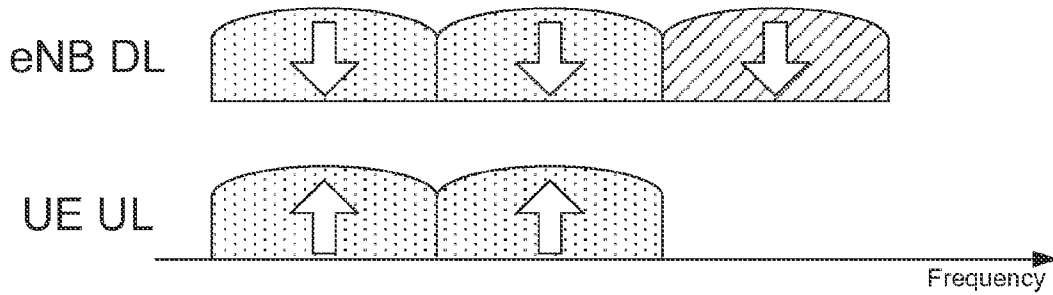


FIG. 3B

Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts



Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research



With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips



Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.