(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
10 April 2008 (10.04.2008)

PCT

(10) International Publication Number
WO 2008/042187 A2

(51) International Patent Classification: Not classified

(21) International Application Number: PCT/US2007/020779

(22) International Filing Date: 26 September 2007 (26.09.2007)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/827,965 3 October 2006 (03.10.2006) US
60/863,188 27 October 2006 (27.10.2006) US

(71) Applicant (*for all designated States except US*): **INTERDIGITAL TECHNOLOGY CORPORATION** [US/US]; 3411 Silverside Road, Concord Plaza, Suite 105, Hagley Building, Wilmington, DE 19810 (US).

(72) Inventors; and
(75) Inventors/Applicants (*for US only*): **SHIN, Sung-Hyuk** [US/US]; 104 Eidner Way, Northvale, NJ 07647 (US). **GRIECO, Donald, M.** [US/US]; 18 Shore Road, Manhassett, NY 11030 (US). **OLESEN, Robert, L.** [US/US]; 3 Country Club Drive, Huntington, NY 11743 (US).

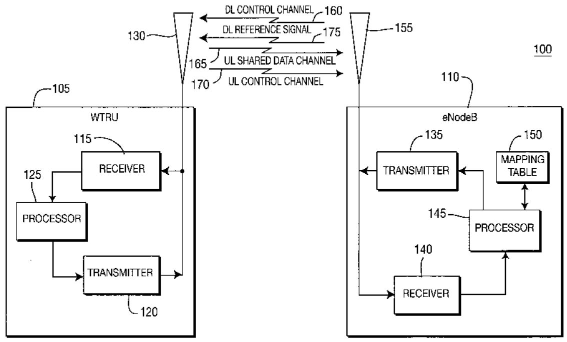
(74) Agent: **WOLINSKY, Scott**; United Plaza, Suite 1600, 30 South 17th Street, Philadelphia, PA 19103 (US).

(81) Designated States (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *without international search report and to be republished upon receipt of that report*

(54) Title: COMBINED OPEN LOOP/CLOSED LOOP (CQI-BASED) UPLINK TRANSMIT POWER CONTROL WITH INTERFERENCE MITIGATION FOR E-UTRA



(57) Abstract: A combined open loop and closed loop (channel quality indicator (CQI)-based) transmit power control (TPC) scheme with interference mitigation for a long term evolution (LTE) wireless transmit/receive unit (WTRU) is disclosed. The transmit power of the WTRU is derived based on a target signal-to-interference noise ratio (SINR) and a pathloss value. The pathloss value pertains to the downlink signal from a serving evolved Node-B (eNodeB) and includes shadowing. An interference and noise value of the serving eNodeB is included in the transmit power derivation, along with an offset constant value to adjust for downlink (DL) reference signal power and actual transmit power. A weighting factor is also used based on the availability of CQI feedback.

WO 2008/042187 A2

[0001] COMBINED OPEN LOOP/CLOSED LOOP (CQI-BASED) UPLINK TRANSMIT POWER CONTROL WITH INTERFERENCE MITIGATION FOR E-UTRA

[0002] FIELD OF INVENTION

[0003] The present invention is related to wireless communication systems.

[0004] BACKGROUND

[0005] For the evolved universal terrestrial radio access (E-UTRA) uplink (UL), there are several transmit power control (TPC) proposals that were submitted to third generation partnership project (3GPP) long term evolution (LTE) Work Group 1 (WG1). These proposals can be generally divided into (slow) open loop TPC and slow closed loop or channel quality information (CQI)-based TPC.

[0006] Open loop TPC is based on pathloss measurement and system parameters where the pathloss measurement is performed at a wireless transmit/receive unit (WTRU) and the system parameters are provided by an evolved Node-B (eNodeB).

[0007] Closed loop TPC is typically based on TPC feedback information, (such as a TPC command), that is periodically sent from the eNodeB where the feedback information is generally derived using signal-to-interference noise ratio (SINR) measured at the eNodeB.

[0008] Open loop TPC can compensate for long-term channel variations, (e.g. pathloss and shadowing), in an effective way, for instance, without the history of the transmit power. However, open loop TPC typically results in pathloss measurement errors and transmit power setting errors. On the other hand, slow closed loop or CQI-based TPC is less sensitive to errors in measurement and transmit power setting, because it is based on feedback signaled from the eNodeB. However, slow closed loop or CQI-based TPC degrades performance when there is no available feedback due to UL transmission pause, or pauses in the feedback transmission or channel variations are severely dynamic.

[0009] SUMMARY

[0010] For the E-UTRA UL, TPC is considered to compensate for at least path loss and shadowing and/or to mitigate interference. An enhanced UL TPC scheme that combines an open loop TPC scheme and a closed loop TPC with interference mitigation is disclosed. The closed loop TCP is based on CQI, (e.g., UL grant information or modulation and coding set (MCS) information). This enhanced UL TPC scheme can be used for both the UL data and control channels. Also, this proposed enhanced UL TPC scheme is flexible and adaptive to dynamic system/link parameters and channel conditions, in order to achieve the E-UTRA UL requirements.

[0011] Additionally, in order to avoid poor UL channel and CQI estimation where the channel and CQI estimation is based on the UL reference signal, it is proposed that the UL TPC for a data channel is performed at a slow rate such as 100 Hz, (i.e., one TPC update per one or two hybrid automatic repeat request (HARQ) cycle period(s)). For data-associated control signaling, the TPC update rate may be increased to 1000 Hz, assuming a maximum CQI reporting rate of once per 1 msec transmission timing interval (TTI).

[0012] BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The foregoing summary, as well as the following detailed description, will be better understood when read with reference to the appended drawings, wherein:

[0014] Figure 1 shows a wireless communication system including a WTRU and an eNodeB; and

[0015] Figure 2 shows a flow diagram of a TPC procedure implemented by the system of Figure 1.

[0016] DETAILED DESCRIPTION

[0017] When referred to hereafter, the terminology "wireless transmit/receive unit (WTRU)" includes but is not limited to a user equipment (UE), a mobile station, a fixed or mobile subscriber unit, a pager, a cellular telephone, a personal digital assistant (PDA), a computer, or any other type of user device capable of operating in a wireless environment. When referred to hereafter, the terminology "evolved Node-B (eNodeB)" includes but is not limited to a base station, a Node-B, a cell, a site controller, an access point (AP), or any other type of interfacing device capable of operating in a wireless environment.

[0018] Figure 1 shows a wireless communication system 100 including at least one WTRU 105 and at least one serving eNodeB 110. The WTRU 105 includes a receiver 115, a transmitter 120, a processor 125 and at least one antenna 130. The serving eNode-B 110 includes a transmitter 135, a receiver 140, a processor 145, a mapping table 150 and at least one antenna 155. The WTRU 105 and the eNodeB 110 communicate via a downlink (DL) control channel 160, a UL shared data channel 165 and a UL control channel 170.

[0019] The processor 145 in the eNodeB 110 performs UL interference over thermal noise (IoT) measurements, based on signals received by the receiver 140, and compares the measured IoT measurements to a predefined threshold. The processor 145 also generates an interference load indicator that is broadcast by the transmitter 135 of the eNodeB 110 on either a regular basis or a trigger basis. The interference load indicator indicates whether or not the IoT measurements performed at the eNodeB 110 exceed the predefined threshold. When the receiver 115 in the WTRU 105 receives and decodes the interference load indicator, the processor 125 in the WTRU 105 is able to determine the status of the IoT at the eNodeB 110, which can be used to mitigate inter-cell interference in the eNodeB 110.

[0020] The WTRU 105 performs open loop TPC based on system parameters and pathloss measurements while it is located in a particular cell.

The WTRU 105 relies on the interference load indicator to mitigate inter-cell interference in the eNodeB 110, which is located in the strongest cell neighboring the particular cell as compared to other neighboring cells. The strongest cell refers to a cell to which the WTRU 105 has the highest path gain, (i.e., least path loss). The WTRU 105 then corrects its open loop based calculated transmit power, which may be biased due to open loop errors, according to CQI received via the DL control channel 160 and target SINR, in order to compensate for the open loop errors.

[0021] It should be noted that the CQI refers to the UL grant information (or MCS) that the eNodeB 110 signals to the WTRU 105 via the DL control channel 160 for UL link adaptation. The CQI represents the WTRU specific UL channel quality which the serving eNodeB 110 feeds back to the WTRU 105 in the DL control channel 160. In E-UTRA, the CQI is provided in the form of UL grant information. The target SINR is a WTRU-specific parameter determined by the eNodeB 110 and signaled to the WTRU 105 via higher layer signaling.

[0022] The WTRU 105 transmit power, P_{Tx}, for the UL shared data channel 165 is determined in an initial transmission phase based on a DL reference signal 175 transmitted by the transmitter 135 of the eNodeB 110. The DL reference signal 175 has a known transmit power that the WTRU 105 uses for pathloss measurement. For intra-cell TPC, the WTRU 105 initial transmit power, P_{Tx}, is defined based on open loop TPC as follows:

$$P_{Tx} = \max\left(\min\left(SINR_T + PL + IN_0 + K, P_{\max}\right),\ P_{\min}\right). \qquad \text{Equation (1A)}$$

where $SINR_T$ is the target signal-to-interference noise ratio (SINR) in dB at the serving eNodeB 110, and PL is the pathloss, (i.e., a set point parameter), in dB, including shadowing, from the serving eNodeB 110 to the WTRU 105. The WTRU 105 measures the pathloss based on the DL reference signal 175, whose transmit power is known at the WTRU 105 via DL signaling. The value IN_0 is the UL interference and noise power in dBm at the serving eNodeB 110. K is a power control margin used for the serving eNodeB 110, taking into account the

DOCKET ALARM

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.

WHAT WILL YOU BUILD? | sales@docketalarm.com | 1-866-77-FASTCASE

fastcase®
Smarter legal research.