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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
13 January 2011 (13.01.2011)

PCT

(10) International Publication Number
WO 2011/005529 A3

(51) International Patent Classification:
G01S 11/06 (2006.01) *H04L 25/02* (2006.01)
H04W 64/00 (2009.01)

(21) International Application Number:
PCT/US2010/039514

(22) International Filing Date:
22 June 2010 (22.06.2010)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/219,351 22 June 2009 (22.06.2009) US
12/817,798 17 June 2010 (17.06.2010) US

(71) Applicant *(for all designated States except US)*: **QUALCOMM INCORPORATED** [US/US]; 5775 Morehouse Drive, San Diego, California 92121 (US).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: **WANG, Renqiu** [CN/US]; 5775 Morehouse Drive, San Diego, California 92121 (US). **XU, Hao** [US/US]; 5775 Morehouse Drive, San Diego, California 92121 (US).

(74) Agent: **ZOHN, Nerrie M.**; 5775 Morehouse Drive, San Diego, California 92121 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, 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, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, 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, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

[Continued on next page]

(54) **Title**: METHOD AND APPARATUS THAT FACILITATES ESTIMATING DOPPLER SPREAD FOR UPLINK TRANSMISSIONS

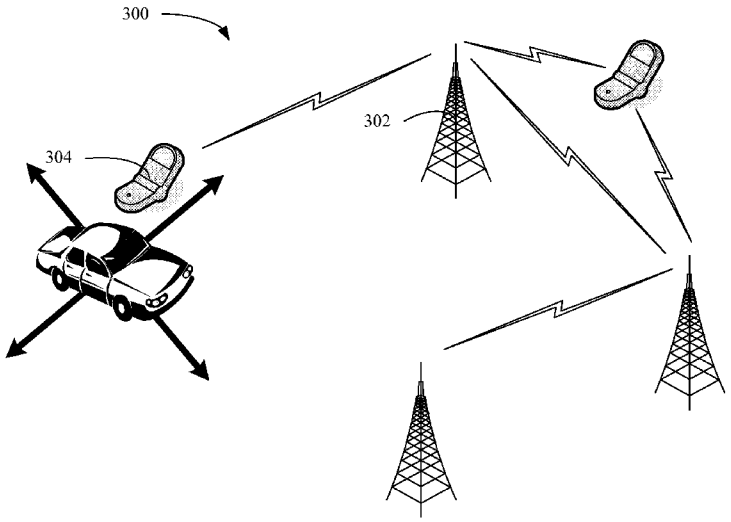


FIG. 3

(57) **Abstract**: Methods, apparatuses, and computer program products are disclosed for performing a Doppler spread estimation. In a first embodiment, an energy associated with a communication from a wireless terminal (304) is ascertained based on at least one pilot symbol and at least one data symbol. Each of an energy variance and a noise variance are then determined to facilitate estimating a speed of the wireless terminal based on the energy variance normalized by the noise variance. In another embodiment, a signal received from a wireless terminal is decoded and replicated. A channel estimate associated with a set of data symbols is then ascertained from the replica, which is used to estimate the speed of the wireless terminal.

WO 2011/005529 A3

WO 2011/005529 A3

Published:

— *with international search report (Art. 21(3))*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

(88) Date of publication of the international search report:
9 September 2011

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2010/039514

A. CLASSIFICATION OF SUBJECT MATTER
INV. G01S11/06 H04W64/00 H04L25/02
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G01S H04W H04L H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, COMPENDEX, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2007/242760 A1 (HSIUNG DA-WEI [TW] ET AL) 18 October 2007 (2007-10-18) abstract paragraph [0013] paragraph [0033] - paragraph [0041] ----- -/--	1-41

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 July 2011	20/07/2011

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Ó Donnabháin, C

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2010/039514

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☒ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2010/039514

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	SANGHO NAM ET AL: "Robust velocity estimation for non-isotropic and AWGN channel", VEHICULAR TECHNOLOGY CONFERENCE, 2005. VTC-2005-FALL. 2005 IEEE 62ND DALLAS, TX, USA 25-28 SEPT., 2005, PISCATAWAY, NJ, USA,IEEE LNKD-DOI:10.1109/VETECF.2005.1558459, vol. 3, 25 September 2005 (2005-09-25), pages 2003-2006, XP010878825, ISBN: 978-0-7803-9152-9	1-5, 13-18, 26,27, 35-41
A	Proposed Maximum Doppler Frequency Estimation Simulation Results -----	6-12, 19-25, 28-34
A	US 6 757 547 B1 (GOEDDEL THOMAS W [US]) 29 June 2004 (2004-06-29) abstract; figure 1 Summary of the Invention column 3, line 36 - column 4, line 12 column 4, line 52ff -----	1-41
X	WO 2007/024027 A1 (NEC CORP [JP]; NGUYEN PHONG [AU]) 1 March 2007 (2007-03-01) page 12 page 18, line 1 - line 10 figure 2 -----	42-54
X	US 2006/227887 A1 (LI LINBO [US] ET AL) 12 October 2006 (2006-10-12) abstract paragraphs [0009], [0 10], [0 48] paragraph [0072] - paragraph [0078] figure 3 -----	52-54

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2010/039514

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2007242760 A1	18-10-2007	CN 101056138 A	17-10-2007
US 6757547 B1	29-06-2004	NONE	
WO 2007024027 A1	01-03-2007	AU 2006203697 A1	15-03-2007
		EP 1917748 A1	07-05-2008
		JP 2009506583 A	12-02-2009
		US 2009279589 A1	12-11-2009
US 2006227887 A1	12-10-2006	CA 2603439 A1	19-10-2006
		EP 1867117 A2	19-12-2007
		JP 2008536400 A	04-09-2008
		KR 20070122532 A	31-12-2007
		US 2011051618 A1	03-03-2011
		WO 2006110455 A2	19-10-2006

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-41

   Non-coherent speed determination

   ---

2. claims: 42-54

   Speed determination using channel estimate
