



(51) International Patent Classification:

H04L 5/00 (2006.01) H04W 4/00 (2009.01)
H04B 7/06 (2006.01) H04L 1/06 (2006.01)
H04L 25/02 (2006.01) H04L 25/03 (2006.01)

(21) International Application Number:

PCT/US2016/066298

(22) International Filing Date:

13 December 2016 (13.12.2016)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

62/276,219 07 January 2016 (07.01.2016) US
62/280,590 19 January 2016 (19.01.2016) US
62/292,194 05 February 2016 (05.02.2016) US
15/376,490 12 December 2016 (12.12.2016) US

(71) Applicant: QUALCOMM INCORPORATED [US/US];
ATTN: International IP Administration, 5775 Morehouse Drive, San Diego, California 92121-1714 (US).

(72) Inventors: GAAL, Peter; 5775 Morehouse Drive, San Diego, California 92121-1714 (US). XU, Hao; 5775 Morehouse Drive, San Diego, California 92121-1714 (US). CHEN, Wanshi; 5775 Morehouse Drive, San Diego, California 92121-1714 (US).

ifornia 92121-1714 (US). WANG, Xiaofeng; 5775 Morehouse Drive, San Diego, California 92121-1714 (US). RI-CO-ALVARINO, Alberto; 5775 Morehouse Drive, San Diego, California 92121-1714 (US).

(74) Agent: READ, Randol W. et al.; Patterson & Sheridan, L.L.P., 24 Greenway Plaza, Suite 1600, Houston, Texas 77046-2472 (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, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, 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, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, 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,

(54) Title: METHODS AND APPARATUS FOR A DATA TRANSMISSION SCHEME FOR NARROW-BAND INTERNET OF THINGS

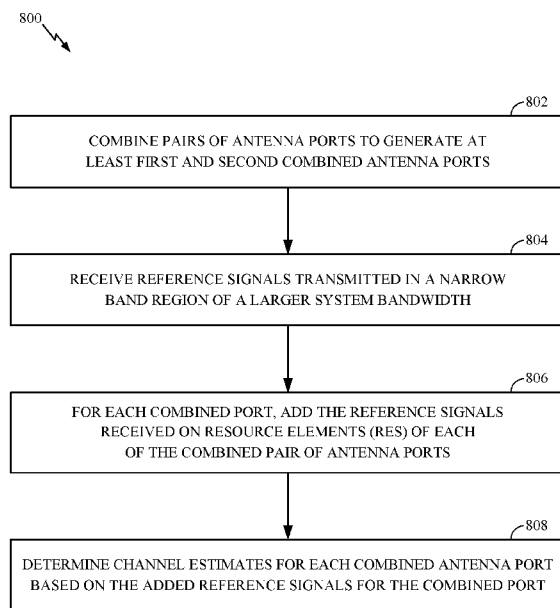


FIG. 8

(57) Abstract: Certain aspects of the present disclosure relate to methods and apparatus for implementing a data transmission scheme for Narrow-Band Internet of Things (NB IoT). A User Equipment (UE) combines pairs of antenna ports to generate at least first and second combined antennas ports. The UE receives reference signals transmitted in a narrow band region of a larger system bandwidth, and for each combined port, adds the references signals received on resource elements (REs) of each of the combined pair of antenna ports. The UE determines channel estimates for each combined antenna port based on the added reference signals for the combined port.



MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,
TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,
KM, ML, MR, NE, SN, TD, TG).

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:

26 October 2017 (26.10.2017)

INTERNATIONAL SEARCH REPORT

International application No PCT/US2016/066298

A. CLASSIFICATION OF SUBJECT MATTER				
INV. H04L5/00 H04B7/06 H04L25/02 H04W4/00 H04L1/06 H04L25/03				
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) H04L H04B H04W				
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 practicable, search terms used) EPO-Internal, WPI Data				
C. DOCUMENTS CONSIDERED TO BE RELEVANT				
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.		
X	US 2013/315081 A1 (KIM YOUNSUN [KR] ET AL) 28 November 2013 (2013-11-28) paragraph [0022] paragraph [0039] paragraph [0132] - paragraph [0147] Eq.2,3 figures 1-3,13	1-44		
A	----- EP 1 290 809 A1 (SAMSUNG ELECTRONICS CO LTD [KR]) 12 March 2003 (2003-03-12) paragraph [0008] paragraph [0066] - paragraph [0076] figure 4 ----- -/--	1-44		
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.				
* Special categories of cited documents : <table style="width: 100%; border: none;"> <tr> <td style="width: 50%; border: none; vertical-align: top;"> "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent 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 </td> <td style="width: 50%; border: none; vertical-align: top;"> "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 </td> </tr> </table>			"A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent 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
"A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent 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			
15 September 2017	25/09/2017			
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Tanbourgi, Ralph			

7

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2016/066298

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>FUJITSU: "CSI-RS Design for Virtualized LTE Antenna in LTE-A System", 3GPP DRAFT; R1-093152, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE, no. Shenzhen, China; 20090818, 18 August 2009 (2009-08-18), XP050351511, [retrieved on 2009-08-18] the whole document</p>	1-44
A	<p>----- SAMSUNG: "Reference signal structure for 4-TX antenna MIMO", 3GPP DRAFT; R1-063254, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE, vol. RAN WG1, no. Riga, Latvia; 20061101, 1 November 2006 (2006-11-01), XP050103704, [retrieved on 2006-11-01] the whole document</p>	1-44
A	<p>----- HANZO L ET AL: "OFDM and MC-CDMA for broadband multi-user communications, WLANs, and broadcasting", OFDM AND MC-CDMA FOR BROADBAND MULTI-USER COMMUNICATIONS, WLANSAND BROADCASTING, XX, XX, 1 January 2003 (2003-01-01), pages 84-92, XP002297739, page 85 - page 92</p>	1-44
X	<p>----- ERICSSON: "E-UTRA downlink scrambling", 3GPP DRAFT; R1-060083, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE , vol. RAN WG1, no. Helsinki, Finland; 20060123 - 20060125 19 January 2006 (2006-01-19), XP050950931, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_AH/LTE_AH_0601/Docs/sec.2.1; [retrieved on 2006-01-19] sec.2.1; page 2</p> <p>----- -/--</p>	45-52

INTERNATIONAL SEARCH REPORT

International application No PCT/US2016/066298

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>"3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Physical channels and modulation (Release 13)", 3GPP STANDARD; 3GPP TS 36.211, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE, vol. RAN WG1, no. V13.0.0, 5 January 2016 (2016-01-05), pages 1-141, XP051047447, [retrieved on 2016-01-05] page 68 page 127</p> <p align="center">-----</p>	1-52

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2016/066298

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.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

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

1. claims: 1-44

Method of wireless communication comprising combining antenna ports

2. claims: 45-52

Method of wireless communication comprising scrambling of data

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No PCT/US2016/066298

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2013315081	A1	28-11-2013	CN 104508988 A
			EP 2853040 A1
			KR 20130130593 A
			US 2013315081 A1
			US 2015230260 A1
			US 2016028461 A1
			WO 2013176480 A1

EP 1290809	A1	12-03-2003	AT 311045 T
			AU 6075001 A
			AU 2001260750 B2
			CA 2409893 A1
			CN 1440593 A
			DE 60115233 D1
			DE 60115233 T2
			EP 1290809 A1
			ES 2248330 T3
			JP 3683218 B2
			JP 2003534705 A
			KR 20010107770 A
			US 2002118727 A1
			WO 0191318 A1
