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6 January 2010 (06.01.2010)(75) Inventors/Applicants (for US only): **AGRAWAL, Avneesh** [US/US]; 5775 Morehouse Drive, San Diego, CA 92121 (US). **SAMPATH, Ashwin** [US/US]; 5775 Morehouse Drive, San Diego, CA 92121 (US). **PALANKI, Ravi** [IN/US]; 5775 Morehouse Drive, San Diego, CA 92121 (US). **BHUSHAN, Naga** [US/US]; 5775 Morehouse Drive, San Diego, CA 92121 (US). **BACHU, Raja, Sekhar** [IN/US]; 5775 Morehouse Drive, San Diego, CA 92121 (US). **KHANDEKAR, Aamod, D.** [IN/US]; 5775 Morehouse Drive, San Diego, CA 92121 (US).

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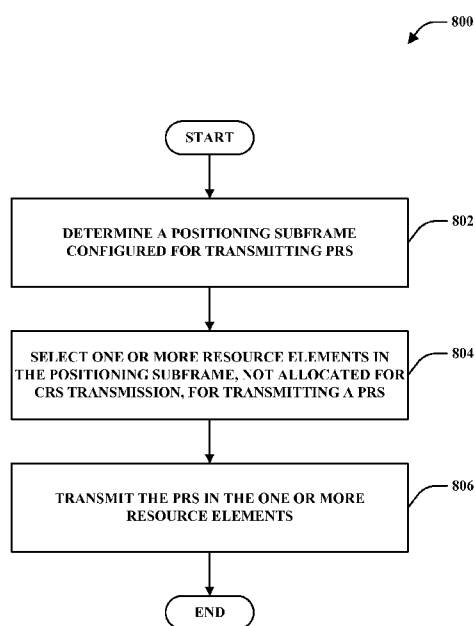
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12/651,838 4 January 2010 (04.01.2010) US(74) Agent: **PATEL, Milan, I.**; Attn: International Ip Administration, 5775 Morehouse Drive, San Diego, CA 92121 (US).(71) Applicant (for all designated States except US): **QUALCOMM INCORPORATED** [US/US]; Attn: International-

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(54) Title: HEARABILITY IMPROVEMENTS FOR REFERENCE SIGNALS



(57) Abstract: Systems and methodologies are described that facilitate providing high reuse for transmitting reference signals, such as positioning reference signals (PRS) and cell-specific reference signals (CRS), to improve hearability thereof for applications such as trilateration and/or the like. In particular, PRSs can be transmitted in designated or selected positioning sub frames. Resource elements within the positioning sub frame can be selected for transmitting the PRSs and can avoid conflict with designated control regions, resource elements used for transmitting cell-specific reference signals, and/or the like. Resource elements for transmitting PRSs can be selected according to a planned or pseudo-random reuse scheme. In addition, a transmit diversity scheme can be applied to the PRSs to minimize impact of introducing the PRSs to legacy devices. Moreover, portions of a subframe not designated for PRS transmission can be utilized for user plane data transmission.

FIG. 8



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, 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, 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))

Published:

- with international search report (Art. 21(3))
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INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER INV. H04L5/00 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		
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		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 1 898 542 A1 (NTT DOCOMO INC [JP]) 12 March 2008 (2008-03-12) * abstract paragraph [0046] - paragraph [0054] paragraph [0069] paragraph [0078] claims 7-9,11 figures 1,4,5,6,9,12,16,19 -----	1-42
A	QIANG WU ET AL: "cdma2000 Highly Detectable Pilot" COMMUNICATIONS WORKSHOPS, 2008. ICC WORKSHOPS '08. IEEE INTERNATIONAL CONFERENCE ON, IEEE, PISCATAWAY, NJ, USA, 19 May 2008 (2008-05-19), pages 16-20, XP031265196 ISBN: 978-1-4244-2052-0 the whole document -----	1-42
-/--		
<div style="display: flex; justify-content: space-between;"> <input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex. </div>		
<div style="display: flex;"> <div style="flex: 1;"> <p>* Special categories of cited documents :</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"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)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="flex: 1;"> <p>"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</p> <p>"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</p> <p>"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.</p> <p>"&" document member of the same patent family</p> </div> </div>		
Date of the actual completion of the international search <div style="text-align: center; font-size: 1.2em;">1 July 2010</div>		Date of mailing of the international search report <div style="text-align: center; font-size: 1.2em;">15/07/2010</div>
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 <div style="text-align: center; font-size: 1.2em;">Schiffer, Andrea</div>

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2010/020271

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X,P	<p>QUALCOMM EUROPE: "On OTDOA in LTE" 3GPP DRAFT; R1-090353, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE, no. Ljubljana; 20090108, 8 January 2009 (2009-01-08), XP050318259 [retrieved on 2009-01-08] the whole document</p> <p>-----</p>	1-42
X	<p>MOTOROLA: "Impact of Supporting "Blank" Subframes" 3GPP TSG RAN PLENARY MEETING NO. 42 5 December 2008 (2008-12-05), XP002589696 Athens, Greece Retrieved from the Internet: URL:http://www.3gpp.org/ftp/tsg_ran/tsg_ra n/TSGR_42/docs/ [retrieved on 2010-06-28] the whole document</p> <p>-----</p>	43-50
X	<p>Qualcomm Europe: "Way forward on forward compatible subframes for Rel-8" 3GPP TSG RAN PLENARY MEETING NO. 42 5 December 2008 (2008-12-05), XP002589697 Athens, Greece Retrieved from the Internet: URL:http://www.3gpp.org/ftp/tsg_ran/tsg_ra n/TSGR_42/docs/ [retrieved on 2010-06-28] the whole document</p> <p>-----</p>	43-50
X	<p>Qualcomm Europe: "Impact of Blank Subframes on Intra-frequency Measurements" 3 GPP TSG-RAN WG4 No. 49 6 November 2008 (2008-11-06), XP002589698 Prague, CZ Retrieved from the Internet: URL:http://www.3gpp.org/ftp/tsg_ran/wg4_ra dio/TSGR4_49/Documents/ [retrieved on 2010-06-28] the whole document</p> <p>-----</p>	43-50

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2010/020271

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: 1-42

Allocation of positioning reference signals

2. claims: 43-50

Blanking of data transmission

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2010/020271

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 1898542	A1	12-03-2008	
		AU 2006258593 A1	21-12-2006
		CA 2611157 A1	21-12-2006
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