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(54) Title: RACH COMBINING ACROSS MULTIPLE ATTEMPTS

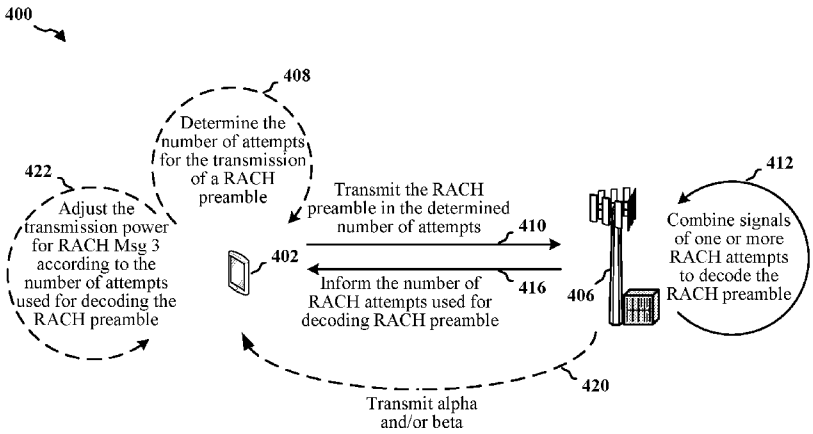

FIG. 4

(57) Abstract: A mechanism is proposed to reduce overhead at the expense of increasing latency for UEs with weak link gain, while the latency for most UEs may remain the same. In one aspect of this disclosure, a UE may determine the number of attempts for transmitting a RACH signal based on one or more of path loss, the transmit power of the UE, the beam correspondence at the UE, or the power of signals received during the synchronization subframe. The UE may transmit the RACH signal in the determined number of attempts. In another aspect of the disclosure, a base station may combine signals of one or more RACH attempts to decode a RACH signal. The base station may inform a UE regarding the number of RACH subframes that the base station uses for decoding the RACH signal through a random access response message.

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[Continued on next page]

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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))*

— *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))*

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2017/032725

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/US2017/032725

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04W74/08 H04B7/08 H04W72/04
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)
H04W 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 practicable, search terms used)
EPO-Internal, INSPEC, IBM-TDB, 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 2016/119038 A1 (THOMAS TIMOTHY [US] ET AL) 28 April 2016 (2016-04-28) paragraphs [0009], [0012] paragraph [0046] - paragraph [0048] paragraph [0058] - paragraph [0059]; figure 8 ----- -/--	1-13, 17-28

[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 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
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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	Vercauteren, Steven

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

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JEONG CHEOL ET AL: "Random access in millimeter-wave beamforming cellular networks: issues and approaches", IEEE COMMUNICATIONS MAGAZINE, IEEE SERVICE CENTER, PISCATAWAY, US, vol. 53, no. 1, 1 January 2015 (2015-01-01), pages 180-185, XP011570628, ISSN: 0163-6804, DOI: 10.1109/MCOM.2015.7010532 [retrieved on 2015-01-14] page 182, left-hand column, lines 16-35; figure 2 page 184, left-hand column, last paragraph - right-hand column	1-13, 17-28
A	LG ELECTRONICS INC: "RACH Soft Combining", 3GPP DRAFT; R1- 074979, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE, vol. RAN WG1, no. Korea; 20071104, 4 November 2007 (2007-11-04), XP050108021, [retrieved on 2007-11-04] page 1 page 3, section "Detecton method"	1-13, 17-28
X	US 2015/359005 A1 (WONG SHIN HORNG [GB] ET AL) 10 December 2015 (2015-12-10) paragraph [0081] - paragraph [0087] paragraph [0092] - paragraph [0093]	14-16, 29,30
X	FUJITSU: "The impacts on RAR caused by preamble repetition", 3GPP DRAFT; R1-151565-THE IMPACTS ON RAR CAUSED BY PREAMBLE REPETITION-FINAL, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS C , vol. RAN WG1, no. Belgrade, Serbia; 20150420 - 20150424 10 April 2015 (2015-04-10), XP050949521, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_80b/Docs/ [retrieved on 2015-04-10] page 2, example 2	14-16, 29,30

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3

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	QUALCOMM INCORPORATED: "4-step RACH procedure consideration", 3GPP DRAFT; R1-1700791 4-STEP RACH PROCEDURE CONSIDERATION, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE , vol. RAN WG1, no. Spokane, USA; 20170116 - 20170120 10 January 2017 (2017-01-10), XP051203106, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_AH/NR_AH_1701/Docs/ [retrieved on 2017-01-10] page 8, paragraph 3 page 8, "Proposal 5" -----	14-16, 29,30

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2017/032725

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2016119038 A1	28-04-2016	EP 3213426 A1	06-09-2017
		US 2016119038 A1	28-04-2016
		WO 2016066366 A1	06-05-2016
US 2015359005 A1	10-12-2015	CN 104956760 A	30-09-2015
		EP 2760248 A1	30-07-2014
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		TW 201446059 A	01-12-2014
		US 2015359005 A1	10-12-2015
		WO 2014114318 A1	31-07-2014

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

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

1. claims: 1-13, 17-28

A method of wireless communication of a user equipment, UE, comprising determining a number of attempts for a transmission of a random-access channel, RACH, signal based on one or more of a path loss, a transmit power of the UE, a beam correspondence at the UE, or a power of signals received during a synchronization subframe, as well as a corresponding apparatus.

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2. claims: 14-16, 29, 30

A method of wireless communication of a base station, comprising informing a user equipment, UE, regarding a number of RACH attempts used for decoding the RACH signal through a random access response message, as well as a corresponding apparatus.
