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- (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). CHEN, Wanshi;

5775 Morehouse Drive, San Diego, California 92121-1714 (US). DAMNJANOVIC, Jelena; 5775 Morehouse Drive, San Diego, California 92121-1714 (US). XU, Hao; 5775 Morehouse Drive, San Diego, California 92121-1714 (US). VAJAPEYAM, Madhavan, Srinivasan; 5775 Morehouse Drive, San Diego, California 92121-1714 (US).

(74) Agent: SCHRAMM, Paul, M.; Holland & Hart LLP, P.O. Box 11583, Salt Lake City, Utah 84147 (US).

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[Continued on next page]

(54) Title: UPLINK CONTROL CHANNEL FOR ACKNOWLEDGING INCREASED NUMBER OF DOWNLINK COMPONENT CARRIERS

²⁰⁰⁰ (57) Abstract: Techniques are described for wireless communication. One method includes determining, based at least in part on a number of downlink component carriers (CCs) scheduled for a user equipment (UE) during a reporting interval, a number of bits to be included in a physical uplink control channel (PUCCH) acknowledgement/nonacknowledgement (ACK/NAK) payload for the reporting interval; and selecting, based at least in part on the determined number of bits, a format of the PUCCH ACK/NAK payload.

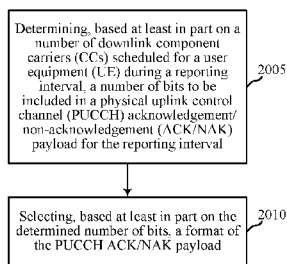


FIG. 20



(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, 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).

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A. CLASSIFICATION OF SUBJECT MATTER
INV. H04L1/00 H04L1/18 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 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 Y	US 2012/218881 A1 (LIANG CHUNLI [CN] ET AL) 30 August 2012 (2012-08-30) abstract paragraph [0008] paragraph [0064] - paragraph [0065] paragraph [0087] - paragraph [0089] ----- -/--	1, 32, 63, 73 2-31, 33-62, 64-72, 74-76

Further documents are listed in the continuation of Box C.

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	"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
"E" earlier application or patent but published on or after the international filing date	"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
"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)	"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
"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search 19 July 2016	Date of mailing of the international search report 27/07/2016
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 Ivanov, Tzvetan

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2016/014756

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	<p>NTT DOCOMO: "Views on DFT-S-OFDM Format Details", 3GPP DRAFT; R1-104925 PUCCH DFT-S-OFDM, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE, vol. RAN WG1, no. Madrid, Spain; 20100823, 17 August 2010 (2010-08-17), XP050450069, [retrieved on 2010-08-17] section 1, Introduction section 2, Explicit DTX Feedback section 3, Shortened Format figures 1(a), 1(b)</p> <p style="text-align: center;">-----</p>	<p>2-5, 33-36, 64-66,74</p>
Y	<p>LG ELECTRONICS: "Details on DFT-S-OFDM format for CA PUCCH", 3GPP DRAFT; R1-104757 LG DFTDETAIL_CAPUCCH, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE, vol. RAN WG1, no. Madrid, Spain; 20100823, 18 August 2010 (2010-08-18), XP050450136, [retrieved on 2010-08-18] section 2.2, Channel coding page 1; table 1 page 2; figure 1</p> <p style="text-align: center;">-----</p>	<p>6-16, 37-47, 67,75</p>
A	<p>SAMSUNG: "UCI Payload Aspects for eIMTA", 3GPP DRAFT; R1-134155 EIMTA UCI PAYLOAD, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE , vol. RAN WG1, no. Guangzhou, China; 20131007 - 20131011 28 September 2013 (2013-09-28), XP050717344, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_74b/Docs/ [retrieved on 2013-09-28] section 1, Introduction section 2, UCI Payload in PUCCH and PUSCH</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">-/--</p>	<p>6-16, 37-47, 67,75</p>

INTERNATIONAL SEARCH REPORT

International application No

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	<p>HUAWEI ET AL: "Details of reusing dual connectivity for PUCCH on SCell with CA", 3GPP DRAFT; R1-142834, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE</p> <p>, vol. RAN WG1, no. Dresden, Germany; 20140818 - 20140822 17 August 2014 (2014-08-17), XP050788319, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/Meetings_3GPP_SYNC/RAN1/Docs/ [retrieved on 2014-08-17] section 1, Introduction section 3.1, UCI feedback when no PUSCH is scheduled figure 1</p> <p style="text-align: center;">-----</p>	<p>17-20, 27,30, 31, 48-51, 58,61, 62,68, 71,72,76</p>
A	<p>HUAWEI ET AL: "Extending PUCCH on PCell and pSCell to Carrier Aggregation", 3GPP DRAFT; R1-142337, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE</p> <p>, vol. RAN WG1, no. Seoul, Korea; 20140519 - 20140523 18 May 2014 (2014-05-18), XP050787931, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/Meetings_3GPP_SYNC/RAN1/Docs/ [retrieved on 2014-05-18] section 2, Motivation to extend PUCCH to PCell on pSCell to CA section 3, Additional work to extend PUCCH on PCell and pSCell to CA</p> <p style="text-align: center;">-----</p>	<p>17-20, 27,30, 31, 48-51, 58,61, 62,68, 71,72,76</p>
Y	<p>QUALCOMM INCORPORATED: "Number of Bits Conveyed on Multi-ACK PUCCH Format", 3GPP DRAFT; R1-103535 NUMBER OF BITS CONVEYED ON MULTI-BIT ACK PUCCH FORMAT, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE,</p> <p>vol. RAN WG1, no. Dresden, Germany; 20100628 - 20100702, 22 June 2010 (2010-06-22), XP050598457, [retrieved on 2010-06-22] section 2.1, Problem Foreseen section 2.2, DAI Designs for LTE Rel-10 tables 1-4</p> <p style="text-align: center;">-----</p>	<p>21-26, 28,29, 52-57, 59,60, 69,70</p>

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2016/014756

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: 1-5, 32-36, 63-66, 73, 74

Timing of ACK/NACK feedback on the uplink using candidate with higher downlink ratio.

2. claims: 6-16, 37-47, 67, 75

Proving ACK/NAK formats for each of a plurality of bit ranges.

3. claims: 17-20, 27, 30, 31, 48-51, 58, 61, 62, 68, 71, 72, 76

Determining a first subset of downlink CCs together with the corresponding ACK/NAK payload, uplink CC, ACK/NAK resource indicator and bundling.

4. claims: 21-26, 28, 29, 52-57, 59, 60, 69, 70

Scheduling of downlink CCs with a number of downlink grants including downlink assignment indices.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2016/014756

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2012218881 A1	30-08-2012	CN 101924616 A	22-12-2010
		CN 102484568 A	30-05-2012
		EP 2482484 A1	01-08-2012
		ES 2560958 T3	23-02-2016
		US 2012218881 A1	30-08-2012
		WO 2012022140 A1	23-02-2012
