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[Continued on next page]

(54) Title: BUNDLING AND HYBRID AUTOMATIC REPEAT REQUEST OPERATION FOR ENHANCED MACHINE-TYPE COMMUNICATION

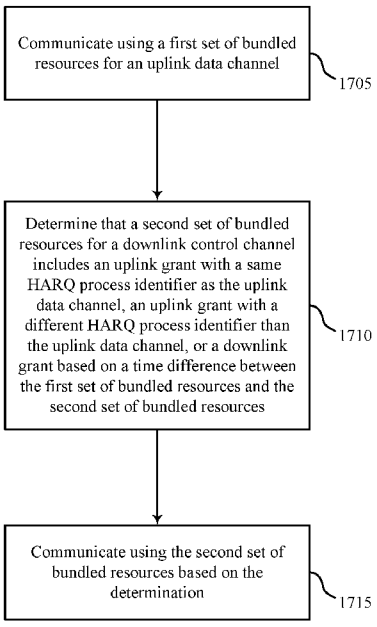


FIG. 17 1700

(57) Abstract: Methods, systems, and devices for wireless communication are described. A user equipment (UE), which may be a machine-type communication device and may have a half-duplex capability, may receive grants for uplink resources and downlink resources that overlap in time. The UE may prioritize the grants and either drop the low priority grant or may monitor a non-overlapping portion of resources assigned by the lower priority grant, for example. The UE may determine an acknowledgement mode for the downlink transmission based on one or more grants or on an explicit indication from a base station in some examples. A control format indicator may be interpreted based on the grant or on the bundling size. In some cases, the UE may identify a retuning time (e.g., for switching between transmit and receive modes or for switching frequencies) and may determine uplink and downlink bundling sizes based on the retuning time.

WO 2017/019587 A3

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).

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:
30 March 2017

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2016/043821

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/US2016/043821

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04L1/18 H04L1/08 H04L5/00 H04W4/00
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 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, COMPENDEX, 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	ERICSSON: "HARQ and TTI bundling for Rel-13 low complexity and coverage enhanced UEs", 3GPP DRAFT; R2-152651 - HARQ AND TTI BUNDLING FOR REL-13 LOW COMPLEXITY AND COVERAGE ENHANCED UES, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-069 , vol. RAN WG2, no. Fukuoka, Japan; 20150525 - 20150529 24 May 2015 (2015-05-24), XP050973534, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/Meetings_3GPP_SYNC/RAN2/Docs/ [retrieved on 2015-05-24]	1,2,4-7, 12,13, 15-18, 23,24, 26-29,34
A	page 1 - page 3	3,14,25

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[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	Kazaniecki, Daniel

2

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

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2016/043821

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	WO 2009/042158 A2 (LUCENT TECHNOLOGIES INC [US]; BALACHANDRAN KRISHNA [US]; CALIN DORU [U) 2 April 2009 (2009-04-02) page 6, line 22 - line 31 -----	8-10, 19-21, 30-32 11,22,33
X	LG ELECTRONICS: "PDSCH related issues for MTC", 3GPP DRAFT; R1-150200, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE , vol. RAN WG1, no. Athens, Greece; 20150209 - 20150213 8 February 2015 (2015-02-08), XP050933414, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/Meetings_3GPP_SYNC/RAN1/Docs/ [retrieved on 2015-02-08] the whole document -----	8-11, 19-22, 30-33
X	RENESAS MOBILE EUROPE LTD: "HARQ Procedure for half Duplex Mode in CC specific TDD Configuration", 3GPP DRAFT; R1-113887, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE, vol. RAN WG1, no. San Francisco, CA, USA; 20111114 - 20111118, 8 November 2011 (2011-11-08), XP050561968, [retrieved on 2011-11-08] the whole document -----	8-11, 19-22, 30-33
X	US 2009/147755 A1 (LIU JINGYUAN [US] ET AL) 11 June 2009 (2009-06-11) figure 4 -----	8,10,19, 21,30, 32,35

2

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2016/043821

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2009042158 A2	02-04-2009	CN 101809928 A	18-08-2010
		EP 2195958 A2	16-06-2010
		JP 2010541381 A	24-12-2010
		KR 20100055495 A	26-05-2010
		WO 2009042158 A2	02-04-2009
US 2009147755 A1	11-06-2009	CN 101884191 A	10-11-2010
		EP 2227876 A1	15-09-2010
		JP 5350390 B2	27-11-2013
		JP 2011507355 A	03-03-2011
		JP 2013128279 A	27-06-2013
		KR 20100089900 A	12-08-2010
		TW 200941990 A	01-10-2009
		US 2009147755 A1	11-06-2009
		WO 2009076213 A1	18-06-2009

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

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

1. claims: 1-7, 12-18, 23-29, 34

   Method and device for communicating using a set of bundled uplink data resources and a set of of bundled downlink control channel resources

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2. claims: 8-11, 19-22, 30-33, 35

   Method and device for receiving two overlapping grants and communicating using one or the other based on the prioritization between them

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