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- (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, 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, KN, KP, KR, 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.

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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:**
3 November 2016

(54) **Title:** DOWNLINK SYNCHRONIZATION CHANNEL FOR THE NARROW-BAND CELLULAR IOT

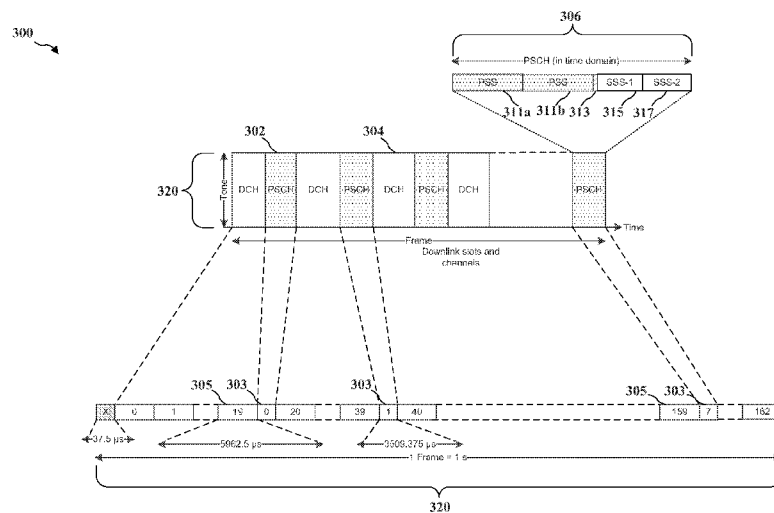
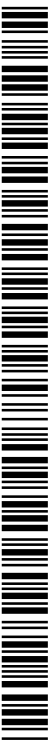


FIG. 3

(57) **Abstract:** To enable efficient synchronization and/or cell acquisition, systems and methods are described for broadcast of a synchronization signal in a synchronization channel. According to an aspect, a base station may generate a synchronization signal and assign the synchronization signal to be carried on a synchronization channel that is time-division multiplexed with one or more other channels (e.g., one or more other downlink channels). The synchronization channel may be a single-carrier channel and/or a wide-band channel. The base station may transmit synchronization signal (e.g., periodically broadcast) on the synchronization channel to enable a time and/or frequency synchronization. According to an aspect, the UE may acquire synchronization information based on detection of the repeating synchronization signal.



INTERNATIONAL SEARCH REPORT

International application No
PCT/US2016/012756

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04W56/00
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)
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

C. 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: "Narrow band OFDMA based proposal for GERAN Cellular IoT", 3GPP DRAFT; GP-140839 - OFDMA CONCEPT DESCRIPTION, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE</p> <p>, vol. TSG GERAN, no. San Francisco, USA; 20141117 - 20141121 17 November 2014 (2014-11-17), XP050874928, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/Meetings_3GPP_SYNC/GERAN/Docs/ [retrieved on 2014-11-17]</p>	<p>1,2, 4-11, 13-18, 20-25, 27-30</p>
A	<p>paragraph [2.1.2] paragraph [2.1.3] paragraph [2.1.6]</p> <p>-/--</p>	<p>3,12,19, 26</p>

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
- "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 23 August 2016	Date of mailing of the international search report 30/08/2016
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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 Larcinese, Annamaria
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INTERNATIONAL SEARCH REPORT

International application No
PCT/US2016/012756

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>figure 4</p> <p>-----</p> <p>QUALCOMM INCORPORATED: "Narrow band OFDMA- Synchronization", 3GPP DRAFT; GP-140841- SYNCHRONISATION, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE</p> <p>, vol. TSG GERAN, no. San Francisco, USA; 20141117 - 20141121 17 November 2014 (2014-11-17), XP050874930, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/Meetings_3GPP_SYNC/GERAN/Docs/ [retrieved on 2014-11-17]</p>	<p>1,2, 4-11, 13-18, 20-25, 27-30</p>
A	<p>the whole document</p>	<p>3,12,19, 26</p>
A	<p>-----</p> <p>HUAWEI TECHNOLOGIES CO ET AL: "NB M2M - Refinements for Physical Broadcast Channels (update of GPC150026)", 3GPP DRAFT; GPC150117 - NB M2M - REFINEMENTS FOR PHYSICAL BROADCAST CHANNELS (UPDATE OF GPC150026) V2, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F</p> <p>, vol. GERAN WG1, no. Sophia-Antipolis, France; 20150202 - 20150205 5 February 2015 (2015-02-05), XP050931452, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/Meetings_3GPP_SYNC/GERAN/Docs/ [retrieved on 2015-02-05] paragraph [0001] - paragraph [04.1]</p> <p>-----</p> <p style="text-align: center;">-/--</p>	<p>10-16, 25-30</p>

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2016/012756

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>HUAWEI TECHNOLOGIES CO ET AL: "Proposed Text for the TR on Physical Broadcast Channels for NB M2M", 3GPP DRAFT; GPC150031 - PROPOSED TEXT FOR THE TR ON PHYSICAL BROADCAST CHANNELS FOR NB M2M V4, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 S</p> <p>, vol. GERAN WG1, no. Sophia-Antipolis, France; 20150202 - 20150205 2 February 2015 (2015-02-02), XP050931364, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/Meetings_3GPP_SYNC/GERAN/Docs/ [retrieved on 2015-02-02] paragraph [7.1.2.1.2.4] - paragraph [7.1.2.1.2.9]</p> <p style="text-align: center;">-----</p>	10,25

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2016/012756

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: 1-9, 17-24

Method and apparatus for generating a synchronisation signal for transmission in a synchronisation channel.

2. claims: 10-16, 25-30

Method and apparatus for receiving from a base station a downlink frame having a first channel time divisionally multiplexed with at least one other downlink channel, differentially demodulating a plurality of symbols of the first channel and determining whether the first channel is a synchronisation channel.
