

Figura 1
(ARTE PREVIO)

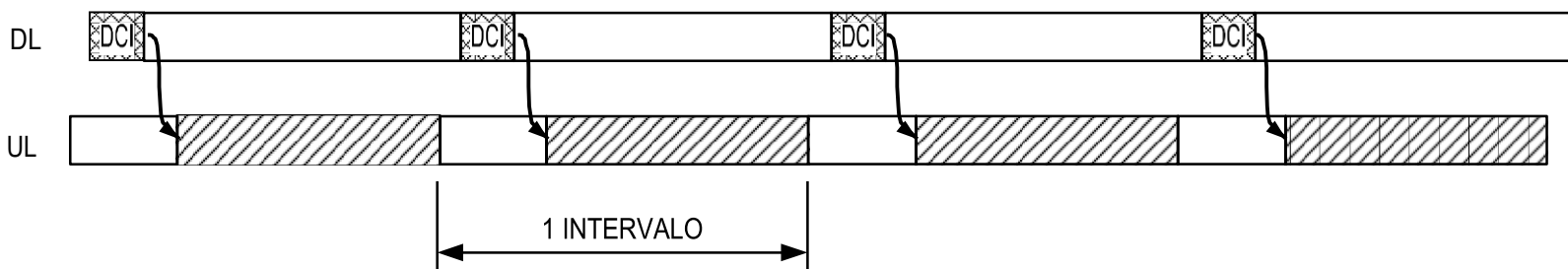


Figura 2

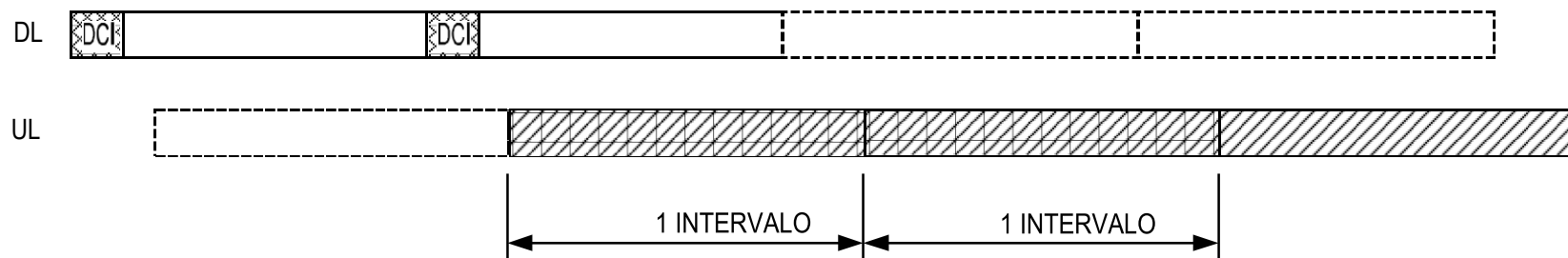


Figura 3

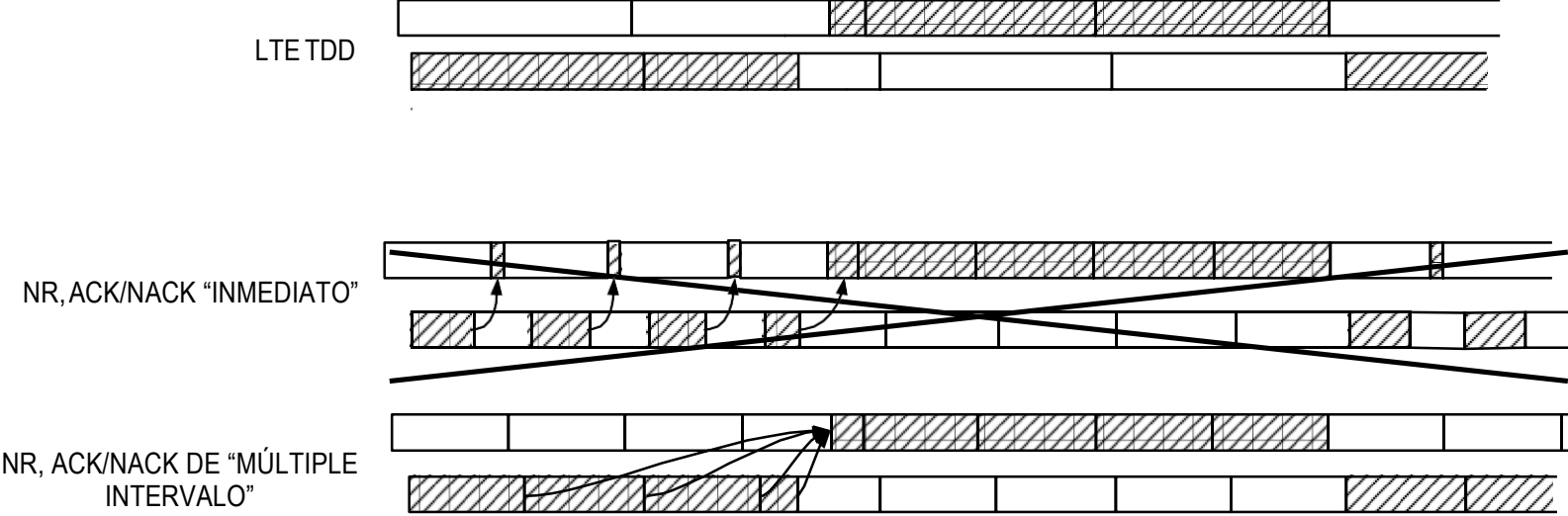


Figura 4

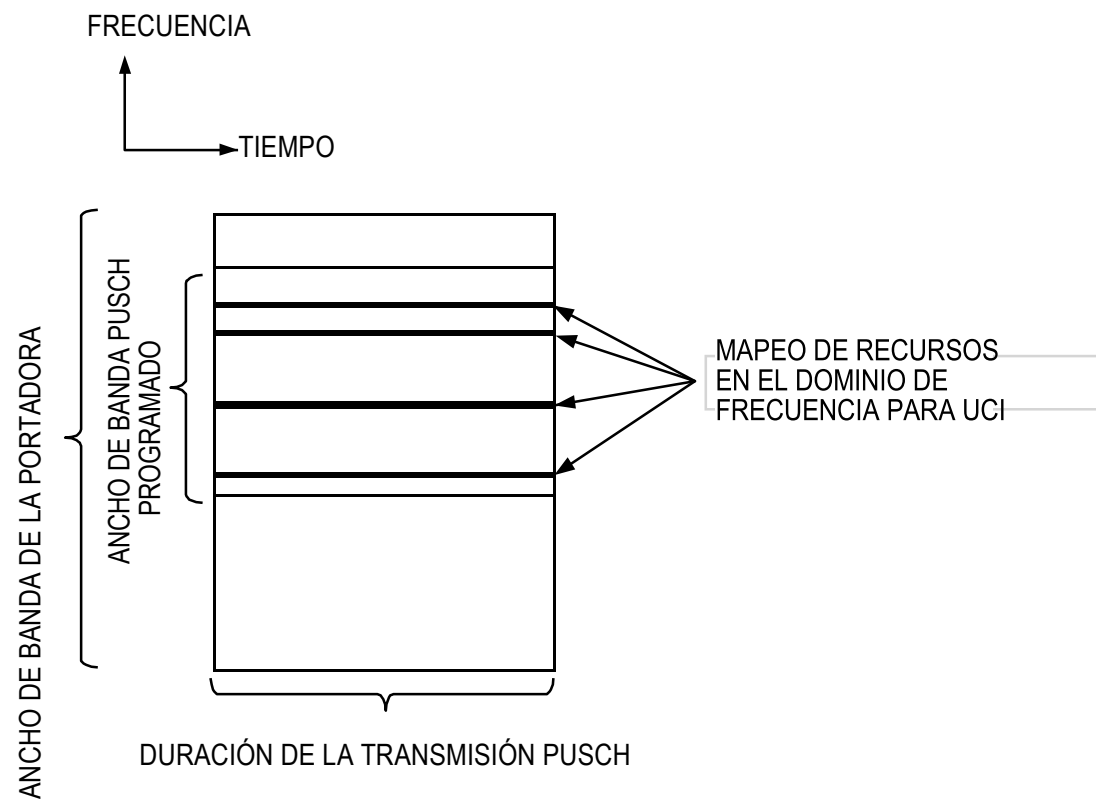


Figura 5

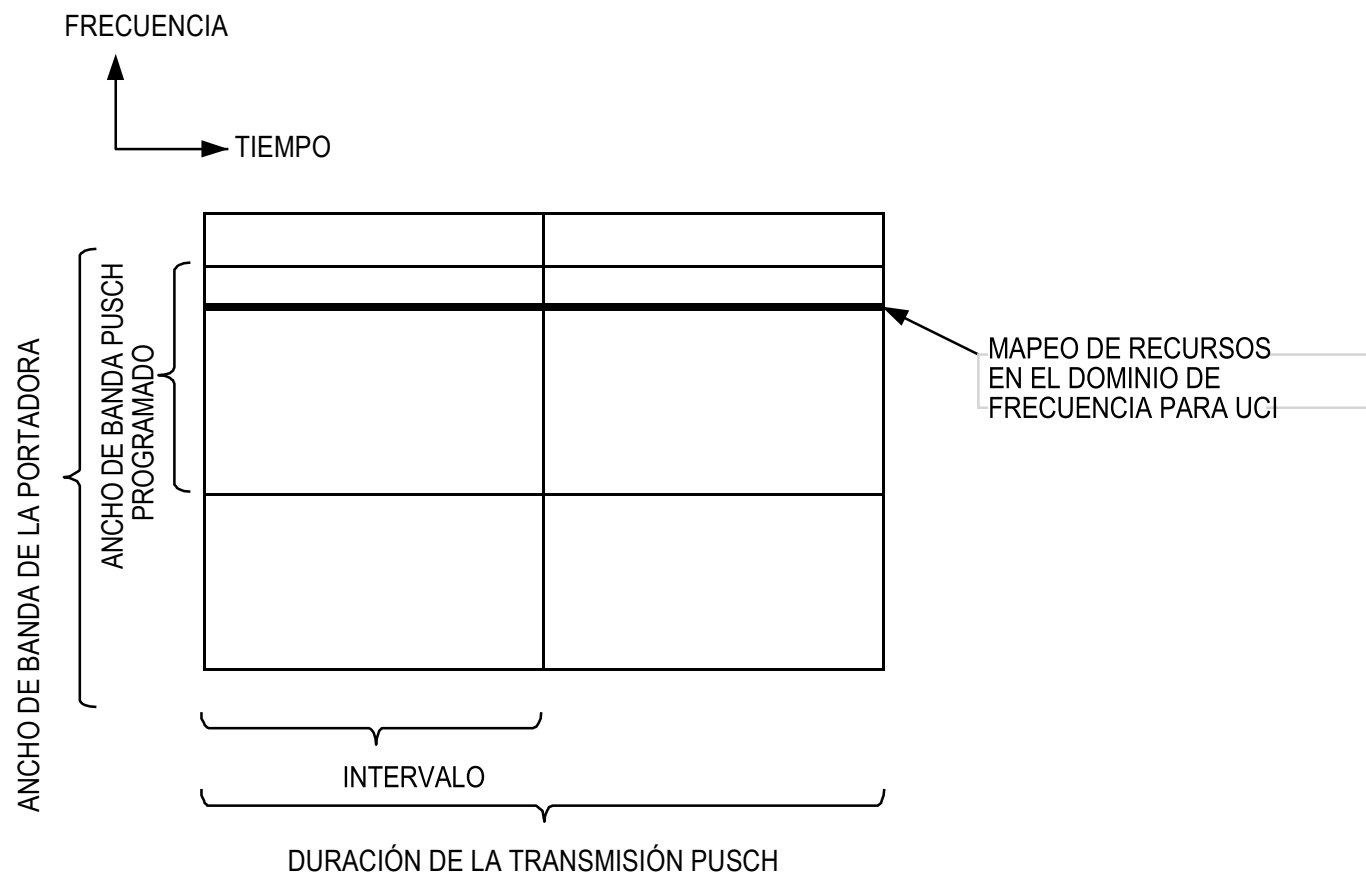


Figura 6

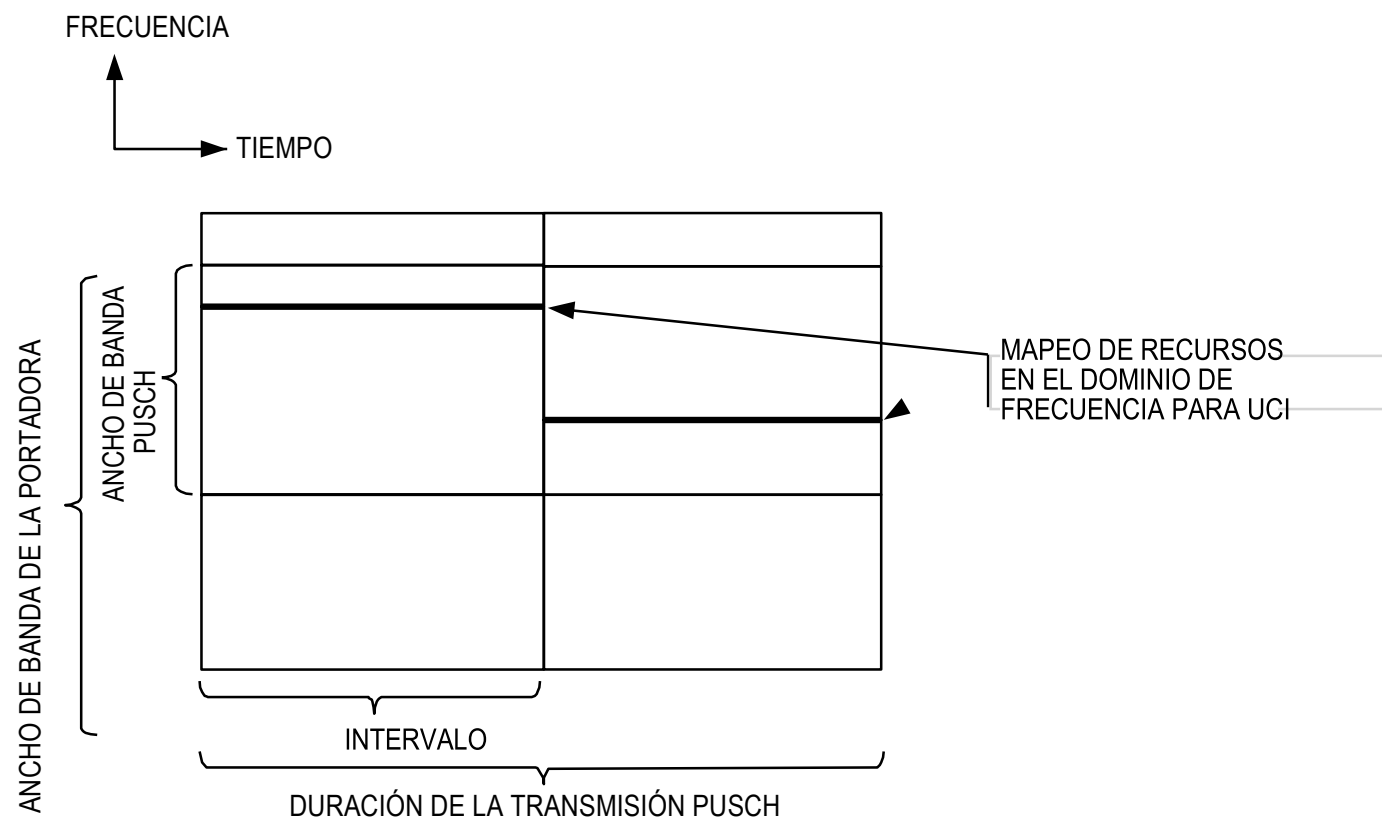


Figura 7

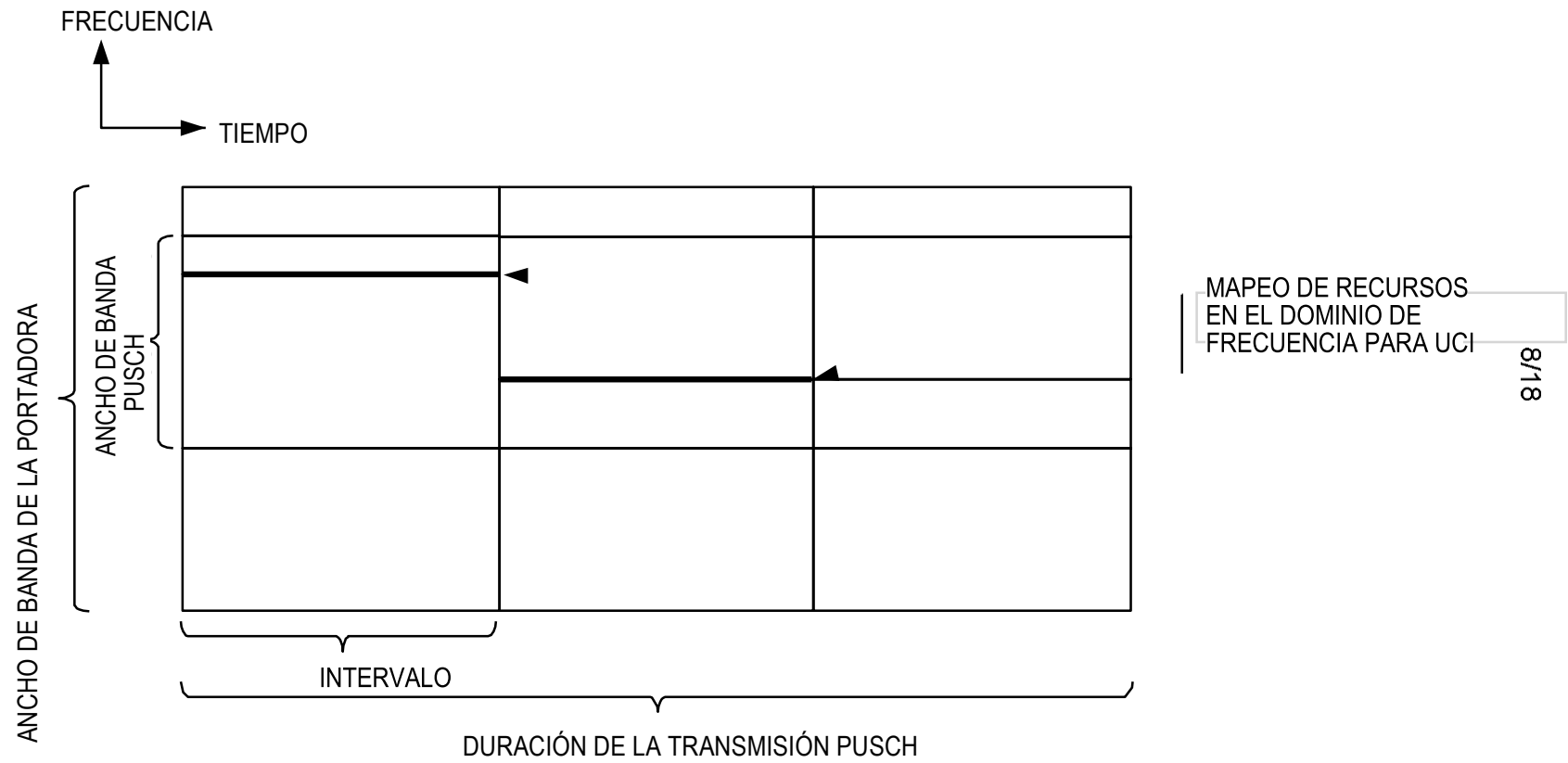


Figura 8

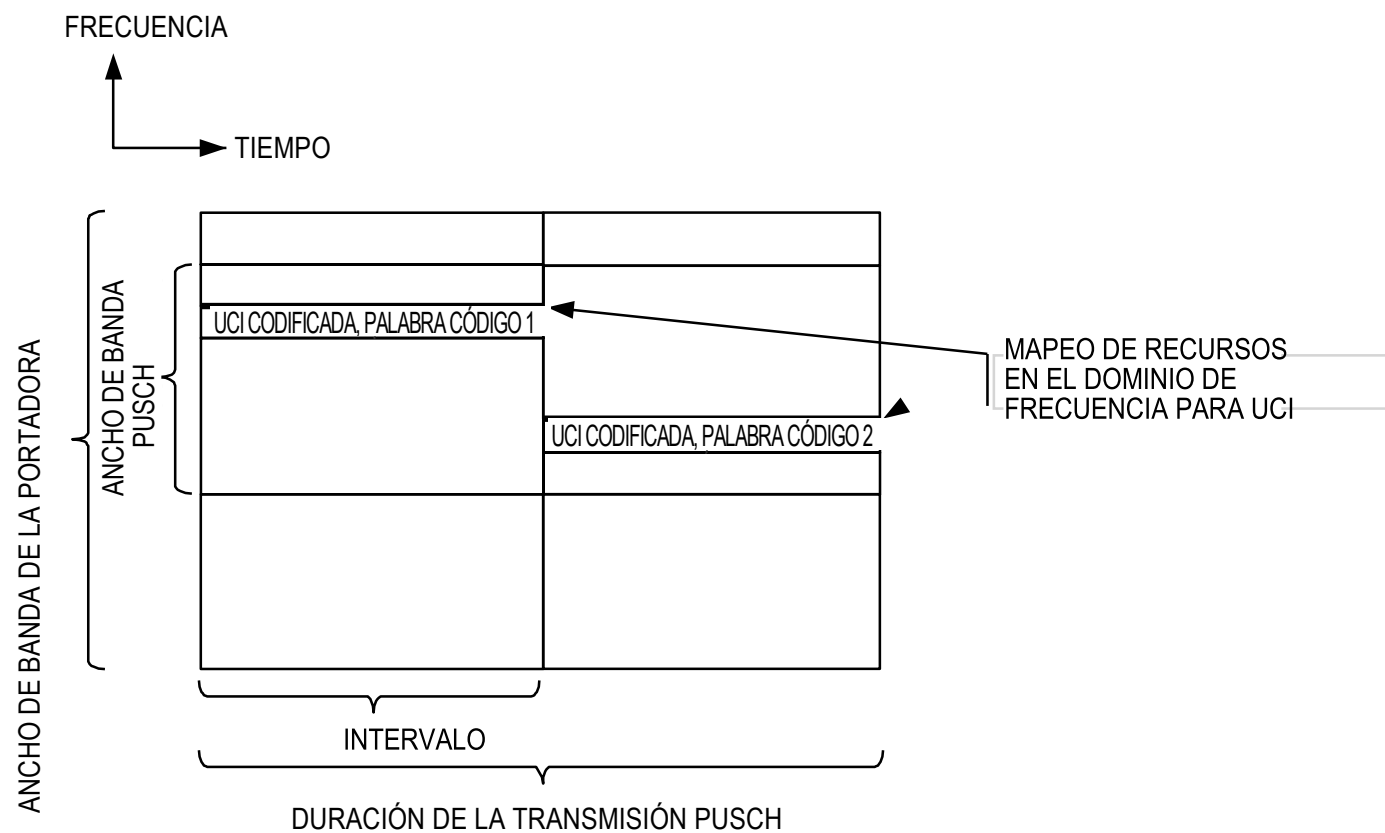


Figura 9

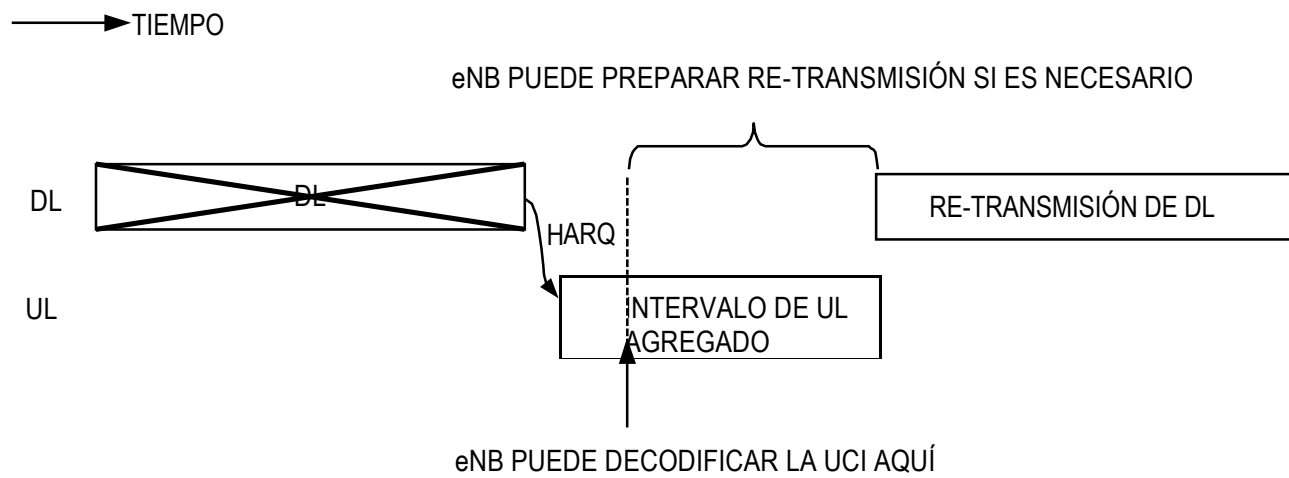


Figura 10

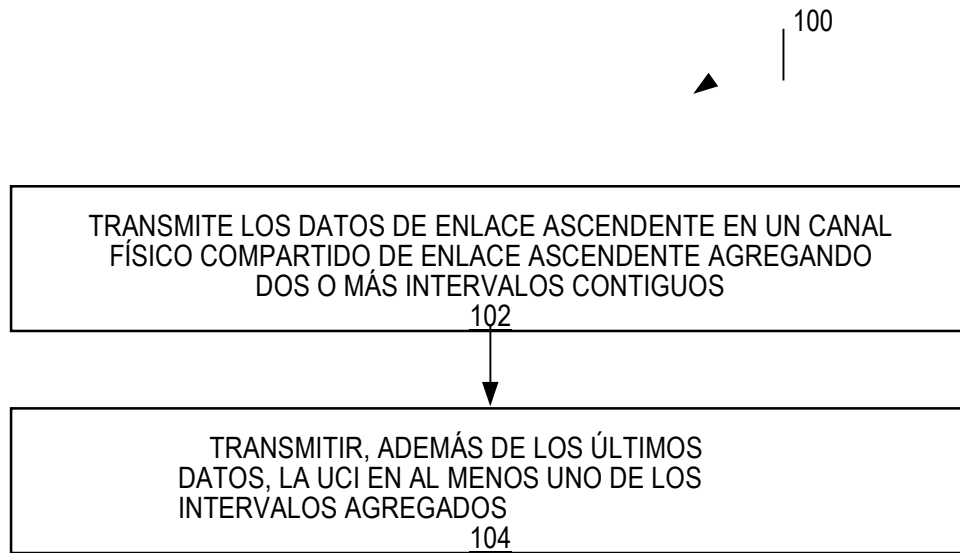


Figura 11

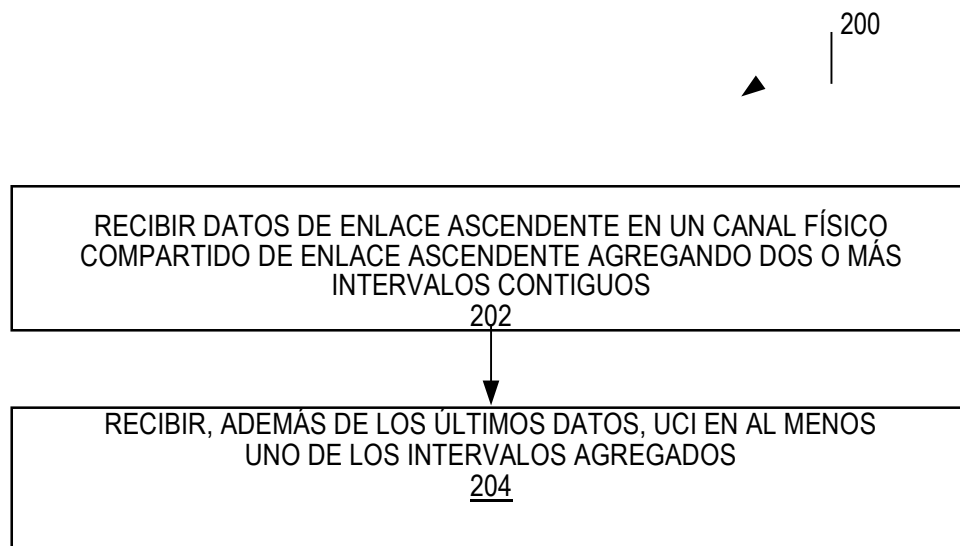


Figura 12

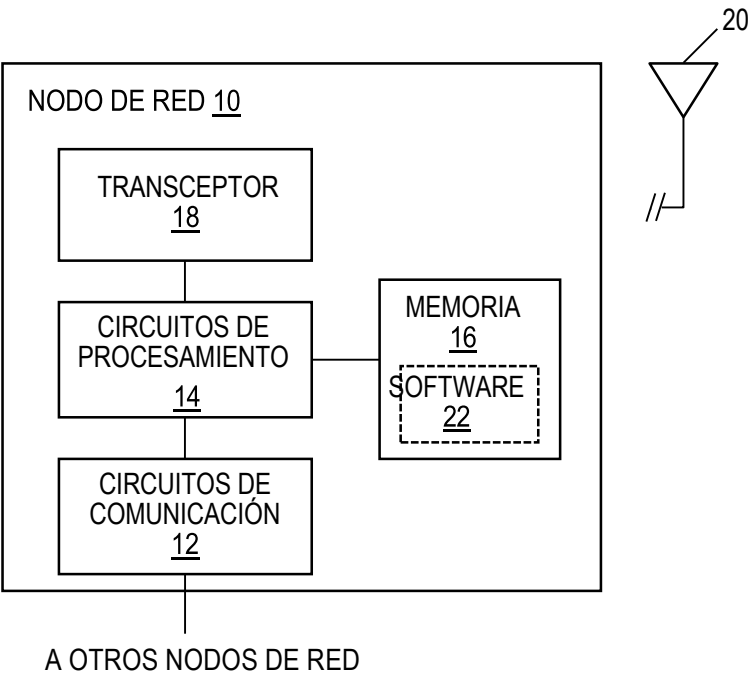


Figura 13

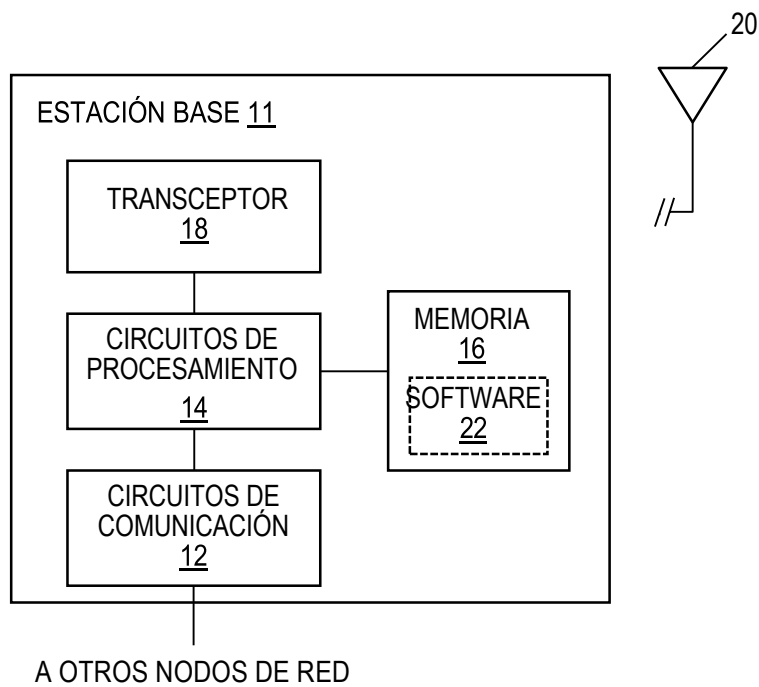


Figura 14

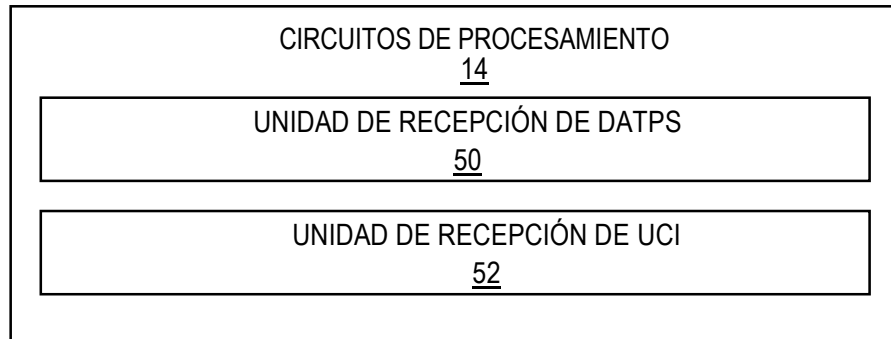


Figura 15

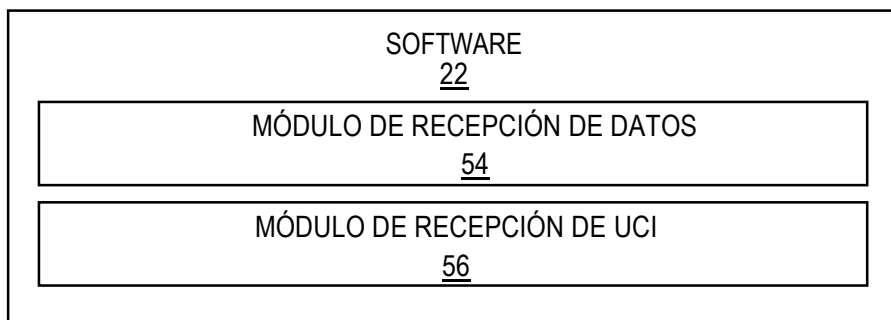


Figura 16

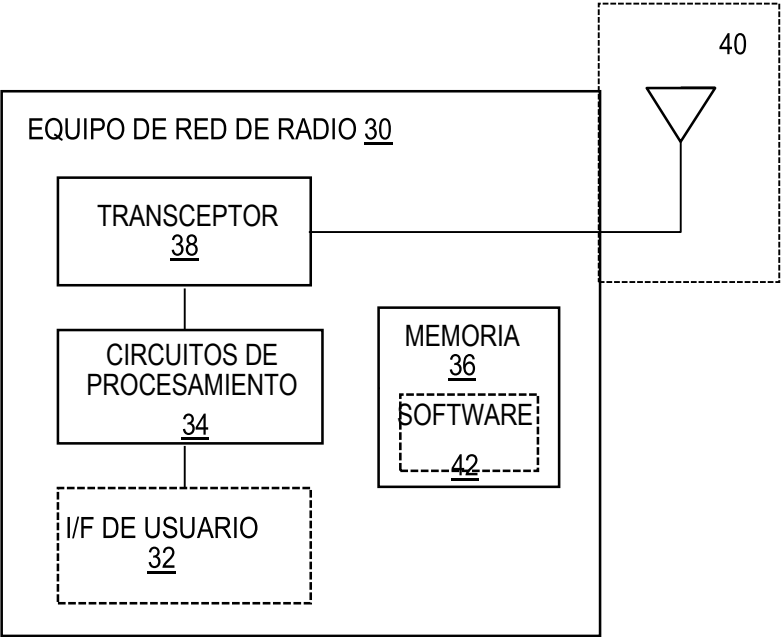


Figura 17

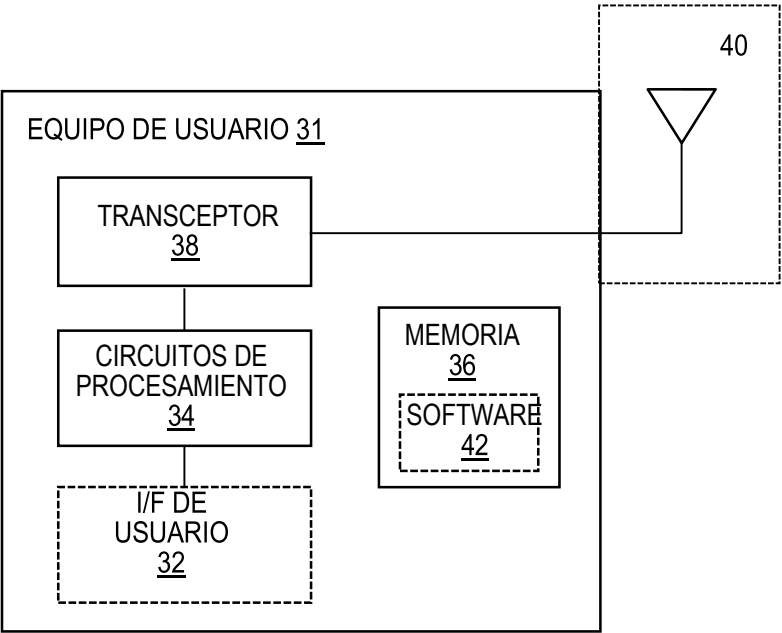


Figura 18

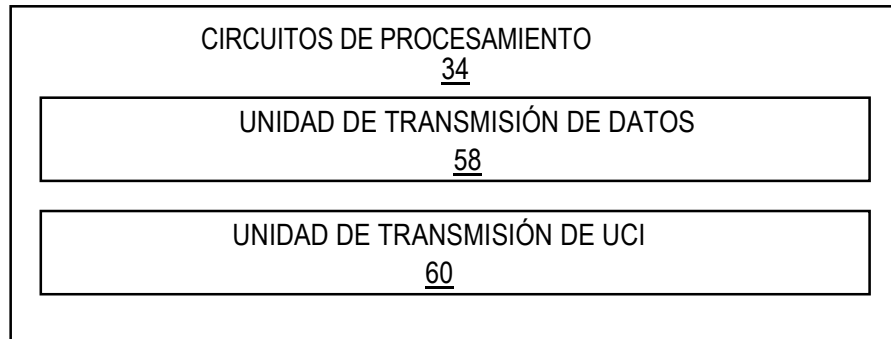


Figura 19

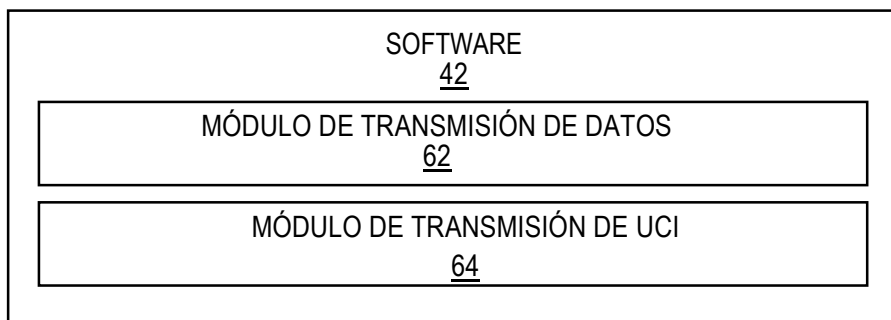


Figura 20

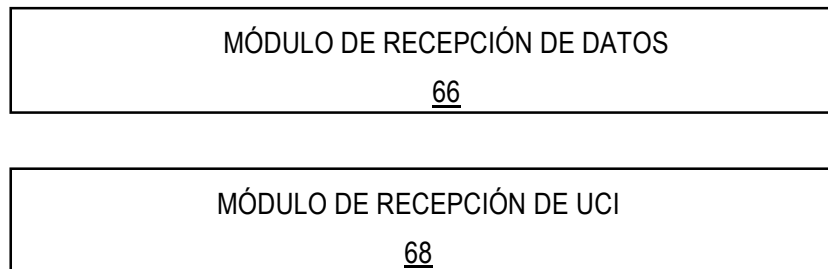


Figura 21

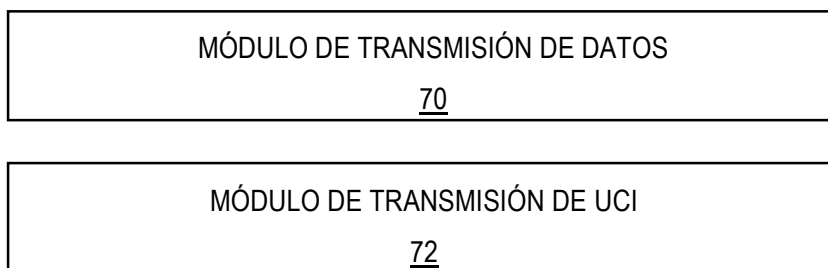


Figura 22

PATENT COOPERATION TREATY

br/7a/hs

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

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Kraus & Weisert
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EINGEGANGEN

07. Jan. 2019

Patentanwälte
KRAUS & WEISERT

PCT

NOTIFICATION OF TRANSMITTAL OF
THE INTERNATIONAL PRELIMINARY
REPORT ON PATENTABILITY

(PCT Rule 71.1)

Date of mailing
(day/month/year)

04.01.2019

Applicant's or agent's file reference
33455WO/br

IMPORTANT NOTIFICATION

International application No.
PCT/EP2017/074861

International filing date (day/month/year)
29.09.2017

Priority date (day/month/year)
30.09.2016

Applicant
Telefonaktiebolaget LM Ericsson (PUBL)

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary report on patentability and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.
4. **REMINDER**

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary report on patentability. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

The applicant's attention is drawn to Article 33(5), which provides that the criteria of novelty, inventive step and industrial applicability described in Article 33(2) to (4) merely serve the purposes of international preliminary examination and that "any Contracting State may apply additional or different criteria for the purposes of deciding whether, in that State, the claimed inventions is patentable or not" (see also Article 27(5)). Such additional criteria may relate, for example, to exemptions from patentability, requirements for enabling disclosure, clarity and support for the claims.

Name and mailing address of the international
preliminary examining authority:



European Patent Office P.B. 5818 Patentlaan 2
NL-2280 HV Rijswijk - Pays Bas
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Authorized Officer

Rubio Hide, Felipe

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PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 33455WO/br	FOR FURTHER ACTION		See Form PCT/IPEA/416
International application No. PCT/EP2017/074861	International filing date (day/month/year) 29.09.2017	Priority date (day/month/year) 30.09.2016	
International Patent Classification (IPC) or national classification and IPC INV. H04L5/00			
Applicant Telefonaktiebolaget LM Ericsson (PUBL)			
1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36. 2. This REPORT consists of a total of <u>7</u> sheets, including this cover sheet. 3. This report is also accompanied by ANNEXES, comprising: a. ☒ (sent to the applicant and to the International Bureau) a total of <u>11</u> sheets, as follows: ☒ sheets of the description, claims and/or drawings which have been amended and/or sheets containing rectifications authorized by this Authority, unless those sheets were superseded or cancelled, and any accompanying letters (see Rules 46.5, 66.8, 70.16, 91.2, and Section 607 of the Administrative Instructions). ☐ sheets containing rectifications, where the decision was made by this Authority not to take them into account because they were not authorized by or notified to this Authority at the time when this Authority began to draw up this report, and any accompanying letters (Rules 66.4bis, 70.2(e), 70.16 and 91.2). ☐ superseded sheets and any accompanying letters, where this Authority either considers that the superseding sheets contain an amendment that goes beyond the disclosure in the international application as filed, or the superseding sheets were not accompanied by a letter indicating the basis for the amendments in the application as filed, as indicated in item 4 of Box No. I and the Supplemental Box (see Rule 70.16(b)). b. ☐ (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing, in the form of an Annex C/ST.25 text file, as indicated in the Supplemental Box Relating to Sequence Listing (see paragraph 3ter of Annex C of the Administrative Instructions).			
4. This report contains indications relating to the following items: ☒ Box No. I Basis of the report ☐ Box No. II Priority ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability ☐ Box No. IV Lack of unity of invention ☒ Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement ☐ Box No. VI Certain documents cited ☒ Box No. VII Certain defects in the international application ☐ Box No. VIII Certain observations on the international application			
Date of submission of the demand 30.07.2018		Date of completion of this report 04.01.2019	
Name and mailing address of the international preliminary examining authority:  European Patent Office P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Fax: +31 70 340 - 3016		Authorized officer Roussos, Fragkiskos Telephone No. +31 70 340-2546	



INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/EP2017/074861

Box No. I Basis of the report

1. With regard to the **language**, this report is based on
- ☒ the international application in the language in which it was filed
 - ☐ a translation of the international application into , which is the language of a translation furnished for the purposes of:
 - ☐ international search (under Rules 12.3(a) and 23.1(b))
 - ☐ publication of the international application (under Rule 12.4(a))
 - ☐ international preliminary examination (under Rules 55.2(a) and/or 55.3(a) and (b))
2. With regard to the **elements*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

Description, Pages

1-13 as originally filed

Claims, Numbers

1-44 filed with the demand for preliminary international examination

Drawings, Sheets

1/18-18/18 as originally filed

- ☐ a sequence listing - see Supplemental Box Relating to Sequence Listing.
3. ☐ The amendments have resulted in the cancellation of:
- ☐ the description, pages
 - ☐ the claims, Nos.
 - ☐ the drawings, sheets/figs
 - ☐ the sequence listing (*specify*):
4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since either they are considered to go beyond the disclosure as filed, or they were not accompanied by a letter indicating the basis for the amendments in the application as filed, as indicated in the Supplemental Box (Rules 70.2(c) and (c-bis)):
- ☐ the description, pages
 - ☐ the claims, Nos.
 - ☐ the drawings, sheets/figs
 - ☐ the sequence listing (*specify*):
5. ☐ This report has been established:
- ☐ taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rules 66.1(d-bis) and 70.2(e)).
 - ☐ without taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91(Rules 66.4bis and 70.2(e)).

6. ☒ With regard to top-up searches (Rules 66.1 *ter* and 70.2(f)):
- ☒ A top-up search was carried out by this Authority on 13.12.2018 (all discovered documents are listed in the Supplemental Box Relating to Top-up Search).
 - ☐ Additional relevant documents have been discovered during the top-up search.
 - ☐ No top-up search was carried out by this Authority because it would serve no useful purpose.
7. ☐ Supplementary international search report(s) from Authority(ies) has/have been received and taken into account in establishing this report (Rule 45bis.8(b) and (c)).

* If item 4 applies, some or all of those sheets may be marked "superseded".

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	<u>1-44</u>
	No: Claims	
Inventive step (IS)	Yes: Claims	<u>1-44</u>
	No: Claims	
Industrial applicability (IA)	Yes: Claims	<u>1-44</u>
	No: Claims	

2. Citations and explanations (Rule 70.7):

see separate sheet

Box No. VII Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see separate sheet

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1 Reference is made to the following documents:

- D1 LG ELECTRONICS: "Discussion on frame structure for NR",
3GPP DRAFT; R1-164560 NR FRAME STRUCTURE_FINAL,
3RD GENERATION PARTNERSHIP PROJECT (3GPP),
MOBILE COMPETENCE CENTRE ; 650, ROUTE DES
LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE
,
vol. RAN WG1, no. Nanjing, China; 20160523 - 20160527 14
May 2016 (2016-05-14), XP051096379,
Retrieved from the Internet:
URL:[http://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_85/](http://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_85/Docs/)
Docs/
[retrieved on 2016-05-14]
- D2 CATT: "Remaining issues on PUCCH for Rel-13 MTC UEs",
3GPP DRAFT; R1-156562, 3RD GENERATION PARTNERSHIP
PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650,
ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS
CEDEX ; FRANCE
,
vol. RAN WG1, no. Anaheim, USA; 20151115 - 20151122 15
November 2015 (2015-11-15), XP051002986,
Retrieved from the Internet:
URL:[http://www.3gpp.org/ftp/Meetings_3GPP_SYNC/RAN1/](http://www.3gpp.org/ftp/Meetings_3GPP_SYNC/RAN1/Docs/)
Docs/
[retrieved on 2015-11-15]
- D3 US 2013/250924 A1 (CHEN WANSHI [US] ET AL) 26 September
2013 (2013-09-26)
- D4 SEQUANS COMMUNICATIONS: "Higher data rates for feMTC",
3GPP DRAFT; R1-166625 - HIGHER DATA RATES FOR
FEMTC, 3RD GENERATION PARTNERSHIP PROJECT
(3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES
LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE

,
vol. RAN WG1, no. Gothenburg, Sweden; 20160822 - 20160826
21 August 2016 (2016-08-21), XP051140306,
Retrieved from the Internet:
URL:http://www.3gpp.org/ftp/Meetings_3GPP_SYNC/RAN1/Docs/
[retrieved on 2016-08-21]

- 2 The present application meets the criteria of Article 33(1) PCT, because the subject-matter of independent claims 1, 12, 23 and 34 meets the requirements of the PCT in respect of novelty (Article 33(2) PCT), inventive step (Article 33(3) PCT) and industrial applicability (Article 33(4) PCT).
- 2.1 Document **D1** is regarded as being the prior art closest to the subject-matter of independent claim 1 and discloses (the references in parentheses apply to this document):
- A method, performed by a radio network device operative in a wireless communication network utilizing slot timing where a slot comprises a predetermined number of symbols (**section 2, suggestion 1 and figure 1**, where a "subframe" or "mini-subframe" comprise the term "slot" as in the application, based on the type of service),
 - of transmitting data and Uplink Control Information, UCI, comprising: transmitting uplink data on a physical uplink shared channel aggregating two or more slots (**section 2, "TDD framing structure" and figure 4**, where a subframe group comprises multiple contiguous UL subframes with only one guard period, as in figure 3 and 4 of the application, that can be used for both data and/or UCI transmission);
 - and transmitting, in addition to the uplink data, UCI on the physical uplink shared channel (**section 3, "Flexible HARQ timing", first paragraph**, where the HARQ ACK/NACK, comprising a UCI, of one or more DL subframes may be transmitted in one of the UL subframes belonging in a subframe group together with the UL data, which are transmitted in PUSCH).
- The subject-matter of claim 1, therefore, differs from this known method of D1 in the following features:
- a) ***"aggregating two or more contiguous slots for an uplink transmission spanning the aggregated slots"***

b) **"receiving an indication of at least one of the aggregated slots in which to transmit UCI; and transmitting UCI in the indicated at least one of the aggregated slots"**

thus rendering said claim novel (Article 33(2) PCT).

The technical effect of these differentiating features is that **in an aggregated uplink slot scenario, the UCI transmission is flexibly controlled, by means of the indication of specific slots**. The problem to be solved by the present invention may therefore be regarded as **"how to provide a flexible and efficient UCI transmission method in a scenario of uplink aggregated slot transmission"**.

The feature a) is disclosed in document **D4** (see **section 3, last two paragraphs and figure 2**, where PUSCH codewords are mapped to multiple consecutive subframes for increased efficiency and performance). However, feature b) is not disclosed or hinted in any of the prior art documents D1-D4. The synergistic effect of the distinguishing features therefore cannot be found in or derived by a skilled person by any combination of prior art documents without exercising inventive skill. Said claim is thus inventive (Article 33(3) PCT).

- 2.2 The subject-matter of independent claims 12, 23 and 34 is corresponding or inter-related to the subject-matter of claim 1 and also meets the criteria of Article 33(1) PCT for the same reasons of section 2.1, which apply *mutatis mutandis*.
- 2.3 The dependent claims 2-11, 13-22, 24-33 and 35-44 also meet the criteria of Article 33(1) PCT by virtue of the independent claims on which they depend.

Re Item VII

Certain defects in the international application

- 3 Independent claims 1, 12, 23 and 34 are not in the two-part form in accordance with Rule 6.3(b) PCT, which in the present case would be appropriate, with those features known in combination from the prior art documents being placed in the preamble (Rule 6.3(b)(i) PCT) and the remaining features being included in the characterising part (Rule 6.3(b)(ii) PCT).

- 4 Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in D1-D4 is not mentioned in the description, nor are these documents identified therein.

Kraus & WeisertPatentanwälte PartGmbH
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Dr. Manuel Schneckenburger ¹
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Dr. Ferdinand Nielsen
Rechtsanwalt¹ Patentanwalt / European Trademark Attorney
² European Patent Attorney

Unser Zeichen

Our Ref.

33455WO FB/MS/brBitte in der Antwort angeben
Please refer to in your reply

November 5, 2018

Re: International patent application PCT/EP2017/074861
Telefonaktiebolaget LM Ericsson (publ)**In response to the Written Opinion issued on September 3, 2018:****I.**

Enclosed new claims 1 to 44 are filed as a replacement for the present set of claims on file. A working copy of the new claims, including marked changes as compared to the present claims, is enclosed as well.

New claim 1 is based on present claim 1 and further specifies that the method includes receiving an indication of at least one of the aggregated slots in which to transmit UCI and that the UCI is then transmitted in the indicated at least one slot. A basis for these amendments can be found, e.g., in original claim 3.

New claims 2 to 11 correspond to present claims 2 and 4 to 12, with minor amendments to render the language of the claims consistent with new claim 1.

- 2 -

New claim 12 is based on present claim 13 and includes amendments which correspond to those of new claim 1 (and have a basis in original claim 15).

New claims 13 to 22 correspond to present claims 14 and 16 to 24, with minor amendments to render the language of the claims consistent with new claim 12.

New claim 23 is based on present claim 26 and includes amendments which correspond to those of new claims 1 and 12 (and have a basis in original claim 28).

New claims 24 to 33 correspond to present claims 27 and 29 to 37, with minor amendments to render the language of the claims consistent with new claim 23.

New claim 34 is based on present claim 38 and includes amendments which correspond to those of new claims 1, 12, and 23 (and have a basis in new claim 40).

New claims 35 to 44 correspond to present claims 39 and 41 to 49, with minor amendments to render the language of the claims consistent with new claim 34.

II.

The Written Opinion raised objections as to a lack of clarity of former claims 6 to 9, 18 to 21, 29 to 34, and 43 to 46, and objections as to a lack of conciseness of former claims 13, 25, 38, and 50. It is respectfully submitted that these objections are overcome by the amendments in the newly filed claims.

III.

Concerning patentability, the Written Opinion raised objections as to a lack of inventiveness of the claimed solution when considering the combined teachings of documents D1 and D4. It is respectfully submitted that these objections are overcome at least when considering the amendments in newly filed independent claims 1, 12, 23, and 34.

In the claimed solution, uplink data are transmitted by a radio network device on a physical uplink shared channel aggregating two or more contiguous slots for an uplink transmission spanning the aggregated slots. An indication provided to the radio network device indicates which of the aggregated slots are to be used by the radio network device for transmitting UCI (Uplink Control Information). In these indicated slot(s) the radio network device then transmits UCI.

Neither document D1 nor document D4 provides hints with respect to a comparable solution. In the first place, it is to be noted that document D1 describes an assignment of subframes to the downlink and uplink transmission directions, without providing further details how the subframes could be used by an uplink transmission of uplink data or uplink control information. Document D1 mentions that an "uplink control part" can be present in certain subframes (see page 5, second paragraph). However, document D1 does not address a scenario in which an uplink transmission spans multiple contiguous subframes. Further, document D1 is also silent about how to transmit UCI in such scenario where an uplink transmission spans multiple contiguous subframes.

Also document D4 cannot provide further indications with respect to the way of transmitting UCI as defined in the claimed solution. While document D4 mentions that a codeword may be mapped to multiple subframes (see section 3, technique (b)), document D4 does not further discuss how to transmit UCI when mapping a codeword to multiple subframes. Accordingly, document D4 also cannot suggest using an indication of slots in which to transmit UCI, as defined in the claimed solution. Since documents D2 and D3 do not address a scenario in which an uplink transmission spans multiple contiguous subframes, these documents also fail to provide further hints with respect to using an indication of slots in which to transmit UCI, as defined in the claimed solution.

In the claimed solution, the indication which of the aggregated contiguous slots are to be used for transmitting the UCI provides a highly efficient way of transmitting the UCI. In particular, it can be taken into account that for a single uplink transmission of data, which spans multiple aggregated slots, transmitting UCI in only one of the aggregated slots may be sufficient. By means of the indication, the slot in which

- 4 -

to transmit the UCI can be flexibly controlled. Still further, the indication can be used to indicate that the UCI is transmitted in multiple slots, e.g., in a repetitive manner in order to provide redundancy. Comparable considerations or benefits cannot be found in the teachings of documents D1, D2, D3, or D4.

Accordingly, even when considering the documents cited in the Written Opinion in combination, the claimed solution was not rendered obvious to the skilled person and thus must be considered as involving an inventive step.

IV.

In view of the above, it is respectfully requested that the objections raised in the Written Opinion be withdrawn and the allowability of the claims be acknowledged in the International Preliminary Report on Patentability. If this request cannot be followed, it is respectfully requested that the undersigned representative be contacted for a telephone consultation (in accordance with the "Notice from the European Patent Office dated August 31, 2011 concerning the issuance of a second Written Opinion in the procedure under Chapter II PCT").



Dr. Markku Schwarz
European Patent Attorney

Encl.

new claims 1 to 44 (clean copy)
new claims 1 to 44 (markup version)

CLAIMS

1. A method (100), performed by a radio network device (30) operative in a wireless communication network utilizing slot timing where a slot comprises a predetermined number of symbols, of transmitting data and Uplink Control Information, UCI, the method comprising:
- transmitting (102) uplink data on a physical uplink shared channel aggregating two or more contiguous slots for an uplink transmission spanning the aggregated slots;
- receiving an indication of at least one of the aggregated slots in which to transmit UCI; and
- transmitting (104), in addition to the uplink data, UCI in the indicated at least one of the aggregated slots on the physical uplink shared channel.
2. The method (100) of claim 1 wherein transmitting (104) UCI comprises: receiving an indication of the number of the aggregated slots in which to transmit UCI; and transmitting UCI in the indicated number of aggregated slots, beginning with the first slot.
3. The method (100) of claim 1 or 2 wherein receiving the indication comprises receiving the indication in Downlink Control Information, DCI.
4. The method (100) of claim 1 or 2 wherein receiving the indication comprises receiving the indication from higher layer signaling.
5. The method (100) of claim 1 wherein transmitting (104) UCI comprises transmitting the UCI on the same subcarrier across two or more of the aggregated slots.
6. The method (100) of claim 1 wherein transmitting (104) UCI comprises transmitting the UCI on different subcarriers in two or more of the aggregated slots.
7. The method (100) of claim 6 wherein transmitting the UCI on different subcarriers in two or more of the aggregated slots comprises selecting the subcarriers according to a pseudo random frequency hopping pattern based on factors available to both the radio network device (30) and a network node (10).

8. The method (100) of claim 7 wherein the pseudo random frequency hopping pattern is based on one or more of subframe number, radio network device identity, and the number of slots in the transmission.
- 5 9. The method (100) of claim 1 wherein UCI is transmitted in at least the first aggregated slot, and further wherein the UCI transmitted in the first aggregated slot is encoded with a code rate ≤ 1 .
- 10 10. The method (100) of claim 10 wherein UCI transmitted in one or more subsequent aggregated slots is repeated.
11. The method (100) of claim 9 wherein UCI is transmitted in one or more subsequent aggregated slots with incremental redundancy.
- 15 12. A radio network device (30) operative in a wireless communication network utilizing slot timing where a slot comprises a predetermined number of symbols, comprising:
- one or more antennas (40);
 - a transceiver (38) operatively connected to the antennas (40); and
 - 20 processing circuitry (34) operatively connected to the transceiver (38) and operative to
 - transmit (102) uplink data on a physical uplink shared channel aggregating two or more contiguous slots for an uplink transmission spanning the aggregated slots;
 - 25 receive an indication of at least one of the aggregated slots in which to transmit Uplink Control Information, UCI; and
 - transmit (104), in addition to the uplink data, UCI, in the indicated at least one of the aggregated slots on the physical uplink shared channel.
- 30 13. The radio network device (30) of claim 12 wherein the processing circuitry (34) is operative to transmit (104) UCI by:
- receiving an indication of the number of the aggregated slots in which to transmit UCI; and
 - 35 transmitting UCI in the indicated number of aggregated slots, beginning with the first slot.

14. The radio network device (30) of claim 12 or 13 wherein the indication is received in Downlink Control Information, DCI.

15. The radio network device (30) of claim 12 or 13 wherein the indication is received
5 from higher layer signaling.

16. The radio network device of claim (30) 12 wherein the processing circuitry (34) is operative to transmit (104) UCI by transmitting the UCI on the same subcarrier across two or more of the aggregated slots.

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17. The radio network device (30) of claim 12 wherein the processing circuitry (34) is operative to transmit (104) UCI by transmitting the UCI on different subcarriers in two or more of the aggregated slots.

15 18. The radio network device (30) of claim 17 wherein transmitting the UCI on different subcarriers in two or more of the aggregated slots comprises selecting the subcarriers according to a pseudo random frequency hopping pattern based on factors available to both the radio network device and a network node (10).

20 19. The radio network device (30) of claim 18 wherein the pseudo random frequency hopping pattern is based on one or more of subframe number, radio network device identity, and the number of slots in the transmission.

20. The radio network device (30) of claim 12 wherein UCI is transmitted in at least the
25 first aggregated slot, and further wherein the UCI transmitted in the first slot is encoded with a code rate ≤ 1 .

21. The radio network device (30) of claim 20 wherein UCI transmitted in one or more subsequent aggregated slots is repeated.

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22. The radio network device (30) of claim 20 wherein UCI is transmitted in one or more subsequent aggregated slots with incremental redundancy.

23. A method (200), performed by network node (10) in a wireless communication
35 network utilizing slot timing where a slot comprises a predetermined number of symbols, of receiving data and Uplink Control Information, UCI, from a radio network device (30), comprising:

receiving (202) from the radio network device (30) uplink data on a physical uplink shared channel aggregating two or more contiguous slots for an uplink transmission spanning the aggregated slots;

transmitting to the radio network device (30) an indication of at least one of the aggregated slots in which to transmit UCI; and

receiving (202) from the radio network device (30), in addition to the uplink data, UCI in the indicated at least one of the aggregated slots on the physical uplink shared channel.

24. The method (200) of claim 23 wherein receiving (202) UCI comprises: transmitting to the radio network device (30) an indication of the number of aggregated slots in which to transmit UCI; and receiving UCI in the indicated number of aggregated slots, beginning with the first slot.

25. The method (200) of claim 23 or 24 wherein transmitting the indication comprises transmitting the indication in Downlink Control Information, DCI.

26. The method (200) of claim 23 or 24 wherein transmitting the indication comprises transmitting the indication in higher layer signaling.

27. The method (200) of claim 23 wherein receiving (202) UCI comprises receiving the UCI on the same subcarrier across two or more of the aggregated slots.

28. The method (200) of claim 23 wherein receiving (202) UCI comprises receiving the UCI on different subcarriers in two or more of the aggregated slots.

29. The method (200) of claim 28 wherein receiving the UCI on different subcarriers in two or more of the aggregated slots comprises selecting the subcarriers according to a pseudo random frequency hopping pattern based on factors available to both the radio network device (30) and the network node (10).

30. The method (200) of claim 29 wherein the pseudo random frequency hopping pattern is based on one or more of subframe number, radio network device identity, and the number of slots in the transmission.

31. The method (200) of claim 23 wherein UCI is received in at least the first slot, and further wherein the UCI received in the first slot is encoded with a code rate ≤ 1 .

32. The method (200) of claim 31 wherein UCI received in one or more subsequent slots is repeated, and further comprising:

initially decoding the UCI received in at least the first slot; and
if the initial decoding fails, performing maximum-ratio combining between UCI received in at least the first aggregated slot and UCI received in one or more subsequent aggregated slots to improve reception.

33. The method (200) of claim 31 wherein UCI received in one or more subsequent slots includes incremental redundancy, and further comprising

initially decoding the UCI received in at least the first aggregated slot; and
if the initial decoding fails, combining the incremental redundancy with the UCI received in at least the first aggregated slot to improve reception.

34. A network node (10) operative in a wireless communication network utilizing slot timing where a slot comprises a predetermined number of symbols, comprising:

one or more antennas (20);
a transceiver (18) operatively connected to the antennas; and
a processing circuitry (14) operatively connected to the transceiver (18) and operative to
receive (202) from a radio network device (30) uplink data on a physical uplink shared channel aggregating two or more contiguous slots for an uplink transmission spanning the aggregated slots;
transmit to the radio network device (30) an indication of at least one of the aggregated slots in which to transmit UCI; and
receive (204) from the radio network device (30), in addition to the uplink data, Uplink Control Information, UCI, in the indicated at least one of the aggregated slots on the physical uplink shared channel.

35. The network node (10) of claim 34 wherein the processing circuitry (14) is operative to receive (204) UCI by:

transmitting to the radio network device (30) an indication of the number of aggregated slots in which to transmit UCI; and
receiving UCI in the indicated number of aggregated slots, beginning with the first slot.

36. The network node (10) of claim 34 or 35 wherein the indication is transmitted in Downlink Control Information, DCI.

5 37. The network node (10) of claim 34 or 35 wherein the indication is transmitted in higher layer signaling.

38. The network node (10) of claim 34 wherein the processing circuitry (14) is operative to receive (204) UCI by receiving the UCI on the same subcarrier across two or
10 more of the aggregated slots.

39. The network node (10) of claim 34 wherein the processing circuitry (14) is operative to receive (204) UCI by receiving the UCI on different subcarriers in two or more of the aggregated slots.

15 40. The network node (10) of claim 39 wherein receiving the UCI on different subcarriers in two or more of the aggregated slots comprises selecting the subcarriers according to a pseudo random frequency hopping pattern based on factors available to both the radio network device (30) and the network node (10).

20 41. The network node (10) of claim 40 wherein the pseudo random frequency hopping pattern is based on one or more of subframe number, radio network device identity, and the number of slots in the transmission.

25 42. The network node (10) of claim 34 wherein UCI is received in at least the first slot, and further wherein the UCI received in the first aggregated slot is encoded with a code rate ≤ 1 .

30 43. The network node (10) of claim 42 wherein UCI received in one or more subsequent aggregated slots is repeated, and further comprising:
initially decoding the UCI received in at least the first aggregated slot; and
if the initial decoding fails, performing maximum-ratio combining between UCI
received in at least the first slot and UCI received in one or more
subsequent aggregated slots to improve reception.

35 44. The network node (10) of claim 42 wherein UCI received in one or more subsequent slots includes incremental redundancy, and further comprising

initially decoding the UCI received in at least the first aggregated slot; and
if the initial decoding fails, combining the incremental redundancy with the UCI
received in at least the first aggregated slot to improve reception.