

P-2019/16939

SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO
DIRECCIÓN DE NUEVAS CREACIONES

E. S. D.

Ref.: Expediente No. NC2019/0003461

Solicitud de registro de patente de invención a nombre de
TELEFONAKTIEBOLAGET LM ERICSSON (PUBL)

1. Yo, CAROLINA DAZA MONTALVO, identificada como aparece al pie de mi firma, domiciliada en la Carrera 11 No. 86-53, piso 3, obrando como apoderada de la sociedad solicitante de la patente de la referencia, **TELEFONAKTIEBOLAGET LM ERICSSON (PUBL)**, en respuesta al Oficio No. **2418** del 10 de abril de 2019, atentamente me permito presentar el siguiente documento:

1.1. **IPRP (International Preliminary Report on Patentability):** De acuerdo con el requerimiento del examinador a través del Oficio 2418, adjuntamos el documento IPRP en inglés, así como la traducción al castellano.

2. Habiendo dado cumplimiento al requerimiento de ese Despacho, solicito respetuosamente se continúe con el trámite de la presente solicitud.

Señor Director,



CAROLINA DAZA MONTALVO

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REIVINDICACIONES

1. Un método para monitorear espacios de búsqueda, el método es realizado por un dispositivo inalámbrico (200), el método comprende:

recibir (S104) un símbolo de multiplexación de división de frecuencia ortogonal, OFDM, en una ranura de enlace descendente, en donde por lo menos parte del símbolo OFDM está incluido en un espacio de búsqueda específico de dispositivo, y en donde por lo menos parte del símbolo OFDM está incluido en un espacio de búsqueda común;

monitorear (S106) el espacio de búsqueda específico de dispositivo por al menos una señal de referencia específica de dispositivo; y

monitorear (S108) el espacio de búsqueda común por al menos una señal de referencia no específica de dispositivo,

en donde el espacio de búsqueda específico de dispositivo está contenido en una primera subbanda y el espacio de búsqueda común está contenido en una segunda subbanda.

2. El método de acuerdo con la reivindicación 1, en donde el espacio de búsqueda específico de dispositivo y el espacio de búsqueda común están contenidos en el símbolo OFDM.

3. El método de acuerdo con cualquiera de las reivindicaciones precedentes, que además comprende:

detectar (S106a) un mensaje de canal de control de enlace descendente físico específico de dispositivo, PDCCH, en el espacio de búsqueda específico de dispositivo; e

identificar (S106b), a partir del mensaje PDCCH específico de dispositivo, los bloques de recurso para una región de datos específica de dispositivo.

4. El método de acuerdo con cualquiera de las reivindicaciones precedentes, que además comprende:

detectar (S108a) un mensaje de canal de control de enlace descendente físico, PDCCH, no específico de dispositivo en el espacio de búsqueda común;

identificar (S108b), a partir del mensaje PDCCH no específico de dispositivo, bloques de recurso para una región de datos no específica de dispositivo.

5. El método de acuerdo con cualquiera de las reivindicaciones precedentes, en donde por lo menos parte del espacio de búsqueda específico de dispositivo está comprendido en el primer símbolo OFDM.

6. El método de acuerdo con cualquiera de las reivindicaciones precedentes, en donde por lo menos parte del espacio de búsqueda común está comprendido en el primer símbolo OFDM.

7. El método de acuerdo con cualquiera de las reivindicaciones precedentes, en donde el símbolo OFDM es un símbolo OFDM inicial en la ranura de enlace descendente.

8. El método de acuerdo con cualquiera de las reivindicaciones precedentes, en donde el espacio de búsqueda específico de dispositivo comprende recursos reservados para una señal de referencia de demodulación, DMRS, específica de dispositivo, y en donde el espacio de búsqueda común comprende recursos reservados para una DMRS no específica de dispositivo.

9. El método de acuerdo con cualquiera de las reivindicaciones precedentes, en donde la DMRS no específica de dispositivo depende de los parámetros de celda,

y en donde la DMRS específica de dispositivo depende de por lo menos un parámetro del dispositivo inalámbrico (200).

10. El método de acuerdo con cualquiera de las reivindicaciones precedentes, en donde el espacio de búsqueda específico de dispositivo y el espacio de búsqueda común por lo menos parcialmente se superponen.

11. El método de acuerdo con cualquiera de las reivindicaciones precedentes, en donde el espacio de búsqueda específico de dispositivo y el espacio de búsqueda común están mutuamente desunidos.

12. El método de acuerdo con cualquiera de las reivindicaciones precedentes, que además comprende:

obtener (S102), a partir de un nodo de red de acceso de radio (300), información relacionada con ubicación de frecuencia dentro del símbolo OFDM del espacio de búsqueda específico de dispositivo y el espacio de búsqueda común.

13. Un dispositivo inalámbrico (200) para monitorear espacios de búsqueda, el dispositivo inalámbrico (200) comprende un circuito de procesamiento (210) y una interfaz de comunicaciones (220), el circuito de procesamiento se configura para hacer que el dispositivo inalámbrico (200):

reciba un símbolo de multiplexación de división de frecuencia ortogonal, OFDM, en una ranura de enlace descendente usando la interfaz de comunicaciones (220), en donde por lo menos parte del símbolo OFDM está incluido en un espacio de búsqueda específico de dispositivo y en donde por lo menos parte del símbolo OFDM está incluido en un espacio de búsqueda común;

monitoree el espacio de búsqueda específico de dispositivo por al menos una señal de referencia específica de dispositivo; y

monitoree el espacio de búsqueda común por al menos una señal de referencia no específica de dispositivo,

en donde el espacio de búsqueda específico de dispositivo está contenido en una primera subbanda y el espacio de búsqueda común está contenido en una segunda subbanda.

14. Un dispositivo inalámbrico (200) para monitorear espacios de búsqueda, el dispositivo inalámbrico (200) comprende:

un circuito de procesamiento (210);

una interfaz de comunicaciones (220); y

un medio de almacenamiento (230) que almacena instrucciones que, cuando se ejecutan por el circuito de procesamiento (210), hacen que el dispositivo inalámbrico (200):

reciba un símbolo de multiplexación de división de frecuencia ortogonal, OFDM, en una ranura de enlace descendente usando la interfaz de comunicaciones (220), en donde por lo menos parte del símbolo OFDM está incluido en un espacio de búsqueda específico de dispositivo, y en donde por lo menos parte del símbolo OFDM está incluido en un espacio de búsqueda común;

monitoree el espacio de búsqueda específico de dispositivo por al menos una señal de referencia específica de dispositivo; y

monitoree el espacio de búsqueda común por al menos una señal de referencia no específica de dispositivo,

en donde el espacio de búsqueda específico de dispositivo está contenido en una primera subbanda y el espacio de búsqueda común está contenido en una segunda subbanda.

15. Un dispositivo inalámbrico (200) para monitorear espacios de búsqueda, el dispositivo inalámbrico (200) comprende:

un módulo receptor (210b) configurado para recibir un símbolo de multiplexación de división de frecuencia ortogonal, OFDM, en una ranura de enlace descendente, en donde por lo menos parte del símbolo OFDM está incluido en un espacio de búsqueda específico de dispositivo, y en donde por lo menos parte del símbolo OFDM está incluido en un espacio de búsqueda común;

un módulo de monitoreo (210c) configurado para monitorear el espacio de búsqueda específico de dispositivo por al menos una señal de referencia específica de dispositivo; y

un módulo de monitoreo (210f) configurado para monitorear el espacio de búsqueda común por al menos una señal de referencia no específica de dispositivo,

en donde el espacio de búsqueda específico de dispositivo está contenido en una primera subbanda y el espacio de búsqueda común está contenido en una segunda subbanda.

16. Un programa de computador (1320a) para monitorear espacios de búsqueda, el programa de computador comprende código de computador el cual, cuando se ejecuta en un circuito de procesamiento (210) de un dispositivo inalámbrico (200), hace que el dispositivo inalámbrico (200):

reciba (S104) un símbolo de multiplexación de división de frecuencia ortogonal, OFDM, en una ranura de enlace descendente, en donde por lo menos parte del símbolo OFDM está incluido en un espacio de búsqueda específico de dispositivo, y en donde por lo menos parte del símbolo OFDM está incluido en un espacio de búsqueda común;

monitoree (S106) un espacio de búsqueda específico de dispositivo usando la por lo menos una señal de referencia específica de dispositivo; y

monitoree (S108) un espacio de búsqueda común usando por lo menos una señal de referencia no específica de dispositivo,

en donde el espacio de búsqueda específico de dispositivo está contenido en una primera subbanda y el espacio de búsqueda común está contenido en una segunda subbanda.

17. Un producto de programa de computador (1310a) que comprende un medio de almacenamiento legible por computador (1330a) que almacena el programa de computador (1320a) de acuerdo con la reivindicación 16.

18. Un método para permitir el monitoreo de espacios de búsqueda, el método es realizado por un nodo de red de acceso de radio (300), el método comprende:

transmitir (S204) un símbolo de multiplexación de división de frecuencia ortogonal, OFDM, en una ranura de enlace descendente, en donde por lo menos parte del símbolo OFDM está incluido en un espacio de búsqueda específico de dispositivo, y en donde por lo menos parte del símbolo OFDM está incluido en un espacio de búsqueda común,

en donde el espacio de búsqueda específico de dispositivo comprende una señal de referencia específica de dispositivo, y/o el espacio de búsqueda común comprende una señal de referencia no específica de dispositivo,

en donde el espacio de búsqueda específico de dispositivo está contenido en una primera subbanda y el espacio de búsqueda común está contenido en una segunda subbanda.

19. El método de acuerdo con la reivindicación 18, en donde el espacio de búsqueda específico de dispositivo y el espacio de búsqueda común están contenidos en el símbolo OFDM

20. El método de acuerdo con la reivindicación 18 o 19, en donde la señal de referencia específica de dispositivo permite que un dispositivo inalámbrico (200) específico o un grupo específico de dispositivos inalámbricos monitoree mensajes de control.

21. El método de acuerdo con cualquiera de las reivindicaciones 18 a 20, en donde la señal de referencia no específica de dispositivo permite que dispositivos inalámbricos no específicos en un área de cobertura del nodo de red de acceso de radio (300) monitoreen mensajes de control.

22. El método de acuerdo con cualquiera de las reivindicaciones 18 a 21, que además comprende:

suministrar (S202) información relacionada con ubicación de frecuencia dentro del símbolo OFDM del espacio de búsqueda específico de dispositivo y el espacio de búsqueda común a un dispositivo inalámbrico (200).

23. El método de acuerdo con cualquiera de las reivindicaciones 18 a 22, en donde la DMRS no específica de dispositivo depende de los parámetros de celda, y en donde la DMRS específica de dispositivo depende de por lo menos un parámetro del dispositivo inalámbrico (200).

24. Un nodo de red de acceso de radio (300) para permitir el monitoreo de espacios de búsqueda, el nodo de red de acceso de radio (300) comprende circuito de procesamiento (310) y una interfaz de comunicaciones (320), el circuito de procesamiento se configura para hacer que el nodo de red de acceso de radio (300):

transmita un símbolo de multiplexación de división de frecuencia ortogonal, OFDM, en una ranura de enlace descendente usando la interfaz de comunicaciones (320), en donde por lo menos parte del símbolo OFDM está incluido en un espacio

de búsqueda específico de dispositivo, y en donde por lo menos parte del símbolo OFDM está incluido en un espacio de búsqueda común;

en donde el espacio de búsqueda específico de dispositivo comprende una señal de referencia específica de dispositivo, y/o el espacio de búsqueda común comprende una señal de referencia no específica de dispositivo,

en donde el espacio de búsqueda específico de dispositivo está contenido en una primera subbanda y el espacio de búsqueda común está contenido en una segunda subbanda

25. Un nodo de red de acceso de radio (300) para permitir el monitoreo de espacios de búsqueda, el nodo de red de acceso de radio (300) comprende:

circuito de procesamiento (310);

una interfaz de comunicaciones (320); y

un medio de almacenamiento (330) que almacena instrucciones que, cuando son ejecutadas por el circuito de procesamiento (310), hacen que el nodo de red de acceso de radio (300):

transmita un símbolo de multiplexación de división de frecuencia ortogonal, OFDM, en una ranura de enlace descendente usando la interfaz de comunicaciones (320), en donde por lo menos parte del símbolo OFDM está incluido en un espacio de búsqueda específico de dispositivo y, en donde por lo menos parte del símbolo OFDM está incluido un espacio de búsqueda común,

en donde el espacio de búsqueda específico de dispositivo comprende una señal de referencia específica de dispositivo, y/o el espacio de búsqueda común comprende una señal de referencia no específica de dispositivo,

en donde el espacio de búsqueda específico de dispositivo está contenido en una primera subbanda y el espacio de búsqueda común está contenido en una segunda subbanda.

26. Un nodo de red de acceso de radio (300) para permitir el monitoreo de espacios de búsqueda, el nodo de red de acceso de radio (300) comprende:

un módulo de transmisión (310b) configurado para transmitir un símbolo de multiplexación de división de frecuencia ortogonal, OFDM, en una ranura de enlace descendente, en donde por lo menos parte del símbolo OFDM está incluido en un espacio de búsqueda específico de dispositivo, y en donde por lo menos parte del símbolo OFDM está incluido en un espacio de búsqueda de referencia común;

en donde el espacio de búsqueda específico de dispositivo comprende una señal de referencia específica de dispositivo, y/o el espacio de búsqueda común comprende una señal de referencia no específica de dispositivo,

en donde el espacio de búsqueda específico de dispositivo está contenido en una primera subbanda y el espacio de búsqueda común está contenido en una segunda subbanda.

27. Un programa de computador (1320b) para permitir el monitoreo de espacios de búsqueda, el programa de computador comprende código de computador el cual, cuando se ejecuta en un circuito de procesamiento (310) de un nodo de red de acceso de radio (300), hace que el nodo de red de acceso de radio (300):

transmita (S204) un símbolo de multiplexación de división de frecuencia ortogonal, OFDM, en una ranura de enlace descendente, en donde por lo menos parte del símbolo OFDM está incluido en un espacio de búsqueda específico de dispositivo, y en donde por lo menos parte del símbolo OFDM está incluido en un espacio de búsqueda común;

en donde el espacio de búsqueda específico de dispositivo comprende una señal de referencia específica de dispositivo, y/o el espacio de búsqueda común comprende una señal de referencia no específica de dispositivo,

en donde el espacio de búsqueda específico de dispositivo está contenido en una primera subbanda y el espacio de búsqueda común está contenido en una segunda subbanda.

28. Un producto de programa de computador (1310b) que comprende un medio de almacenamiento legible por computador (1330b) que almacena el programa de computador (1320b) de acuerdo con la reivindicación 27.

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 P51555WO1	FOR FURTHER ACTION		See Form PCT/PEA/416																
International application No. PCT/SE2016/051077	International filing date (day/month/year) 02.11.2016	Priority date (day/month/year)																	
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>6</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>9</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: <table style="width: 100%; border: none;"> <tr> <td>☒ Box No. I</td> <td>Basis of the report</td> </tr> <tr> <td>☐ Box No. II</td> <td>Priority</td> </tr> <tr> <td>☐ Box No. III</td> <td>Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</td> </tr> <tr> <td>☐ Box No. IV</td> <td>Lack of unity of invention</td> </tr> <tr> <td>☒ Box No. V</td> <td>Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</td> </tr> <tr> <td>☐ Box No. VI</td> <td>Certain documents cited</td> </tr> <tr> <td>☒ Box No. VII</td> <td>Certain defects in the international application</td> </tr> <tr> <td>☒ Box No. VIII</td> <td>Certain observations on the international application</td> </tr> </table>				☒ 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
☒ Box No. I	Basis of the report																		
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☐ 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 03.09.2018		Date of completion of this report 17.10.2018																	
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 Dhibi, Youssef Telephone No. +31 70 340-8913																	



**INTERNATIONAL PRELIMINARY REPORT
ON PATENTABILITY**

International application No.
PCT/SE2016/051077

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

1-20 as originally filed

Claims, Numbers

1-28 filed in electronic form on

25-09-2018

Drawings, Sheets

1/6-6/6 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)).

**INTERNATIONAL PRELIMINARY REPORT
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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 05.10.2018 (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>1-28</u>
	No: Claims	
Inventive step (IS)	Yes: Claims	<u>1-28</u>
	No: Claims	
Industrial applicability (IA)	Yes: Claims	<u>1-28</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

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

Re Item V:

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

1 Prior Art

Reference is made to the following document:

D1: US 2016/043849 A1 (LEE MOON-IL [US] ET AL) 11 February 2016 (2016-02-11)

2 Novelty / Inventive Step

The present application meets the requirements of Art. 33(1) PCT: The subject-matter of claims 1-28 is novel (Art. 33(2) PCT) and involves an inventive step (Art. 33(3) PCT) as explained in the following.

- 2.1 Document D1 is considered to be the closest prior art to the subject-matter of **claim 1**. It discloses (the references in parentheses applying to this document):

A method for monitoring search spaces, the method being performed by a wireless device (e.g. **Abstract; Paras 3 and 67**), the method comprising:

- a) receiving an orthogonal frequency-division multiplexing, OFDM, symbol in a downlink slot, wherein at least part of the OFDM symbol is included in a device-specific search space and wherein at least part of the OFDM symbol is included in a common search space (see **Para 67**: "..the EPDCCH UE-specific search space starting symbol may be the SAME as the starting symbol for the EPDCCH common search space" and "...the starting symbol for the UE-specific search space may be the SAME as the starting symbol of the EPDCCH common search space in the subframe.."; Regarding OFDM: First, the considered system is an LTE(-A) based system (see **Para 2**), and second, **Paras 68, 91, and 100** e.g. explicitly mention OFDM.);
- b) monitoring the device-specific search space for at least one device-specific reference signal (e.g. **Paras 67 and 68**); and
- c) monitoring the common search space for at least one non-device-specific reference signal (e.g. **Paras 67 and 68**).

The method of claim 1 differs from the one of D1 in that *the device-specific search space is contained in a first subband and the common search space is contained in a second subband*.

The technical effect resulting from the distinguishing features is that the efficiency of search space monitoring for OFDM based communication systems is increased, since amongst others the (blind) decoding latency is reduced.

The technical problem solved can, therefore, be considered as "how to increase the efficiency of search space monitoring for OFDM based communication systems?".

The claimed method for solving this technical problem is neither disclosed nor rendered obvious by the available prior art. In particular, neither D1 nor any of the remaining document(s) cited in the search report discloses or otherwise suggests the use of the distinguishing features mentioned above to solve the above-stated technical problem. A skilled person would not be able to derive the proposed solution without the need of inventive skills, neither in an obvious way from D1, nor by way of combining the teaching of any of the (additional) documents cited in the search report.

Consequently, the subject-matter of claim 1 is novel (Art. 33(2) PCT) and involves an inventive step (Art. 33(3) PCT).

- 2.2 The subject-matter of dependent **claims 2-12** relates to further implementation details of the method of claim 1 and is, therefore, also novel (Art. 33(2) PCT) and involves an inventive step (Art. 33(3) PCT).
- 2.3 The arguments provided in 2.1 and 2.2. above, apply, mutatis mutandis, to the subject-matter of corresponding apparatus **claim 13** as well as apparatus **claims 14 and 15**, which, as explained in point "Re item VIII" below, relate to the same subject-matter as claim 13. The subject-matter of **claims 13-15** is, therefore, also novel (Art. 33(2) PCT) and involves an inventive step (Art. 33(3) PCT).
- 2.4 The arguments provided in 2.1 and 2.2. above, apply, mutatis mutandis, to the subject-matter of corresponding **claims 16 and 17**, which is, therefore, also novel (Art. 33(2) PCT) and involves an inventive step (Art. 33(3) PCT).
- 2.5 The arguments provided in 2.1-2.5 above, apply, mutatis mutandis, to the subject-matter of interrelated **claims 18-28**, which is, therefore, also novel (Art. 33(2) PCT) and involves an inventive step (Art. 33(3) PCT). Note that claims 24, 25, and 26 relate to the same subject-matter as explained in point "Re item VIII" below.

Re Item VII

Certain defects in the international application

- i) The requirements of Rule 5.1(a)(ii) PCT are not met by present application, since the document D1 is not identified in the description and the relevant background art disclosed therein is not briefly discussed.

- ii) The requirements of Rule 6.3(b) PCT are not met, since the two-part form is not used for the independent claims.

Re Item VIII

Certain observations on the international application

3 Clarity

- 3.1 Claims 13, 14, and 15** have been drafted as separate independent claims. They, however, all relate to the same subject-matter, namely the same apparatus comprising the same means (named differently in the different claims) which apparently (are configured to) perform the same operations. Present application, therefore, lacks conciseness.
- 3.2 Claims 24, 25, and 26** have been drafted as separate independent claims. They, however, all relate to the same subject-matter, namely the same apparatus comprising the same means (named differently in the different claims) which apparently (are configured to) perform the same operations. Present application, therefore, lacks conciseness.

ERICSSON

Date
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Your Reference

Attending to this matter

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European Patent Office

Via CMS (epoline Case Management System)

80298 Munich
GERMANY**Response to Written Opinion pursuant to Article 34 PCT**

Application Number: PCT/SE2016/051077
Application Date: 2016-11-02
Applicant: Telefonaktiebolaget LM Ericsson (publ)
Our Reference: P51555 WO1

Enclosures:

Claims: Substitute claims 1-28
Marked-up claim amendments for information purposes only

Dear Sirs,

In response to the Written Opinion of the ISA, the applicant hereby submits the following comments and enclosed amendments pursuant to Article 34 PCT.

Amendments

Please find enclosed amended claims 1-28 replacing the claims previously on file.

In claim 1, the feature "*wherein at least part of the OFDM symbol is included in a device-specific search space and a common search space*" has been rephrased as "*wherein at least part of the OFDM symbol is included in a device-specific search space, and wherein at least part of the OFDM symbol is included in a common search space*". That the same part of the OFDM symbol need not necessarily be part of both the device-specific search space and the common search space is for example disclosed in claim 6; page 11, lines 5-10; and Fig. 7 together with page 14, lines 16-25. Fig. 7 shows that the device-specific control region and the common control region may be located in different subbands of the OFDM symbol. That the device-specific search space may be provided in the device-specific control region, and that the common search space may be provided in the common control region is for example disclosed on page 1, line 24 to page 2, line 24; page 3, lines 4-10; page 5, lines 18-25; page 9, lines 11-14; page 12, lines 24-26; and page 16, lines 4-10.

It has been further specified in claim 1 that "*the device-specific search space is contained in a first subband and the common search space is contained in a second subband*". Basis for this amendment may for example be found in claim 6; Fig. 7; page 11, lines 5-10; and page 16, lines 11-12.

A new claim 2 has been introduced. Basis for claim 2 may for example be found on page 9, lines 11-14; page 11, lines 25-26; and on page 16, lines 14-17.

Claims 2-5 have been renumbered accordingly.

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Previously pending claim 6 has been deleted.

It has been further specified in claim 12 that the information is obtained from a radio access network node. Basis for this amendment may for example be found in claim 21 and on page 10, line 29 to page 11, line 1.

Claims 13, 14, 15, 16 and 18 have been amended in analogy with claim 1.

A new claim 19 has been introduced. It is directed to subject-matter corresponding to new claim 2.

Claims 19-27 have been renumbered accordingly.

Claims 24-27 (previously claims 23-26) have been amended in analogy with claim 1.

Novelty

As described in the Written Opinion of the ISA, paragraph 67 in D1 discloses that "*the EPDCCH UE-specific search space starting symbol may be the same as the starting symbol of for the EPDCCH common search space*". However, D1 fails to disclose that the UE-specific search space is contained in a first subband and that the common search space is contained in a second subband. Hence, D1 fails to disclose the following feature from claim 1 as amended:

- a) "*wherein the device-specific search space is contained in a first subband and the common search space is contained in a second subband*"

The above feature a) has some parts in common with original claim 6. Item V, point 2.2 iii) in the Written Opinion refers to paragraphs 61, 77-79 and 86 in D1 as allegedly disclosing the subject-matter of original claims 6, 10 and 11. None of these paragraphs in D1 discloses the above feature a). Paragraph 61 in D1 discloses for example that the PRB pairs for a UE-specific search space and the PRB pairs for a common search space may be overlapped. Paragraphs 77-79 in D1 disclose for example that an EPDCCH UE-specific search space resource set may be fully and/or partially overlapped with an EPDCCH common search space resource, and that a UE-specific search space may not be overlapped with an EPDCCH common search space. Paragraph 86 in D1 discloses for example that in the same subframe, the available RE count in a PRB pair may be different in EPDCCH UE-specific search space (USS) and EPDCCH common search space (CSS). None of these paragraphs in D1 disclose that the UE-specific search space is contained in a first subband, or that the common search space is contained in a second subband. For example, the fact that a UE-specific search space is not overlapped with an EPDCCH common search space (as disclosed in paragraph 78 in D1) does not in any way imply that that the UE-specific search space is contained in a first subband and that the common search space is contained in a second subband. Indeed, two search spaces may for example be non-overlapping even if they are contained in the same subband, and a search space may for example be distributed over several subbands rather than being contained in a subband.

As described in the Written Opinion, paragraph 97 in D2 discloses that "*the location of the starting symbol of the UE-specific search space for the E-PDCCH... is considered as being identical to the location of the starting symbol of the common search space for the E-EPDCCH*". However, D2 fails to disclose that the UE-specific search space is contained in a first subband and that the common search space is contained in a second subband. Hence, D2 fails to disclose the above feature a) from claim 1 as amended. The above feature a) has some parts in common with original claim 6.

Point 2.3 ii) in the Written Opinion refers to paragraphs 71, 90-109 in D2 as allegedly disclosing the subject-matter of original claims 2-12. However, for at least the same reasons as those explained above for D1, none of these paragraphs in D2 discloses that the UE-specific search space is contained in a first subband, or that the common search space is contained in a second subband.

For at least these reasons, the subject-matter of claim 1 is novel. The subject-matter of each of claims 2-28 is novel at least for similar reasons.

Inventive step

As described above in relation to novelty, both D1 and D2 fail to disclose the above feature a) from claim 1 as amended. A technical effect of this distinguishing feature is that it facilitates handling of the search spaces, making the search space monitoring more efficient. Hence, regardless of whether D1 or D2 is considered by the examiner as representing the closest prior art, the objective technical problem may be formulated as how to make search space monitoring more efficient (see for example page 3, lines 4-5 in the application as filed). Faced with this objective technical problem, the skilled person would find no teaching in D1 or D2 leading to a solution falling within the terms of claim 1 as amended. In particular, the skilled person would find no teaching in D1 or D2 leading towards a solution involving the distinguishing feature a).

For at least these reasons, the subject-matter of claim 1 as amended is inventive. The subject-matter of each of claims 2-28 is inventive at least for similar reasons.

Observations regarding newly introduced dependent claims 2 and 19

These claims specify that *"the device-specific search space and the common search space are contained in the OFDM symbol"*, which allows for an even more efficient monitoring of the search spaces, so that latency may be reduced (see for example page 3, lines 4-10, and page 9, lines 11-14, in the application as filed). D1 and D2 neither disclose nor suggest this feature. For example, paragraph 67 in D1 discloses that the starting symbol of a UE-specific search space may be the same as the starting symbol of a common search space, but D1 fails to teach or suggest that such search spaces may be contained in an OFDM symbol.

Conclusion

The applicant has addressed all objections but those under Items VII and VIII, which will be handled in the national phase, and respectfully expects issuance of an entirely favorable IPRP. The representative is available to discuss any remaining deficiencies by phone if the IPEA sees this as efficient.

Yours faithfully,

Anders Hansson
European Patent Attorney
Association Ericsson (EPO Reg. No 643)

CLAIMS

1. A method for monitoring search spaces, the method being performed by a wireless device (200), the method comprising:
- receiving (S104) an orthogonal frequency-division multiplexing, OFDM, symbol in a
5 downlink slot, wherein at least part of the OFDM symbol is included in a device-specific search space, and wherein at least part of the OFDM symbol is included in a common search space;
- monitoring (S106) the device-specific search space for at least one device-specific reference signal; and
- monitoring (S108) the common search space for at least one non-device-specific reference
10 signal,
- wherein the device-specific search space is contained in a first subband and the common search space is contained in a second subband.
2. The method according to claim 1, wherein the device-specific search space and the common search space are contained in the OFDM symbol.
- 15 3. The method according to any of the preceding claims, further comprising:
- detecting (S106a) a device-specific physical downlink control channel, PDCCH, message in the device-specific search space; and
- identifying (S106b), from the device-specific PDCCH message, resource blocks for a device-specific data region.
- 20 4. The method according to any of the preceding claims, further comprising:
- detecting (S108a) a non-device-specific physical downlink control channel, PDCCH, message in the common search space;
- identifying (S108b), from the non-device-specific PDCCH message, resource blocks for a non-device-specific data region.
- 25 5. The method according to any of the preceding claims, wherein at least part of the device-specific search space is comprised in the first OFDM symbol.
6. The method according to any of the preceding claims, wherein at least part of the common search space is comprised in the first OFDM symbol.

7. The method according to any of the preceding claims, wherein the OFDM symbol is an initial OFDM symbol in the downlink slot.

8. The method according to any of the preceding claims, wherein the device-specific search space comprises resources reserved for a device-specific demodulation reference signal, DMRS, and wherein the common search space comprises resources reserved for a non-device-specific DMRS.

9. The method according to any of the preceding claims, wherein the non-device-specific DMRS depends on cell parameters, and wherein the device-specific DMRS depends on at least one parameter of the wireless device (200).

10. The method according to any of the preceding claims, wherein the device-specific search space and the common search space at least partially overlap.

11. The method according to any of the preceding claims, wherein the device-specific search space and the common search space are mutually disjoint.

12. The method according to any of the preceding claims, further comprising:

obtaining (S102), from a radio access network node (300), information regarding frequency location within the OFDM symbol of the device-specific search space and the common search space.

13. A wireless device (200) for monitoring search spaces, the wireless device (200) comprising processing circuitry (210) and a communication interface (220), the processing circuitry being configured to cause the wireless device (200) to:

receive an orthogonal frequency-division multiplexing, OFDM, symbol in a downlink slot using the communication interface (220), wherein at least part of the OFDM symbol is included in a device-specific search space, and wherein at least part of the OFDM symbol is included in a common search space;

monitor the device-specific search space for at least one device-specific reference signal; and

monitor the common search space for at least one non-device-specific reference signal, wherein the device-specific search space is contained in a first subband and the common search space is contained in a second subband.

14. A wireless device (200) for monitoring search spaces, the wireless device (200) comprising:

processing circuitry (210);
a communication interface (220); and

5 a storage medium (230) storing instructions that, when executed by the processing circuitry (210), cause the wireless device (200) to:

receive an orthogonal frequency-division multiplexing, OFDM, symbol in a downlink slot using the communication interface (220), wherein at least part of the OFDM symbol is included in a device-specific search space, and wherein at least part of the OFDM
10 symbol is included in a common search space;

monitor the device-specific search space for at least one device-specific reference signal; and

monitor the common search space for at least one non-device-specific reference signal,

15 wherein the device-specific search space is contained in a first subband and the common search space is contained in a second subband.

15. A wireless device (200) for monitoring search spaces, the wireless device (200) comprising:

a receive module (210b) configured to receive an orthogonal frequency-division
20 multiplexing, OFDM, symbol in a downlink slot, wherein at least part of the OFDM symbol is included in a device-specific search space, and wherein at least part of the OFDM symbol is included in a common search space;

a monitor module (210c) configured to monitor the device-specific search space for at least one device-specific reference signal; and

25 a monitor module (210f) configured to monitor the common search space for at least one non-device-specific reference signal,

wherein the device-specific search space is contained in a first subband and the common search space is contained in a second subband.

16. A computer program (1320a) for monitoring search spaces, the computer program
30 comprising computer code which, when run on processing circuitry (210) of a wireless device (200), causes the wireless device (200) to:

receive (S104) an orthogonal frequency-division multiplexing, OFDM, symbol in a

downlink slot, wherein at least part of the OFDM symbol is included in a device-specific search space, and wherein at least part of the OFDM symbol is included in a common search space;

monitor (S106) a device-specific search space using the at least one device-specific reference signal; and

5 monitor (S108) a common search space using the at least one non-device-specific reference signal,

wherein the device-specific search space is contained in a first subband and the common search space is contained in a second subband.

17. A computer program product (1310a) comprising a computer-readable storage medium
10 (1330a) storing the computer program (1320a) according to claim 16.

18. A method for enabling monitoring of search spaces, the method being performed by a radio access network node (300), the method comprising:

transmitting (S204) an orthogonal frequency-division multiplexing, OFDM, symbol in a downlink slot, wherein at least part of the OFDM symbol is included in a device-specific search
15 space, and wherein at least part of the OFDM symbol is included in a common search space, wherein the device-specific search space comprises a device-specific reference signal, and/or the common search space comprises a non-device-specific reference signal,

wherein the device-specific search space is contained in a first subband and the common search space is contained in a second subband.

20 19. The method according to claim 18, wherein the device-specific search space and the common search space are contained in the OFDM symbol.

20. The method according to claim 18 or 19, wherein the device-specific reference signal enables a specific wireless device (200) or a specific group of wireless devices to monitor control messages.

25 21. The method according to any of claims 18 to 20, wherein the non-device-specific reference signal enables non-specific wireless devices in a coverage area of the radio access network node (300) to monitor control messages.

22. The method according to any of claims 18 to 21, further comprising:
providing (S202) information regarding frequency location within the OFDM symbol of
30 the device-specific search space and the common search space to a wireless device (200).

23. The method according to any of claims 18 to 22, wherein the non-device-specific DMRS depends on cell parameters, and wherein the device-specific DMRS depends on at least one parameter of the wireless device (200).

24. A radio access network node (300) for enabling monitoring of search spaces, the radio access network node (300) comprising processing circuitry (310) and a communication interface (320), the processing circuitry being configured to cause the radio access network node (300) to:
transmit an orthogonal frequency-division multiplexing, OFDM, symbol in a downlink slot using the communications interface (320), wherein at least part of the OFDM symbol is included in a device-specific search space, and wherein at least part of the OFDM symbol is included in a common search space;

wherein the device-specific search space comprises a device-specific reference signal, and/or the common search space comprises a non-device-specific reference signal,

wherein the device-specific search space is contained in a first subband and the common search space is contained in a second subband.

25. A radio access network node (300) for enabling monitoring of search spaces, the radio access network node (300) comprising:

processing circuitry (310);

a communication interface (320); and

a storage medium (330) storing instructions that, when executed by the processing circuitry

(310), cause the radio access network node (300) to:

transmit an orthogonal frequency-division multiplexing, OFDM, symbol in a downlink slot using the communications interface (320), wherein at least part of the OFDM symbol is included in a device-specific search space, and wherein at least part of the OFDM symbol is included in a common search space;

wherein the device-specific search space comprises a device-specific reference signal, and/or the common search space comprises a non-device-specific reference signal,

wherein the device-specific search space is contained in a first subband and the common search space is contained in a second subband.

26. A radio access network node (300) for enabling monitoring of search spaces, the radio access network node (300) comprising:

a transmit module (310b) configured to transmit an orthogonal frequency-division multiplexing, OFDM, symbol in a downlink slot, wherein at least part of the OFDM symbol is

included in a device-specific search space, and wherein at least part of the OFDM symbol is included in a common reference search space;

wherein the device-specific search space comprises a device-specific reference signal, and/or the common search space comprises a non-device-specific reference signal,

5 wherein the device-specific search space is contained in a first subband and the common search space is contained in a second subband.

27. A computer program (1320b) for enabling monitoring of search spaces, the computer program comprising computer code which, when run on processing circuitry (310) of a radio access network node (300), causes the radio access network node (300) to:

10 transmit (S204) an orthogonal frequency-division multiplexing, OFDM, symbol in a downlink slot, wherein at least part of the OFDM symbol is included in a device-specific search space, and wherein at least part of the OFDM symbol is included in a common search space;

wherein the device-specific search space comprises a device-specific reference signal, and/or the common search space comprises a non-device-specific reference signal,

15 wherein the device-specific search space is contained in a first subband and the common search space is contained in a second subband.

28. A computer program product (1310b) comprising a computer-readable storage medium (1330b) storing the computer program (1320b) according to claim 27.

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