

PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(PCT Rule 71.1)

To:

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Date of mailing
(day/month/year)

28.07.2021

Applicant's or agent's file reference
P137126PC00

IMPORTANT NOTIFICATION

International application No.
PCT/EP2019/066721

International filing date (day/month/year)
24.06.2019

Priority date (day/month/year)

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:



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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 P137126PC00	FOR FURTHER ACTION		See Form PCT/IPEA/416
International application No. PCT/EP2019/066721	International filing date (day/month/year) 24.06.2019	Priority date (day/month/year)	
International Patent Classification (IPC) or national classification and IPC INV. H04B7/06			
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 26.04.2021		Date of completion of this report 28.07.2021	
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Fax: +49 89 2399 - 4465		Authorized officer Spinnler, Florian Telephone No. +49 89 2399-8482 	

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/EP2019/066721

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

1-33 as originally filed

Claims, Numbers

1-27 filed with the letter of

05-07-2021

Drawings, Sheets

1/3-3/3 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
ON PATENTABILITY**

International application No.
PCT/EP2019/066721

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 14.07.2021 (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>1-27</u>
	No: Claims	
Inventive step (IS)	Yes: Claims	
	No: Claims	<u>1-27</u>
Industrial applicability (IA)	Yes: Claims	<u>1-27</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

Reference is made to the following documents:

- D1 US 2017/132852 A1 (MORITA JUNICHI [JP] ET AL) 11 May 2017
(2017-05-11)
- D2 EP 3 236 594 A2 (IPCOM GMBH & CO KG [DE]) 25 October 2017
(2017-10-25)

The following document was not cited in the international search report. A copy of the document is appended hereto.

- D4 US 2016/149302 A1 (SANDEROVICH AMICHAH [IL] ET AL) 26 May 2016
(2016-05-26)

Re Item V

- 1 The present application does not meet the requirements of Article 33(1) PCT because the subject-matter of claims 1-27 does not involve an inventive step within the meaning of Article 33(3) PCT.
- 1.1 The document D4 is regarded as being the prior art closest to the subject-matter of claim 1, and discloses (the references in parentheses applying to this document)
- **A method performed by a node 102, 104, 120 of a wireless communication network 100, the wireless communication network comprising a wireless device 104, a radio access network node 102 and one or more wireless communication network nodes 106, at least one of the wireless device and the radio access network node comprising a plurality of antenna elements configurable to provide a transmit or receive radio beam 110, 112 for communication with the other of the wireless device and the radio access network node, the method comprising:**
(figure 2; paragraph 33)
 - **obtaining 200 an indication of a wireless network node with which the wireless device has established a wireless connection;**
(paragraph 38)

- **obtaining 202 one or more signal metrics for one or more transmit or receive radio beams which are directed towards a coverage area of the indicated wireless network node, or which are directed to receive transmissions from the coverage area of the indicated wireless network node;**
(paragraph 57)
- **and determining whether or not a transmit or receive radio beam of the one or more transmit or receive radio beams corresponds to a line-of-sight, LoS, between the radio access network node and the wireless device based on a comparison 204 between the signal metric for the transmit or receive radio beam and a first threshold.**
(paragraphs 58 and 62)

1.1.1 The subject-matter of claim 1 therefore differs from this known method in that the wireless network node is a wireless LC network node and in the wireless connection is a wireless LC connection.

1.1.2 This has the technical effect that a diversified communication network is provided.

1.1.3 The problem to be solved by the present invention may therefore be regarded as how to modify or adapt the teachings of D4 to provide a diversified communication network.

1.1.4 The solution proposed in claim 1 of the present application cannot be considered to involve an inventive step (Article 33(3) PCT), for the following reasons:

The document D4 already discloses the determination of a line-of-sight connection between radio nodes using radio antennas as defined by claim 1. By contrast to D4 the wireless network node is a wireless LC network node. However, the LC connection of claim 1 does not interact with the features of the line-of-sight determination. In order to provide a diversified communication network, it is well-known to include a variety of communication means such as optical or light communication. As a result the skilled person would modify D4 by further establishing a LC connection with a wireless LC network node.

1.1.5 The same reasoning applies, mutatis mutandis, to the subject-matter of the corresponding independent claims 14 and 15, which therefore are also considered not inventive.

- 1.2 Claims 2 and 16: In order to efficiently implement the measurement of the channel characteristics, it is obvious to use an estimated distance as a basis for the first threshold (D4: paragraphs 7 and 8).
- 1.3 Claims 3 and 17: Within the implementation of the beamforming, it is obvious for the skilled person that the antenna elements need to be configurable to provide the corresponding beams. It is furthermore a general and well-known design option to use a subset of beams and to perform a corresponding measurement such as beam training.
- 1.4 Claims 4 and 18: It is well-known to use either analog or digital beamforming with the corresponding combiners and codebooks.
- 1.5 Claims 5 and 19: The document D4 already discloses the features of claims 5 and 19 (paragraphs 57 and 62).
- 1.6 Claims 6 and 20: Within an implementation of the beamforming technique it is obvious for the skilled person to test and compare beams with a second threshold.
- 1.7 Claims 7 and 21: In order to efficiently implement the communication technique of D4 it is obvious for the skilled person to measure beams from different directions if there is no LoS connection available.
- 1.8 Claims 8 and 22: During the implementation of the wireless LC communication it is obvious to use the defined indication. E.g. as exemplary disclosures, the documents D1 and D2 already disclose the step of transmitting a message from the wireless device (D1: figure 7: S201, S203; D2: paragraph 32).
- 1.9 Claims 9 and 23: In order to establish the wireless LC connection it is obvious to transmit the identity. E.g. as an exemplary disclosure, the documents D1 and D2 already disclose the transmission of an identity of the wireless device (D1: paragraph 36: "*The visible-light data is, for example, an ID signal including predetermined information.*"; D2: paragraphs 20, 32).
- 1.10 Claims 10 and 24: It is an obvious design measure of a beamforming technique to perform measurements on transmit and receive beams.
- 1.11 Claims 11 and 25: The document D4 already discloses the features of claims 11 and 25 (paragraphs 39 and 62-64).
- 1.12 Claims 12 and 26: It is a well-known design option to use a time-of-flight for the calculation of a distance which is disclosed by D4 (paragraph 8: "Existing techniques for determining the distance include time-of-flight (TOF), estimations of the power-delay-profile (PDP), received power level, and in-room mapping.").

- 1.13 Claims 13 and 27: The documents D1, D2 and D4 already disclose the node being one of: the wireless device; the radio access network node; and a communication network node (D1: paragraph 90, figures 2, 3B; D2: paragraph 24, figure 4; D4: paragraphs 24 and 25; figures 1 and 2).
- 2 One could argue that the documents D1 and D2 do not disclose the determination whether or not a transmit or receive radio beam of the one or more transmit or receive radio beams corresponds to a line-of-sight, LoS. However, the document D4 discloses this feature in the context of a radio beam. It is thus shown that the determination of the LoS beam using radio signals is known.

Re Item VII

Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in documents D1, D2 and D4 is not mentioned in the description, nor are these documents identified therein.

European Patent Office
D-80298 München
Germany

5 July 2021

Our ref: P137126PC00/CDH

For the attention of the EPO

International (PCT) Patent Application No. PCT/EP2019/066721
Telefonaktiebolaget LM Ericsson (publ)

We refer to the written opinion of the International Preliminary Examination Authority dated 7 May 2021, and file herewith an amended set of claims. We also provide a set of claims showing the changes made in marked-up copy.

The claims are amended throughout to recite that the transmit or receive beams are radio beams. We respectfully submit that this was implicit from the claim language as filed, in which the transmit and receive beams are generated by a plurality of antenna elements in a radio access network node and/or a wireless device. Further support may be found in the first paragraph on page 6, and numerous other examples throughout the application as filed.

In the written opinion, the Examiner maintained their objections that claim 1 lacked novelty with respect to US 2017/0132852 (D1), and lacked an inventive step with respect to EP 3236594 (D2). We respectfully disagree.

Claim 1 recites a method for determining whether a line-of-sight exists between a radio access network (RAN) node and a wireless device. The method recites the steps of obtaining an indication of a wireless light communication (LC) network node to which the wireless device has established a connection; obtaining one or more signal metrics for Tx/Rx beams directed to or from the coverage area of the wireless LC network node; and determining whether a Tx/Rx beam corresponds to a line of sight (LoS) between the RAN node and the wireless device by comparing the signal metrics to a threshold. Claim 14 is a machine-readable medium claim corresponding to claim 1, while claim 15 is an apparatus claim corresponding to claim 1.

The claimed method thus relates to a system which comprises at least three elements: a wireless device, a RAN node, and a wireless LC network node. The fact of an established connection between the wireless device and the wireless LC network node is used to determine a coverage area in which the wireless device is located. Signal metrics for radio Tx/Rx beams directed towards or from the coverage area are then compared to a threshold to determine whether the Tx/Rx beam corresponds to a line of sight.

D1 describes a system for establishing that a LoS exists for mm-wave communication between a data transmission device and a data reception device, when a visible light connection (VLC) can be established between those two devices. Thus the mm-wave connection is established only in the same direction as the VLC itself. Figures 3A to 3B of D1 best depict this concept, together with the method shown in Figure 2. In step S101, the data reception device transmits visible light data, and this information alone is used by the data transmission device to determine whether millimeter-wave communication is possible in step S103 and whether a line-of-sight exists between the two devices. Paragraph [0071] makes this relationship very clear:

“For example, if the visible-light reception controller 17 determines that visible-light data is not received, the visible-light reception controller 17 determines that millimeter-wave communication is impossible. On the other hand, if the visible-light reception controller 17 determines that visible-light data is received, the visible-light reception controller 17 determines that millimeter-wave communication is possible. As described above, the possible communication range of visible-light communication is set at a distance substantially equal to a possible communication range of millimeter-wave communication.”

It is clear therefore that the system disclosed in D1 used visible light as a proxy for millimeter-wave communication. Once visible light communication is established between the two devices, millimeter-wave communication is also possible.

This stands in contrast to embodiments of the disclosure and the claimed subject matter. Claim 1 recites the features of a radio access network node or wireless device comprising a plurality of antenna elements configurable to provide a transmit or receive radio beam. Claim 1 recites the features of “obtaining one or more signal metrics for one or more transmit or receive radio beams”, and utilizing “a comparison between the signal metric... and a first threshold”.

The Examiner argues that it is “an implicit feature of D1 that at least one threshold needs to be used for the decision in step S103”. The use of a threshold may or may not be implicit in D1. What is clear, however, is that D1 only utilizes visible light for this determination. In the passages cited by the Examiner themselves, it is the visible-light reception controller that determines whether millimeter-wave communication is possible (see paragraph [0074]). These are measurements of visible light, not any millimeter-wave transmissions.

D1 fails to disclose at least the claimed features of “obtaining one or more signal metrics for one or more transmit or receive radio beams”, or of “determining whether or not a transmit or receive radio beam... corresponds to a line-of-sight... based on a comparison between the signal metric for the transmit or receive radio beam and a first threshold”.

For these reasons at least, claim 1 is novel with respect to D1.

As noted in our previous letter, D2 discloses similar subject matter to D1, in which a radio connection is set up based on detection of an optical signal. In D2, VLC technology is used to determine the direction between two vehicles; this direction is then used to calculate a phase shift of each antenna in a massive MIMO antenna array installed in each vehicle for radio communication. Like D1, therefore, the direction of the radio connection is in the same direction as the optical signal. Figures 1 to 2 of D2 best depict this concept.

In detail, it is noted that the Examiner again cites passages of D2 in which signal metrics of visible light are measured. For example, paragraph [0025], cited by the Examiner describes the

use of a camera-like arrangement with an array of sensors for the detection of a direction to a vehicle emitting a VLC signal. At this point, there are no radio transmissions whatsoever. This is clear from later parts of paragraph [0025], where it is stated that “this directional information is then used to set parameters of a radio connection that is going to be established subsequent to a VLC connection”.

Thus D2 also fails to disclose obtaining signal metrics for one or more transmit or receive radio beams, or determining whether or not a transmit or receive beam corresponds to a line of sight based on a comparison of the signal metric for the transmit or receive radio beam to a threshold.

Therefore we respectfully submit that claim 1 is novel. We further respectfully submit that claim 1 possesses an inventive step with regard to the cited prior art.

In particular, as noted above, neither D1 nor D2 discloses a method in which one or more signal metrics for radio transmit or receive beams are obtained, and then compared to a threshold to determine whether the transmit or receive beam corresponds to a line of sight. The technical effect of these features is to enable the determination of a line of sight between a radio access network node and a wireless device, when a wireless light communication network node is not necessarily co-located with either the radio access network node or the wireless device. That is, signal metrics of radio transmit or receive beams, directed towards or from the coverage area of a wireless light communication network node, are compared to a threshold to determine whether a line of sight exists between the radio access network node and the wireless device.

Either D1 or D2 may be taken as the closest prior art document. The objective technical problem may be formulated as, “how to adapt the system of D1 or D2 to account for situations in which the wireless light communication network node is not co-located with either the radio access network node or the wireless device”.

First, it will be immediately apparent that the objective technical problem would not obviously occur to the skilled person based on the disclosures of D1 or D2. Both these documents disclose use cases in which the visible light communication device is necessarily co-located with either a radio access network node or a wireless device, as there are effectively only two devices: in D1, a data transmitting device located on a vehicle, and a data receiving device located in a garage; in D2, two vehicles communicating with each other. Thus the objective technical problem does not arise obviously from the disclosure of D1 or D2.

Second, it would not be obvious to adapt the disclosure of either D1 or D2 so as to read on to the claimed invention, as this would involve fundamentally altering the methods disclosed in those documents. That is, in both D1 and D2, the determination of a line of sight in visible light is used as a proxy for the determination of a line of sight in radio communications. This fact holds only where there are two devices transmitting to each other using visible light and radio communications, along the same direction. It does not hold once the visible light communication device is located elsewhere.

Third, neither D1 nor D2 provides any hint to the claimed solution, which is to determine signal metrics of the radio transmit/receive beams and compare those signal metrics to a threshold to determine whether the beam corresponds to a line of sight.

We therefore respectfully submit that claim 1 possesses an inventive step. As the other claims either correspond to or depend on claim 1, these claims possess an inventive step for similar reasons.

In view of the comments provided above, we respectfully request issuance of an International Preliminary Report on Patentability which is positive with respect to the novelty and inventive step of the claims.

Yours faithfully

Christopher Hall
Authorised Representative
HASELTINE LAKE KEMPNER LLP

CLAIMS

1. A method performed by a node (102, 104, 120) of a wireless communication network (100), the wireless communication network comprising a wireless device (104), a radio access network node (102) and one or more wireless light communication, LC, network nodes (106), at least one of the wireless device and the radio access network node comprising a plurality of antenna elements configurable to provide a transmit or receive radio beam (110, 112) for communication with the other of the wireless device and the radio access network node, the method comprising:
- 5 obtaining (200) an indication of a wireless LC network node with which the wireless device has established a wireless LC connection;
- obtaining (202) one or more signal metrics for one or more transmit or receive radio beams which are directed towards a coverage area of the indicated wireless LC network node, or which are directed to receive transmissions from the coverage area of the indicated wireless LC network node; and
- 15 determining whether or not a transmit or receive radio beam of the one or more transmit or receive radio beams corresponds to a line-of-sight, LoS, between the radio access network node and the wireless device based on a comparison (204) between the signal metric for the transmit or receive radio beam and a first threshold.
- 20
2. The method according to claim 1, wherein the first threshold is based on an estimated distance between the wireless device (104) and the radio access network node (102).
- 25
3. The method according to claim 1 or 2, wherein the plurality of antenna elements are configurable to provide a plurality of pre-defined transmit or receive radio beams (110, 112), and wherein the step (202) of obtaining one or more signal metrics comprises obtaining signal metrics for a subset of the plurality of pre-defined transmit or receive radio beams, the subset of pre-defined transmit or receive radio beams corresponding to those transmit radio beams (110, 112) which are directed towards a coverage area of the indicated wireless LC network node, or those receive radio beams (112, 110)
- 30
- 35

which are directed to receive transmissions from the coverage area of the indicated wireless LC network node (106).

4. The method according to claim 3, wherein the plurality of transmit or receive radio beams (110, 112) are defined by one or more of: a plurality of analog beamformers; a plurality of analog combiners; a digital codebook of beamformers; and a digital codebook of combiners.
5. The method according to any one of the preceding claims, further comprising obtaining (210) one or more signal metrics for one or more transmit or receive radio beams (110, 112) not directed towards the coverage area of the indicated wireless LC network node (106), or not directed to receive transmissions from the coverage area of the indicated wireless LC network node.
6. The method according to claim 5, further comprising comparing (212) the obtained one or more signal metrics to a second threshold, to determine whether or not RF communication is possible using the one or more transmit or receive radio beams (110, 112) not directed towards the coverage area of the indicated wireless LC network node (106), or not directed to receive transmissions from the coverage area of the indicated wireless LC network node.
7. The method according to claim 5 or 6, wherein the step (210) of obtaining signal metrics for one or more transmit or receive radio beams (110, 112) not directed towards the coverage area of the indicated wireless LC network node (106), or not directed to receive transmissions from the coverage area of the indicated wireless LC network node is performed responsive to a determination that no LoS exists between the radio access network node (102) and the wireless device (104).
8. The method according to any one of the preceding claims, wherein the step (200) of obtaining an indication of a wireless LC network node comprises receiving a message from the wireless device (104) comprising the indication of the wireless LC network node (106).

9. The method according to any one of claims 1 to 7, wherein the step (200) of obtaining an indication of a wireless LC network node comprises receiving a message from the wireless LC network node (106) comprising the indication of an identity of the wireless device (104).
- 5
10. The method according to any one of the preceding claims, wherein the step (202) of obtaining signal metrics comprises:
- 10 performing measurements on signals transmitted or received using the one or more transmit or receive radio beams (110, 112) to obtain respective values for the signal metric for each of the one or more transmit or receive radio beams.
11. The method according to any one of the preceding claims, wherein the signal metric comprises one or more of: received signal strength; received signal power; received signal quality; signal-to-noise ratio; and signal-to-noise-and-interference ratio.
- 15
12. The method according to any one of the preceding claims, further comprising utilizing a LoS transmit or receive radio beam to perform (208) time-of-flight measurements between the wireless device (104) and the radio access network node (102).
- 20
13. The method according to any one of the preceding claims, wherein the node is one of: the wireless device (104); the radio access network node (102); and a communication network node (120).
- 25
14. A non-transitory machine-readable medium storing instructions for execution by processing circuitry of a node (102, 104, 120) of a wireless communication network (100), the wireless communication network comprising a wireless device (104), a radio access network node (102) and one or more wireless light communication, LC, network nodes (106), at least one of the wireless device and the radio access network node comprising a plurality of antenna elements configurable to provide a transmit or receive radio beam (110, 112) for communication with the other of the wireless device and the radio access network node, execution of the instructions by the processing circuitry causing the node to:
- 30
- 35

37

obtain (200) an indication of a wireless LC network node with which the wireless device has established a wireless LC connection;

5 obtain (202) one or more signal metrics for one or more transmit or receive radio beams which are directed towards a coverage area of the indicated wireless LC network node, or which are directed to receive transmissions from the coverage area of the indicated wireless LC network node; and

10 determine whether or not a transmit or receive radio beam of the one or more transmit or receive radio beams corresponds to a line-of-sight, LoS, between the radio access network node and the wireless device based on a comparison (204) between the signal metric for the transmit or receive radio beam and a first threshold.

15 15. A node (102, 104, 120, 300) of a wireless communication network (100), the wireless communication network comprising a wireless device (104), a radio access network node (102) and one or more wireless light communication, LC, network nodes (106), at least one of the wireless device and the radio access network node comprising a plurality of antenna elements configurable to provide a transmit or receive radio beam (110, 112) for communication with
20 the other of the wireless device and the radio access network node, the node comprising processing circuitry (302) and a non-transitory machine-readable medium (304), the non-transitory machine-readable medium storing instructions which, when executed by the processing circuitry, cause the node to:

25 obtain (200) an indication of a wireless LC network node with which the wireless device has established a wireless LC connection;

30 obtain (202) one or more signal metrics for one or more transmit or receive radio beams which are directed towards a coverage area of the indicated wireless LC network node, or which are directed to receive transmissions from the coverage area of the indicated wireless LC network node; and

35 determine whether or not a transmit or receive radio beam of the one or more transmit or receive radio beams corresponds to a line-of-sight, LoS, between the radio access network node and the wireless device based on a comparison (204) between the signal metric for the transmit or receive radio beam and a first threshold.

16. The node according to claim 15, wherein the first threshold is based on an estimated distance between the wireless device (104) and the radio access network node (102).
- 5
17. The node according to claim 15 or 16, wherein the plurality of antenna elements are configurable to provide a plurality of pre-defined transmit or receive radio beams (110, 112), and wherein the node is caused to obtain one or more signal metrics for a subset of the plurality of pre-defined transmit or receive radio beams, the subset of pre-defined transmit or receive radio beams corresponding to those transmit radio beams (110, 112) which are directed towards a coverage area of the indicated wireless LC network node, or those receive radio beams (112, 110) which are directed to receive transmissions from the coverage area of the indicated wireless LC network node (106).
- 10
18. The node according to claim 17, wherein the plurality of transmit or receive radio beams (110, 112) are defined by one or more of: a plurality of analog beamformers; a plurality of analog combiners; a digital codebook of beamformers; and a digital codebook of combiners.
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19. The node according to any one of claims 15 to 18, wherein node is caused to obtain (210) one or more signal metrics for one or more transmit or receive radio beams (110, 112) not directed towards the coverage area of the indicated wireless LC network node (106), or not directed to receive transmissions from the coverage area of the indicated wireless LC network node.
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20. The node according to claim 19, wherein the node is caused to compare (212) the obtained one or more signal metrics to a second threshold, to determine whether or not RF communication is possible using the one or more transmit or receive radio beams (110, 112) not directed towards the coverage area of the indicated wireless LC network node (106), or not directed to receive transmissions from the coverage area of the indicated wireless LC network node.
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21. The node according to claim 19 or 20, wherein the node is caused to obtain signal metrics for one or more transmit or receive radio beams (110, 112) not directed towards the coverage area of the indicated wireless LC network node (106), or not directed to receive transmissions from the coverage area of the indicated wireless LC network node responsive to a determination that no LoS exists between the radio access network node (102) and the wireless device (104).
22. The node according to any one of claims 15 to 21, wherein the node is caused to obtain an indication of a wireless LC network node by receiving a message from the wireless device (104) comprising the indication of the wireless LC network node (106).
23. The node according to any one of claims 15 to 21, wherein the node is caused to obtain an indication of a wireless LC network node by receiving a message from the wireless LC network node (106) comprising the indication of an identity of the wireless device (104).
24. The node according to any one of claims 15 to 23, wherein the node is caused to obtain signal metrics by:
performing measurements on signals transmitted or received using the one or more transmit or receive radio beams (110, 112) to obtain respective values for the signal metric for each of the one or more transmit or receive radio beams.
25. The node according to any one of claims 15 to 24, wherein the signal metric comprises one or more of: received signal strength; received signal power; received signal quality; signal-to-noise ratio; and signal-to-noise-and-interference ratio.
26. The node according to any one of claims 15 to 25, wherein the node is caused to utilize a LoS transmit or receive radio beam to perform (208) time-of-flight measurements between the wireless device (104) and the radio access network node (102).

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27. The node according to any one of claims 15 to 26, wherein the node is one of: the wireless device (104); the radio access network node (102); and a communication network node (120).

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