

TITLE OF INVENTION: IMPROVING IDLE MODE RADIO MEASUREMENTS**TECHNICAL FIELD**

Various example embodiments relate generally to idle mode radio measurements.

5 BACKGROUND

A user equipment may perform idle mode radio measurements of surrounding environment. Results of the radio measurements may be provided to network. However, such measuring process needs improvements.

BRIEF DESCRIPTION

10 In an aspect, the present disclosure refers to a method at a user equipment, comprising:

determining a cell to connect with;

determining capabilities of the user equipment in relation to carrier aggregation comprising a carrier of the cell;

15 receiving a measurement indication identifying a plurality of carriers to be measured in idle mode, wherein the plurality of carriers comprise carriers that the user equipment can aggregate with the carrier of the cell and carriers that the user equipment cannot aggregate with the carrier of the cell; and

performing, for early measurement reporting and based on the determined capabilities of the user equipment in relation to carrier aggregation, idle mode measurements of only those carriers from the plurality of carriers which the user equipment can aggregate with the carrier of the cell; and

indicating results of the idle mode measurements to a network node of the cell upon connection establishment with the cell.

25 In another aspect, the present disclosure refers to a user equipment, comprising means for performing:

determining a cell to connect with;

determining capabilities of the user equipment in relation to carrier aggregation comprising a carrier of the cell;

30 receiving a measurement indication identifying a plurality of carriers to be measured in idle mode, wherein the plurality of carriers comprise carriers that

the user equipment can aggregate with the carrier of the cell and carriers that the user equipment cannot aggregate with the carrier of the cell; and

performing, for early measurement reporting and based on the determined capabilities of the user equipment in relation to carrier aggregation, idle mode measurements of only those carriers from the plurality of carriers which the user equipment can aggregate with the carrier of the cell; and

indicating results of the idle mode measurements to a network node of the cell upon connection establishment with the cell.

In another aspect, the present disclosure refers to a computer program product comprising program instructions which, when the program is executed by a user equipment, cause the user equipment to carry out the method according to any of the above aspects.

LIST OF THE DRAWINGS

In the following, the invention will be described in greater detail with reference to the embodiments and the accompanying drawings, in which

Figure 1A and 1B present communication networks, according to some embodiments;

Figure 2 shows a user equipment being in a coverage area of a plurality of cells;

Figures 3 and 4 show methods, according to some embodiments;

Figures 5 and 6 illustrate some examples of determining which carriers to measure and report, according to some embodiments;

Figure 7 shows a flow diagram, according to an embodiment; and

Figures 8 and 9 illustrate apparatuses, according to some embodiments.

DESCRIPTION OF EMBODIMENTS

The following embodiments are exemplary. Although the specification may refer to “an”, “one”, or “some” embodiment(s) in several locations of the text, this does not necessarily mean that each reference is made to the same embodiment(s), or that a particular feature only applies to a single embodiment. Single features of different embodiments may also be combined to provide other embodiments.

Embodiments described may be implemented in a radio system, such as one comprising at least one of the following radio access technologies (RATs): Worldwide Interoperability for Micro-wave Access (WiMAX), Global System for

CLAIMS

1. A method at a user equipment, comprising:
determining a cell to connect with;
5 determining capabilities of the user equipment in relation to carrier aggregation comprising a carrier of the cell;
receiving a measurement indication identifying a plurality of carriers to be measured in idle mode, wherein the plurality of carriers comprise carriers that the user equipment can aggregate with the carrier of the cell and carriers that the user equipment cannot aggregate with the carrier of the cell; and
10 performing, for early measurement reporting and based on the determined capabilities of the user equipment in relation to carrier aggregation, idle mode measurements of only those carriers from the plurality of carriers which the user equipment can aggregate with the carrier of the cell; and
15 indicating results of the idle mode measurements to a network node of the cell upon connection establishment with the cell.
2. The method of claim 1, further comprising:
determining that the network node of the cell supports reporting
20 idle mode measurements during the connection establishment.
3. The method of any of claims 1 to 2, wherein the indicated results of the idle mode measurements cause triggering the carrier aggregation by the network node of the cell, without the network node of the cell asking for connected mode radio measurements to be performed.
25
4. The method of any of claims 1 to 3, further comprising:
determining, based on the capabilities of the user equipment in relation to carrier aggregation, those carriers from the plurality of carriers which
30 the user equipment can aggregate with the carrier of the cell, wherein the determining comprises utilizing information of at least one carrier aggregation configuration used by the user equipment within a past predetermined period of time.
- 35 5. The method of any of claims 1 to 4, wherein the measurement indication is received in a system information block.

6. The method of any of claims 1 to 5, wherein those carriers that the user equipment can, based on the determined capabilities of the user equipment in relation to carrier aggregation, aggregate with the carrier of the cell are required to be associated with other cells than macro cells.

5

7. The method of any of claims 1 to 6, wherein the indication of the results is provided in a radio resource control connection setup completion message.

10

8. A user equipment, comprising means for performing:
determining a cell to connect with;
determining capabilities of the user equipment in relation to carrier aggregation comprising a carrier of the cell;
receiving a measurement indication identifying a plurality of carriers to be measured in idle mode, wherein the plurality of carriers comprise carriers that the user equipment can aggregate with the carrier of the cell and carriers that the user equipment cannot aggregate with the carrier of the cell; and
performing, for early measurement reporting and based on the determined capabilities of the user equipment in relation to carrier aggregation, idle mode measurements of only those carriers from the plurality of carriers which the user equipment can aggregate with the carrier of the cell; and
indicating results of the idle mode measurements to a network node of the cell upon connection establishment with the cell.

15

20

25

9. The user equipment of claim 8, wherein the means are further configured to perform:

determining that the network node of the cell supports reporting idle mode measurements during the connection establishment.

30

10. The user equipment of any of claims 8 to 9, wherein the indicated results of the idle mode measurements cause triggering the carrier aggregation by the network node of the cell, without the network node of the cell asking for connected mode radio measurements to be performed.

35

11. The user equipment of any of claims 8 to 10, further comprising: means for determining, based on the capabilities of the user equip-

ment in relation to carrier aggregation, those carriers from the plurality of carriers which the user equipment can aggregate with the carrier of the cell, wherein the determining comprises utilizing information of at least one carrier aggregation configuration used by the user equipment within a past predetermined period of time.

12. The user equipment of any of claims 8 to 11, wherein the measurement indication is received in a system information block.

13. The user equipment of any of claims 8 to 12, wherein those carriers that the user equipment can, based on the determined capabilities of the user equipment in relation to carrier aggregation, aggregate with the carrier of the cell are required to be associated with other cells than macro cells.

14. The user equipment of any of claims 8 to 13, wherein the indication of the results is provided in a radio resource control connection setup completion message.

15. A computer program product comprising program instructions which, when the program is executed by a user equipment, cause the user equipment to carry out the method according to any of claims 1 to 7.