IMPROVING IDLE MODE RADIO MEASUREMENTS

TECHNICAL FIELD

Various example embodiments relate generally to idle mode radio measurements.

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

According some aspects, there is provided the subject matter of the independent claims. Some further aspects are defined in the dependent claims.

In an aspect, there is a method at a user equipment, comprising: determining a first cell to connect with; determining capabilities of the user equipment in relation to carrier aggregation comprising a carrier of the first cell; receiving, from a network node of the first cell, a measurement indication identifying a plurality of carriers to be measured in idle mode, wherein the measurement indication comprises carriers that the user equipment can aggregate with the carrier of the first cell and carriers that the user equipment cannot aggregate with the carrier of the first cell; autonomously determining the carriers to be measured by filtering out those carriers from the measurement indication which the user equipment cannot, based on the determined capabilities, aggregate with the carrier of the first cell; performing idle mode radio measurements of the determined carriers to be measured; and reporting results of the idle mode radio measurements to the network node of the first cell upon connection establishment with the first cell.

In an aspect, there is an apparatus, comprising: at least one processor and at least one memory including a computer program code, wherein the at least one memory and the computer program code are configured, with the at least one processor, to cause a user equipment to perform: determine a first cell to connect with; determine capabilities of the user equipment in relation to carrier aggregation comprising a carrier of the first cell; cause a reception of a measurement indication identifying a plurality of carriers to be measured in idle mode, wherein the

measurement indication comprises carriers that the user equipment can aggregate with the carrier of the first cell and carriers that the user equipment cannot aggregate with the carrier of the first cell; autonomously determine the carriers to be measured by filtering out those carriers from the measurement configuration which the user equipment cannot, based on the determined capabilities, aggregate with the carrier of the first cell; perform idle mode radio measurements of the determined carriers to be measured; and report results of the idle mode radio measurements to the network node of the first cell upon connection establishment with the first cell.

in an example, there is an apparatus, comprising at least one processor and at least one memory including a computer program code, wherein the at least one memory and the computer program code are configured, with the at least one processor, to cause a network node to perform: detect a connection establishment of a user equipment to a first cell served by the network node; upon the connection establishment, cause a reception of results of idle mode radio measurements performed by the user equipment, wherein the results comprise radio measurements results for those carriers which the user equipment can aggregate with the carrier of the first cell; and utilize the received results for carrier aggregation setup for the user equipment.

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):

Claims

1. A method at a user equipment, comprising:

determining a first cell to connect with;

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

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

autonomously determining the carriers to be measured by filtering out those carriers from the measurement indication which the user equipment cannot, based on the determined capabilities, aggregate with the carrier of the first cell;

performing idle mode radio measurements of the determined carriers to be measured; and

reporting results of the idle mode radio measurements to the network node of the first cell upon connection establishment with the first cell.

2. An apparatus, comprising:

at least one processor and at least one memory including a computer program code, wherein the at least one memory and the computer program code are configured, with the at least one processor, to cause a user equipment to perform:

determine a first cell to connect with;

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

cause a reception of a measurement indication identifying a plurality of carriers to be measured in idle mode, wherein the measurement indication comprises carriers that

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

autonomously determine the carriers to be measured by filtering out those carriers from the measurement configuration which the user equipment cannot, based on the determined capabilities, aggregate with the carrier of the first cell;

perform idle mode radio measurements of the determined carriers to be measured; and

report results of the idle mode radio measurements to the network node of the first cell upon connection establishment with the first cell.

3. The apparatus of claim 2, wherein the at least one memory and the computer program code are configured, with the at least one processor, to cause the user equipment further to perform:

determine that the network node of the first cell supports reporting idle mode radio measurements during the connection establishment.

4. The apparatus of any of claims 2 to 3, wherein the reported results of the idle mode radio measurements cause triggering the carrier aggregation by the network node of the first cell, without the network node of the first cell asking for connected mode radio measurements to be performed.

5. The apparatus of any of claims 2 to 4, wherein the at least one memory and the computer program code are configured, with the at least one processor, to cause the user equipment further to perform:

cause a reception, from the network node of the first cell, of an indication indicating that a carrier aggregation is to be triggered for the user equipment, wherein the carrier

aggregation comprises receiving data over the carrier of the first cell and over one or more of the carriers that were measured during the idle mode radio measurements.

6. The apparatus of any of claims 2 to 5, wherein the at least one memory and the computer program code are configured, with the at least one processor, to cause the user equipment further to perform:

receive a measurement indication indicating to perform idle mode radio measurements; and

autonomously determine the cells to be measured based on the determined capabilities such that only those carriers that the user equipment can aggregate with the carrier of the first cell are measured.

7. The apparatus of any of claims 2 to 6, wherein the autonomous determination comprises utilizing information of at least one carrier aggregation configuration used by the user equipment within a past predetermined period of time.

8. The apparatus of any of claims 2 to 7, wherein the measurement indication is received in a system information block.

9. The apparatus of any of claims 2 to 8, wherein those carriers that the user equipment can, based on the determined capabilities, aggregate with the carrier of the first cell are required to be associated with other cells than macro cells.

10. The apparatus of any of claims 2 to 9, wherein the apparatus is a user equipment and the apparatus is operating according to the long term evolution or according to the long term evolution advanced, or according to new radio , 5G.

11. A computer program product embodied on a

distribution medium readable by a computer and comprising program instructions which, when loaded into an apparatus, execute the method according to claim 1.

12. A computer program product comprising program instructions which, when loaded into an apparatus, execute the method according to claim 1.

13. An apparatus, comprising means for performing the method according to claim 1.