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(54) Title: TRACK AND USE LOCATION AND SPEED OF USERS FOR HANDLING SCENARIOS IN SMALL CELL DEPLOYMENTS

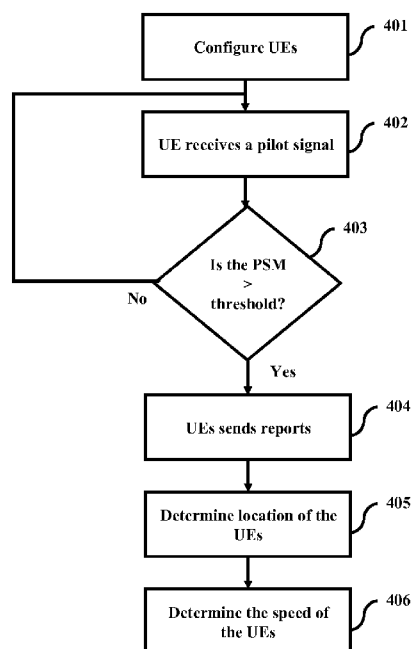


FIG. 4

(57) Abstract: Track and use location and speed of users for handling scenarios in small cell deployments. The present invention relates to communication networks and, more particularly, to location tracking and location based services in communication networks. The embodiments herein disclose a mechanism to enable access network to do effective mobility, traffic and interference management for UEs in a CDMA based cellular communication network. A method and corresponding elements are disclosed for managing user equipment in a communication network, where the method comprises steps of a network controller lowering pilot strength measurement threshold in the user equipment; the user equipment sending a report to the network controller, when the received pilot strength measurement exceeds the pilot strength measurement threshold; the network controller determining location and speed of the user equipment using a plurality of the reports.



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TRACK AND USE LOCATION AND SPEED OF USERS FOR HANDLING SCENARIOS IN SMALL CELL DEPLOYMENTS

TECHNICAL FIELD

5 [001] The present invention relates to communication networks and, more particularly, to location tracking and location based services in communication networks.

BACKGROUND

10 [002] In existing CDMA based cellular communication networks, heterogeneous deployments are becoming commonplace to address operator issues related to coverage, capacity and energy efficiency. Heterogeneous networks deployments have cells of different radii - macrocells, microcells, picocells and so on placed adjacent to each other
15 and with overlapping coverage. The mobility, traffic and interference management procedures for User Equipments (UEs) in such deployments require that the network should be cognizant of the context in which the UE is operating - like available cells in the proximity of the UE that can provide service and the anticipated time the UE would be available in the
20 proximity of those cells. The network should be aware of the speed and location of the UE for making effective mobility, traffic and interference management decisions for the UEs. Due to the smaller size of the picocells involved in such heterogeneous networks, if the network is not aware of the speed and location of the UEs present within the network, the UE may not
25 always be connected to the network using at least one cell. This may be due to the fact that the UE moves between picocells at a very high speed.

 [003] There are procedures in the upcoming standards available that require the UEs to report such information, but vast majority of current day UEs do not have capability to report such information. Also, when such

advanced devices will be available is not clear.

[004] Further, the standards require the UE to send reports comprising such information by comparing the signal strength with a predefined threshold. However, the thresholds as defined will not result in
5 UEs sending reports to the network, in such a frequency that the network will be aware of the location and speed of the UE at all instances of time.

SUMMARY

[005] In view of the foregoing, an embodiment herein provides a method and system for managing a user equipment in a cellular
10 communication network, the method comprising steps of a network controller lowering pilot strength measurement threshold in the user equipment, wherein the user equipment compares received pilot strength measurement with the pilot strength measurement threshold; the user equipment sending a report to the network controller, when the received
15 pilot strength measurement exceeds the pilot strength measurement threshold; and the network controller determining location and speed of the user equipment using a plurality of the reports.

[006] These and other aspects of the embodiments herein will be better appreciated and understood when considered in conjunction with the
20 following description and the accompanying drawings.

BRIEF DESCRIPTION OF THE FIGURES

[007] The embodiments herein will be better understood from the
25 following detailed description with reference to the drawings, in which:

[008] FIG. 1 depicts a system, according to embodiments as disclosed herein;

[009] FIG. 2 depicts a network controller, according to embodiments as disclosed herein;

[0010] FIG. 3 depicts a UE, according to embodiments as disclosed herein; and

[0011] FIGs. 4, 5, 6 and 7 depict flowcharts, according to embodiments as disclosed herein.

5 **DETAILED DESCRIPTION OF EMBODIMENTS**

[0012] The embodiments herein and the various features and advantageous details thereof are explained more fully with reference to the non-limiting embodiments that are illustrated in the accompanying drawings and detailed in the following description. Descriptions of well-known components and processing techniques are omitted so as to not
10 unnecessarily obscure the embodiments herein. The examples used herein are intended merely to facilitate an understanding of ways in which the embodiments herein may be practiced and to further enable those of skill in the art to practice the embodiments herein. Accordingly, the examples
15 should not be construed as limiting the scope of the embodiments herein.

[0013] The embodiments herein disclose a mechanism to enable access network to do effective mobility, traffic and interference management for UEs in a CDMA based cellular communication network. Referring now to the drawings, and more particularly to FIGS. 1 through 7,
20 where similar reference characters denote corresponding features consistently throughout the figures, there are shown embodiments.

[0014] FIG. 1 depicts a communication network, according to embodiments as disclosed herein. The communication network as depicted comprises of a plurality of User Equipments (UEs), a plurality of picocells
25 102 and a network controller 103. The communication network may be a Code Division Multiple Access (CDMA) based network such as a High Rate Packet Data (HRPD) network, a CDMA2000-1x network, High Speed Packet Access (HSPA) network. The communication network may

comprise of a plurality of macrocells and a plurality of microcells. The macrocells and microcells further contain a plurality of picocells 102 within themselves, where the coverage area of the picocells 102 overlaps with the coverage area of the macrocells and microcells. The picocells 102 may be
5 adjacent to each other or non-adjacent to each other. The base stations for each of the picocells 102 are connected to the network controller 103 using a suitable communication means. The connection means may be a wired communication means or a wireless communication means.

[0015] The network controller 103 configures the UEs 101 to send
10 reports comprising of Pilot Strength Measurements (PSM) and Route Update Messages (RUMs) at intervals to the network controller 103. The network controller 103 may configure the UEs at the time of negotiating with the UEs. The network controller 103 may configure the UEs at the time of negotiating with the UEs using set management parameters, which
15 are sent by the network controller 103 to the UEs 101 during the negotiation process. The network controller 103 may also configure the UEs at any point in time. The network controller 103 may also configure the UEs 101 at any point in time using the attribute override measurement parameters. The network controller 103 configures the UEs 101 to send the
20 reports to the network controller 103 by lowering the threshold with which each UE 101 compares the received pilot signal strength. This lowered threshold will result in the reports being sent to the network controller 103 at more frequent intervals. The intervals may be in the order of milliseconds.

25 [0016] The network controller 103 may receive multiple copies of the report from a UE via multiple cells, which may be picocells, microcells or macrocells. The network controller 103 determines the location of the UE 101 using the multiple copies of the report using triangulation. The network controller 103 may determine the speed of the UE 101 using

variations in successive RUMs, which have been received in successive reports.

[0017] The network controller 103 may determine the distance of a UE 101 to a picocell 102, once the network controller 103 is aware of the location and speed of the UE 101. The network controller 103 estimates the approximate time the UE 101 is expected to be within the picocell 102, based on the speed and radius of the picocell 102. The network controller 103 further calculates a ratio, which is the radius of the picocell to the speed of the UE 101. If the ratio is below a movement threshold, then the network controller 103 does not perform any further action. If the ratio is above the movement threshold, then the network controller 103 initiates handoff of the UE 101 to the nearest picocell 102. The movement threshold may be specified by the operator of the network controller 103.

[0018] In another embodiment herein, the network controller 103 on receiving a report from the picocell 102 of interference resulting from communication between UEs 101 in its vicinity and other cells. The network controller 103 further calculates a ratio, which is the radius of the picocell to the speed of the UE 101. If the ratio is below a movement threshold, then the network controller 103 initiates handing off the UEs 101 to disjoint carriers, which may not belong to picocell 102. If the ratio is above the movement threshold, then the network controller 103 initiates handoff of the UE 101 to the interfered picocell 102. This enables the picocell 102 to perform power control on the reverse link and mitigate the interference.

[0019] In another embodiment herein, a macrocell or a microcell may report to the network controller 103 that the load on the cell has increased. This increase in the load may be due to an increase in the number of UEs 101 served by the cell. The network controller 103 determines the UEs 101 which is in the vicinity of picocells 102, where the

network controller 103 is aware of the location of the UEs and the location and size of the picocells. The network controller 103 further calculates a ratio, which is the radius of the picocell to the speed of the UE 101. If the ratio is below a movement threshold, then the network controller 103 does not perform an action. If the ratio is above the movement threshold, then the network controller 103 initiates handoff of the UE 101 to the closest picocell 102.

[0020] FIG. 2 depicts a network controller, according to embodiments as disclosed herein. The network controller as depicted comprises of a controller 201, a transmitter 202 and a receiver 203. The controller 201 configures the UEs 101 to send reports comprising of Pilot Strength Measurements (PSM) and Route Update Messages (RUMs) at intervals to the network controller 103. The controller 201 may configure the UEs at the time of negotiating with the UEs. The controller 201 may configure the UEs at the time of negotiating with the UEs using set management parameters, which are sent by the controller 201 to the UEs 101 through the transmitter 203 during the negotiation process. The controller 201 may also configure the UEs at any point in time. The controller 201 may also configure the UEs 101 at any point in time using the attribute override measurement parameters, which are sent by the controller 201 to the UEs 101 through the transmitter 203.

[0021] The controller 201 may receive multiple copies of the report from a UE via multiple cells, which may be picocells, microcells or macrocells. The network controller 103 receives the reports through the receiver 202. The controller 201 determines the location of the UE 101 using the multiple copies of the report using triangulation. The controller 201 may determine the speed of the UE 101 using variations in successive RUMs, which have been received in successive reports.

[0022] The controller 201 may determine the distance of a UE 101

to a picocell 102, once the controller 201 is aware of the location and speed of the UE 101. The controller 201 estimates the approximate time the UE 101 is expected to be within the picocell 102, based on the speed and radius of the picocell 102. The controller 201 further calculates a ratio, which is
5 the radius of the picocell to the speed of the UE 101. If the ratio is below a movement threshold, then the controller 201 does not perform any further action. If the ratio is above the movement threshold, then the controller 201 initiates handoff of the UE 101 to the nearest picocell 102. The movement threshold may be specified by the operator of the controller 201.

10 [0023] In another embodiment herein, the controller 201 on receiving a report from the picocell 102 of interference resulting from communication between UEs 101 in its vicinity and other cells. The controller 201 further calculates a ratio, which is the radius of the picocell to the speed of the UE 101. If the ratio is below a movement threshold, then
15 the controller 201 initiates handing off the UEs 101 to disjoint carriers, which may not belong to picocell 102. If the ratio is above the movement threshold, then the controller 201 initiates handoff of the UE 101 to the interfered picocell 102. This enables the picocell 102 to perform power control on the reverse link and mitigate the interference.

20 [0024] In another embodiment herein, a macrocell or a microcell may report to the controller 201 that the load on the cell has increased. This increase in the load may be due to an increase in the number of UEs 101 served by the cell. The controller 201 determines the UEs 101 which is in the vicinity of picocells 102, where the controller 201 is aware of the
25 location of the UEs and the location and size of the picocells. The controller 201 further calculates a ratio, which is the radius of the picocell to the speed of the UE 101. If the ratio is below a movement threshold, then the controller 201 does not perform an action. If the ratio is above the movement threshold, then the controller 201 initiates handoff of the UE

101 to the closest picocell 102.

[0025] FIG. 3 depicts a UE, according to embodiments as disclosed herein. The UE 101, as depicted comprises of a controller 301, a searcher module 302, a transmitter 303 and a receiver 304. The controller 301 is
5 configured by the network controller 103 to send reports comprising of Pilot Strength Measurements (PSM) and Route Update Messages (RUMs) at intervals to the network controller 103. The controller 301 may be configured at the time of negotiating with the UEs using set management parameters, which are sent by the network controller 103 to the UEs 101
10 during the negotiation process through the receiver 304. The controller 301 may be configured at any point in time using the attribute override measurement parameters through the receiver 304. The controller 301 sends the reports to the network controller 103 through the transmitter 303, after the searcher module 302 receives a pilot signal and the received pilot
15 signal strength is compared by the controller 301 with a lowered threshold. If the pilot signal strength is higher than the threshold, then the controller 301 sends a report to the network controller 103. This lowered threshold will result in the reports being sent to the network controller 103 at more frequent intervals. The intervals may be in the order of milliseconds.

20 [0026] FIG. 4 depicts a flowchart, according to embodiments as disclosed herein. The network controller 103 configures (401) the UEs 101 by altering the threshold to send reports at intervals to the network controller 103. The network controller 103 may configure the UEs at the time of negotiating with the UEs 101 using set management parameters.
25 The network controller 103 may also configure the UEs 101 at any point in time using attribute override measurement parameters. On receiving (402) a pilot signal, the UE 101 compares (403) the PSM to the threshold. If the PSM is greater than the threshold, the UE 101 sends (404) a report comprising of Pilot Strength Measurements (PSM) and Route Update

Messages (RUMs) to the network controller 103. The network controller 103 determines (405) the location of the UE 101 using the multiple copies of the report using triangulation. The network controller 103 determines (406) the speed of the UE 101 using variations in successive RUMs, which
5 have been received in successive reports. The various actions in method 400 may be performed in the order presented, in a different order or simultaneously. Further, in some embodiments, some actions listed in FIG. 4 may be omitted.

[0027] FIG. 5 depicts a flowchart, according to embodiments as disclosed herein. The network controller 103 monitors (501) the location
10 of the UEs 101 and checks (502) if the UE 101 is close to a picocell 102. The network controller 103 monitors the location of the UEs 101 using triangulation and the reports sent by the UEs 101. If a UE 101 is close to a picocell, the network controller 103 estimates (503) the speed of the UE
15 101. The network controller 103 may estimate the speed of the UE 101 using successive RUMs sent by the UE 101. The network controller 103 estimates (504) the approximate time the UE 101 is expected to be within the picocell 102, based on the speed of the UE 101 and radius of the picocell 102. The network controller 103 further calculates (505) a ratio,
20 which is the radius of the picocell to the speed of the UE 101. The network controller 103 compares (506) the ratio to the movement threshold. If the ratio is above the movement threshold, then the network controller 103 initiates (507) handover of the UE 101 to the nearest picocell 102. The various actions in method 500 may be performed in the order presented, in
25 a different order or simultaneously. Further, in some embodiments, some actions listed in FIG. 5 may be omitted.

[0028] FIG. 6 depicts a flowchart, according to embodiments as disclosed herein. The network controller 103 receives (601) a report from the picocell 102 of interference resulting from communication between

UEs 101 in its vicinity and other cells. The network controller then checks (602) if there are any UEs 101 close to the picocell 102. The network controller 103 monitors the location of the UEs 101 using triangulation and the reports sent by the UEs 101. If a UE 101 is close to a picocell, the
5 network controller 103 estimates (603) the speed of the UE 101. The network controller 103 may estimate the speed of the UE 101 using successive RUMs sent by the UE 101. The network controller 103 estimates (604) the approximate time the UE 101 is expected to be within the picocell 102, based on the speed of the UE 101 and radius of the
10 picocell 102. The network controller 103 further calculates (605) a ratio, which is the radius of the picocell to the speed of the UE 101. The network controller 103 compares (606) the ratio to the movement threshold. If the ratio is above the movement threshold, then the network controller 103 initiates (607) handover of the UE 101 to the nearest picocell 102 and the
15 picocell 102 performs (608) power control on the reverse link, hereby reducing the interference. The various actions in method 600 may be performed in the order presented, in a different order or simultaneously. Further, in some embodiments, some actions listed in FIG. 6 may be omitted.

20 [0029] FIG. 7 depicts a flowchart, according to embodiments as disclosed herein. The network controller 103 receives (701) a report from a cell that the load on the cell has increased. The network controller then checks (702) if there are any UEs 101 being served by the cell which is close to picocells 102. The network controller 103 monitors the location of
25 the UEs 101 using triangulation and the reports sent by the UEs 101. If a UE 101 is close to a picocell, the network controller 103 estimates (703) the speed of the UE 101. The network controller 103 may estimate the speed of the UE 101 using successive RUMs sent by the UE 101. The network controller 103 estimates (704) the approximate time the UE 101 is

expected to be within the picocell 102, based on the speed of the UE 101 and radius of the picocell 102. The network controller 103 further calculates (705) a ratio, which is the radius of the picocell to the speed of the UE 101. The network controller 103 compares (706) the ratio to the
5 movement threshold. If the ratio is above the movement threshold, then the network controller 103 initiates (707) handover of the UE 101 to the nearest picocell 102. The various actions in method 700 may be performed in the order presented, in a different order or simultaneously. Further, in some embodiments, some actions listed in FIG. 7 may be omitted.

10 [0030] The embodiments herein disclose a HRPD network, it may be obvious to a person of ordinary skill in the art to extend the embodiments as disclosed herein to any CDMA based network such as a CDMA2000-1x, HSPA and so on.

15 [0031] Though the embodiments as disclosed above disclose a network architecture using picocells directly connected to the network controller, it may be obvious to a person of ordinary skill in the art to extend the embodiments as disclosed herein to a network architecture which uses gateway architecture, where the picocell is connected to the network controller through a gateway.

20 [0032] The embodiments disclosed herein can be implemented through at least one software program running on at least one hardware device and performing network management functions to control the network elements. The network elements shown in Figs. 1, 2 and 3 include
25 blocks which can be at least one of a hardware device, or a combination of hardware device and software module.

[0033] The embodiment disclosed herein specifies a system and

method for notifying a user of call forwarding feature activated by the forward-to-number. Therefore, it is understood that the scope of the protection is extended to such a program and in addition to a computer readable means having a message therein, such computer readable storage
5 means contain program code means for implementation of one or more steps of the method, when the program runs on a server or mobile device or any suitable programmable device. The method is implemented in a preferred embodiment through or together with a code written in e.g. Very high speed integrated circuit Hardware Description Language (VHDL) or
10 any other coding language, or implemented by one or more VHDL or several software modules being executed on at least one hardware device. The hardware device can be any kind of device which can be programmed including e.g. any kind of computer like a server or a personal computer, or the like, or any combination thereof, e.g. one processor and two FPGAs.
15 The device may also include means which could be e.g. hardware means like e.g. an ASIC, or a combination of hardware and software means, e.g. an ASIC and an FPGA, or at least one microprocessor and at least one memory with software modules located therein. The method embodiments described herein could be implemented in pure hardware or partly in
20 hardware and partly in software. Alternatively, the invention may be implemented on different hardware devices, e.g. using a plurality of CPUs.

[0034] The foregoing description of the specific embodiments will so fully reveal the general nature of the embodiments herein that others can,
25 by applying current knowledge, readily modify and/or adapt for various applications such specific embodiments without departing from the generic concept, and, therefore, such adaptations and modifications should and are intended to be comprehended within the meaning and range of equivalents of the disclosed embodiments. It is to be understood that the phraseology or

terminology employed herein is for the purpose of description and not of limitation. Therefore, while the embodiments herein have been described in terms of preferred embodiments, those skilled in the art will recognize that the embodiments herein can be practiced with modification within the spirit
5 and scope of the claims as described herein.

WE CLAIM :-

1. A method for managing a user equipment in a cellular communication network, said method comprising steps of

A network controller lowering pilot strength measurement threshold in said user equipment, wherein said user equipment compares received pilot strength measurement with said pilot strength measurement threshold;

Said user equipment sending a report to said network controller, when said received pilot strength measurement exceeds said pilot strength measurement threshold;

Said network controller determining location and speed of said user equipment using a plurality of said reports.

2. The method, as claimed in claim 1, wherein said communication network is a Code Division Multiple Access based communication network.

3. The method, as claimed in claim 1, wherein said network controller lowers pilot strength measurement in said user equipment using at least one of

Set management parameters; or

Attribute override measurements.

4. The method, as claimed in claim 1, wherein said reports comprise of Pilot Strength measurements; and

Route Update messages.

5. The method, as claimed in claim 1, wherein said network controller determines location of said user equipment using said plurality of reports using triangulation.

6. The method, as claimed in claim 1, wherein said method further comprises steps of

Said network controller determining proximity of said user equipment to a picocell;

Said network controller determining time said user equipment is expected to be in said picocell; and

Said network controller initiating hand off of said user equipment to said picocell, if ratio of radius of said picocell to speed of said user equipment is above a second threshold.

7. The method, as claimed in claim 1, wherein said method further comprises steps of

Said network controller listing user equipments in proximity to an interfered picocell;

Said network controller initiating hand off of said user equipments to said picocell, if ratio of radius of said picocell to speed of said user equipment is above a third threshold.

8. The method, as claimed in claim 1, wherein said method further comprises steps of

Said network controller receiving a report from a macrocell of increased load;

Said network controller determining proximity of user equipments served by said microcell to a picocell;

Said network controller determining time said user equipment is expected to be in said picocell; and

Said network controller initiating hand off of said user equipment to said picocell.

9. A network controller in a cellular communication network, said network controller comprising at least one means adapted for

Lowering pilot strength measurement threshold in said user equipment, wherein said user equipment compares received pilot strength measurement with said pilot strength measurement threshold;

Receiving a report from said user equipment, wherein said report is sent by said user equipment on detecting that received pilot strength

measurement is greater than said pilot strength measurement threshold;

Determining location and speed of said user equipment using a plurality of said reports.

10. The network controller, as claimed in claim 8, wherein said network controller as adapted for lowering pilot strength measurement in said user equipment using at least one of

Set management parameters; or

Attribute override measurements.

11. The network controller, as claimed in claim 1, wherein said network controller is adapted for determining location of said user equipment using said plurality of reports using triangulation.

12. The network controller, as claimed in claim 8, wherein said network controller further comprises at least one means adapted for

determining proximity of said user equipment to a picocell;

determining time said user equipment is expected to be in said picocell;

and

initiating hand off of said user equipment to said picocell, if ratio of radius of said picocell to speed of said user equipment is above a second threshold.

13. The network controller, as claimed in claim 8, wherein said network controller further comprises at least one means adapted for

listing user equipments in proximity to an interfered picocell;

initiating hand off of said user equipments to said picocell, if ratio of radius of said picocell to speed of said user equipment is above a third threshold.

14. The network controller, as claimed in claim 8, wherein said network controller further comprises at least one means adapted for

- receiving a report from a macrocell of increased load;
- determining proximity of user equipments served by said microcell to a picocell;
- determining time said user equipment is expected to be in said picocell;
- and
- initiating hand off of said user equipment to said picocell.

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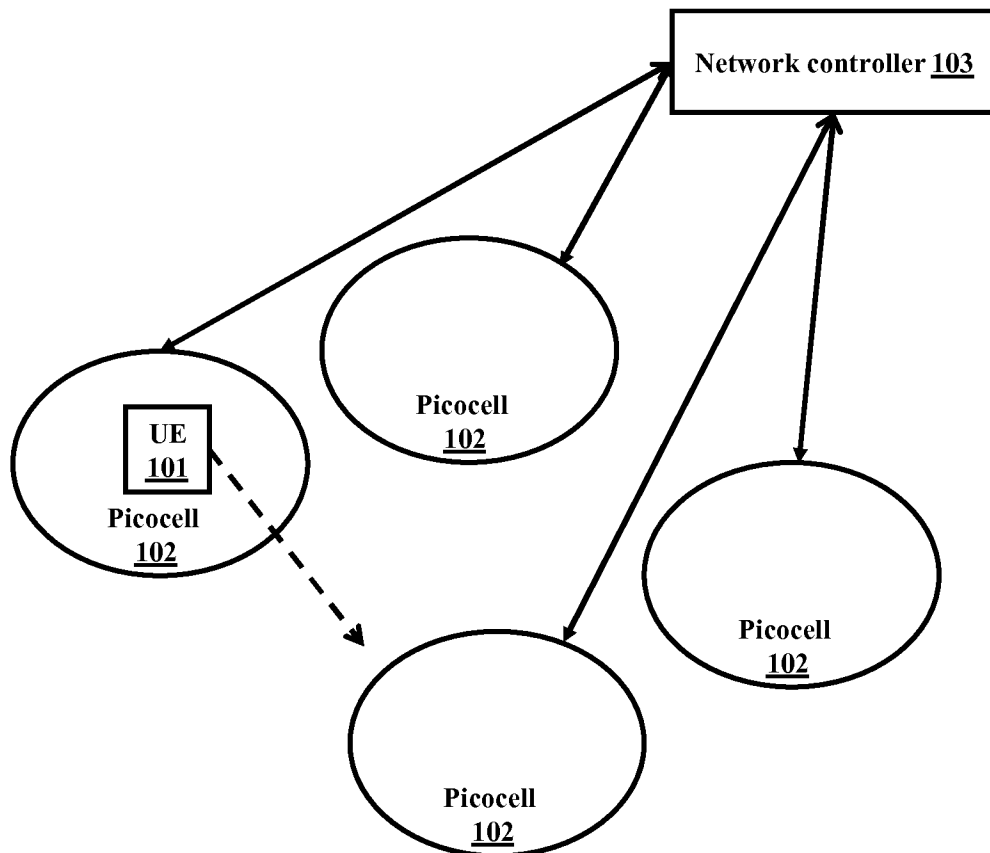


FIG-1

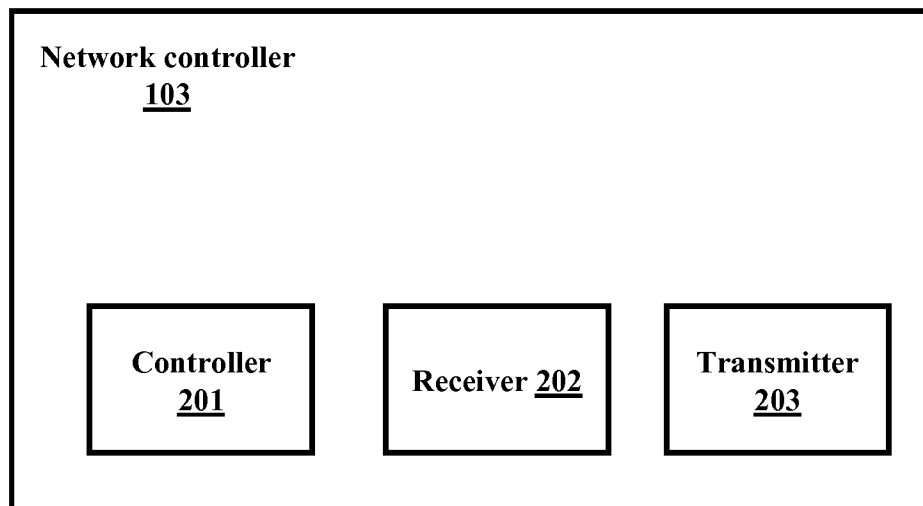


FIG. 2

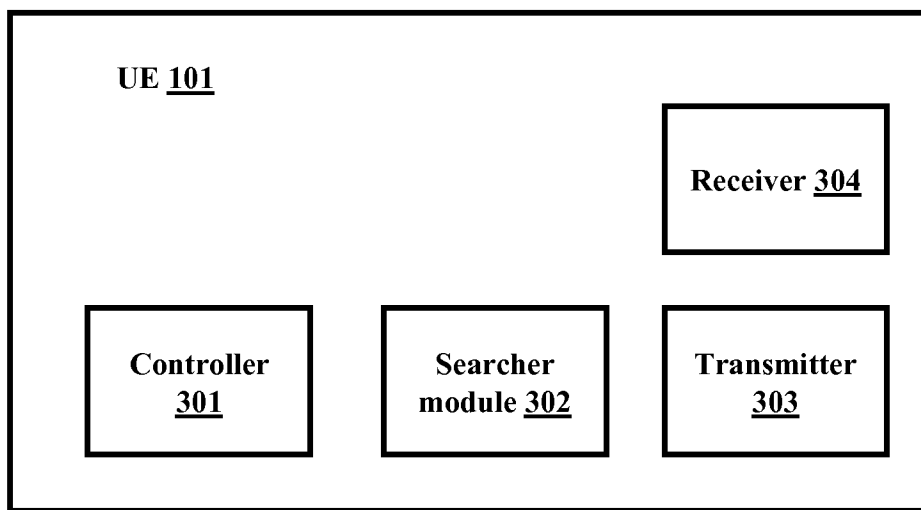


FIG. 3

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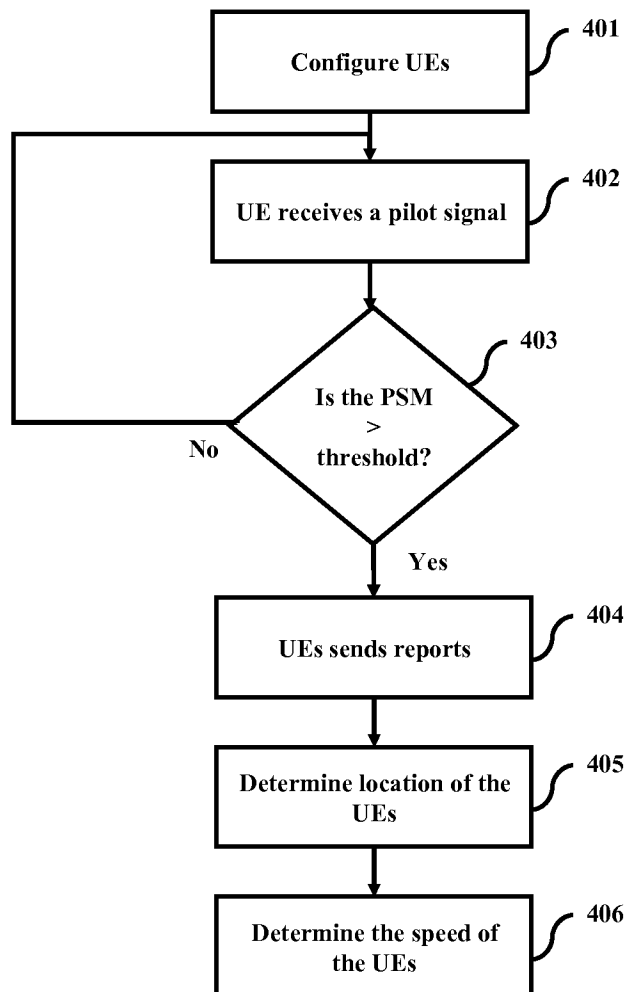


FIG. 4

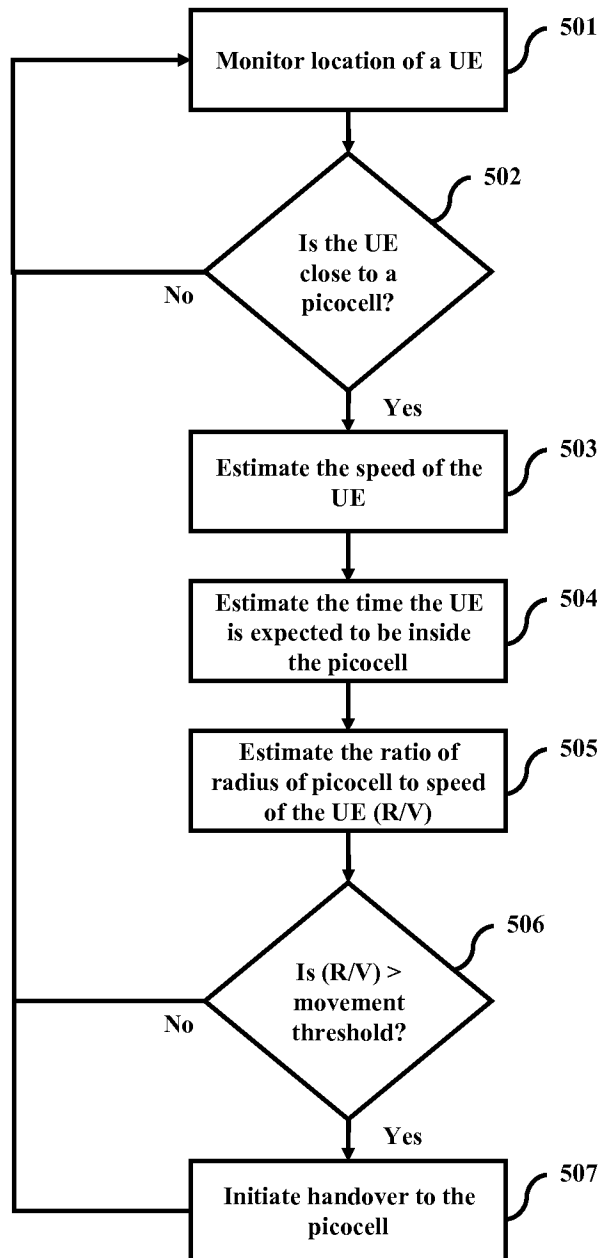


FIG. 5

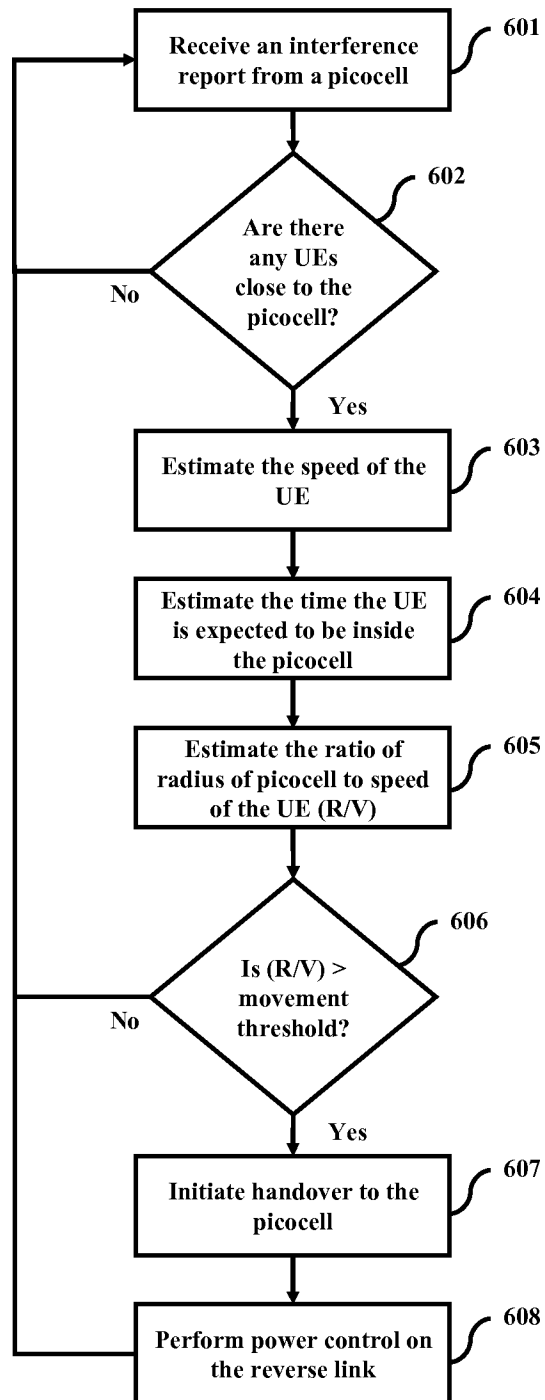


FIG. 6

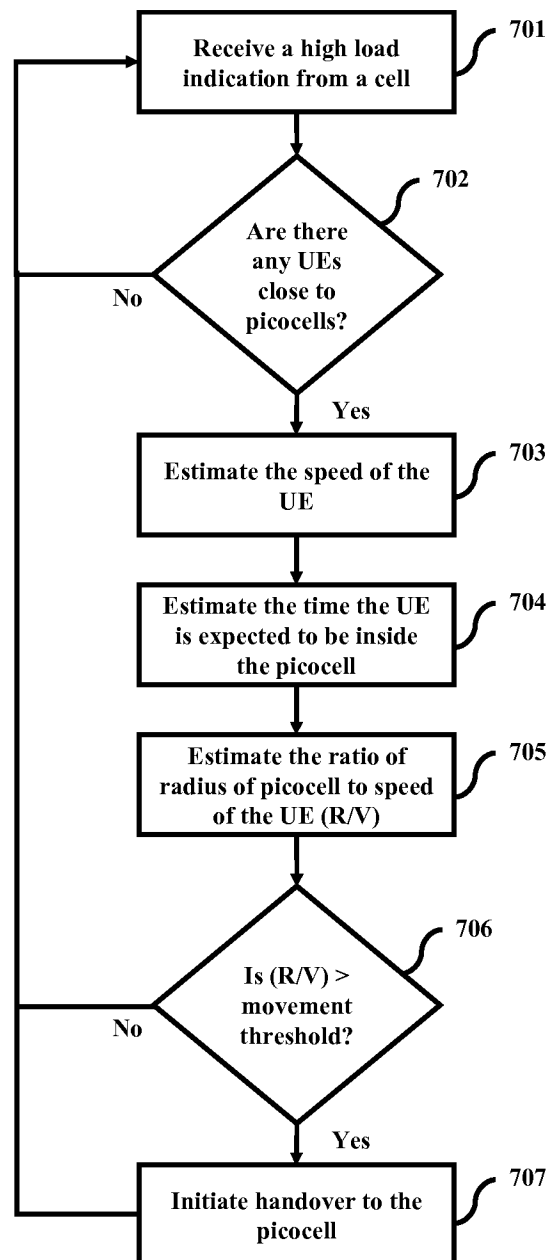


FIG. 7

INTERNATIONAL SEARCH REPORT

International application No

PCT/IB2011/003186

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04W64/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H04W

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, COMPENDEX, INSPEC, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2006/025158 A1 (LEBLANC FREDERICK W	1-5,9-11
Y	[US] ET AL) 2 February 2006 (2006-02-02) paragraphs [0004], [0081] paragraphs [0101] - [0104] paragraphs [0283], [0285] paragraphs [0287] - [0288] paragraphs [0306], [0328] - [0329] paragraphs [0410] - [0411] paragraphs [0480] - [0482] paragraphs [0486], [0586] ----- -/-	6-8, 12-14



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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Date of the actual completion of the international search

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