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WO 2009/023596 A1 **WO 2004/077711 A2**
WO 2003/076964 A1 **US 20080240008 A1**

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Other: **WPI, EPODOC**

(54) Title of the Invention: **Interference management for straddled carrier deployments**
Abstract Title: **INTERFERENCE MANAGEMENT FOR STRADDLED CARRIER DEPLOYMENTS**

(57) A method of controlling the downlink power of a basestation in a cellular communications network is provided. The method is especially relevant to small cells, such as Access Point and Femtocells. The downlink power is controlled based on a measure of the pathloss between the basestation and at least one user equipment device in a coverage area of the basestation. A plurality of pathloss measurements are made, and, for each pathloss measurement, it is determined whether the user equipment is moving or stationery at the time that the pathloss measurement is made. Only the pathloss measurements made when the user equipment is moving are used when forming the measure of the pathloss.This enables femtocell deployment in straddled carrier or co-channel carrier configurations.

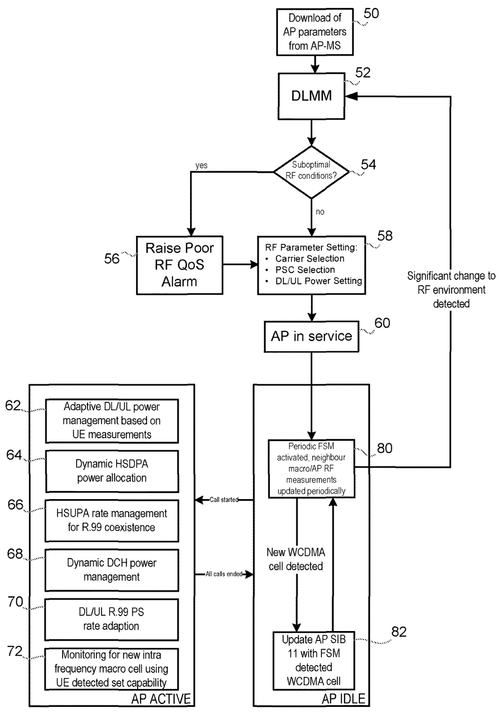

Figure 3

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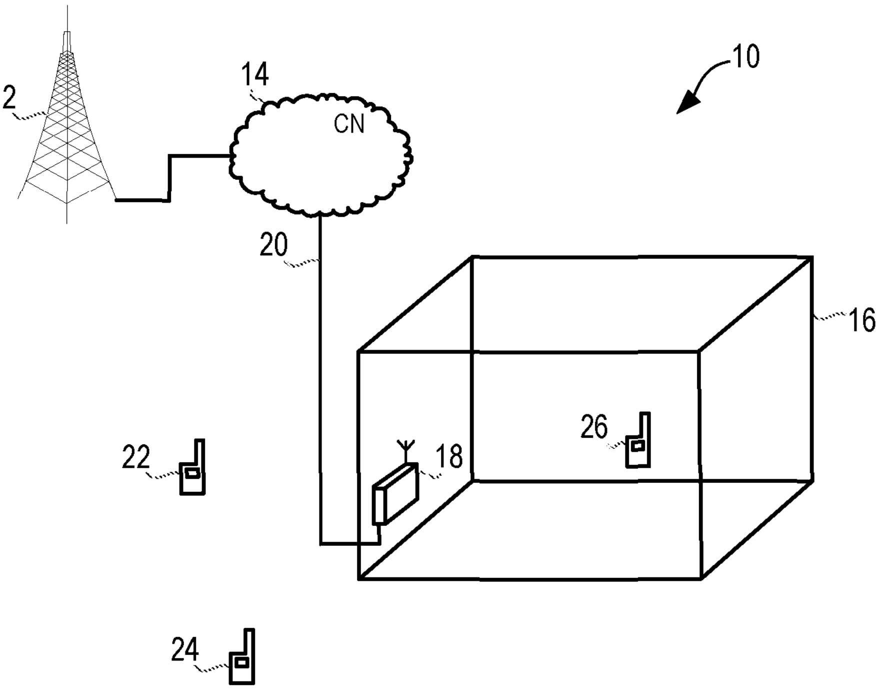

Figure 1

03 09 12

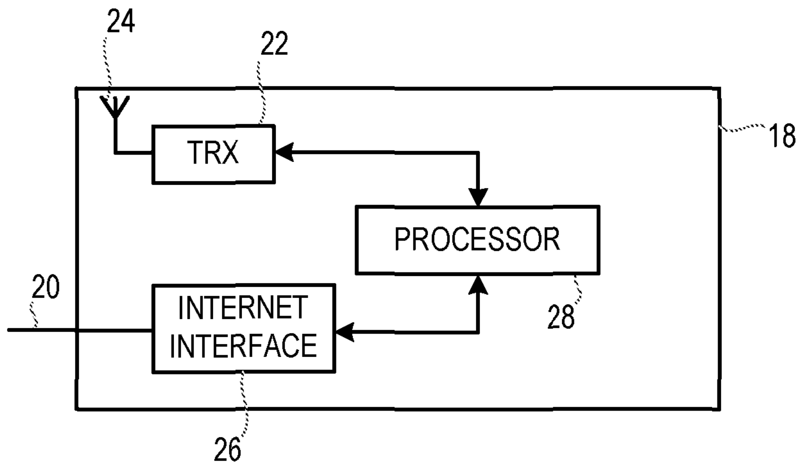

Figure 2

03 09 12

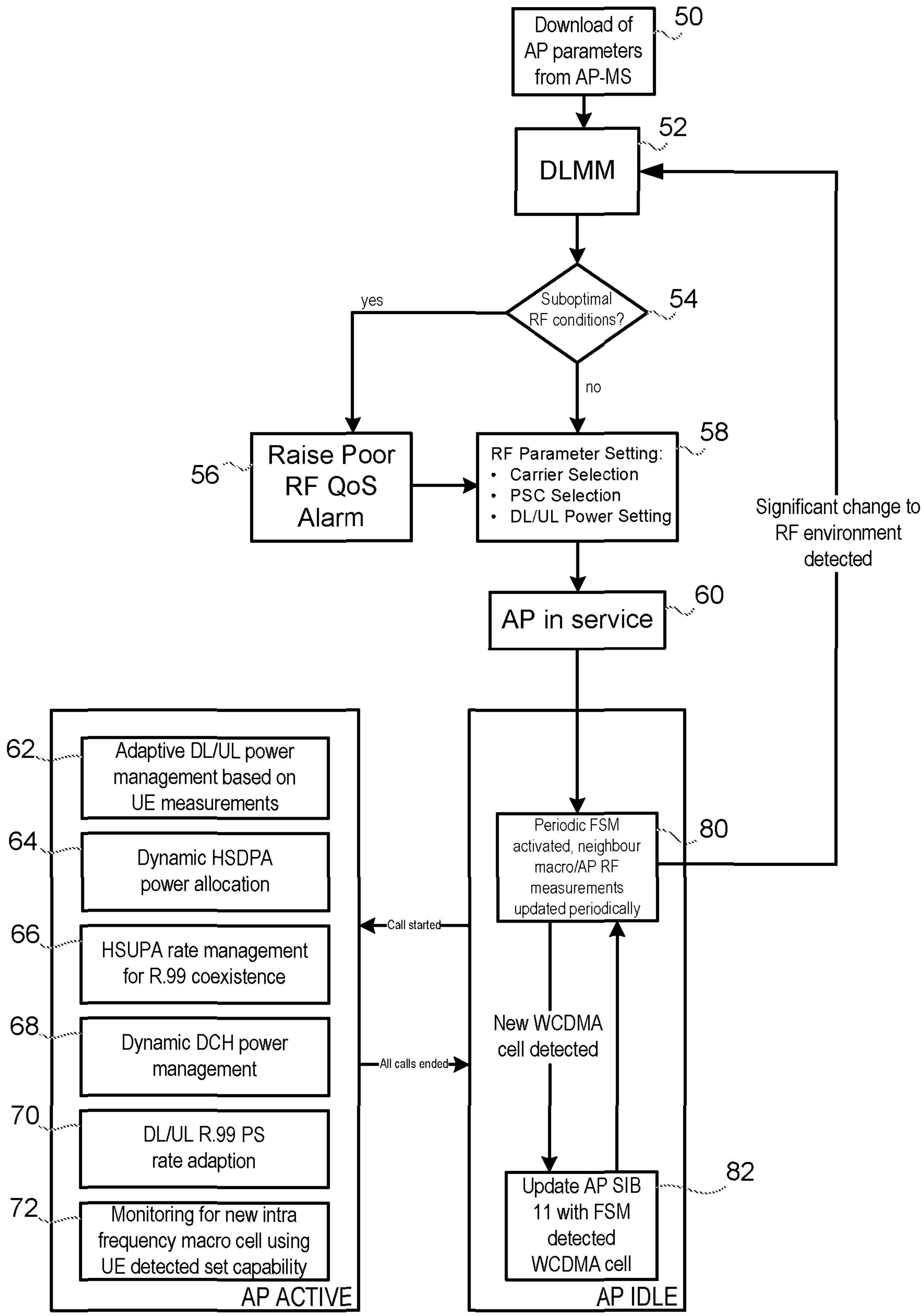

Figure 3

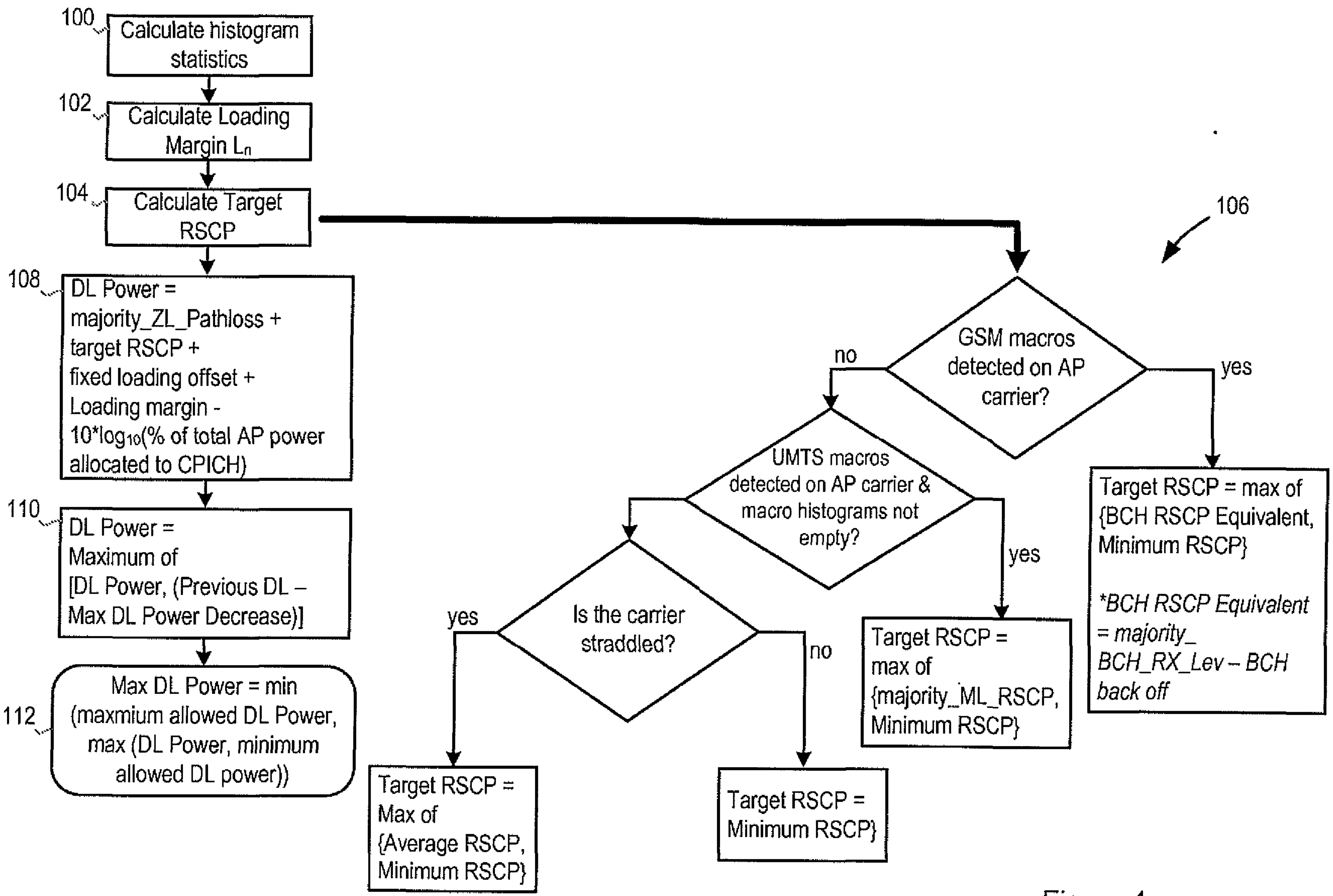

Figure 4

03 09 12

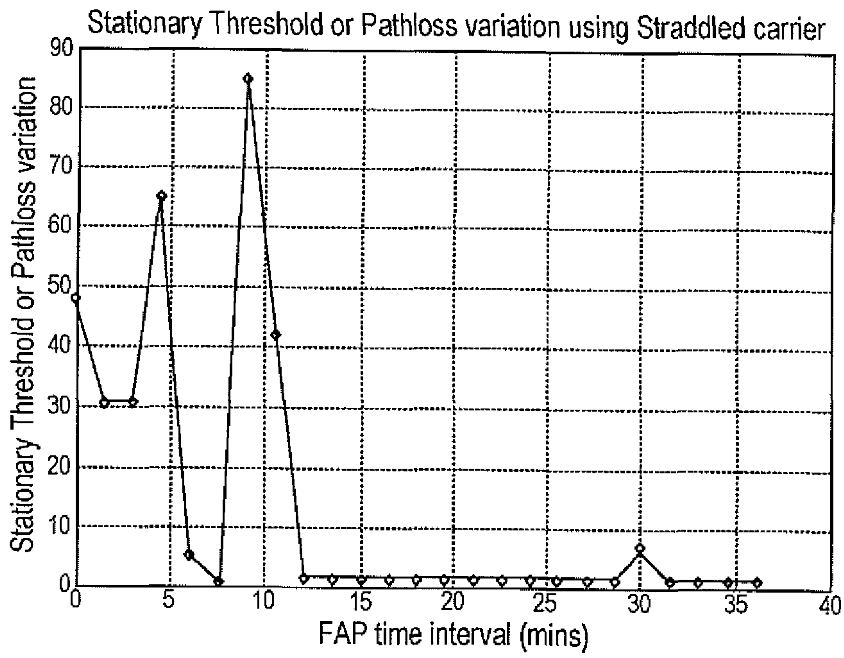
Stationary Threshold or Pathloss variation using Straddled carrier
Stationary Threshold or Pathloss variation
90
80
70
60
50
40
30
20
10
0
0
5
10
15
20
25
30
35
40
FAP time interval (mins)

Figure 5

INTERFERENCE MANAGEMENT FOR STRADDLED CARRIER DEPLOYMENTS

This invention relates to interference management, and in particular to methods and systems for setting power levels in a basestation of a cellular communications network, in order to manage levels of interference between devices in the network. The invention is particularly, though not necessarily exclusively, relevant to setting power levels in a basestation in a small cell, or in a femtocell basestation.

In many regions around the world, WCDMA (Wideband Code Division Multiple Access) mobile network operators fall broadly into two groups. The first group are those operators who have three UMTS (Universal Mobile Telecommunications System) carriers. When deploying femtocells, these operators tend to use a carrier that is either not operational or is only used in 'hot spot' or border regions. In this manner, the interference effects of deploying femtocells are considered to be minimal, assuming that the femtocells have some basic form of interference management.

The second group of operators are those that may only have two UMTS carriers and do not have the luxury of assigning a relatively unused carrier to the femtocell population. Interference management is a relevant concern for this group of operators. Operators that fall within this group might for example have a spectrum policy whereby a single UMTS Rel 99 camping carrier is deployed throughout the operator's territory, and a Rel 99 and/or HSDPA (High Speed Downlink Packet Access) capacity carrier is deployed in certain regions of the territory. In general, HSDPA enabled phones are handed over to the HSDPA carrier when a call is established, and may remain on this carrier after the call is concluded. Alternatively, in certain deployments, the user may return to the camping carrier after call termination. A 2G GSM (Global System for Mobile communications) voice layer that is also deployed throughout the region and is used to provide coverage when there is no 3G coverage.

In this spectrum configuration, there are three options available to an operator deploying femtocells, namely (a) deploying the femtocells on the Rel 99 camping carrier (b) deploying the femtocells on the HSDPA carrier or (c) deploying the femtocells straddling (i.e. midway between) the Rel 99 and HSDPA carriers. This straddling carrier deployment effectively creates a third carrier (the UMTS standard can support up to three different Universal Terrestrial Radio Access (UTRA) Absolute Radio

Frequency Channel Numbers (UARFCNs) in the Idle mode neighbour cell lists, including the serving UARFCN).

It is then desirable to set transmit powers in the femtocell that manage interference to levels that enable femtocell deployments in either straddled carrier or co-channel carrier configurations.

According to a first aspect of the present invention, there is provided a method of controlling the downlink power of a basestation in a cellular communications network, the method comprising:

controlling the downlink power based on a measure of the pathloss between the basestation and at least one user equipment device in a coverage area of the basestation;

wherein the measure of the pathloss is formed based on a plurality of pathloss measurements, and

wherein the method comprises:

making a plurality of pathloss measurements,

for each pathloss measurement, determining whether the user equipment is moving or stationary at the time that the pathloss measurement is made, and

using only the pathloss measurements made when the user equipment is moving, when forming the measure of the pathloss.

For a better understanding of the present invention, and to show how it may be put into effect, reference will now be made, by way of example, to the accompanying drawings, in which:-

Figure 1 illustrates a cellular communications network, in accordance with an aspect of the invention;

Figure 2 illustrates a femtocell basestation, in accordance with an aspect of the invention;

Figure 3 is a flow chart, illustrating an RRM configuration algorithm in accordance with an aspect of the present invention;

Figure 4 is a flow chart, illustrating a method for setting a downlink power of a femtocell basestation, in accordance with an aspect of the invention;

Figure 5 illustrates a step in the method of Figure 4.

Figure 1 shows a part of a cellular communications network 10.

Figure 1 shows a macrolayer basestation 12, having a dedicated connection in to a core network (CN) 14 of the cellular communications network. The macrolayer basestation 12 provides cellular service across a coverage area. Located in the coverage area is a building 16, which contains a femtocell basestation 18, which in this example is connected in to the core network (CN) 14 of the cellular communications network by means of an existing broadband internet connection 20. Of course, it will be appreciated that there will be many such buildings and femtocell basestations in an operational network, but the illustrated devices are sufficient for an explanation and understanding of the present invention.

User equipment (UE) devices 22, 24, such as mobile phones, smartphones, internet access devices, portable computers or the like, are located in the coverage area of the network outside the building 16, while a user equipment device 26 is located within the building 16. Of course, it will be appreciated that there will be many such UE devices in an operational network, but the illustrated devices are sufficient for an explanation and understanding of the present invention.

Figure 2 shows the femtocell basestation, or femto access point (AP), 18 in more detail. Specifically, the femtocell basestation 18 includes radio transceiver (TRX) circuitry 22. The TRX circuitry 22 detects signals received by an antenna 24. The TRX circuitry 22 is able to receive signals transmitted by UE devices on assigned system uplink (UL) frequencies, but is also able to receive signals transmitted by other basestations on assigned system downlink (DL) frequencies. The TRX circuitry 22 also converts signals into a suitable form for transmission over the radio interface.

The femtocell basestation 18 also includes an internet interface 26, for establishing the connection over the internet to the core network 14 of the cellular network.

The femtocell basestation 18 operates under the control of a processor 28, which is responsible for various functions. The operation of the processor 28 will be described herein only to the extent required for an understanding of the present invention.

In traditional cellular networks, the Mobile Network Operator (MNO) is responsible for Radio Access Network (RAN) designs which include configuration of each basestation's RF parameters such as carrier frequency, transmit power levels, DL primary scrambling codes, neighbour cell lists etc. However, for a network of femtocells that is expected to be deployed by the MNO customers in an ad hoc manner, with a deployment population that will more than likely outnumber macrolayer basestations, a different approach to deployment is required, such as automatic configuration. In addition, the femtocells are expected to coexist with the existing MNO networks, with the possibility of sharing radio resources such as carrier frequencies, and this presents a whole new set of challenges. One of the key challenges is controlling Radio Frequency (RF) interference impacts from the femto network, and this requires careful control of femtocell RF parameters, so that the positive benefits of femtocells can be realised without causing impacts to the existing macro network.

The inputs to the Radio Resource Management (RRM) auto-configuration algorithms come mainly from measurements and information derived from the femto AP's network scanning function known as the Network Listen Mode. The Network Listen Mode has two operational states, namely the Down Link Monitor Mode (DLMM) and the Fast Sniff Mode (FSM). The DLMM is typically invoked at power on to scan the surrounding 3G WCMDA and 2G GSM basestations, including neighbouring femto APs. This involves measuring signals levels, decoding broadcast channels and extracting radio frequency (RF) parameters associated with the surrounding macro network. The FSM is periodically invoked after power on when the AP is idle, to collect short samples off the downlink (WCDMA and GSM), and in the process continuously refreshing information held about macro neighbours and neighbouring APs detected during previous DLMM runs, while also building up information on any newly detected macro neighbours or neighbouring APs. In addition, the inputs to the RRM algorithms are complemented by UE measurements collected as users move around the femto AP coverage area, to help fine tune the femto APs RF parameters.

Figure 3 is a flow chart, showing a summary of the RRM process in the femtocell basestation 18, which may for example be a residential femtocell AP. On powering up, the femto AP connects to an access point management system (AP-MS) in the core network 14, runs through a series of diagnostic functions (i.e. self check, register with the management system, download most recent software load etc) and sets up its IP network configurations. Following the successful hardware and system configuration, the femto AP goes through a radio frequency (RF) auto-configuration. This auto-configuration occurs in several stages.

In a first stage, the femto AP downloads (step 50 in Figure 3) from the management system RF parameters, such as the Universal Terrestrial Radio Access (UTRA) Absolute Radio Frequency Channel Numbers (UARFCNs), the maximum and minimum allowed total DL/UL transmit power levels, and the femto AP DL primary scrambling codes. From the range of UARFCNs the femto AP uses the Downlink Monitor Mode (DLMM) of the Network Listen Mode function to detect and decode the 3G WCDMA and 2G GSM broadcast channels (BCH) of all surrounding base stations and Femto APs. The APs neighbour cell list is created from these detected cells.

In a second stage, the UARFCN carrier and primary scrambling code selection is completed, as per the RRM processes described below. This is followed by setting of the initial total downlink and uplink transmit power levels. Finally, the cell is brought up and the AP's System Information Blocks (SIBs) are updated with the 3G WCDMA and 2G GSM neighbour cell lists, as well as idle mode mobility parameters that encourage UEs to stick to the femto AP once camped on.

In a third stage, after power up, RF optimisation takes place, as described in more detail below.

Down Link Monitor Mode (DLMM) is typically activated (step 52 in Figure 3) at power up, once per day, or when a change to the surrounding 3G WCDMA environment is detected by the FSM. In the DLMM, the femto AP can determine whether RF conditions are poor (step 54 in Figure 3), and, if so, can raise an alarm in step 56. In the DLMM, the femto AP performs a cell search and measurements on all possible carriers that it is allowed to operate on, as indicated by the management system, in order to detect the nearby 3G WCDMA or 2G GSM macrocells and any collocated femto AP primary scrambling codes. Thus, the capabilities of DLMM include:

detection of surrounding WCDMA basestations, including other femto APs and GSM basestations;

Common Pilot Channel (CPICH) Received Signal Code Power (RSCP) or Relative Common Pilot Channel Energy per chip versus Noise (CPICH Ec/Io) measurements on detected surrounding WCDMA basestations and carrier received signal strength indication (RSSI) measurements;

RSSI measurements on detected surrounding GSM basestations;

extraction of cell system information from Broadcast Channels of detected WCDMA and GSM basestations, such as neighbour cells lists, cell ID, mobility parameters, CPICH transmit (Tx) Power, etc.;

calculation of frequency offsets from detected surrounding 3G WCDMA and 2G GSM macrocells, which are used to correct for frequency drift in the femto AP's local frequency reference.

The detections and measurements made in the DLMM are used as inputs to the initial auto-configuration of the femto AP's RF parameters such as UARFCN carrier, primary scrambling codes, neighbour cell lists and DL/UL power setting (step 58 in Figure 3).

When this has been completed, the access point can enter service in step 60 of Figure 3.

When the access point is active, that is, there is at least one call active, the femtocell access point can obtain information from UE measurement reports. This allows further control of RF parameters.

For example, downlink and uplink powers can be optimised (step 62 in Figure 3), based on the femto AP UE measurement reports. The optimisation aims to minimise radio frequency (RF) leakage, and dead zones, outside the intended AP coverage area, and to avoid an uplink noise rise to the surrounding macrolayer (ML) node Bs.

As another example, dynamic High Speed Downlink Packet Access (HSDPA) power allocation can be performed (step 64 in Figure 3) for active sessions, aiming to allocate as much power as possible to HSDPA sessions, depending on the current cell loading, hence ensuring optimal use of total available power.

As another example, dynamic management of a noise rise target for High Speed Uplink Packet Access HSUPA can be performed (step 66 in Figure 3), aiming to limit the HSUPA power whenever HSUPA sessions could impact Release 99 services in the uplink.

As another example, dynamic dedicated channel (DCH) power management can be performed (step 68 in Figure 3) for DCHs, aiming to ensure that total DCH power available is available to all DCHs as needed, while also ensuring fair distribution of resources across DCHs.

As another example, DL/UL radio access bearer (RAB) rate adaption can be performed (step 70 in Figure 3) for Release.99 packet switched (PS) sessions that will reconfigure RABs to a lower data rate, for example when experiencing interference, and will restore the RAB to a higher data rate at an appropriate time, for example when no longer experiencing interference.

UE measurements relating to basestations that it can detect can also be used (step 72 in Figure 3) to monitor for new macrolayer basestations on the same frequency as the femtocell.

After successful power on, Fast Sniff Mode (FSM) is activated (step 80 in Figure 3) whenever the AP is idle (i.e. there is no active voice or data session in progress). In Fast Sniff Mode, the femto AP periodically (for example, every 90 seconds) tunes to the 3G WCDMA and 2G GSM DL frequency band, and samples the DL for about 20 milliseconds. From the DL samples, it is possible to:

refresh previous signal measurements such as CPICH RSCP, CPICH Ec/Io and RSSI made on previously detected 3G WCDMA cells, 2G GSM cells and nearby femto APs;

refresh previously read WCDMA cell system information such as mobility parameters, by comparing current value tags of SIBs to their last known values;

detect the presence of new WCDMA primary scrambling codes or their disappearance;

calculate the frequency offsets from surrounding 3G WCDMA and 2G GSM macro cells, and use these to correct for frequency drift in the femto AP's local frequency reference.

The detections, measurements made and information gathered by the FSM are used to update the femto AP's RF parameters, as indicated by step 82 in Figure 3. For example, neighbour cell lists are updated if a new WCDMA macro cell is detected. If changes, or significant events, are detected in the RF environment using the Fast Sniff Mode (FSM) of the Network Listen Mode function, this could indicate that that the initial RF parameters selected are no longer optimal, and could be used to trigger a rerun of the DLMM process for auto-configuration of the parameters in question.

As described with reference to Figure 3, one element of the interference management for the femtocell is the setting of the total downlink power as a function of the surrounding macro layer interference levels.

When femtocells are deployed on the same carrier as the macro network down link, dead zones will occur, and automatic down link power adaptation is used in order to manage the size of the dead zone around each femtocell.

Using the maximum and minimum allowed total DL powers provided by the AP MS as the operating bounds, the AP will automatically and continuously adjust its DL power as shown in Figure 4. The aim of this process is that the CPICH Ec/No of the femtocell is of sufficient quality to provide adequate coverage and performance for UEs on that cell within the expected femto coverage area, while causing minimal impact to macro layer CPICH Ec/Io quality. To do this, the femtocell uses the DLMM and FSM to set the initial down link power and then uses the FSM and UE measurements to continue to adapt the down link power.

As shown in Figure 4, the process involves calculating statistics of the pathloss from the femtocell to the UE in the form of a histogram (step 100), as described in more detail below; calculating a loading margin (step 102), again as described in more detail below; and calculating a target value for the RSCP (step 104). The target value for the RSCP can be calculated in any convenient manner, but Figure 4 shows at 106 one possible way of calculating the target RSCP.

The calculation of the Down Link Power (at step 108) is then a recursive formula updated every few seconds, using this information as follows:

DL Power = Majority_ZL_Pathloss + Target_RSCP + Fixed_Loading_offset + Loading_Margin - 10*log(%power allocated to CPICH)

The Majority_ZL_Pathloss = 95th percentile of the femto cell to UE path loss. In this embodiment of the invention, these measurements are gathered in a histogram (step 100) at times when the UE is considered to be mobile and not stationary over a window of time. Further details of the mobility detector are provided below.

The Target_RSCP when deployed on a clear carrier is a minimum RSCP value (typically -105dBm, where dBm is an abbreviation for the power ratio in decibel (dB) of the measured power referenced to one milliwatt) and acts as a floor. On a carrier that is determined at power up to be occupied it is the DLMM measured value of the macro network, or the 95th Percentile of the UE reported RSCP values. When deployed on a straddled carrier, it is the average of the 95% percentile of the RSCP measurements obtained during fast sniff or DLMM on both carriers.

The Fixed_Loading_Offset is a database parameter that can be used to bias the maximum DL Transmit power.

The Loading_Margin is an additional power that is added to account for variability of the macro layer interference within the building and inter-cell interference caused by network loading. The determination of this Loading_Margin is described in more detail below.

10*log(%power allocated to CPICH) typically = -10dB when 10% of total power is allocated to the CPICH.

As described above, the calculation of the downlink power relies on statistics relating to the variations in the pathloss between the femtocell and a UE that is within the coverage area of the femtocell. The pathloss can be measured at various times, and the results used to generate these statistics. However, it is entirely possible that a UE might remain stationary at one specific location within the coverage area for considerable periods of time. If so, the pathloss measurements at that location will have an undesirably large impact on the statistics. A UE mobility detector algorithm is therefore used to detect whether a user is mobile or stationary. If a user is mobile, then the UE measurements would provide a good path loss fingerprint of the building. However, if the user is stationary, then the UE measurements would only provide the pathloss to a single point (or localized point) in the building, and would not provide a fingerprint of the pathloss throughout the expected coverage area.

The intra frequency measurements reports of the Received Signal Code Power (RSCP) and CPICH Ec/Io on the pilot channel are typically reported every second by the UE. The path-loss measurement between the UE and the femto access point is calculated by subtracting the RSCP from the CPICH transmit power of the femto. The mobility detector works by performing a stationary check on a sample set after every N^{th} sample is received. The stationary check is based on the statistical variance of the samples received. This is compared against a stationary threshold. The stationary threshold is a database parameter set at 10. The set of N samples which pass the stationary check are then used in the calculation of the Downlink femto transmit power. Figure 5 shows the simulation results for the mobility detector. The plot of the stationary variance versus the FAP operational time is shown. The period showing the peaks above 10 indicate the period when the UE was mobile and the sample are used to adapt the downlink powers. The stationary periods are also shown from 11 to 36 minutes on the horizontal axis.

The variance is calculated as:

$$\frac{1}{N}\sum_{i=1}^{N}(x_i - \bar{x})^2$$

i.e. σ^2.

In other words, the pathloss is calculated at regular intervals. Then, after every N samples, the N calculated pathloss values are compared with the mean of those N pathloss values. The N differences are squared, and the variance, or mean square difference σ^2 is formed. Then, it is determined whether that variance exceeds a threshold value. If so, it is determined that the UE was moving during the time period covered by those N samples, and the calculated pathloss values from that period are used in calculating the downlink power. If the variance does not exceed the threshold value, it is determined that the UE was not moving during the time period covered by those N samples, and the calculated pathloss values from that period are ignored in calculating the downlink power.

The threshold value can also be made adaptable. For example, if the mean path loss is large (i.e. the user is some distance from the femtocell) for a particular sample set, then it could be expected that (assuming the same user behaviour) the variance of the path loss sample would be smaller than the variance of the path loss sample set when the average is lower (i.e. user is closer to femtocell). Such variability is to be expected due to radio propagation differences. Hence, the algorithm could bias the threshold value downwards as the average pathloss of the sample set increases. Alternatively, the algorithm could bias the threshold value upwards as the average path loss of the sample set decreases.

Thus, the mobility detector is used to obtain an improved pathloss fingerprint of the coverage area of the FAP. The pathloss statistics obtained from the process are then used to dynamically adjust the femto (FAP) downlink power.

The calculation in step 108 also uses a value for a Loading Margin, as determined in step 102. That is, the adaptive down link femto cell power adaptation algorithm makes use of an ongoing downlink load margin calculation to determine the level of macro layer interference within the building. Although applicable to all spectrum deployments (clear carrier, occupied carrier and straddled carrier) this solution is of particular importance for a straddled carrier deployment as there is no macro layer RSCP measurement to provide an interference reference. The calculation uses an X/Y clustering type algorithm, which excludes the effect of intra-cell loading and only reacts to the inter-cell interference. Intra-cell interference is essentially negated by the Orthogonal Variable Spreading Factor (OVSF) code orthogonality on the down link of a small cell.

As mentioned above, the load margin calculation uses a X/Y cluster algorithm which is based on a combination of the 90% Transmit Code Power (referred to below as the majority_Tx_code_power) and the CPICH Ec/No (referred to below as the Majority_ZL_EcNo) measurements to determine the appropriate load margin. In this embodiment, there are three load margins (low, medium or high) that can be used.

Specifically, this always ensures that additional load margin is used when the majority femtocell CPICH Ec/No drops below the specified target CPICH Ec/No, and the transmit code power saturates above the target allowed transmit code power for a particular service or an average over a range of services.

The target CPICH Ec/No and the target transmit code power are typically set as database parameters. Alternatively, the target transmit code power could also be calculated adaptively as a function of femtocell loading. The Transmit Code Power histogram (from whence the 90% is calculated) is gathered from layer 1 DL DCH code power measurements gathered across all calls – irrespective of service.

As an example, if there is a large variance in the average ML interference relative to the FSM interference levels measured at the femto cell, then it is expected that the femto cell CPICH Ec/Io would be poor, and additional DL DCH code power would be required to achieve the 90% coverage target. Furthermore, if the macro layer cell loading increases then this could also result in an increase in required DCH code power and degraded CPICH Ec/Io.

The behaviour of the X/Y load margin cluster algorithm follows this set of rules:

if (Majority_ZL_EcNo < Min_EcNo) and (majority_Tx_code_power > =target transmit code power); Load_margin = High_Loadmargin;
elseif (Majority_ZL_EcNo < Min_EcNo) and (majority_Tx_code_power < target transmit code power); Load_margin = Medium_Loadmargin;
elseif (Majority_ZL_EcNo > Min_EcNo) and (majority_Tx_code_power) < target transmit code power); Load_margin = Low_Loadmargin;
elseif (Majority_ZL_EcNo >Min_EcNo) and (majority_Tx_code_power >= target transmit code power); Load_margin = Low_Loadmargin;
end;

Having calculated a target value for the downlink power in step 108, step 110 calculates a desired value, using a maximum value for the downlink power decrease, so that the desired value does not fluctuate excessively. Then, in step 112, the maximum downlink power value is set, to ensure that the desired value falls between the maximum and minimum allowed values obtained from the management system.

There is thus described a process for setting a maximum downlink power that allows service to be provided throughout the coverage area of the femtocell, without causing undue interference with other basestations.

CLAIMS

1. A method of controlling the downlink power of a basestation in a cellular communications network, the method comprising:

controlling the downlink power based on a measure of the pathloss between the basestation and at least one user equipment device in a coverage area of the basestation;

wherein the measure of the pathloss is formed based on a plurality of pathloss measurements, and

wherein the method comprises:

making a plurality of pathloss measurements,

for each pathloss measurement, determining whether the user equipment is moving or stationary at the time that the pathloss measurement is made, and

using only the pathloss measurements made when the user equipment is moving, when forming the measure of the pathloss.

2. A method as claimed in claim 1, wherein the step of determining whether the user equipment is moving or stationary at the time that the pathloss measurement is made comprises:

forming a measure of a statistical variance of a series of pathloss measurements taken during a time period, and

determining that the user equipment is moving during the time period if the measure of the statistical variance is greater than a threshold value, or determining that the user equipment is stationary during the time period if the measure of the statistical variance is smaller than the threshold value.

3. A method as claimed in claim 2, further comprising:

adapting the threshold value based on the pathloss measurements.

4. A method as claimed in claim 3, further comprising:

setting a higher threshold value when the pathloss measurements indicate that the pathloss is low, and a lower threshold value when the pathloss measurements indicate that the pathloss is high.

5. A method as claimed in any preceding claim, wherein the measure of the pathloss comprises a pathloss value that is exceeded by a predetermined percentage of the pathloss measurements.

6. A method of controlling a downlink power of a basestation in a cellular communications network, the method comprising:

determining at a time that a pathloss from the basestation to a user equipment is measured, whether the user equipment is moving or stationary, and

using said measured pathloss in determining the downlink power, only if it is determined that the user equipment was moving during a time period in which the pathloss was measured.

7. A basestation, for use in a cellular communications network, the basestation being adapted to control its downlink power in accordance with a method as claimed in any of claims 1 to 6.

8. A computer program product, comprising a computer readable medium, containing instructions for causing the method as claimed in any of claims 1 to 6 to be performed.

9. A cellular communications network, comprising at least one basestation according to claim 7, and at least one user equipment device.

10. A user equipment device, when used in a network as claimed in claim 9.

Application No:	GB1111256.2	**Examiner:**	Mrs Emma Porter
Claims searched:	1-10 (All)	**Date of search:**	19 October 2011

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
A	-	US2008/0240008 A1 (BACKES et al) see whole document, especially paragraphs 329-355.
A	-	WO2004/077711 A2 (HAWE et al) see whole document, especially pages 11, 39, 40, 81-92.
A	-	WO03/076964 A1 (ERICSSON) see whole document, especially pages 3-6
A	-	WO2009/023596 A1 (QUALCOMM) see whole document.

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^{X} :

Worldwide search of patent documents classified in the following areas of the IPC

H04B; H04J; H04W

The following online and other databases have been used in the preparation of this search report

WPI, EPODOC

International Classification:

Subclass	Subgroup	Valid From
H04W	0052/28	01/01/2009
H04W	0052/22	01/01/2009