(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
1 April 2010 (01.04.2010)

PCT

(10) International Publication Number
WO 2010/034495 A1

(51) International Patent Classification:
H04W 24/02 (2009.01)

(21) International Application Number:
PCT/EP2009/006905

(22) International Filing Date:
24 September 2009 (24.09.2009)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
08016750.5 24 September 2008 (24.09.2008) EP

(71) Applicant *(for all designated States except US)*: **NEC EUROPE LTD.** [DE/DE]; Kurfuersten-Anlage 36, 69115 Heidelberg (DE).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: **SCHROEDER, André** [DE/DE]; Fahrgasse 4, 60311 Frankfurt (DE). **LUNDQVIST, Henrik** [SE/DE]; Roemerstrasse 18, 69115 Heidelberg (DE). **BRUNNER, Marcus** [CH/DE]; Hermann-Oberth-Weg 2, 69181 Leimen (DE). **NUNZI, Giorgio** [IT/DE]; Alte Eppelheimer Strasse 35, 69115 Heidelberg (DE).

(74) Agent: **ULLRICH & NAUMANN**; Luisenstrasse 14, 69115 Heidelberg (DE).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

(54) **Title**: METHOD AND SYSTEM FOR CONFIGURATION OF A FEMTO RADIO BASE STATION

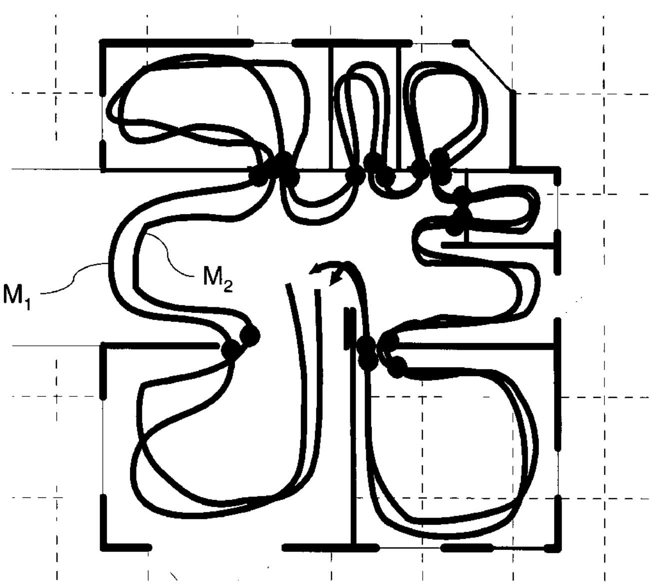

Fig. 2

(57) **Abstract**: A method for configuration of a femto radio base station, wherein a mobile terminal is provided within the transmission range of said femto radio base station, is characterized in the following steps: said mobile terminal performing measurements to identify the radio environment at the site of said femto radio base station, evaluating said measurements by means of a configuration manager under control of the operator of said femto radio base station, said configuration manager adjusting the configuration parameters of said femto radio base station on the basis of the evaluation results. Furthermore, a corresponding system for configuration of a femto radio base station is disclosed.

WO 2010/034495 A1

METHOD AND SYSTEM FOR CONFIGURATION OF A FEMTO RADIO BASE STATION

The present invention relates to a method and a system for configuration of a femto radio base station, wherein a mobile terminal is provided within the transmission range of said femto radio base station.

There is currently an interest from mobile network operators to deploy so called femtocells (also known as home base stations, home BTS, picocells, homeNBs, or femto radio base stations) which would be installed within the homes of the operators' customers (see for reference Airvana whitepaper, "Femtocells: Transforming The Indoor Experience"). Such femtocells, currently being developed and standardized for both 3G and 4G networks, are low power mobile base stations at the edge of the operator network. Installation of home BTSs will typically be handled by the customers themselves without any technical training, therefore it has to be a simple plug-and-play procedure. Home base stations are connected to a normal broadband internet connection, similar to a WiFi Access Point, but the radio interface is based on wide area cellular network standards such as WiMAX (Worldwide Interoperability for Microwave Access), UMTS (Universal Mobile Telecommunications System) or 3GPP LTE (Long Term Evolution).

One reason for the introduction of femtocells is the increase of operator network coverage for the sake of a better user experience and therewith to make a big step towards fixed-mobile-convergence. Like Wi-Fi access points, femtocells are designed to be deployed in home and office environments in order to give full coverage in the respective area and deployment of high density is expected in areas with high population or office density. However, the deployment of femtocells comes along with drawbacks of which one is interference effects between macro and femto levels of the network.

Since home BTSs are normally deployed in the same licensed spectrum as the wide area network of the operator it is important to configure the radio interface correctly to avoid interference with other base stations. It is also necessary to prevent the home BTS from being deployed in an area where the operator does not have a license to use the spectrum, at least if the spectrum is used for other purposes, or where it can interfere with the networks of other operators, for example in another country (see for reference Nortel, "UE assisted localization of home cells", 3GPP, R4-071461, August 2007).

A study of the treatment of the above mentioned effects is especially of importance since high density deployment is expected in areas with high population or office density. Femto Forum (Interference Management Scenarios: Evaluation Against 3GPP HNB, Femto Forum Working Group 2 Document, Draft v.0.1, 15-Apr-2008) and 3GPP WG4 (TR25.820 3G Home NodeB Study Item, Technical Report, v8.0.0, 2008-03) currently perform similar analyses of interference effects. The Femto Forum classifies different interference scenario types which are illustrated in connection with Fig. 1.

Fig. 1 schematically illustrates two adjacent apartments (left and right), wherein femto radio base stations are installed in each of the apartment. In the left apartment, a femtocell F_1 is positioned in the rear left room, whereas femto radio base station F_2 is located in the right apartment in the front left part. Both apartments are located within the coverage area of a macro network that is served by the Macro NodeB illustrated in Fig. 1. The Femto Forum analysed various interference scenario types, which are indicated by the arrows.

According to a first scenario, a femtocell UE (User Equipment) is assumed to be located in the right apartment near the apartment window in direct sight of the Macro NodeB, which might be a rooftop macrocell. The macrocell becomes fully loaded, while the femtocell UE is connected with the femtocell F_2 at the edge of its range, resulting in a macrocell downlink interference into the femtocell UE receiver indicated by the arrow labeled A. On the other hand, when the femtocell UE is transmitting at full power while being connected to the femtocell F_2 at the edge of its range, femtocell uplink interference to the macrocell NodeB receiver is experienced (arrow labeled D).

According to another interference scenario it is assumed that weak coverage of the macro network is obtained throughout the right apartment. A macro UE (that does not have access to the femtocell F_2) is located next to the femtocell F_2 and has a call established at full power from the macro UE device. Another device (FUE) that has ongoing call at the edge of femtocell coverage will then experience macrocell uplink interference (arrow labeled B). Further, it may be assumed that macro UE is connected to the macro network at the edge of macro coverage. It is also located in the same room as femtocell F_2 (to which it is not allowed to access). The femtocell F_2 may then be fully loaded in the downlink, thus resulting in femtocell downlink interference to the macro cell UE receiver (arrow labeled C).

The last interference scenario illustrated in Fig. 1 is a femtocell downlink and uplink interference to nearby femtocell UE receivers. According to this scenario it is assumed that the two apartments are adjacent to each other and that femtocells (F_1 and F_2) are located one within each apartment. The owner of F_2 visits their neighbor's apartment, and is on the edge of coverage of their own femtocell F_2, but very close to F_1 Then, downlink interference is likely to occur when the owner of F_1 establishes a call requiring full power from the femtocell. On the other hand, uplink interference will presumably occur when the owner of F_2 establishes a call that requires peak UE power to their own femtocell while they are located next to F_1. This kind of interferences experienced when a femto UE being located in the right apartment but being associated with the femtocell of the left apartment (both downlink and uplink) is indicated by the arrows labeled E and F.

One means to control the interference effects exemplarily described above is to adjust the maximum transmission power of femtocells. In this context, the goal is to find a good power trade-off between the maximization of femtocell coverage and the minimization of interference induced to the overall network. Even if the femtocells have a maximum limit for the transmit power it will be beneficial to determine if they can provide sufficient coverage with a lower power. This would also limit the mobility related problems when many cells become visible even if they are not accessible to other users.

Existing technology is designed to support a measurement of the radio environment at the site of the femtocell, i.e. in a specific area around the femtocell, and to visualize the respective results. To this end most existing technology uses special measurement equipment and special evaluation/visualization PC software. However, also first technologies exist that use standard commercial handsets to gather measurement probes, for instance the QuOTA Automated Wireless Test System (as described under http://www.teleres.com.au/a/722.html).

Facing the expected high number of devices that need to be deployed – unlike macro cells – operators can neither plan the deployment of each femtocell, nor can they perform respective site surveys to adjust the base station configuration appropriately. Moreover, operators do not have interest in letting users configure base stations to ensure proper use and to avoid abuse. These aspects should be considered when designing an effective configuration mechanism.

It is therefore an object of the present invention to improve and further develop a method and a system for configuration of a femto radio base station in such a way that, by employing cost-effective mechanisms that are readily to implement, an efficient and reliable configuration of the femto radio base station is achieved, wherein interferences are avoided as far as possible.

In accordance with the invention, the aforementioned object is accomplished by a method comprising the features of claim 1. According to this claim such a method is characterized in the steps of

said mobile terminal performing measurements to identify the radio environment at the site of said femto radio base station,

evaluating said measurements by means of a configuration manager under control of the operator of said femto radio base station,

said configuration manager adjusting the configuration parameters of said femto radio base station on the basis of the evaluation results.

Furthermore, the aforementioned object is accomplished by a system comprising the features of claim 16. According to this claim such a system is characterized in that said mobile terminal is configured to perform measurements to identify the radio environment at the site of said femto radio base station,

wherein a configuration manager under control of the operator of said femto radio base station is provided, said configuration manager being configured to evaluate said measurements,

said configuration manager being further configured to adjust the configuration parameters of said femto radio base station on the basis of the evaluation results.

According to the invention it has been recognized that an efficient and reliable configuration of the femto radio base station can be achieved by combining a measurement of the femtocell coverage in a user-assisted site survey and a subsequent automatic evaluation and femtocell configuration adjustment. More specifically, a mobile terminal, in particular the mobile terminal owned by the customer who is installing the femto radio base station, is positioned within the transmission range of the femto radio base station. The mobile terminal then performs various measurements that are intended to gain information about the current radio conditions at the site of the femto radio base station, for instance to find out which base stations can possibly interfere with the radio femto base station under configuration. Measurements at the site of the femto radio base station means that the measurements are performed in a certain area around the femto radio base station in which the femto radio base station is intended to be employed, for instance in an apartment, an office, etc. The mobile terminal informs a configuration manager under control of the operator of said femto radio base station of the measurement results, which are evaluated by the configuration manager and used to determine the radio configuration for the femto radio base station. Consequently, a reliable and efficient configuration of the femto radio base station is guaranteed avoiding both the deployment of any unlicensed frequencies as well as interferences with existing network components. Moreover, the installation procedure is simple and can be installed without any special technical skills of the customer since the configuration process is not in the sphere of the customer's responsibilities, but is performed remotely via the operator-controlled configuration manager. That is, the user actively takes part in the configuration of the operator network, but still the configuration is operator controlled.

The method and the system according to the present invention do not require the deployment of any dedicated measurement equipment; in fact, the entire interaction with the operator side, which is in charge of measurement evaluation and configuration adjustment, is done by the user only employing his mobile terminal. In this context, the use of the term “mobile terminal” is to be understood in a broad sense and is not intended to limit the scope of the present invention in any way. In particular, the user’s mobile terminal may be a mobile phone, a PDA, handset, a data terminal or any other device being capable of performing wireless communication. To summarize, the present invention realizes a hybrid approach of using user-performed measurements for an operator-sided automated evaluation and femtocell configuration process.

Concerning the measurements performed by a user’s mobile terminal, it is worth noting, that a user may perform these measurements actively in a dedicated measurement procedure. On the other hand, it is possible to use a “passive-measurement” method in which the mobile terminal gathers radio coverage quality measures during normal user activity. After a certain amount of time and gathered quality information, this information may be used to evaluate whether the current femto radio base station settings are appropriate or not. However, the difference to actively performed measurements is that the user does not get an overview of the distribution of signal quality in his environment and that the femto radio base station would adapt to the user’s recent behavior and used devices.

According to one embodiment of the invention various measurement points are defined and the mobile terminal is successively moved to the measurement points in order to perform measurements for identifying the radio environment at the site of the measurement points. In such point-based measurement approach distinct locations of site may be chosen as measurement points, for instance one measurement point in each room of an apartment.

According to another preferred embodiment a measurement path is defined and the mobile terminal is moved along the measurement path in order to perform the measurements for identifying the radio environment along the measurement path.

The measurement path may be a walk through an apartment including several or all rooms of the apartment.

Concerning the definition of locations, measurement points as well as measurement paths can be either specified in textual form, i.e. by entering names or using pre-defined locations (e.g. selection of rooms like kitchen, living-room, bath-room, etc. by means of using e.g. a drop-down menu installed at the mobile terminal). Alternatively or additionally, a graphical notation may be used by drawing locations on a user-sketched or loaded outline of the scenario. The drawing does not have to be exact, but it is used to give a user the hint on where he was walking along.

In a path-based approach it may further be provided that the user indicates waypoints along the path while moving the mobile terminal along that path. For instance, the waypoints could be indicated by pressing a specified bottom of the mobile terminal. In a specific embodiment it may be provided that the user indicates waypoints along the path whenever he enters and/or leaves a room of his apartment where the radio femto base station is to be installed.

According to a particularly advantageous embodiment in a first step the measurements are performed with the femto radio base station being set to a first radio configuration. In a next step the configuration of the femto radio base station is changed to at least one different second radio configuration and the measurements are repeated along basically the same path as in the first measurement. The at least two radio configurations of the femto radio base station have different settings of one or more configuration parameters. For instance, the at least two radio configurations of the femto radio base station may differ from each other with respect to the transmission power settings. Alternatively, instead of changing the radio configuration, the two measurements may be performed with the femto radio base station being positioned in different locations, e.g. in the living-room in the first measurement and in the kitchen in the second measurement.

With respect to allowing a smooth comparison of the two measurement sequences with each other, the measurement results of the at least two measurement sequences may be aligned in time and/or in space. In particular in indoor scenarios the alignment may be performed by means of the above mentioned waypoints which have been indicated along the measurement path. By using the waypoints no spatial information is required, in fact, the at least two measurement series get aligned in time, which is enough for internal evaluation. However, it is still possible to visualize the measurement results by projecting the temporal measurement sequences onto a spatial path, e.g. drawn by the user. Optionally, temporal waypoints can be projected to spatial waypoints and the measurements can be transformed accordingly to support the sequence projection.

Alternatively or additionally, the alignment between the at least two measurement sequences may be performed by means of using a Dynamic Time Warping (DTW) mechanism. For instance, a DTW mechanism that can be applied is described e.g. in S. Salvador and P. Chan, “FastDTW: Toward Accurate Dynamic Time Warping in Linear Time and Space”, in Proceedings of KDD Workshop on Mining, Temporal and Sequential Data, 2004, the entire disclosure of which is incorporated herein by way of reference.

In case of outdoor scenarios it may be provided that measurements are associated to global positioning information. To this end the mobile terminal may be equipped with means for position determination, for instance a GNSS/GPS (Global Navigation Satellite System/Global Positioning System) receiver, or the mobile terminal may be enabled to receive position information by other means. The position information can be used by the configuration manager who can assign the measurements, which were e.g. collected continuously along a measurement path, specific location information based on the received GNSS/GPS information.

With respect to achieving a set of information as significant and complete as possible it may be provided that the measurements to be performed by the mobile terminal in order to identify the radio environment at the site of the femto radio base station include multiple steps. The measurements may be basically performed as in wireless site surveys or wireless drive tests. In particular, the measurements, which may be performed on express request by the configuration manager, may include a search for neighboring cells. Moreover, the mobile terminal can be forced to make handovers to all different cells that are available in order to measure cell specific information such as cell-IDs. Additionally or alternatively, the radio spectrum may be scanned in order to find out which frequencies are used and which ones are unused. It is to be understood that the list of specified measurements is not concluding and that a skilled person may perform different kinds of measurements. Moreover, it is important to note that most of the measurements are likely to be available in the radio access standard, but additional measurements specific for home eNB (evolved NodeB) are not ruled out. Such measurements could be employed, for instance, for adapting the power of the femto radio base station on interference estimations using mobile terminal measurements.

As regards effective information delivery to the configuration manager, it may be provided that the results of the measurements are transferred to the configuration manager by means of establishing a connection between said femto radio base station and said configuration manager via the internet. In this connection the femto radio base station may employ address and security information that may be provided in connection with the delivery of the femto radio base station to a customer. For instance, the customer may be requested to enter a pin code when starting the configuration proceeding.

The results from the measurements may be used by the configuration manager to determine the best radio configuration for the femto radio base station. For example, this determination can be specified based on the information of which spectrum is used/unused as identified from the measurements or it may be based on information about the network planning of the operator. However, a combination of both methods proofs to be most suitable since that would take into account both the macro cells and neighboring femto radio base stations. In connection with evaluating an appropriate configuration for the femto radio base station the configuration manager may adapt for instance the transmission power of the femto radio base station, the bit range with which the femto radio base station is allowed to transmit data, the frequency band, and/or similar operation parameters.

Advantageously, the configuration manager may also recommend a suitable location for positioning said femto radio base station in order to achieve best possible overall performance. For instance, there may be situations in which a femto radio base station is positioned in a place where interferences are rather strong even with the transmission power of the femto radio base station set relatively low. Changing the position, e.g. by installing the femto radio base station in another room of an apartment, can significantly improve the situation in that the transmission power can be increased to a reasonable level without causing intolerable disturbances due to interferences. Additionally or alternatively, the configuration manager may recommend a suitable direction for a beneficial orientation of said femto radio base station.

There are several ways how to design and further develop the teaching of the present invention in an advantageous way. To this end, it is to be referred to the patent claims subordinate to patent claims 1 and 16 and to the following explanation of preferred examples of embodiments of the invention, illustrated by the figures. In connection with the explanation of the preferred examples of embodiments of the invention by the aid of the figures, generally preferred embodiments and further developments of the teaching will be explained. In the drawings

Fig. 1 schematically illustrates various example interference scenarios analyzed by the Femto Forum,

Fig. 2 schematically illustrates a sketch of two measurement paths with waypoints in an apartment according to an embodiment of the present invention,

Fig. 3 schematically illustrates a mapping of two measurement sequences by using waypoints according to an embodiment of the present invention, and

Fig. 4 schematically illustrates an alignment of two spatial measurement paths according to an embodiment of the present invention by using a Dynamic Time Warping mechanism.

In the following three different embodiments of the present invention will be explained in some more detail: a point-based indoor scenario, a path-based indoor scenario and a path-based outdoor scenario.

1) Point-based indoor scenario

In a point-based indoor scenario a user goes to distinct locations of site and employs his mobile terminal in order to perform point-based measurements. For instance, in case the femto radio base station is intended to be installed in the user's apartment, the user specifies one (or more) measurement points in each room of his apartment or at least in those rooms in which he whishes to employ the femto radio base station. The definition of locations can be either specified in textual form, i.e. by entering names or using pre-defined locations (e.g. selection of rooms like kitchen, living room, bath room, etc. in a drop-down menu of the user's mobile terminal). Alternatively, graphical means may be provided that enable a user to sketch the outline of the scenario on the display of his mobile terminal. The respective information on the position of the user-defined measurement points may be transferred to an operator-controlled configuration manager via the femto radio base station and the internet or wirelessly via a macrocell.

After having performed the radio quality measurements the mobile terminal transfers the measurement result to the operator network, or, more specifically, to the operator-controlled configuration manager. Based on these results the configuration manager performs evaluation of measurements, e.g. by using thresholds (for instance a minimum transmission power threshold that guarantees the customer the notion of having connectivity in every measurement point), specific conditions, cost-functions (i.e. trade-off between good coverage and an as-low-as-possible power configuration), etc.

On the basis of the evaluation results the configuration manager sets an appropriate configuration and gives feedback to the user. The feedback could indicate the user that the installation of the femto radio base station has successfully been terminated. In case of poor evaluation results that e.g. yield strong interferences with macrocells or neighbored femtocells even in case of a moderate transmission power setting, the feedback could also serve as advice to the user about testing a new location for the radio femto base station.

2) Path-based indoor scenario
Current systems either use GNSS information to trace the measurements in space or points need to be drawn by a user at which subsequent measurements are performed. This is necessary since the main purpose of current systems is to visualize the measured site. On the other hand, the method according to the present invention does not use any spatial information: According to a specific embodiment measurements get aligned in time, which is enough for internal evaluation (not considering user feedback). However, it is still possible to visualize the results by projecting the temporal measurement sequence onto a spatial path, drawn by the user. Optionally, temporal waypoints can be projected to spatial waypoints and the measurements are transformed accordingly to support the sequence projection.

Fig. 2 illustrates a user-generated sketch of an apartment in which a femto radio base station is to be installed. In a first step the user performs a first measurement M_1 along a path with power setting P_1. The path has been selected by the user himself, and it includes all rooms of the apartment, as can be obtained from Fig. 2. While moving along the path, the user indicates waypoints (in time), e.g. when entering/leaving a room. For instance, it can be provided that the waypoints are specified by pressing a certain button on the user's mobile terminal. In Fig. 2 the waypoints are indicated by the solid-filled circles. In a subsequent step the user performs a second measurement M_2 along the same path with power setting P_2, which e.g. is reduced compared to the power setting P_1 of the first measurement M_1. Again, while moving along the path, the user indicates waypoints (in time), which is done according to the same scheme as in the first measurement sequence (i.e. when entering/leaving a room, for instance).

When the configuration manager received the results of both continuous measurement sequences M_1 and M_2, he first performs an alignment of both sequences. This is necessary for the two sequences being comparable, as in practice it has to be assumed that the user had walked the path in both measurement series with at least slightly different speeds, resulting in the two measurement series being – typically irregularly – shifted against each other. A mapping of the measurement sequences is schematically illustrated in Fig. 3 where the lower curve represents the signal strength measured in the first walk along the path (M_1), and the upper curve the signal strength measured in the second walk along the path (M_2). In a specific embodiment the configuration manager aligns the measurement series in time by using Dynamic Time Warping (DTW) as well as waypoints indicated by the user along the path. The alignment by means of waypoints is shown in Fig. 3 (indicated by the dotted line arrows). In case waypoints are used, DTW can be applied to matching parts between waypoints separately, not to the entire sequence, resulting in a reduction of the computational effort. It is to be noted that different kinds of DTW mechanisms can be applied for alignment, for instance the ones described in Smith, T. F. and Waterman, M. S., (1981) Identification of common molecular subsequences. J. Mol. Biol., 147, 195-197.

After having mapped the measurement sequences to each other, the configuration manager can compare the radio quality results of both series with each other for each point along the measurement path. As can be obtained from Fig. 2, the signal strength in measurement sequence M_2 is significantly reduced compared to the signal strength in measurement sequence M_1 due to the reduced power setting during the second measurement. Consequently, as the signal strength is below a preset threshold over wide segments of the path, the configuration manager will try to realize a setting of the femto radio base station with a power setting being higher than during the second measurement sequence.

The feedback to the user is given in the same way as described in connection with the point-based indoor scenario.

3.) Path-based outdoor scenario
Due to position information being available in an outdoor campus scenario, continuously collected measurements can be associated to GNSS information. In contrast to the path-based method for indoor environments, measurements can be gathered not only over time, but they can be directly linked to geographical information. Therefore, alignment does not have to be carried out in time, but happens in space (an alignment in time resulting therefrom can be regarded as side-effect).

As described in connection with the path-based indoor scenario, the user again performs the following steps:

1. The user performs measurement M_1 along a path with power setting P_1.
2. The user performs measurement M_2 along same path with power setting P_2.
3. M_1 and M_2 are continuous measurement series that get aligned in space using Dynamic Time Warping (DTW) as illustrated in Fig. 4.
4. The configuration manager sets configuration and gives feedback to user as described above.

Many modifications and other embodiments of the invention set forth herein will come to mind the one skilled in the art to which the invention pertains having the benefit of the teachings presented in the foregoing description and the associated drawings. Therefore, it is to be understood that the invention is not to be limited to the specific embodiments disclosed and that modifications and other embodiments are intended to be included within the scope of the appended claims. Although specific terms are employed herein, they are used in a generic and descriptive sense only and not for purposes of limitation.

Claims

1. Method for configuration of a femto radio base station, wherein a mobile terminal is provided within the transmission range of said femto radio base station, characterized in the following steps:

said mobile terminal performing measurements to identify the radio environment at the site of said femto radio base station,

evaluating said measurements by means of a configuration manager under control of the operator of said femto radio base station,

said configuration manager adjusting the configuration parameters of said femto radio base station on the basis of the evaluation results.

2. Method according to claim 1, wherein various measurement points are defined, and wherein said mobile terminal is successively moved to said measurement points in order to perform said measurements for identifying the radio environment at the site of said measurement points.

3. Method according to claim 1 or 2, wherein a measurement path is defined, wherein said mobile terminal is moved along said measurement path in order to perform said measurements for identifying the radio environment along said measurement path.

4. Method according to claim 2 or 3, wherein said measurement points and/or said measurement path is specified by means of textual description, by using pre-defined locations, and/or by means of a graphical notation.

5. Method according to claim 3 or 4, wherein waypoints are indicated while moving said mobile terminal along said path.

6. Method according to any of claims 1 to 5, wherein said measurements are performed with said femto radio base station being set to a first radio configuration, and wherein said measurements are repeated with said femto radio base station being set to at least one different second radio configuration.

7. Method according to claim 6, wherein said at least two radio configurations differ from each other with respect to at least one setting parameter of the configuration of said femto radio base station, in particular with respect to the transmission power setting.

8. Method according to claim 7 or 8, wherein the measurement results of said at least two measurements are being aligned in time and/or in space.

9. Method according to claim 8, wherein said alignment is performed by means of using said waypoints.

10. Method according to claim 8 or 9, wherein said alignment is performed by means of using a Dynamic Time Warping (DTW) mechanism.

11. Method according to any of claims 1 to 10, wherein said measurements are associated to global positioning information.

12. Method according to any of claims 1 to 11, wherein said measurements performed by said mobile terminal to identify the radio environment at the site of said femto radio base station include searching for neighboring cells, making handovers to different available radio cells, scanning the radio frequency spectrum, and/or performing a location determination.

13. Method according to any of claim 1 to 12, wherein the results of said measurements are transferred to said configuration manager by means of establishing a connection between said femto radio base station and said configuration manager via the internet.

14. Method according to any of claims 1 to 13, wherein said configuration manager determines a suitable radio configuration for said femto radio base station based on information from said measurements regarding interferences and/or unused spectrum and/or based on information about the operator's network planning.

15. Method according to any of claims 1 to 14, wherein said configuration manager recommends a suitable location and/or a suitable direction to move for positioning said femto radio base station at a better place.

16. System for configuration of a femto radio base station, wherein a mobile terminal is provided within the transmission range of said femto radio base station, in particular for performing a method according to any of claims 1 to 15,
characterized in that

said mobile terminal is configured to perform measurements to identify the radio environment at the site of said femto radio base station,

wherein a configuration manager under control of the operator of said femto radio base station is provided, said configuration manager being configured to evaluate said measurements,

said configuration manager being further configured to adjust the configuration parameters of said femto radio base station on the basis of the evaluation results.

17. System according to claim 16, wherein said femto radio base station and said configuration manager are connected via the internet.

18. System according to claim 16 or 17, wherein said mobile terminal is equipped with means for specifying measurement points and/or a measurement path.

19. System according to any of claims 16 to 18, wherein said mobile terminal is equipped with means for position determination or is able to receive position information.

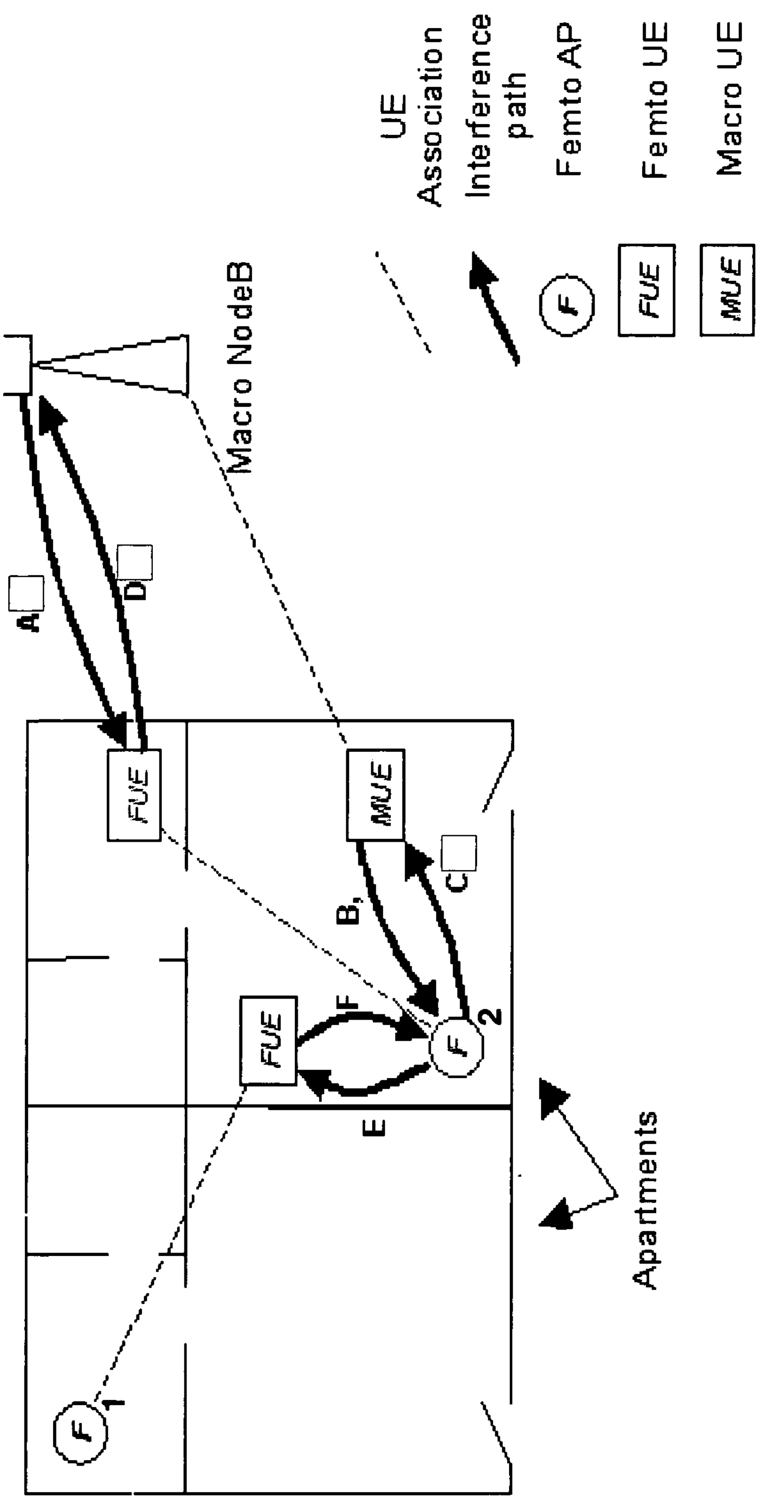
Macro NodeB
A
D
FUE
MUE
B,
C
F
E
FUE
F
2
F
1
Apartments
UE Association
Interference path
F
Femto AP
FUE
Femto UE
MUE
Macro UE

Fig. 1

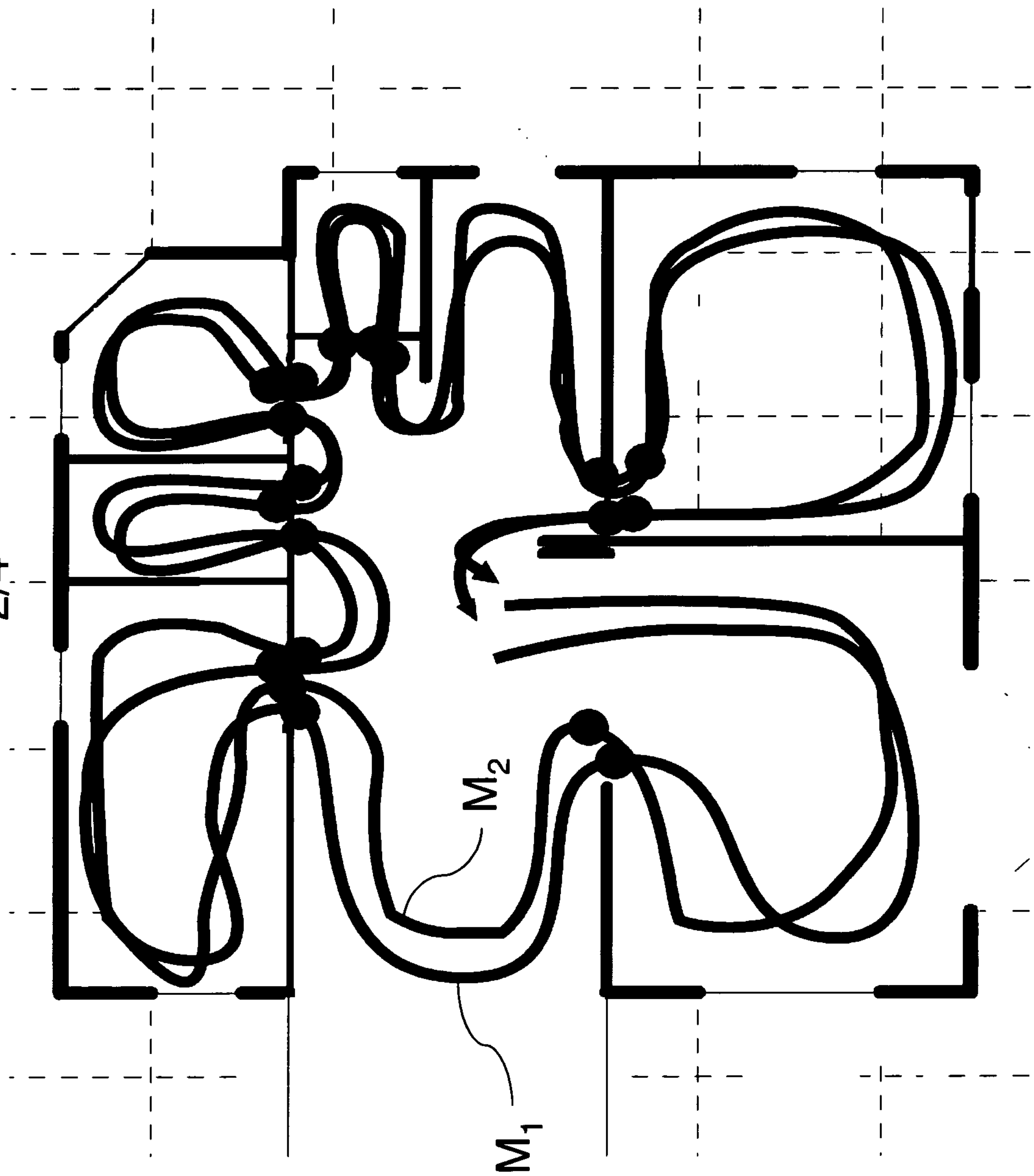

Fig. 2

3/4

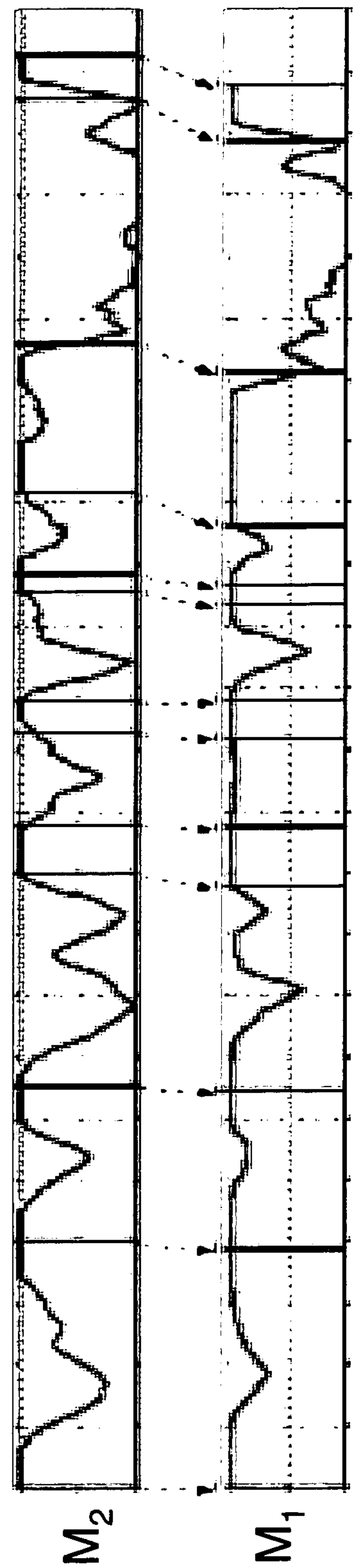

Fig. 3

4/4

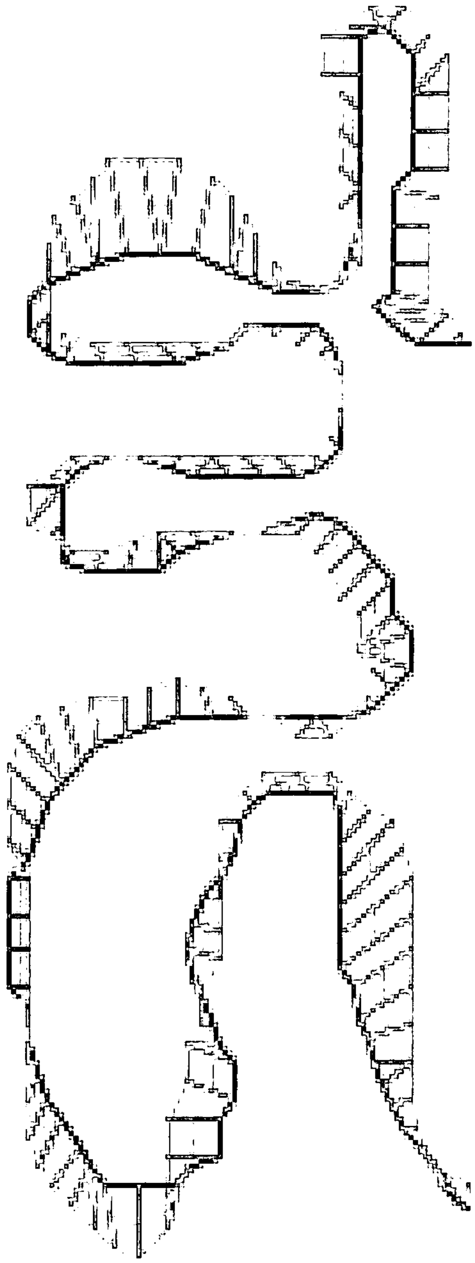

Fig. 4

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2009/006905

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04W24/02

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, 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	WO 2006/071399 A2 (MOTOROLA INC [US]; HEASER CHERYL B [US]; SMOLINSKE JEFFREY C [US]) 6 July 2006 (2006-07-06) paragraph [0010] - paragraph [0013] paragraph [0015] paragraph [0017] - paragraph [0020] claims 1-8; figures 2,3 -----	1,12,14,16

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
5 February 2010	16/02/2010

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Nogueroles Petersen

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	WO 2006/010958 A2 (RICHARDSON ANDREW [GB]) 2 February 2006 (2006-02-02) page 1, lines 12-21 page 2, lines 12-24 page 6, line 7 - page 7, line 20 page 8, lines 2-8,19-31 page 10, lines 5-15 page 10, line 25 - page 11, line 6 page 15, line 22 - page 16, line 30 page 20, line 8 - page 21, line 8; figures 2,4,5 -----	1-3,12, 14,16 1-3,12, 14,16
Y	US 2007/097939 A1 (NYLANDER TOMAS [SE] ET AL) 3 May 2007 (2007-05-03) paragraphs [0032], [0033], [0035], [0037], [0062] paragraph [0067] - paragraph [0076] claims 1,3; figures 1a-1e,2,3 -----	1-3,12, 14,16
E	WO 2009/123658 A1 (SONY ERICSSON MOBILE COMM AB [SE]; CAMP WILLIAM O [US]; COLE GARY [US]) 8 October 2009 (2009-10-08) page 1, line 10 - page 3, line 32 page 8, line 24 - page 9, line 23 page 13, lines 1-9 page 13, line 29 - page 16, line 3 claims 1-3,7,8; figures 1,5,6 -----	1,11-14, 16-17,19
A	VODAFONE ET AL: "HNB Radio Resource Management Considerations" 3GPP DRAFT; R4-081595, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE, vol. RAN WG4, no. Munich, Germany; 20080613, 13 June 2008 (2008-06-13), XP050180142 [retrieved on 2008-06-13] Sections 2 and 2.1.2 -----	1-19
A	WO 2008/093100 A2 (UBIQUISYS LTD [GB]; CARTER ALAN [GB]; WHITTAKER STEPHEN [GB]; MAIDA AM) 7 August 2008 (2008-08-07) page 1, line 21 - page 2, line 17 page 4, line 7 - page 6, line 2 page 8, lines 9-20 -----	1-19
A	US 2007/042799 A1 (JUBIN JOHN C [US] ET AL) 22 February 2007 (2007-02-22) paragraphs [0004], [0005], [0007], [0010]; figure 3 ----- -/--	1-19

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2009/006905

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 1 398 985 A2 (BROADCOM CORP [US]) 17 March 2004 (2004-03-17) paragraphs [0004] - [0006], [0018] - [0020]; figure 10 -----	1-19

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2009/006905

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2006071399 A2	06-07-2006	CN 101088251 A	12-12-2007
		US 2006140153 A1	29-06-2006
WO 2006010958 A2	02-02-2006	EP 1782551 A2	09-05-2007
		US 2008069028 A1	20-03-2008
US 2007097939 A1	03-05-2007	NONE	
WO 2009123658 A1	08-10-2009	US 2009253421 A1	08-10-2009
WO 2008093100 A2	07-08-2008	EP 2119031 A2	18-11-2009
		GB 2447439 A	17-09-2008
		US 2008188265 A1	07-08-2008
US 2007042799 A1	22-02-2007	NONE	
EP 1398985 A2	17-03-2004	US 2004054767 A1	18-03-2004
		US 2009296604 A1	03-12-2009