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(54) Titre : PROCEDE ET SYSTEME POUR OPTIMISER LES TEMPS D'ORDRE DE MARCHE ET LES PERFORMANCES DE CHANGEMENT DE CELLULE DE TERMINAUX MOBILES

(54) Title: METHOD AND ARRANGEMENT FOR OPTIMIZING THE OPERATIONAL TIMES AND CELL CHANGE PERFORMANCE OF MOBILE TERMINALS

(57) Abrégé/Abstract:
The invention at hand involves a method and an arrangement for optimizing the operational times and cell change performance of mobile terminals in a mobile communication network having adjacent radio cells. The mobile terminal temporarily stores network specific characteristics for adjacent radio cells which are not suitable for cell change when the mobile communication network is in operation and it uses said characteristics as decision criteria for cell change, and said information is used, in particular, to exclude said adjacent radio cells from additional radio technical measurements and identification methods. By implementing the terminal performance according to the inventive method, it is possible to significantly increase the operational times and the cell change performance of a mobile terminal in specific situations and to improve the service for a mobile radio customer. The inventive device can also be used for mobile terminals according to GSM or UMTS standard, and also for other radio network technology (for example, wireless LAN (W-LAN), cdma2000, WiMAX, WiBro, enhanced UTRAN, etc.).

The invention at hand involves a method and an arrangement for optimizing the operational times and cell change performance of mobile terminals in a mobile communication network having adjacent radio cells. The mobile terminal temporarily stores network specific characteristics for adjacent radio cells which are not suitable for cell change when the mobile communication network is in operation and it uses said characteristics as decision criteria for cell change, and said information is used, in particular, to exclude said adjacent radio cells from additional radio technical measurements and identification methods. By implementing the terminal performance according to the inventive method, it is possible to significantly increase the operational times and the cell change performance of a mobile terminal in specific situations and to improve the service for a mobile radio customer. The inventive device can also be used for mobile terminals according to GSM or UMTS standard, and also for other radio network technology (for example, wireless LAN (W-LAN), cdma2000, WiMAX, WiBro, enhanced UTRAN, etc.).

Method and arrangement for optimizing the operational times and cell change performance of mobile terminals.

The invention at hand involves a method and an arrangement for optimizing the operational times and cell change performance of mobile terminals, as used in a cellular mobile communication network, for example according to GSM or UMTS Standard.

In cellular mobile networks according to GSM standard as well as UMTS standard, as defined by 3GPP [www.3gpp.org], cell change occurs in so-called idle mode or in specific stages of connected mode with UMTS (URA_PCH, CELL_PCH and CELL_FACH) through mobile radio unit based cell change algorithm. The same applies to cell change in packet-based GPRS. For this cell change, the radio network informs via the so-called radio channel (BCCH) the respective terminal via potential adjacent radio cells.

The network operator is obliged to control the emitted adjacent radio cells. In this connection, quite a number of possible proximity relationships can be emitted which can include also adjacent radio cells of a different radio access technology (GSM, UMTS, cdma2000) or frequencies (for example with UMTS). Expansions for existing mobile radio technology can also allow for a disclosure of further technologies (for example WLAN, WiMAX, etc.) on the radio channel of, for example, UMTS [DE10302404A1].

The following specifications regarding prior art apply primarily to a use according to GSM and UMTS standard. According to 3GPP standard, mobile terminals are required to measure configured adjacent radio cells continuously or with a defined period type in order to initiate a potential cell change to a radio technically improved cell. The

details of this requirement are defined for GSM mobile radio units in [3GPP TS 45.008] and for UMTS mobile radio units in [3GPP TS 25.304, TS 25.133 and TS 25.331]. The above-mentioned technical specifications also describe when a cell **change** has to be performed and which criteria of the potential target cell has to be fulfilled so that a cell **change** may indeed be performed through the mobile terminal.

Moreover, these technical specifications define what further procedures must be performed after a cell **change** for example, the performance of the so-called CELL UPDATE procedure in a UMTS system for mobile terminals in RRC connected mode status CELL_PCH.

The preceding description of prior art refers only to the radio part (AS-access stratum) of a cellular mobile network.

The core network (CN) located behind the radio network provides further procedures and requirements for the performance of mobile terminals: the management of mobility of a mobile radio unit is managed according to the status of the mobile terminal through the core network or radio network, respectively (idle vs. connected mode). In the technical standards according to 3GPP, the term is MM – mobility-management in "non access stratum" (NAS). In order to manage mobility through the core network, a cellular mobile radio system is divided in so-called location areas (LA) and routing areas (RA).

If a mobile terminal registers with the core network for the first time ("attach" procedure), the location of the mobile terminal is known to the core network with the granularity of the location area. For a (vernacular) call (mobile terminated call – MTC) programmed for the mobile terminal, the CS (circuit switched) core network – here the so-called mobile switching center (MSC) -- performs a paging procedure throughout the entire location area to which the called mobile terminal has to respond with defined procures [3GPP TS 24.008].

For packet-oriented (PS) data circuits, the routing area (RA) concept is used. This mobility management principle is comparable to the location area principle. However, it is controlled by a core network element programmed for the packet-oriented data communication – the "serving gateway serving node" – SGSN. The rules and procedures

are described in detail in [3GPP TS 23.060].

A further basic principle for the CS (MCS) as well as for the PS (SGSN) is that the mobility of a mobile terminal is controlled on LA or RA granularity, respectively and, in case of a change of LA or RA, mobile terminals must inform the respective core network element (MSC or SGSN) of the change performed. These procedures are called location area update (LAU) and routing area update (RAU).

In mobile radio systems according to GSM or UMTS standard, there is also the possibility to prevent a mobile terminal from having access to specific location or routing areas through the core network (NAS). For this, the core network has the possibility of rejecting a location or routing area update of a mobile terminal, whereupon the core network informs the mobile terminal of the reason for rejection. This method is defined in [3GPP TS 24.008] and is called location registration reject.

[3GPP TS 24.008] defines also a number of reasons for rejection and the resulting consequences and requirements for a mobile terminal.

Procedures required on the part of a mobile terminal after LAU rejection are, for example, the performance of a PLMN selection upon receiving reason #13 (i.e., searching a new network operator (PLMN)), searching a different adjacent radio cell within a different location/routing area upon receiving a rejection with reasons #14, or #15, etc... For details, reference is made to [3GPP TS 24.008].

According to 3GPP specifications, the rejection of location area updates through the core network has also an effect on the performance of the mobile terminal in selecting potential target cells in the radio network:

According to TS 25.304 and TS 45.008, mobile terminals are only allowed to select an adjacent radio cell for cell change if the cell fulfills specific requirements. For instance, a cell selected as a candidate for a potential cell change must belong to the actively used PLMN (that is, it must have the same PLMN identity as the actively used cell – a special in this regard is the concept of "equivalent PLMNs" (ePLMN), which allows the mobile terminal under certain conditions to change to another PLMN as if these adjacent radio cells

would belong to the actively used PLMN [TS 24.008]).

Other necessary requirements for changing to a target cell are that the target cell may not be barred ("barred cell"), may not be reserved for one particular operator (only UMTS) ("operated reserved cell") and, finally, may not be included in the "list of forbidden location areas for roaming" [TS 25.304]. This list includes all location area identities in which a location area update for an initiated cell change has once been rejected.

A particular disadvantage of recent prior art is the fact that, neither according to GSM nor according to UMTS standard, a mobile terminal includes sufficient information about adjacent radio cells in the active cell to inhibit radio technical measurements and identification of the potential target cell.

In order to detect whether an adjacent radio cell (which has been disclosed to ALL mobile terminals as potential target for a cell change by means of cell reselection via the radio channel of the actively used cell) fulfills the necessary requirements for a cell change, the mobile terminal must synchronize with the potential target cell after its measurement and select its radio channel (BCCH) in order to extract the required information (PLMN ID of the target cell, respective location or routing area identity, "barred status," other cell characteristics, ...).

For reasons of capacity, it has been deliberately avoided to emit this information in the actual source cell. It has to be taken into consideration that, according to recent prior art, the information required for a cell change controlled by the mobile terminal is provided via the radio channel of a cell, and this information is the same for all mobile terminals located in this cell.

Consequently, according to recent prior art it is not necessarily possible to provide different mobile terminals with different proximity information via the radio channel.

It should be noted that the qualifications of the potential adjacent radio cell can be different/specific for each mobile terminal (some mobile terminals are restricted from access to certain location areas, others are not). The latter case is mainly defined from

the requirements of the network operators and can be designed differently in different mobile networks.

Pamphlet US 2002/0123348 A1 discloses a method to be used in a radio network. Said radio network features radio cells suitable to be used by cell user equipment in operation and accepted by a second operator radio network. The method features an addressing as a restricted radio cell, each radio cell of the first operator network features a competitive cell and the rejection of a utilization attempt by the cell user equipment, which is accepted by a second operator network of the rejected radio cell.

This pamphlet has the disadvantage that, in order to avoid unnecessary measurements of adjacent radio cells, no information is stored via specific target cells, which, in turn, prevents further measurements of potential target cell(s) of configured adjacent radio cells.

Pamphlet EP 1 286 561 A1 discloses a method for selection of a new geographical transmission range for a mobile radio connection, at which a radio network access receives information from a list of one or several transmission ranges, which include mobile services or no services, and the information received for requesting the service of a new transmission range are examined, at which the selection of a geographical transmission range is determined on the basis of the information received.

Also this pamphlet has the disadvantage that, in order to avoid unnecessary transmission of information, no information is stored, which, in turn, prevents further requests and transmission of potential radio network accesses for a radio connection.

The objective of the invention is to provide a method for optimizing the operational times and cell **change** performance of mobile terminals which offers the possibility that different mobile terminals use and store for cell reselection different proximity information (which are provided via radio channel).

According to the invention, this objective is achieved by a method for optimizing operational times and cell change performance of a mobile terminal in a mobile communication network having adjacent radio cells, comprising:

temporarily storing at the mobile terminal network specific characteristics for the adjacent radio cells which are not suitable for cell change when the mobile communication network is in operation;

using by the mobile terminal the characteristics as decision criteria for cell change;

storing at the mobile terminal information via specific target cells in order to avoid unnecessary measurements of at least one potential target cell, the at least one potential target cell being at least one of the adjacent radio cells and configured by a radio channel, and in order to avoid the at least one potential target cell in further identification of the adjacent radio cells.

According to one aspect of the invention there is provided a method for optimizing operational times and cell exchange performance of a mobile terminal in a mobile communication network having adjacent cells, the method comprising:

temporarily storing at the mobile terminal network specific codes for the adjacent radio cells which are not suitable for cell exchange when the mobile communication network is in operation; and

using in the mobile terminal the codes as decision criteria for cell exchange;

wherein the mobile terminal suppresses radio measurement and the procedures for code identification of cells which are not suitable as candidates for cell exchange, thereby reducing the number of measurements to be carried out by the mobile terminal during operation.

Basically the invention is based on reducing the number of measurements the activated mobile terminal has to perform and, consequently, inhibiting in particular the radio technical measurements and procedures required to identify the characteristics of cells which are not suitable candidates for cell **change.**

The invention at hand represents a significant improvement of prior art since it makes it possible to prevent radio technical measurements of adjacent radio cells if a mobile terminal according to GSM or UMTS standard has already examined the qualification as potential target cell of this adjacent radio cell and has determined that it is not suitable as target cell for this mobile terminal.

The reasons why the target cell is not suitable for the mobile terminal are listed in prior art.

In the embodiment, the suggested method applies primarily to a case in which the target cell is not suitable for cell change since access to this cell through a location or routing area update via the core network has already been rejected.

As an alternative embodiment, it can also be applied to a case in which the target cell belongs, for example, to a different PLMN, the target cell is "barred" or marked as "reserved for network operators."

The subsequent explanations describe an exemplified embodiment of the invention-based method.

A national roaming agreement between two mobile network operators with different PLMN identity within one country is used as a starting point of an embodiment of the invention-based method.

For instance, this national roaming agreement allows the customers of operator B (PLMN B) to roam in the areas of operator A (PLMN A) (that is, to make use of mobile network services of operator A), where operator B does not supply his own mobile network provisions. This embodiment also arranges, for example, that operator A operates a mobile network according to GSM as well as UMTS standard. This operator has configured his GSM network in such a way that a mobile terminal, which supports GSM as well as UMTS, automatically changes to UMTS in areas where operator A supplies UMTS provisions without a need for the mobile radio user to interfere (by UE based cell reselection). This arrangement is shown in figure 1.

The automatic change from so-called dual-mode mobile terminals (dual-mode UEs) – that is, devices supporting GSM as well as UMTS – is made possible by emitting proximity information via the UMTS network in the GSM network in areas in which an UMTS network lies above the GSM network. It has to be taken into consideration that with this parameterization typical for current combined GSM/UMTS networks ALL dual-mode UEs of cell reselection (that is, UE based cell exchanges) follow from GSM to UMTS as soon as the quality of UMTS networks is adequate.

The exemplified national roaming agreement between operator A and operator B also provides, for instance, that the customers of operator B are allowed to use the entire GSM network of operator A. However, they will not be allowed access to the UMTS section of

the network of operator A (even if the customers of operator B, who are within the network of operator A, have a dual-mode UE which principally would support access to UMTS). Consequently, the exemplified roaming agreement specifies that customers B (or only a certain number of these customers) are prevented from accessing the UMTS network of operator A.

For example, this can be achieved by inhibiting the attempt by a mobile terminal of a customer of operator B to access the UMTS network of operator A. In order to achieve this, operator A has his GSM/UMTS network configured in such a way that the cells of the GSM and UMTS networks each are in different location areas (LA) and every change from GSM to UMTS and UMTS to GSM initiates a location area update.

The core network of operator A now has the possibility to prevent, with a respective rejection code, the attempt of a customer of B to access, for example, the location areas which use UMTS technology (or even only a certain number) by rejecting the location area updates (LAU).

Present-day implementing of such rejection procedures allow for a distinction of mobile terminals, for instance, according to source (for example by means of IMSI). Thus, access can be allowed for customers of A, while customers of B are being rejected.

Consequently, prior art allows for a rejection of customer B – without UMTS access authorization – in the UMTS network of A, by rejecting LAU. However, since through configuration of cell-change-parameters all dual-mode-compatible mobile terminals in the areas in which operator A also has UMTS supply initiate cell change from GSM to UMTS (but only mobile terminals of operator A are allowed access in the target UMTS location areas), the rejected mobile terminals of operator B must abandon the cell change and remain in the original GSM cell. In this context it has to be taken into consideration that the first attempt to access is rejected through LAU reject from the target network (UMTS network of operator A). Further attempts to access of already rejected mobile terminals of operator B fail in that these LA in which the rejection took place are included in the "list of forbidden LA for roaming."

However, prior art requires of these mobile terminals that they continue to follow the cell change parameters in the original GSM cell and continue to measure radio technically potential target cells (including the configured UMTS cells of operator A). These requirements are defined in the technical specifications [TS45.008] for GSM and [3GPP TS25.304, TS25.133 and TS 25.331].

In brief, the basic disadvantage of prior art is the requirement of measuring the potential target cells according to the configuration on the radio channel of the active cell, EVEN if access to this target cell is PROHIBITED.

Consequently, in the scenario described a mobile terminal of operator B would remain in the GSM cells of operator A. However, according to the requirements in the above-mentioned specifications, it would continue to measure radio technically the UMTS target cells not suitable for this mobile terminal.

This requirement has significant negative effects on the operational times of the mobile terminal since the unnecessary measurements mean additional energy consumption for the mobile terminal.

Accordingly, the invention-based method suggests that a mobile terminal "memorizes" that access to a particular adjacent radio cell is not possible (for example, because the LAU in this cell has already been rejected). In addition to the "list of forbidden LA for roaming" mentioned above, a mobile terminal maintains an additional list in which, for instance, the cell identities of the cells ("Cell ID") or other characteristics which clearly identify an adjacent radio cell are recorded, in which an LAU failed, or in which the cells that a mobile terminal has measured, but that could not be used for a cell change because they belong to an LA which is included in the "list of forbidden LA for roaming." Examples for characteristics are, for instance, the frequency of an adjacent radio cell with GSM, the BSIC with a GSM adjacent radio cell, the scrambling code of an adjacent radio cell with UMTS, a carrier frequency with WLAN, a "SSID" with WLAN, etc. The invention-based method does not have any restriction regarding identity.

According to this, using the stored information, a mobile terminal could avoid the measurement of adjacent radio cells that are anyway not suitable candidates for cell change.

Consequently, through a restriction to actually possible adjacent radio cells, the mobile terminal could increase its operational times by avoiding unnecessary measurements.

As a result, in the preceding scenario, a mobile radio unit of customer B in the GSM network of operator A would follow cell change to UMTS. However there, because of access restrictions ("UMTS Las are not allowed for devices of B"), it would receive an LAU reject and subsequently change again to GSM.

With the invention-based method, all UMTS cells (which belong to the rejected/prohibited LA) could be discarded in the measurements to follow since a change is not allowed anyway.

The invention-based method provides a special advantage with stationary mobile terminals which remain below the prohibited UMTS supply of operator A and, consequently, can completely avoid the necessary measurements for a cell change to UMTS that is anyway ineffective.

In order to allow access into the now barred (UMTS) location areas, even after the access requirements have been changed, the invention-based method suggests that a mobile terminal memorizes the rejection of access only for a specific period of time (for example, 24h or until it is switched off).

After disconnecting the mobile terminal, which has inhibited the measurements or identification procedures of not suitable target cells, the mobile terminal resumes the measurements or identification procedures of these target cells after being connected again.

This applies also if the mobile terminal has performed a cell change to another cell.

Otherwise, the mobile terminal would continue to be denied access to the (UMTS) LA even after the agreement between operators A and B has been changed because it would not resume on its own the measurements on the original target cell (unless other requirements for deleting the "list of forbidden LA for roaming" defined in [TS 24.008] are being fulfilled).

An application of the invention is possible not only for mobile terminals according to GSM or UMTS standards. It can also be applied to other radio network technologies (for

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A method for optimizing operational times and cell exchange performance of a mobile terminal in a mobile communication network having adjacent cells, the method comprising:

temporarily storing at the mobile terminal network specific codes for the adjacent radio cells which are not suitable for cell exchange when the mobile communication network is in operation; and

using in the mobile terminal the codes as decision criteria for cell exchange;

wherein the mobile terminal suppresses radio measurement and the procedures for code identification of cells which are not suitable as candidates for cell exchange, thereby reducing the number of measurements to be carried out by the mobile terminal during operation.

2. A method according to claim 1, wherein the mobile terminal functions according to any radio standard.

3. A method according to claim 2, wherein the radio standard is IEEE 802.11, WiMAX, or WiBro.

4. A method according one of claims 1 through 3, wherein the mobile terminal is a cellular phone according to GSM or UMTS standard and excludes from further measurements or identification procedures any of the adjacent radio cells which belong to location areas in which the cellular phone has already been rejected through a reject of a "location area update."

5. A method according to one of claims 1 through 3, wherein the mobile terminal is a cellular phone according to GSM or UMTS standard and excludes from further measurements or identification procedures any of the adjacent radio cells which belong to routing areas in which the cellular phone has already been rejected through a reject of a "routing area update."

6. A method according to claim 4, wherein the cellular phone excludes from further measurements or identification procedures any of the adjacent radio cells which belong to routing areas in which the cellular phone has already been rejected through a reject of a "routing area update."

7. A method according to one of claims 4 through 6, wherein the cellular phone excludes from further measurements or identification procedures any of the adjacent radio cells which are included as being rejected in a "list of forbidden location areas for roaming."

8. A method according to one of claims 1 through 3, wherein the mobile terminal is according to WLAN standard, and excludes from further measurements or identification procedures, after having detected that they cannot be used, any of the adjacent radio cells or access points which emit non-serviceable characteristics.

9. A method according to claim 8, wherein the WLAN standard is IEEE 802.11.

10. A method according to claim 8 or 9, wherein the non-serviceable characteristics comprise an "SSID."

11. A method according to one of claims 1 through 3 and 8 through 10, wherein adjacent access points are emitted on a second radio channel of a different radio technology.

12. A method according to claim 11, wherein the different radio technology is GSM, UMTS, or cdma2000.

13. A method according to claim 1, wherein the mobile terminal is a cellular phone according to GSM or UMTS standard and excludes from further measurements or identification procedures any of the adjacent radio cells which the cellular phone has already detected as not suitable for cell change since a target cell has been classified as "barred cell."

14. A method according to claim 1, wherein the mobile terminal is a cellular phone according to GSM or UMTS standard and excludes from further measurements any of the adjacent radio cells which the cellular phone has detected as not suitable for cell change since a target cell has been classified as reserved for "operator reserved cell."

15. A method according to one of claims 1 and 8 through 11, wherein the mobile terminal is a cellular phone according to GSM or UMTS standard and excludes from further measurements or identification procedures any of the adjacent radio cells which the cellular phone has detected as not suitable for cell change since a target cell has been classified as not suitable for cell change.

16. A method according to claim 1, wherein the mobile terminal is a cellular phone according to any standard other than GSM or UMTS standard and excludes from further measurements or identification procedures any of the adjacent radio cells which it has detected as not suitable for cell change since this target cell has been classified as not suitable for cell change.

17. A method according to one of claims 1 through 16, wherein the mobile terminal, which has inhibited the measurements of not suitable target cells, will resume the measurement of these target cells after a definite period of time has elapsed.

18. A method according to claim 17, wherein the definite period of time is 24 hours.

19. A method according to one of claims 1 through 18, wherein the mobile terminal, which has inhibited the measurements or identification procedures of not suitable target cells, will resume the measurement or identification procedures of these target cells after the mobile terminal has been switched off and on again.

20. A method according to one of claims 1 through 18, wherein the mobile terminal, which has inhibited the measurements or identification procedures of not suitable target cells, will resume the measurement or identification procedures of these target cells after the mobile terminal has performed a cell change to a different cell.

21. A method according to one of claims 1 through 18, wherein the mobile terminal, which has inhibited the measurements or identification procedures of not suitable target cells, will resume the measurement or identification procedures of these target cells after the mobile terminal has received from the mobile network a dedicated message to measure these target cells.

22. A method according to one of claims 1 through 21, wherein the method is performed by a computer program having a program code on the mobile terminal.

23. A method according to one of claims 1 through 22, wherein the method involves a system for optimizing the operational times and cell change performance of mobile terminals in the mobile communication network, and the mobile terminal has at least one storage unit and/or one data processing unit which, during operation in the mobile communication network, stores and processes the data of the measurements and identification procedures performed.

24. A computer-readable storage medium having instructions thereon which, when executed by a computer processor on a mobile terminal, cause a method as defined in one of claims 1 through 23 to be executed.

25. A system for optimizing operational times and cell change performance of mobile terminals in a mobile communication network having adjacent radio cells, wherein one of the mobile terminals has at least one storage unit and/or one data processing unit which, during operation in the mobile communication network, stores and processes the data according to a method as defined in one of claims 1 through 23.

October 17, 2007

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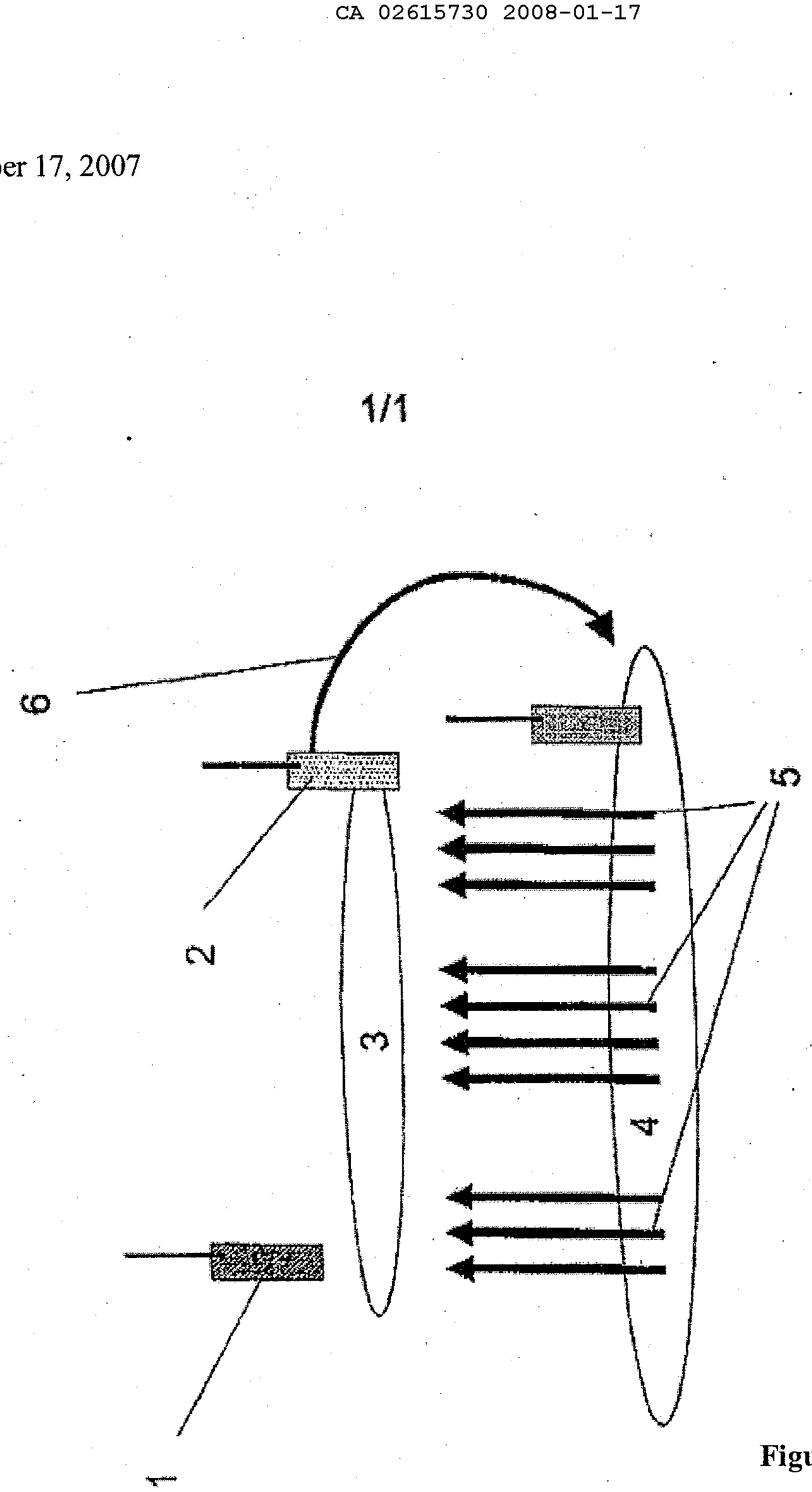

Figure 1

AMENDED SHEET

Received at the EPO on Oct. 17, 2007 08:27:02 CHANGED SHEET