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(54) BASE STATION SELECTION METHOD FOR HETEROGENEOUS OVERLAY NETWORKS

BASISSTATIONSAUSWAHLVERFAHREN FÜR HETEROGENE OVERLAY-NETZWERKE

PROCÉDÉ DE SÉLECTION DE STATION DE BASE POUR RÉSEAUX SUPERPOSÉS HÉTÉROGÈNES

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Description

TECHNICAL FIELD

[0001] This application relates to heterogeneous overlay networks and, more particularly, to seamlessly transfer a mobile station between two carriers in a heterogeneous overlay network.

BACKGROUND

[0002] The Institute of Electrical and Electronics Engineers (IEEE) has adopted a set of standards for wireless local area networks (WLANs), known as 802.11, as well a set of standards for wireless metropolitan area networks (WMANs), known as 802.16. Wireless products satisfying the 802.11 and 802.16 standards are currently on the market, for example. The term, WiFi, describes equipment satisfying the 802.11 standard. The term, WiMAX, short for worldwide interoperability for microwave access, describes equipment satisfying the 802.16 standard.

[0003] Currently being developed is an 802.16m standard, known also as "4G", "LTE-advanced", (where "LTE" means "long-term evolution") and "advanced air interface", which supports data rates of 100 megabits/second mobile and 1 gigabit/second fixed. Under the advanced air interface standard, heterogeneous networks, or "overlay networks", with potentially different cell sizes or even different radio access technologies (RAT) may be co-located in the deployment. This gives an extra degree of freedom for mobility and cell selection optimization, which was previously only based on the downlink signal strength.

[0004] Thus, there is a continuing need to provide optimal mobile station support as it travels through a heterogeneous overlay network.

[0005] Document US 2007/0129045 discloses multimode methods and devices using battery power level for selection of the modes.

SUMMARY

[0006] There is provided a method to select a serving base station of a mobile device traveling through a mobile neighbourhood as set out in claims 1, 5 and 9.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] The foregoing aspects and many of the attendant advantages of this document will become more readily appreciated as the same becomes better understood by reference to the following detailed description, when taken in conjunction with the accompanying drawings, wherein like reference numerals refer to like parts throughout the various views, unless otherwise specified.

Figure 1 is a schematic block diagram of a heterogeneous overlay network in a wireless neighborhood, according to some embodiments;

Figure 2 is a block diagram of a base station selection method executed in a wireless network and/or mobile station, according to some embodiments;

Figure 3 is a block diagram of a base station selection method, according to some embodiments;

Figure 4 is a schematic block diagram of a simplified wireless neighborhood, according to some embodiments;

Figure 5 is a flow diagram illustrating operations performed by the base station selection method of Figure 2 in performing simplified cell selection, according to some embodiments;

Figure 6 is a flow diagram illustrating operations performed by the base station selection method of Figure 2 in determining mobility of a mobile device, according to some embodiments; and

Figure 7 is a flow diagram illustrating operations performed by the base station selection method of Figure 2 in performing nuanced cell selection, according to some embodiments.

DETAILED DESCRIPTION

[0008] In accordance with the embodiments described herein, a base station selection method is disclosed to select between two base stations for connection to a mobile device in a wireless neighborhood. The wireless neighborhood may support multiple carriers and multiple radio access technologies. The base station selection method performs mobility estimation of the mobile device, where possible, to perform cell selection, but is also capable of performing cell selection without knowing the mobility of the device. Considerations such as mobile station battery level, traffic demands, and load balancing are used to make optimal selections for the mobile device as it travels through the wireless neighborhood.

[0009] Figure 1 is a schematic block diagram of a wireless neighborhood 100, according to some embodiments, for connecting a mobile device 50 to a wireless network. In the wireless neighborhood 100, a first set of base stations 30A, 30B, and 30C (collectively, "base stations 30") and a second set of base stations 40A, 40B, 40C, and 40D (collectively, "base stations 40"), are simultaneously available to a mobile device 50 that travels through the wireless neighborhood. Each base station 30, 40 has an associated coverage area 32, 42, respectively. As shown, the cell coverage areas 32 of each base station 30 overlaps with the respective cell coverage areas 42 of each base station 40, and even overlaps other base stations of the same type (e.g., cell coverage area 42 of base station 30A overlaps with cell coverage 42 area of base station 30B).

[0010] The base stations 30 appear to be larger than the base stations 40. The base stations 30 are known as macro cells and the base stations 40 are known as pico cells. In addition to generally being larger than pico cells, macro cells 30 are defined as those base stations that provide seamless mobility coverage. One example of such macro cells is a base station with a large coverage area, such as one supporting all kinds of mobile device users, from pedestrians to users on a high-speed train. In contrast, pico cells 40 are defined herein as those base stations that provide low-mobility support, such as one supporting mainly stationary/pedestrian mobile users (hotspot coverage). Macro cells 30 provide seamless mobility coverage, while pico cells 40 provide hotspot coverage or additional capacity enhancement. Although macro cells 30 are depicted in Figure 1 as being larger than pico cells 40, there may be exceptions in which the macro cells are smaller than the pico cells.

[0011] Note that the pico cells 40 may or may not be separated base stations from those macro cell base stations 30. That is, a single macro cell base station may have a small cell coexisting within its cell coverage area (as denoted schematically by ovals surrounding the base station tower). For example, in Figure 1, the cell coverage area of the base station 30A of the wireless neighborhood 100 includes two pico cells 40A and 40B; the base station 30B includes one pico cell 40D partially overlapping its coverage area; and the coverage area of the base station 30C includes one pico cell 40C.

[0012] In addition to having both macro cells 30 and pico cells 40, the wireless neighborhood 100 may also consist of different carriers. A carrier is a particular frequency in which the base station operates. Thus, in Figure 1, some base stations may operate on a first carrier frequency (e.g., 2.4 GHz with a 40 MHz bandwidth) while other base stations operate on a second carrier frequency (e.g., 700 MHz with a 22 MHz bandwidth).

[0013] In some embodiments, both the macro cells 30 and the pico cells 40 operate under the same carrier. The presence of both macro cells and pico cells provides more widespread coverage in the wireless neighborhood 100, particularly in locations where the macro cell coverage areas 32 leave coverage "holes". In other embodiments, the macro cells 30 and the pico cells operate under different carriers.

[0014] Further, the wireless neighborhood 100 may support different radio access technologies (RATs). There are several radio access technologies available to the mobile device 50, including, but not limited to; universal mobile telephone system (UMTS), long-term evolution (LTE), wireless local area network (WLAN), ultra-mobile broadband (UMB), high-speed packet access (HSPA), wideband code division multiple access (WCDMA), worldwide interoperability for microwave access (WiMAX). As used herein, the term "RAT" is intended to encompass any of these technologies and more, in other words, any type of wireless access technology. Where the wireless neighborhood 100 supports different RAT technologies simultaneously, the wireless neighborhood is known as a heterogeneous overlay network.

[0015] The mobile station or mobile device 50 may remain in a single location in the wireless neighborhood 100, or may travel through the wireless neighborhood, as indicated by the arrow. Although the mobile device 50 is depicted as a cellular phone, the mobile device 50 may instead be a smart phone, a personal digital assistant, a laptop computer, or other portable device that includes the 802.16m advanced air interface features. As used herein, the terms, "mobile station", "mobile device", "mobile device 50", or "mobile station 50" are not meant to be limited to a single mobile device type, but may represent any device that supports the advanced air interface standard. In the figures, the acronym, MS, is used to describe the mobile device.

[0016] The base station that connects the mobile device 50 to the wireless network is known as its serving base station. Where the mobile device 50 has the capability to operate under either a macro cell 30 or a pico cell 40, there are a number of possible scenarios for which base station may be deemed its serving base station as the mobile device travels through the wireless neighborhood 100. In the past, the selection of an optimum carrier and base station within the carrier was based only on the downlink signal strength. There are reasons why this limited approach may not be optimal for the mobile device 50, as described in more detail below.

[0017] Figure 2 is a block diagram of a base station selection method 200 operable in a network 80, according to some embodiments. The network 80 includes the base stations 30 and 40 as well as the mobile station 50 featured in Figure 1. A network backbone 60 includes a server system 70, a processor-based system for executing the base station selection method 200. The server system 70 includes a central processing unit (CPU) 72 and a memory 74. Once the base station selection method 200 is loaded into the memory 74, it is executable by the CPU 72. The base station selection method 200 optimally selects one of the base stations 30, 40 from the wireless neighborhood 100 for connecting the mobile station 50 to the network 80.

[0018] In addition to being executable in the network server 60, some portion of the base station selection method 200 may also be executed in a distributed fashion among the base stations 30, 40. Or, the base station selection method 200 may be run in the mobile station 50. In IEEE 802.16m, both base station-initiated handover (for which the method 200 is run in the network backbone 60 or in the base stations 30, 40) and mobile station-initiated handover (for which the method 200 is run in the mobile station 50) are allowed.

[0019] Figure 3 is a block diagram of a base station selection method 200, according to some embodiments. As a mobile device 50 travels through the wireless neighborhood 100, the base station selection method 200 chooses whether to perform a handover operation of the mobile device from a macro cell 30 to a pico cell 40, or vice-versa (e.g., change its serving base station), based on a number of criteria. The base station selection method 200 is operable in both single-carrier networks and in heterogeneous overlay networks, such as the wireless neighborhood 100 of Figure 1.

[0020] In its simplest implementation, the base station selection method 200 determines the location of the mobile device 50, either explicitly or implicitly, then selects a serving base station based on the device location. In other implementations, other considerations such as battery level of the mobile device 50 as well as traffic demands and load balancing of the wireless neighborhood 100 are considered before selecting a serving base station. While the base station selection method 200 creates a single access point for simpler wireless networks, both single access and dual access (in which the mobile device 50 uses a first base station for downlink transactions and a second base station for uplink transactions and thus has two serving base stations) are possible in heterogeneous overlay networks.

[0021] In some embodiments, the base station selection method 200 performs mobile station mobility estimation 205, using either a GPS method 210, a counting method 215, or a Doppler shift estimation method 220. Where the base station selection method 200 is unable to estimate the mobility of the mobile device 50, mobility adaptive triggers 225 may be defined without knowing the mobility of the device. Once either the mobility estimation of the device 50 is known or the mobility adaptive triggers are defined, the base station selection method 200 performs cell selection 230. In addition to being affected by whether the transmission is an uplink 255 or a downlink 250 transmission, the cell selection 230 also considers the battery level 235 of the mobile station 50, the traffic demands 240 of the network, and load balancing 245. Finally, the base station selection method 200 performs multiple-RAT cell selection based on mobile device traffic 260 in heterogeneous overlay networks. Several example wireless neighborhoods and implementations of the base station selection method 200 are described herein.

[0022] Where the base station selection method 200 indicates that a pico cell 40 is a good candidate for handover, there may be additional consideration for cell selection. In some embodiments, the macro cells 30 have higher transmit power than the pico cells 40. Thus, the downlink throughput of the macro cells 30 may be better than that of the pico cells 40, even if the mobile device 50 is closer to one of the pico cells. On the other hand, in the uplink, it may be desirable to use pico cells 40, since better uplink throughput may be achieved given fixed mobile station transmit power, allowing the mobile station to use less power and thus save battery life.

[0023] Figure 4 is a schematic block diagram of a simplified wireless neighborhood 100B, according to some embodiments. As with the heterogeneous overlay network of Figure 1, the wireless neighborhood 100B has coexisting macro cells 30 and pico cells 40 available to the mobile devices 50A and 50B. Both the macro cells 30 and the pico cells 40 are presumed to operate under a single radio access technology.

[0024] The mobile device 50A uses the pico cell 40A as its serving base station because either the device is battery constrained or is mostly running uplink traffic. The mobile device 50B attaches to the macro cell 30A as its serving base station because the device is mostly running downlink traffic (and is not battery constrained).

[0025] Figure 5 is a flow diagram showing operation of the base station selection method 200 operating in the simplified wireless neighborhood 100B of Figure 4, according to some embodiments. Where the mobile station 50 is battery constrained (block 202A), the base station selection method 200 either hands the mobile station over to or maintains a connection to the nearest adjacent pico cell 40 (block 204A). If the battery is not constrained, a determination is made whether the mobile station 50 is mostly receiving downlink transactions or issuing uplink transactions (block 206A). If the traffic is mostly downlink, attachment with the macro cell 30 is maintained or a handover from the current serving pico cell to the nearest macro cell 30 occurs (block 208A). Otherwise, the nearest pico cell 40 is the appropriate serving base station (block 204A), since the mobile station 50 is mostly engaging in uplink operations. Once the serving base station is either maintained or changed, the operations of Figure 5 are periodically repeated, in some embodiments. In this manner, the base station selection method 200 regularly obtains the current condition of the mobile device 50 with the wireless neighborhood 100B and updates its serving base station, as needed.

[0026] Implicit in the operations illustrated in Figure 5 for the simplified wireless neighborhood 100B of Figure 4 is knowing the location of the mobile device 50. Where a choice may be made between a macro cell 30 or a pico cell 40 as the serving base station, the base station selection method 200 nevertheless wants to select base stations that are closest to the mobile device 50.

[0027] In some embodiments, the base station selection method 200 also considers the mobility of the device 50. The mobility includes not just knowing the current location of the device 50, but also how quickly or slowly the device is traveling through the wireless neighborhood 100. The base station selection method 200 is capable of performing mobility estimation 205 (Figure 3) of the mobile device 50.

[0028] In some embodiments, the base station selection method 200 allows a slow-mobility mobile device 50 to attach to the pico cells 40 for load balancing and capacity enhancement. For high-mobility mobile device, the base station selection method 200 maintains the connection between the mobile device 50 and the macro cell 30, so as to avoid unnecessary handover and associated signaling overhead on both the radio access network (RAN) and on the core network 80.

[0029] One way to achieve such optimized cell selection is to explicitly consider the mobility of the mobile device 50. The base station selection method 200 considers three ways to estimate mobility: using a global positioning system (GPS) or other location service 210, counting previous mobility events 215, and performing physical layer

Doppler shift estimation 220.

[0030] The location service method 210 may employ widely available GPS or other location service information to estimate the mobility of the mobile device 50. The accuracy of such location services varies widely. For example, certain location-based services may operate using radio measurement and may have a large margin of error. Even so, the accuracy of location services may be improved upon, such as by using a history log and performing window averaging.

[0031] The second method employed by the base station selection method 200, counting previous mobility events 215, is a more rough estimation than using the location service method 210, but incurs less processing at the mobile device 50, and may be purely calculated by the network. The previous mobility events that are counted may include handover, location updates, scan reports, and so on.

[0032] The third method employed by the base station selection method 200, physical layer Doppler shift estimation 220, may be done using a tuned physical layer algorithm. From this, the mobility of the mobile device 50 may be estimated from a Doppler shift measurement taken of the channel in which transactions between the mobile device and the serving base station take place.

[0033] Once the mobility estimation is available, the base station selection method 200 may decide whether or not to allow the mobile device 50 to be handed over from a macro cell 30 to a pico cell 40, even if the pico cell is currently available (and perhaps even closer) to the mobile device. Where high mobility users incur many handover operations, this may cause an increase in the signaling load of the network. In such situations, the base station selection method 200 may keep the high-speed mobile device 50 maintaining a connection to a macro cell 30 rather than moving to a pico cell 40.

[0034] Figure 6 is a flow diagram illustrating operations of the base station selection method 200 in selecting a serving base station based on the mobility of the mobile device 50, according to some embodiments. The base station selection method 200 obtains the mobility information about the mobile device 50 (block 202B), such as using one of the mechanisms described above and illustrated in Figure 3. If the mobile device 50 is determined to be highly mobile (block 204B), the base station selection method 200 either hands the mobile device over to or maintains its attachment to the macro cell 30 (block 206B). Since the mobile device 50 is traveling through the wireless neighborhood 100 at a high rate of speed, it does not make much sense to hand the device over to a pico cell 40, then again to a macro cell 30, then again to a pico cell 40, with only its location, or, similarly, only signal strength relative to these base stations being considered. Instead, by maintaining connection to the macro cell 30 when the mobile device 50 is highly mobile, unnecessary handover and signaling overhead is avoided for the network 80.

[0035] Where the mobile device 50 is deemed a low-mobility device (block 204B), the base station selection method 200 either maintains attachment to or hands the device over to the nearest pico cell 40 (block 208B) as its serving base station. Where the mobile device 50 is first attached to a pico cell 40, the base station selection method 200 hands the device over to a macro cell 30 only where it is deemed highly mobile. The threshold for high mobility versus low mobility is determined by network operators on a case-by-case basis, and may change depending on the traffic in the wireless neighborhood 100, on the network 80, and other considerations.

[0036] The same design goal of the base station selection method 200 may be achieved in combination with mobility estimation, or even without mobility estimation, by defining mobility adaptive triggers. For example, if the base station selection method 200 wants to ensure the mobile device 50 is indeed remaining supported by the pico cell 40 having low mobility, the base station selection method 200 will configure the measurement period for this cell to average over a long enough window and only allow handover if its measurement is good enough and also varies insignificantly over time. Thus, as one example, the base station selection method 200 may obtain several measurements of the mobile device 50 over a one-minute time period. If the average of these measurements does not vary and remains high enough, then the mobile device 50 is assumed to be stationary or substantially stationary within the pico cell coverage area. Such a configuration may be mobile device-specific (as in LTE) or target-cell specific (as in WiMAX). If the mobile device 50 is deemed to be a low-mobility device, the configured cell-specific measurement will automatically classify the target pico cell 40 as a good candidate for handover, whereas, if the mobile station is deemed high-mobility, the measurement will indicate the pico cell 40 is not a good candidate for handover.

[0037] Where the base station selection method 200 is executed in the mobile station 50, to reduce mobile station complexity in terms of managing too many concurrent cell selection rules, where the network 80 is configured to optimize low mobility with a default rule already defined in the mobile station, e.g., provisioned in the device, the base station selection method 200 may choose to only configure special high-mobility optimization rules for high-mobility users. On the other hand, the network 80 may be configured to optimize high mobility, in which case the base station selection method 200 would configure special low-mobility optimization rules for low-mobility users. Thus, the base station selection method 200 is optimized depending on the characteristics of the network 80 in which the mobile device 50 operates.

[0038] A problem similar to the one being solved by the base station selection method 200 is identified in United States Patent Application No. 12/494,145, filed on June 29, 2009, entitled, "Dual Base Stations for Wireless Communication Systems" (hereinafter, "dual base stations case"). In the dual base stations case, an idealized solution is proposed in which the mobile device 50 receives a downlink operation from a macro cell 30 while transmitting uplink operations to a pico cell 40. Such "dual attach access points" proposed by the dual base stations case is quite demanding on signaling channel design and network coordination.

[0039] Instead, the base station selection method 200 is a simplified approach, because, in contrast to the dual base stations case, the current network architecture and mobile device behavior remain unchanged. The base station selection method 200 makes a decision on finding a single point of attachment for the mobile device 50, based on its need. In some embodiments, the base station selection method 200 includes one or a combination of the following input factors in determining whether to perform a handover of the mobile device to a different serving base station: battery level indication, traffic demands, and load balancing.

[0040] Battery level indication is available to the network under the advanced air interface (802.16m). Thus, the battery level of the mobile device 50, which supports the advanced air interface, is ascertainable. When the battery level of the mobile device 50 is low, the base station selection method 200 may prefer to allow the mobile station to select a pico cell 40 as its attachment point, as shown above in Figure 5.

[0041] The base station selection method 200 may monitor or obtain traffic information of the mobile device. If the mobile device 50 is mainly performing download operations and has a high quality of service (QoS) requirement (relative to throughput), the base station selection method 200 may prefer to maintain attachment of the mobile device to the macro cell 30. If the mobile device 50 is mainly performing upload operations, then the base station selection method 200 may prefer to move its attachment to the pico cell 40 as its serving base station.

[0042] As with battery level indication and traffic information, the base station selection method 200 may also be influenced by the need to balance the load of the network 80. Figure 7 is a flow diagram depicting operations of the base station selection method 200 in weighing these factors before deciding whether the serving base station of the mobile device 50 should be changed or not.

[0043] The base station selection method 200 determining whether the mobile device 50 has a high downlink quality of service requirement relative to throughput (block 202C). If so, either the serving base station is changed from a pico cell to the nearest macro cell or the attachment to the macro cell 40 is maintained (block 210C). Otherwise, the base station selection method 200 determines whether a pico cell 40 or a macro cell 30 as the serving base station would be called for under network load balancing analysis (block 204C). If network load balancing calls for moving from a macro cell 30 to a pico cell 40, the mobile device 50 is handed over to the nearest pico cell (block 206C) as its new serving base station. Otherwise, the base station selection method 200 analyzes the battery level of the mobile device 50. If the battery level does not exceed some predetermined threshold (block 208C), then the battery level is low, necessitating that the mobile device 50 stay attached to or be handed over to the nearest pico cell 40 (block 208D). Where the battery life of the mobile device 50 exceeds the predetermined threshold, attachment or handover to the macro cell 30 occurs (block 210C).

[0044] As explained above, the macro cells 30 and pico cells 40 may employ different radio access technology (RAT). Depending on deployment and network connectivity, the optimizations of the base station selection method 200 described above may be applicable for a more general heterogeneous network case.

[0045] Returning to Figure 1, the base stations 30A, 30C, 40C, and 40D are from a first RAT while the base stations 30B, 40A, and 40B are from a second RAT. In such a multi-RAT configuration, the "dual access provider" approach in the dual base stations case is actually more realistic than maintaining connectivity with two physical access points of the same radio access technology in the network (since most current network architectures do not support this). Current mobile devices typically have multiple radios, such as Bluetooth, WiFi, GSM (global system for mobile communications) 3G (third generation) and 4G(fourth generation) devices.

[0046] Further, the mobile device 50 may have multiple concurrent connections running on different RATs, a possibility that was not considered in the dual base stations case. For example, if the mobile device 50 has both WiMAX and WiFi radio simultaneously enabled, the mobile device may direct traffic with strong quality of service (QoS) requirements (e.g., in terms of latency or guaranteed bit rate) onto a WiMAX network, while directing best-effort traffic onto its Wifi network, thus prolonging the battery life of the mobile device.

[0047] Such an operation is possible today via user manual input. The base station selection method 200 allows mobile station implementation or network operation to automatically configure radio selection based on the above considerations, such that the base station selection is geared to optimize the user experience or the network operation (or both) instead of a selection being made purely from user personal preference.

[0048] Currently, mobility in heterogeneous networks is not fully optimized in today's WiMAX or LTE network. The current 4G network is optimized for single tier (macro cells only) network, assuming that most users are of low mobility. There are no specifications to enable mobility triggers that differentiates different cell types or different mobility properties of the mobile device 50.

[0049] The base station selection method 200 thus determines whether to perform a handover of a mobile device 50 between a macro cell 30 and a pico cell 40 based on an estimation of the mobile station's mobility, the battery life of the mobile station, whether the transmission is uplink or downlink, and multiple access provider association in a heterogeneous overlay network.

[0050] In the IEEE 802.16m advanced air interface standard, multiple companies introduced the concept of a cell-specific handover trigger. The motivation at that time was to trigger a fast handover to a pico cell that is covering a coverage hole. The original cell-specific handover trigger did not consider overlay handover optimization. The base station selection method 200, by contrast, is dedicated to optimizing handover operations in a heterogeneous overlay network such as the wireless neighborhood 100 in Figure 1.

[0051] While the application has been described with respect to a limited number of embodiments, those skilled in the art will appreciate numerous modifications and variations therefrom.

Claims

1. A method (200) to select a serving base station of a mobile device (50) traveling through a wireless neighborhood (100), the serving base station to be connected to a network (100), the method comprising the steps of:

    checking, by a server system (70) operable in the wireless neighborhood (100), the battery level of the mobile device (50), wherein the serving base station of the mobile device (50) is either a macro cell (30A; 30B; 30C) that supports high-mobility devices or a pico cell (40A; 40B; 40C; 40D) that provides low-mobility coverage on the network (100);
    periodically obtaining the condition of the mobile device (50);
    if the battery level does not exceed a predetermined threshold, selecting, by the server system (70), the pico cell (40A; 40B; 40C; 40D) as the serving base station of the mobile device (50), wherein the pico cell (40A; 40B; 40C; 40D) is the nearest to the mobile device (50) of a plurality of pico cells (40) in the wireless neighborhood (100); the method **characterized by** further including the steps:

        if the battery level does exceed the predetermined threshold, determining, by the server system (70), whether the mobile device (50) is receiving more downlink transactions from the serving base station than sending uplink transactions to the serving base station; and
        if the mobile device (50) is receiving more downlink transactions from the serving base station than sending uplink transactions to the serving base station, selecting, by the server system (70), the macro cell (30A; 30B; 30C) as the serving base station of the mobile device, wherein the macro cell (30A; 30B; 30C) is the nearest to the mobile device (50) of a plurality of macro cells (30) in the wireless neighborhood (100).

2. The method (200) of claim 1, further comprising:

    if the mobile device (50) is sending more uplink transactions to the serving base station than receiving downlink traffic from the serving base station, selecting, by the server system (70), the pico cell (40A; 40B; 40C; 40D) as the serving base station of the mobile device (50) in the wireless neighborhood (100).

3. The method (200) of claim 1, further comprising:

    if the plurality of macro cells (30) uses a first radio access technology, RAT, and the plurality of pico cells (40) uses a second RAT; and
    if the mobile device (50) has both the first RAT and the second RAT simultaneously enabled, then the mobile device (50) directs traffic with strong quality of service requirements onto the nearest macro cell (30A; 30B; 30C) employing the first RAT while directing best-effort traffic onto the nearest pico cell (40A; 40B; 40C; 40D) employing the second RAT, such that the mobile device (50) maintains two concurrent connections to two different base stations, wherein the dual connection of the mobile device (50) to two different RATs prolongs the battery life of the mobile device (50).

4. The method (200) of claim 1, further comprising:

    if the plurality of macro cells (30) uses a first radio access technology, RAT, and the plurality of pico cells (40) uses a second RAT; and
    if the mobile device (50) has both the first RAT and the second RAT simultaneously enabled, then
    analyzing, by the server system (70), the network based on mobility, traffic pattern, and load balancing; and
    selecting, by the server system (70), the nearest macro cell (30A; 30B; 30C) employing the first RAT as the serving base station of the mobile device (50) based on the network analysis.

5. A method (200) to select a serving base station for a mobile device (50) traveling through a wireless neighborhood (100), the serving base station to be connected to a network, the method comprising the steps of:

    checking, by the mobile device (50), the battery level of the mobile device (50), wherein the serving base station of the mobile device (50) is either a macro cell (30A; 30B; 30C) that supports

high-mobility devices or a pico cell (40A; 40B; 40C; 40D) that provides low-mobility coverage on the network;
periodically obtaining the condition of the mobile device (50);
if the battery level does not exceed a predetermined threshold, selecting; by the mobile device (50), the pico cell (40A; 40B; 40C; 40D) as the serving base station of the mobile device (50), wherein the pico cell (40A; 40B; 40C; 40D) is the nearest to the mobile device (50) of a plurality of pico cells (40) in the wireless neighborhood (100); the method **characterized by** further including the steps:
if the battery level does exceed the predetermined threshold, determining, by the mobile device (50), whether the mobile device (50) is receiving more downlink transactions from the serving base station than sending uplink transactions to the serving base station; and
if the mobile device (50) is receiving more downlink transactions from the serving base station than sending uplink transactions to the serving base station, selecting, by the mobile device (50), the macro cell (30A; 30B; 30C) as the serving base station of the mobile device (50), wherein the macro cell (30A; 30B; 30C) is the nearest to the mobile device (50) of a plurality of macro cells (30) in the wireless neighborhood (100).

6. The method (200) of claim 5, further comprising:

if the mobile device (50) is mostly sending uplink transactions to the serving base station, selecting, by the mobile device (50), the pico cell (40A; 40B; 40C; 40D) as the serving base station of the mobile device (50) in the wireless neighborhood.

7. The method (200) of claim 5, further comprising:

if the plurality of macro cells (30) uses a first radio access technology, RAT, and the plurality of pico cells (40) uses a second RAT; and
if the mobile device (50) has both the first RAT and the second RAT simultaneously enabled, then the mobile device (50) directs traffic with strong quality of service requirements onto the nearest macro cell (30A; 30B; 30C) employing the first RAT while directing best-effort traffic onto the nearest pico cell (40A; 40B; 40C; 40D) employing the second RAT, such that the mobile device (50) maintains two concurrent connections to two different base stations, wherein the dual connection of the mobile device (50) to two different RATs prolongs the battery life of the mobile device (50).

8. The method (200) of claim 5, further comprising:

if the plurality of macro cells (30) uses a first radio access technology, RAT, and the plurality of pico cells (40) uses a second RAT; and
if the mobile device (50) has both the first RAT and the second RAT simultaneously enabled, then analyzing, by the mobile device (50), the network based on mobility, traffic pattern, and load balancing; and
selecting, by the mobile device (50), the nearest macro cell (30A; 30B; 30C) employing the first RAT as the serving base station of the mobile device (50) based on the network analysis.

9. A method (200) to select a serving base station of a mobile device (50) traveling through a wireless neighborhood (100), the serving base station to be connected to a network, the method comprising the steps of:

checking, by a base station entity operating in the wireless neighborhood (100), the battery level of the mobile device, wherein the serving base station of the mobile device is either a macro cell that supports high-mobility devices or a pico cell that provides low-mobility coverage on the network;
periodically obtaining the condition of the mobile device,
if the battery level does not exceed a predetermined threshold, selecting, by the base station entity, the pico cell (40A; 40B; 40C; 40D) as the serving base station of the mobile device, wherein the pico cell (40A; 40B; 40C; 40D) is the nearest to the mobile device of a plurality of pico cells (40) in the wireless neighborhood (100); the method **characterized by** further including the steps:
if the battery level does exceed the predetermined threshold, determining, by the base station entity, whether the mobile device (50) is receiving more downlink transactions from the serving base station than sending uplink transactions to the serving base station; and
if the mobile device (50) is receiving more downlink transactions from the serving base station than sending uplink transactions to the serving base station, selecting, by the base station, the macro cell (30A; 30B; 30C) as the serving base station of the mobile device (50), wherein the macro cell (30A; 30B; 30C) is the nearest to the mobile device (50) of a plurality of macro cells (30) in the wireless neighborhood (100).

10. The method (200) of claim 9, further comprising:

If the mobile device (50) is mostly sending uplink transactions to the serving base station, selecting, by the base station entity, the pico cell (40A; 40B; 40C; 40D) as the serving base station of the mobile device (50) in the wireless neighborhood (100).

11. The method (200) of claim 9, further comprising:

if the plurality of macro cells (30) uses a first radio access technology, RAT, and the plurality of pico cells (40) uses a second RAT; and
if the mobile device has both the first RAT and the second RAT simultaneously enabled, then the mobile device (50) directs traffic with strong quality of service requirements onto the nearest macro cell (30A; 30B; 30C) employing the first RAT while directing best-effort traffic onto the nearest pico cell (40A; 40B; 40C; 40D) employing the second RAT, such that the mobile device (50) maintains two concurrent connections to two different base stations, wherein the dual connection of the mobile device (50) to two different RATs prolongs the battery life of the mobile device (50).

12. The method (200) of claim 9, further comprising:

if the plurality of macro cells (30) uses a first radio access technology, RAT, and the plurality of pico cells (40) uses a second RAT; and
if the mobile device (50) has both the first RAT and the second RAT simultaneously enabled, then
analyzing, by the base station entity, the network based on mobility, traffic pattern, and load balancing; and
selecting, by the base station entity, the nearest macro cell (30A; 30B; 30C) employing the first RAT as the serving base station of the mobile device (50) based on the network analysis.

13. The method of claim 9, wherein the base station entity is the serving base station.

14. The method of claim 9, wherein the base station entity is the serving base station and a second base station operating in the wireless neighborhood (100).

15. The method of claim 9, wherein the base station entity is the serving base station and a plurality of base stations operating in the wireless neighborhood (100).

Patentansprüche

1. Verfahren (200) zum Auswählen einer dienenden Basisstation einer mobilen Vorrichtung (50), die sich durch eine drahtlose Nachbarschaft (100) fortbewegt, wobei die dienende Basisstation mit einem Netz (100) verbunden sein soll, wobei das Verfahren die folgenden Schritte umfasst:

Prüfen des Batteriestands der mobilen Vorrichtung (50) durch ein Serversystem (70), das in der drahtlosen Nachbarschaft (100) betriebsbereit ist, wobei die dienende Basisstation der mobilen Vorrichtung (50) entweder eine Makrozelle (30A; 30B; 30C), die Vorrichtungen mit hoher Mobilität unterstützt, oder eine Pikozelle (40A; 40B; 40C; 40D), die eine Abdeckung für niedrige Mobilität auf dem Netz (100) liefert, ist;
periodisches Beziehen des Zustands der mobilen Vorrichtung (50);
wenn der Batteriestand einen vorgegebenen Schwellenwert nicht überschreitet, Auswählen der Pikozelle (40A; 40B; 40C; 40D) als die dienende Basisstation der mobilen Vorrichtung (50) durch das Serversystem (70), wobei die Pikozelle (40A; 40B; 40C; 40D) die nächste zu der mobilen Vorrichtung (50) von mehreren Pikozellen (40) in der drahtlosen Nachbarschaft (100) ist; wobei das Verfahren **dadurch gekennzeichnet ist, dass** es ferner die folgenden Schritte umfasst:
wenn der Batteriestand den vorgegebenen Schwellenwert überschreitet, Bestimmen durch das Serversystem (70), ob die mobile Vorrichtung (50) mehr Abwärtsstrecken-Transaktionen von der dienenden Basisstation empfängt als sie Aufwärtsstrecken-Transaktionen an die dienende Basisstation sendet, und
wenn die mobile Vorrichtung (50) mehr Abwärtsstrecken-Transaktionen von der dienenden Basisstation empfängt als sie Aufwärtsstrecken-Transaktionen an die dienende Basisstation sendet, Auswählen der Makrozelle (30A; 30B; 30C) als die dienende Basisstation der mobilen Vorrichtung durch das Serversystem (70), wobei die Makrozelle (30A; 30B; 30C) die nächste zu der mobilen Vorrichtung (50) von mehreren Makrozellen (30) in der drahtlosen Nachbarschaft (100) ist.

2. Verfahren (200) nach Anspruch 1, das ferner Folgendes umfasst:

Auswählen der Pikozelle (40A; 40B; 40C; 40D) als die dienende Basisstation der mobilen Vorrichtung (50) in der drahtlosen Nachbarschaft (100) durch das Serversystem (70), wenn die mobile Vorrichtung (50) mehr Aufwärtsstrecken-Transaktionen an die dienende Basisstation sendet als Abwärtsstrecken-Verkehr von der dienenden Basisstation empfängt.

3. Verfahren (200) nach Anspruch 1, das ferner Folgendes umfasst:

wenn die mehreren Makrozellen (30) eine erste Funkzugangstechnologie, RAT, verwenden und die mehreren Pikozellen (40) eine zweite RAT verwenden und
wenn die mobile Vorrichtung (50) sowohl die erste RAT als auch die zweite RAT gleichzeitig aktiviert hat, Richten des Verkehrs mit starken Dienstgüteanforderungen durch die mobile Vorrichtung (50) auf die nächste Makrozelle (30A; 30B; 30C), die die erste RAT nutzt, während durch sie Best-Effort-Verkehr auf die nächste Pikozelle (40A; 40B; 40C; 40D), die die zweite RAT nutzt, gerichtet wird, so dass die mobile Vorrichtung (50) zwei gleichzeitig ablaufende Verbindungen zu zwei verschiedenen Basisstationen beibehält, wobei die doppelte Verbindung der mobilen Vorrichtung (50) mit zwei verschiedenen RATs die Batterielebensdauer der mobilen Vorrichtung (50) verlängert.

4. Verfahren (200) nach Anspruch 1, das ferner Folgendes umfasst:

wenn die mehreren Makrozellen (30) eine erste Funkzugangstechnologie, RAT, verwenden und die mehreren Pikozellen (40) eine zweite RAT verwenden und
wenn die mobile Vorrichtung (50) sowohl die erste RAT als auch die zweite RAT gleichzeitig aktiviert hat, dann
Analysieren des Netzes durch das Serversystem (70) auf der Grundlage der Mobilität, des Verkehrsmusters und der Lastverteilung und
Auswählen der nächsten Makrozelle (30A; 30B; 30C), die die erste RAT nutzt, als die dienende Basisstation der mobilen Vorrichtung (50) durch das Serversystem (70) auf der Grundlage der Netzanalyse.

5. Verfahren (200) zum Auswählen einer dienenden Basisstation für eine mobile Vorrichtung (50), die sich durch eine drahtlose Nachbarschaft (100) fortbewegt, wobei die dienende Basisstation mit einem Netz verbunden sein soll, wobei das Verfahren die folgenden Schritte umfasst:

Prüfen des Batteriestands der mobilen Vorrichtung (50) durch die mobile Vorrichtung (50), wobei die dienende Basisstation der mobilen Vorrichtung (50) entweder eine Makrozelle (30A; 30B; 30C), die Vorrichtungen mit hoher Mobilität unterstützt, oder eine Pikozelle (40A; 40B; 40C; 40D), die eine Abdeckung für niedrige Mobilität auf dem Netz liefert, ist;
periodisches Beziehen des Zustands der mobilen Vorrichtung (50);
wenn der Batteriestand einen vorgegebenen Schwellenwert nicht überschreitet, Auswählen der Pikozelle (40A; 40B; 40C; 40D) als die dienende Basisstation der mobilen Vorrichtung (50) durch die mobile Vorrichtung (50), wobei die Pikozelle (40A; 40B; 40C; 40D) die nächste zu der mobilen Vorrichtung (50) von mehreren Pikozellen (40) in der drahtlosen Nachbarschaft (100) ist; wobei das Verfahren **dadurch gekennzeichnet ist, dass** es ferner die folgenden Schritte enthält:
wenn der Batteriestand den vorgegebenen Schwellenwert überschreitet, Bestimmen durch die mobile Vorrichtung (50), ob die mobile Vorrichtung (50) mehr Abwärtsstrecken-Transaktionen von der dienenden Basisstation empfängt als sie Aufwärtsstrecken-Transaktionen an die dienende Basisstation sendet, und
wenn die mobile Vorrichtung (50) mehr Abwärtsstrecken-Transaktionen von der dienenden Basisstation empfängt als sie Aufwärtsstrecken-Transaktionen an die dienende Basisstation sendet, Auswählen der Makrozelle (30A; 30B; 30C) als die dienende Basisstation der mobilen Vorrichtung (50) durch die mobile Vorrichtung (50), wobei die Makrozelle (30A; 30B; 30C) die nächste zu der mobilen Vorrichtung (50) von mehreren Makrozellen (30) in der drahtlosen Nachbarschaft (100) ist.

6. Verfahren (200) nach Anspruch 5, das ferner Folgendes umfasst:

wenn die mobile Vorrichtung (50) zumeist Aufwärtsstrecken-Transaktionen an die dienende Basisstation sendet, Auswählen der Pikozelle (40A; 40B; 40C; 40D) als die dienende Basisstation der mobilen Vorrichtung (50) in der drahtlosen Nachbarschaft durch die mobile Vorrichtung (50).

7. Verfahren (200) nach Anspruch 5, das ferner Folgendes umfasst:

wenn die mehreren Makrozellen (30) eine erste Funkzugangstechnologie, RAT, verwenden und die mehreren Pikozellen (40) eine zweite RAT verwenden und
wenn die mobile Vorrichtung (50) sowohl die erste RAT als auch die zweite RAT gleichzeitig aktiviert hat, Richten durch die mobile Vorrichtung (50) des Verkehrs mit starken Dienstgüteanforderungen auf die nächste Makrozelle (30A; 30B; 30C), die die erste RAT nutzt, während durch sie Best-Effort-Verkehr auf die nächste Pikozelle (40A; 40B; 40C; 40D), die die zweite RAT nutzt, gerichtet wird, so dass die mo-

bile Vorrichtung (50) zwei gleichzeitig ablaufende Verbindungen zu zwei verschiedenen Basisstationen beibehält, wobei die doppelte Verbindung der mobilen Vorrichtung (50) mit zwei verschiedenen RATs die Batterielebensdauer der mobilen Vorrichtung (50) verlängert.

8. Verfahren (200) nach Anspruch 5, das ferner Folgendes umfasst:

wenn die mehreren Makrozellen (30) eine erste Funkzugangstechnologie, RAT, verwenden und die mehreren Pikozellen (40) eine zweite RAT verwenden und
wenn die mobile Vorrichtung (50) sowohl die erste RAT als auch die zweite RAT gleichzeitig aktiviert hat, dann Analysieren des Netzes durch die mobile Vorrichtung (50) auf der Grundlage der Mobilität, des Verkehrsmusters und der Lastverteilung und
Auswählen der nächsten Makrozelle (30A; 30B; 30C), die die erste RAT nutzt, als die dienende Basisstation der mobilen Vorrichtung (50) durch die mobile Vorrichtung (50) auf der Grundlage der Netzanalyse.

9. Verfahren (200) zum Auswählen einer dienenden Basisstation einer mobilen Vorrichtung (50), die sich durch eine drahtlose Nachbarschaft (100) fortbewegt, wobei die dienende Basisstation mit einem Netz verbunden sein soll, wobei das Verfahren die folgenden Schritte umfasst:

Prüfen des Batteriestands der mobilen Vorrichtung durch eine Basisstationsentität, die in der drahtlosen Nachbarschaft (100) betrieben wird, wobei die dienende Basisstation der mobilen Vorrichtung entweder eine Makrozelle, die Vorrichtungen mit hoher Mobilität unterstützt, oder eine Pikozelle, die eine Abdeckung für niedrige Mobilität auf dem Netz liefert, ist;
periodisches Beziehen des Zustands der mobilen Vorrichtung;
wenn der Batteriestand einen vorgegebenen Schwellenwert nicht überschreitet, Auswählen der Pikozelle (40A; 40B; 40C; 40D) als die dienende Basisstation der mobilen Vorrichtung durch die Basisstationsentität, wobei die Pikozelle (40A; 40B; 40C; 40D) die nächste zu der mobilen Vorrichtung von mehreren Pikozellen (40) in der drahtlosen Nachbarschaft (100) ist;
wobei das Verfahren **dadurch gekennzeichnet ist, dass** es ferner die folgenden Schritte enthält:
wenn der Batteriestand den vorgegebenen Schwellenwert überschreitet, Bestimmen durch die Basisstationsentität, ob die mobile Vorrichtung (50) mehr Abwärtsstrecken-Transaktionen von der dienenden Basisstation empfängt als sie Aufwärtsstrecken-Transaktionen an die dienende Basisstation sendet, und
wenn die mobile Vorrichtung (50) mehr Abwärtsstrecken-Transaktionen von der dienenden Basisstation empfängt als sie Aufwärtsstrecken-Transaktionen an die dienende Basisstation sendet, Auswählen der Makrozelle (30A; 30B; 30C) als die dienende Basisstation der mobilen Vorrichtung (50) durch die Basisstation, wobei die Makrozelle (30A; 30B; 30C) die nächste zu der mobilen Vorrichtung (50) von mehreren Makrozellen (30) in der drahtlosen Nachbarschaft (100) ist.

10. Verfahren (200) nach Anspruch 9, das ferner Folgendes umfasst:

wenn die mobile Vorrichtung (50) zumeist Aufwärtsstrecken-Transaktionen an die dienende Basisstation sendet, Auswählen der Pikozelle (40A; 40B; 40C; 40D) als die dienende Basisstation der mobilen Vorrichtung (50) in der drahtlosen Nachbarschaft (100) durch die Basisstationsentität.

11. Verfahren (200) nach Anspruch 9, das ferner Folgendes umfasst:

wenn die mehreren Makrozellen (30) eine erste Funkzugangstechnologie, RAT, verwenden und die mehreren Pikozellen (40) eine zweite RAT verwenden und
wenn die mobile Vorrichtung sowohl die erste RAT als auch die zweite RAT gleichzeitig aktiviert hat, dann Richten durch die mobile Vorrichtung (50) des Verkehrs mit starken Dienstgüteanforderungen auf die nächste Makrozelle (30A; 30B; 30C), die die erste RAT nutzt, während durch sie Best-Effort-Verkehr auf die nächste Pikozelle (40A; 40B; 40C; 40D), die die zweite RAT nutzt, gerichtet wird, so dass die mobile Vorrichtung (50) zwei gleichzeitig ablaufende Verbindungen zu zwei verschiedenen Basisstationen beibehält, wobei die doppelte Verbindung der mobilen Vorrichtung (50) mit zwei verschiedenen RATs die Batterielebensdauer der mobilen Vorrichtung (50) verlängert.

12. Verfahren (200) nach Anspruch 9, das ferner Folgendes umfasst:

wenn die mehreren Makrozellen (30) eine erste Funkzugangstechnologie, RAT, verwenden und die mehreren Pikozellen (40) eine zweite RAT verwenden und
wenn die mobile Vorrichtung (50) sowohl die erste RAT als auch die zweite RAT gleichzeitig

aktiviert hat, dann
Analysieren des Netzes durch die Basisstationsentität auf der Grundlage der Mobilität, des Verkehrsmusters und der Lastverteilung und
Auswählen der nächsten Makrozelle (30A; 30B; 30C), die die erste RAT nutzt, als die dienende Basisstation der mobilen Vorrichtung (50) durch die Basisstationsentität auf der Grundlage der Netzanalyse.

13. Verfahren nach Anspruch 9, wobei die Basisstationsentität die dienende Basisstation ist.

14. Verfahren nach Anspruch 9, wobei die Basisstationsentität die dienende Basisstation und eine zweite Basisstation, die in der drahtlosen Nachbarschaft (100) betrieben wird, umfasst.

15. Verfahren nach Anspruch 9, wobei die Basisstationsentität die dienende Basisstation und mehrere Basisstationen, die in der drahtlosen Nachbarschaft (100) betrieben werden, umfasst.

Revendications

1. Procédé (200) pour sélectionner une station de base de desserte d'un dispositif mobile (50) se déplaçant à travers une zone sans fil (100), la station de base de desserte devant être connectée à un réseau (100), le procédé comprenant les étapes suivantes :

la vérification, par un système serveur (70) pouvant fonctionner dans le voisinage sans fil (100), du niveau de batterie du dispositif mobile (50), dans lequel la station de base de desserte du dispositif mobile (50) est soit une macrocellule (30A ; 30B ; 30C) qui prend en charge les dispositifs à haute mobilité soit une picocellule (40A ; 40B ; 40C ; 40D) qui fournit une couverture à faible mobilité sur le réseau (100) ;
l'obtention périodique de l'état du dispositif mobile (50) ;
si le niveau de batterie ne dépasse pas un seuil prédéterminé, la sélection, par le système serveur (70), de la picocellule (40A ; 40B ; 40C ; 40D) en tant que station de base de desserte du dispositif mobile (50), dans lequel de la picocellule (40A ; 40B ; 40C ; 40D) est la plus proche du dispositif mobile (50) d'une pluralité de picocellules (40) dans le voisinage sans fil (100) ;
le procédé étant **caractérisé en ce qu'**il comprend en outre les étapes suivantes :

si le niveau de batterie ne dépasse pas le seuil prédéterminé, la détermination, par le système serveur (70), du fait de savoir si le dispositif mobile (50) reçoit plus de transactions de liaison descendante depuis la station de base de desserte qu'il n'envoie de transactions de liaison montante à la station de base de desserte ; et
si le dispositif mobile (50) reçoit plus de transactions de liaison descendante depuis la station de base de desserte qu'il n'envoie de transactions de liaison montante à la station de base de desserte, la sélection, par le système serveur (70), de la macrocellule (30A ; 30B ; 30C) en tant que station de base de desserte du dispositif mobile, dans lequel la macrocellule (30A ; 30B ; 30C) est la plus proche du dispositif mobile (50) d'une pluralité de macrocellules (30) dans le voisinage sans fil (100).

2. Procédé (200) selon la revendication 1, comprenant en outre :

si le dispositif mobile (50) envoie plus de transactions montantes à la station de base de desserte qu'il ne reçoit de trafic de liaison descendante depuis la station de base de desserte, la sélection, par le système serveur (70), de la picocellule (40A ; 40B ; 40C ; 40D) en tant que station de base de desserte du dispositif mobile (50) dans le voisinage sans fil (100).

3. Procédé (200) selon la revendication 1, comprenant en outre :

si la pluralité de macrocellules (30) utilise une première technologie d'accès radio, RAT (Radio Access Technology), et si la pluralité de picocellules (40) utilise une seconde RAT ; et
si le dispositif mobile (50) possède à la fois la première RAT et la seconde RAT simultanément activées, alors, l'orientation par le dispositif mobile (50), d'un trafic présentant d'importantes exigences de qualité de service vers la macrocellule la plus proche (30A ; 30B ; 30C) utilisant la première RAT, tout en orientant le trafic de meilleur effort vers la picocellule la plus proche (40A ; 40B ; 40C ; 40D) utilisant la seconde RAT, de manière à ce que le dispositif mobile (50) maintienne deux connexions simultanées à deux stations de base différentes, dans lequel la double connexion du dispositif mobile (50) à deux RAT différentes prolonge la durée de vie de la batterie du dispositif mobile (50).

4. Procédé (200) selon la revendication 1, comprenant en outre :

si la pluralité de macrocellules (30) utilise une première technologie d'accès radio, RAT, et si la pluralité de picocellules (40) utilise une se-

conde RAT ; et
si le dispositif mobile (50) possède à la fois la première RAT et la seconde RAT simultanément activées, alors, l'analyse, par le système serveur (70), du réseau sur la base de la mobilité, de la structure du trafic, et de l'équilibrage de la charge ; et
la sélection, par le système serveur (70), de la macrocellule la plus proche (30A ; 30B ; 30C) utilisant la première RAT en tant que station de base de desserte du dispositif mobile (50) sur la base de l'analyse de réseau.

5. Procédé (200) pour sélectionner une station de base de desserte pour un dispositif mobile (50) se déplaçant à travers une zone sans fil (100), la station de base de desserte devant être connectée à un réseau, le procédé comprenant les étapes suivantes :

la vérification, par le dispositif mobile (50), du niveau de batterie du dispositif mobile (50), dans lequel la station de base de desserte du dispositif mobile (50) est soit une macrocellule (30A ; 30B ; 30C) qui prend en charge des dispositifs à haute mobilité soit une picocellule (40A ; 40B ; 40C ; 40D) qui fournit une couverture à faible mobilité sur le réseau ;
l'obtention périodique de l'état du dispositif mobile (50) ;
si le niveau de batterie ne dépasse pas un seuil prédéterminé, la sélection, par le dispositif mobile (50), de la picocellule (40A ; 40B ; 40C ; 40D) en tant que station de base de desserte du dispositif mobile (50), dans lequel la picocellule (40A ; 40B ; 40C ; 40D) est la plus proche du dispositif mobile (50) d'une pluralité de picocellules (40) dans le voisinage sans fil (100) ;
le procédé étant **caractérisé en ce qu'**il comprend en outre les étapes suivantes :

si le niveau de batterie ne dépasse pas le seuil prédéterminé, la détermination, par le dispositif mobile (50), du fait de savoir si le dispositif mobile (50) reçoit plus de transactions de liaison descendante depuis la station de base de desserte qu'il n'envoie de transactions de liaison montante à la station de base de desserte ; et
si le dispositif mobile (50) reçoit plus de transactions de liaison descendante de la station de base de desserte qu'il n'envoie de transactions de liaison montante à la station de base de desserte, la sélection, par le dispositif mobile (50), de la macrocellule (30A ; 30B ; 30C) en tant station de base de desserte du dispositif mobile (50), dans lequel la macrocellule (30A ; 30B ; 30C) est la plus proche du dispositif mobile (50) d'une pluralité de macrocellules (30) dans le voisinage sans fil (100).

6. Procédé (200) selon la revendication 5, comprenant en outre :

si le dispositif mobile (50) envoie principalement des transactions de liaison montante à la station de base de desserte, la sélection, par le dispositif mobile (50), de la picocellule (40A ; 40B ; 40C ; 40D) en tant que station de base de desserte du dispositif mobile (50) dans le voisinage sans fil.

7. Procédé (200) selon la revendication 5, comprenant en outre :

si la pluralité de macrocellules (30) utilise une première technologie d'accès radio, RAT, et si la pluralité de picocellules (40) utilise une seconde RAT ; et
si le dispositif mobile (50) possède à la fois la première RAT et la seconde RAT simultanément activées, alors, l'orientation, par le dispositif mobile (50), du trafic présentant d'importantes exigences de qualité de service vers la macrocellule la plus proche (30A ; 30B ; 30C) utilisant la première RAT, tout en orientant le trafic de meilleur effort vers la picocellule la plus proche (40A ; 40B ; 40C ; 40D) utilisant la seconde RAT, de manière à ce que le dispositif mobile (50) maintienne deux connexions simultanées à deux stations de base différentes, dans lequel la double connexion du dispositif mobile (50) à deux RAT différentes prolonge la durée de vie de la batterie du dispositif mobile (50).

8. Procédé (200) selon la revendication 5, comprenant en outre :

si la pluralité de macrocellules (30) utilise une première technologie d'accès radio, RAT, et si la pluralité de picocellules (40) utilise une seconde RAT ; et
si le dispositif mobile (50) possède à la fois la première RAT et la seconde RAT simultanément activées, alors, l'analyse, par le dispositif mobile (50), du réseau sur la base de la mobilité, de la structure du trafic, et de l'équilibrage de la charge ; et
la sélection, par le dispositif mobile (50), de la macrocellule la plus proche (30A ; 30B ; 30C) utilisant la première RAT en tant que station de base de desserte du dispositif mobile (50) sur la base de l'analyse de réseau.

9. Procédé (200) pour sélectionner une station de base de desserte d'un dispositif mobile (50) se déplaçant à travers un voisinage sans fil (100), la station de base de desserte devant être connectée à un réseau, le procédé comprenant les étapes suivantes :

la vérification, par une entité de station de base fonctionnant dans le voisinage sans fil (100), du niveau de batterie du dispositif mobile, dans lequel la station de base de desserte du dispositif mobile est soit une macrocellule qui prend en charge des dispositifs à haute mobilité soit une picocellule qui fournit une couverture de faible mobilité sur le réseau ;
l'obtention périodique de l'état du dispositif mobile, si le niveau de batterie ne dépasse pas un seuil prédéterminé, la sélection, par l'entité de station de base, de la picocellule (40A ; 40B ; 40C ; 40D) en tant que station de base de desserte du dispositif mobile, dans lequel la picocellule (40A ; 40B ; 40C ; 40D) est la plus proche du dispositif mobile d'une pluralité de picocellules (40) dans le voisinage sans fil (100) ;
le procédé étant **caractérisé en ce qu'**il comprend en outre les étapes suivantes :

si le niveau de batterie ne dépasse pas le seuil prédéterminé, la détermination, par l'entité de station de base, du fait de savoir si le dispositif mobile (50) reçoit plus de transactions de liaison descendante depuis la station de base de desserte qu'il n'envoie de transactions de liaison montante à la station de base de desserte ; et
si le dispositif mobile (50) reçoit plus de transactions de liaison descendante depuis la station de base de desserte qu'il n'envoie de transactions de liaison montante à la station de base de desserte, la sélection, par la station de base, de la macrocellule (30A ; 30B ; 30C) en tant que station de base de desserte du dispositif mobile (50), dans lequel la macrocellule (30A ; 30B ; 30C) est la plus proche du dispositif mobile (50) d'une pluralité de macrocellules (30) dans le voisinage sans fil (100).

10. Procédé (200) selon la revendication 9, comprenant en outre :

si le dispositif mobile (50) envoie principalement des transactions de liaison montante à la station de base de desserte, la sélection, par l'entité de station de base, de la picocellule (40A ; 40B ; 40C ; 40D) en tant que station de base de desserte du dispositif mobile (50) dans le voisinage sans fil (100).

11. Procédé (200) selon la revendication 9, comprenant en outre :

si la pluralité de macrocellules (30) utilise une première technologie d'accès radio, RAT, et si la pluralité de picocellules (40) utilise une seconde RAT ; et
si le dispositif mobile possède à la fois la première RAT, et la seconde RAT simultanément activées, alors, l'orientation, par le dispositif mobile (50), d'un trafic présentant d'importantes exigences de qualité de service vers la macrocellule la plus proche (30A ; 30B ; 30C) utilisant la première RAT tout en orientant le trafic de meilleur effort vers la picocellule la plus proche (40A ; 40B ; 40C ; 40D) utilisant de la seconde RAT, de manière à ce que le dispositif mobile (50) maintienne deux connexions simultanées à deux stations de base différentes, dans lequel la double connexion du dispositif mobile (50) à deux RAT différentes prolonge la durée de vie de la batterie du dispositif mobile (50).

12. Procédé (200) selon la revendication 9, comprenant en outre :

si la pluralité de macrocellules (30) utilise une première technologie d'accès radio, RAT, et si la pluralité de picocellules (40) utilise une seconde RAT ; et
si le dispositif mobile (50) possède à la fois la première RAT et la seconde RAT simultanément activées, l'analyse, par l'entité de station de base, du réseau sur la base de la mobilité, de la structure du trafic, et de l'équilibrage de la charge ; et
la sélection, par l'entité de station de base, de la macrocellule la plus proche (30A ; 30B ; 30C) utilisant la première RAT en tant que station de base de desserte du dispositif mobile (50) sur la base de l'analyse de réseau.

13. Procédé selon la revendication 9, dans lequel l'entité de station de base est la station de base de desserte.

14. Procédé selon la revendication 9, dans lequel l'entité de station de base est la station de base de desserte et une seconde station de base fonctionnant dans le voisinage sans fil (100).

15. Procédé selon la revendication 9, dans lequel l'entité de station de base est la station de base de desserte et une pluralité de stations de base fonctionnant dans le voisinage sans fil (100).

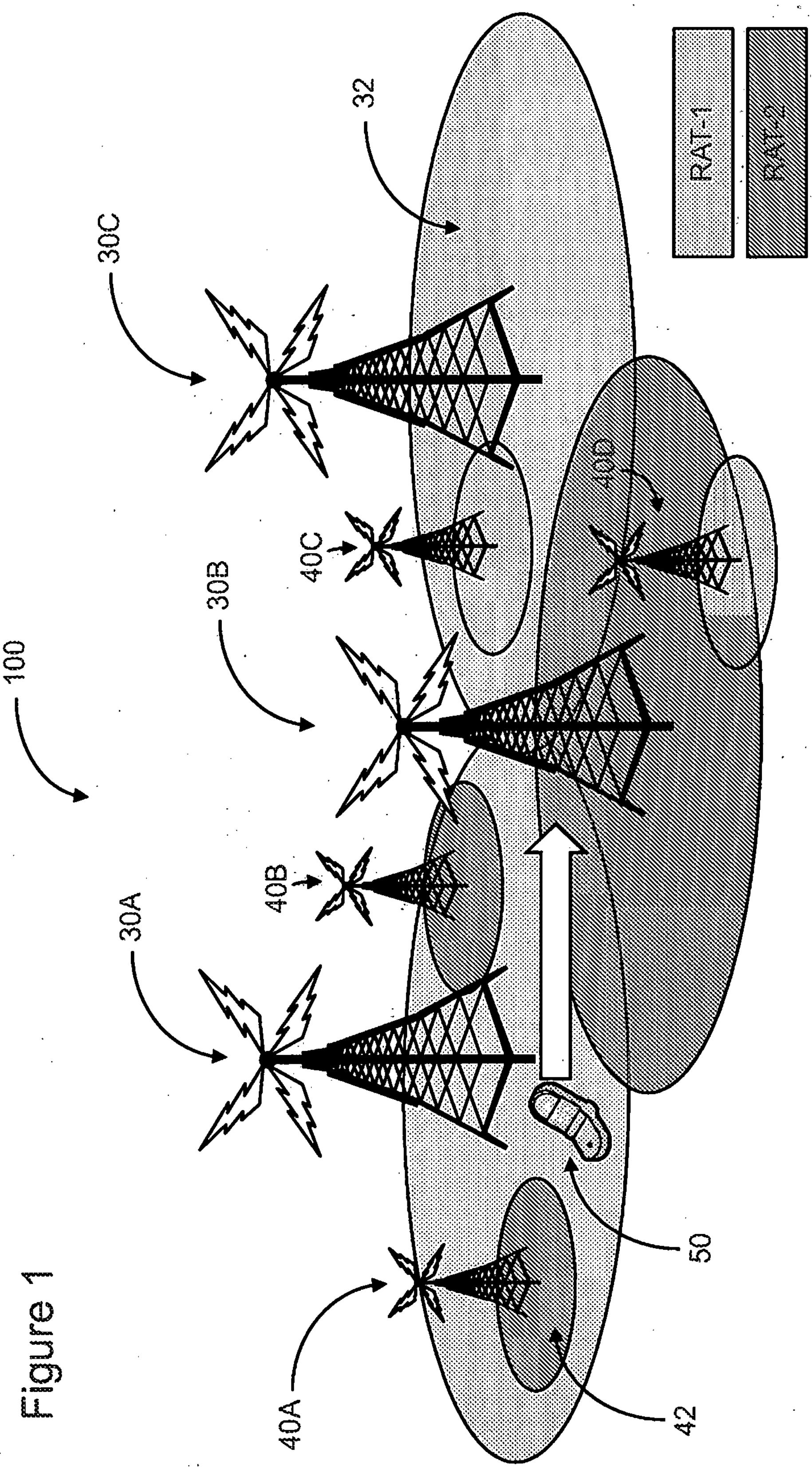


Figure 1

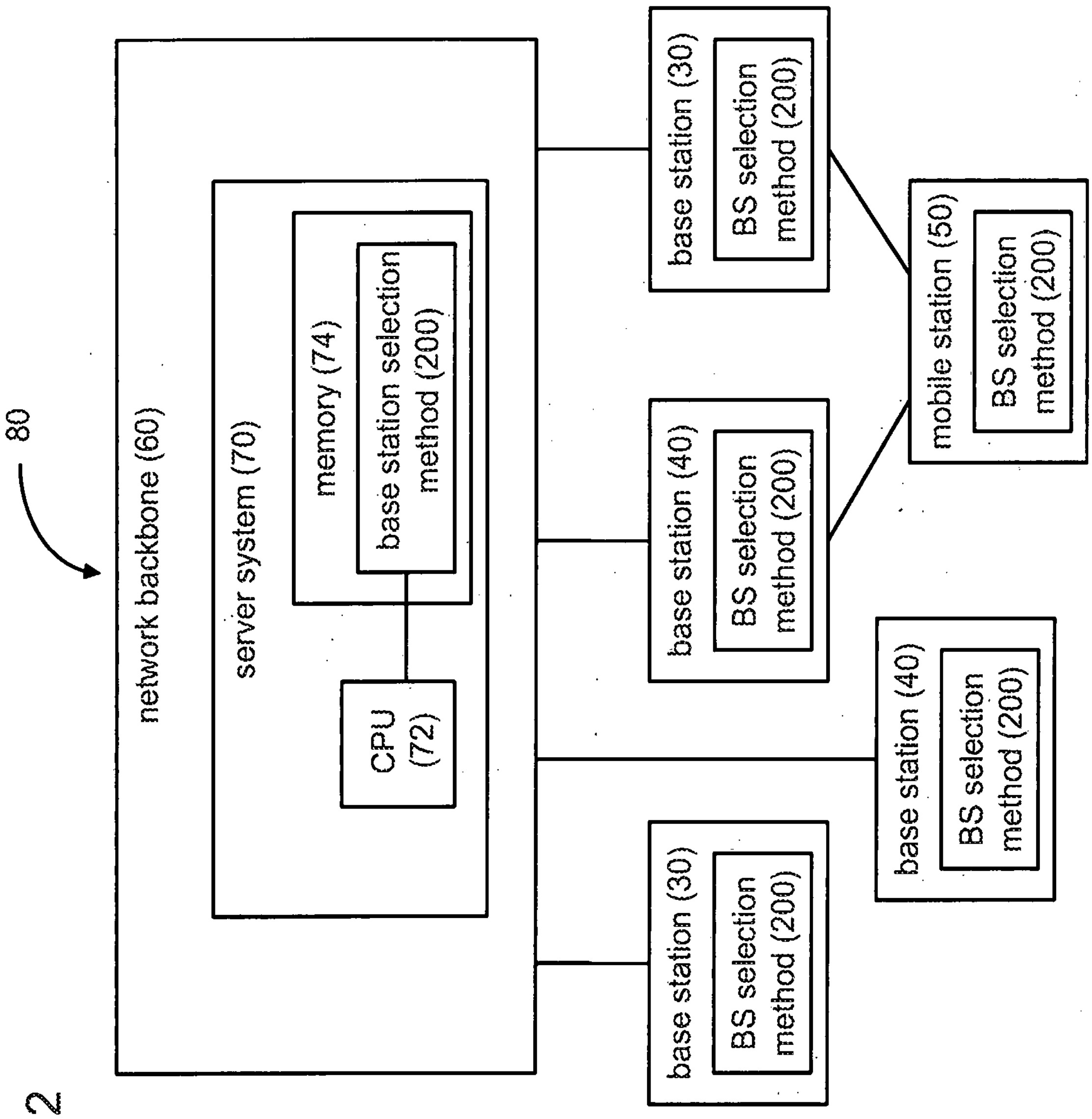
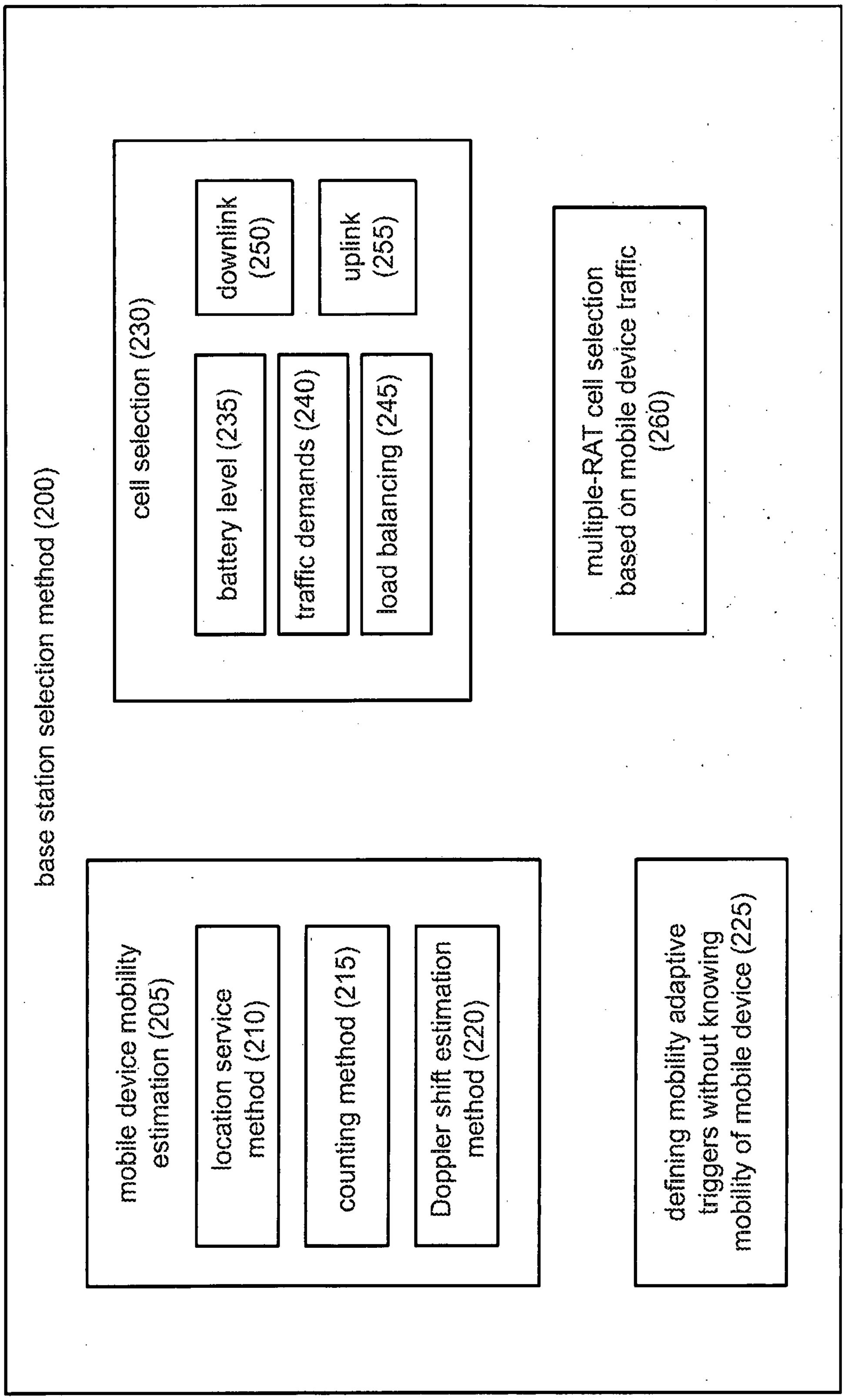

80
network backbone (60)
server system (70)
memory (74)
base station selection method (200)
CPU (72)
base station (30)
BS selection method (200)
base station (40)
BS selection method (200)
base station (40)
BS selection method (200)
base station (30)
BS selection method (200)
mobile station (50)
BS selection method (200)

Figure 2

Figure 3


base station selection method (200)
mobile device mobility estimation (205)
location service method (210)
counting method (215)
Doppler shift estimation method (220)
defining mobility adaptive triggers without knowing mobility of mobile device (225)
cell selection (230)
battery level (235)
traffic demands (240)
load balancing (245)
downlink (250)
uplink (255)
multiple-RAT cell selection based on mobile device traffic (260)

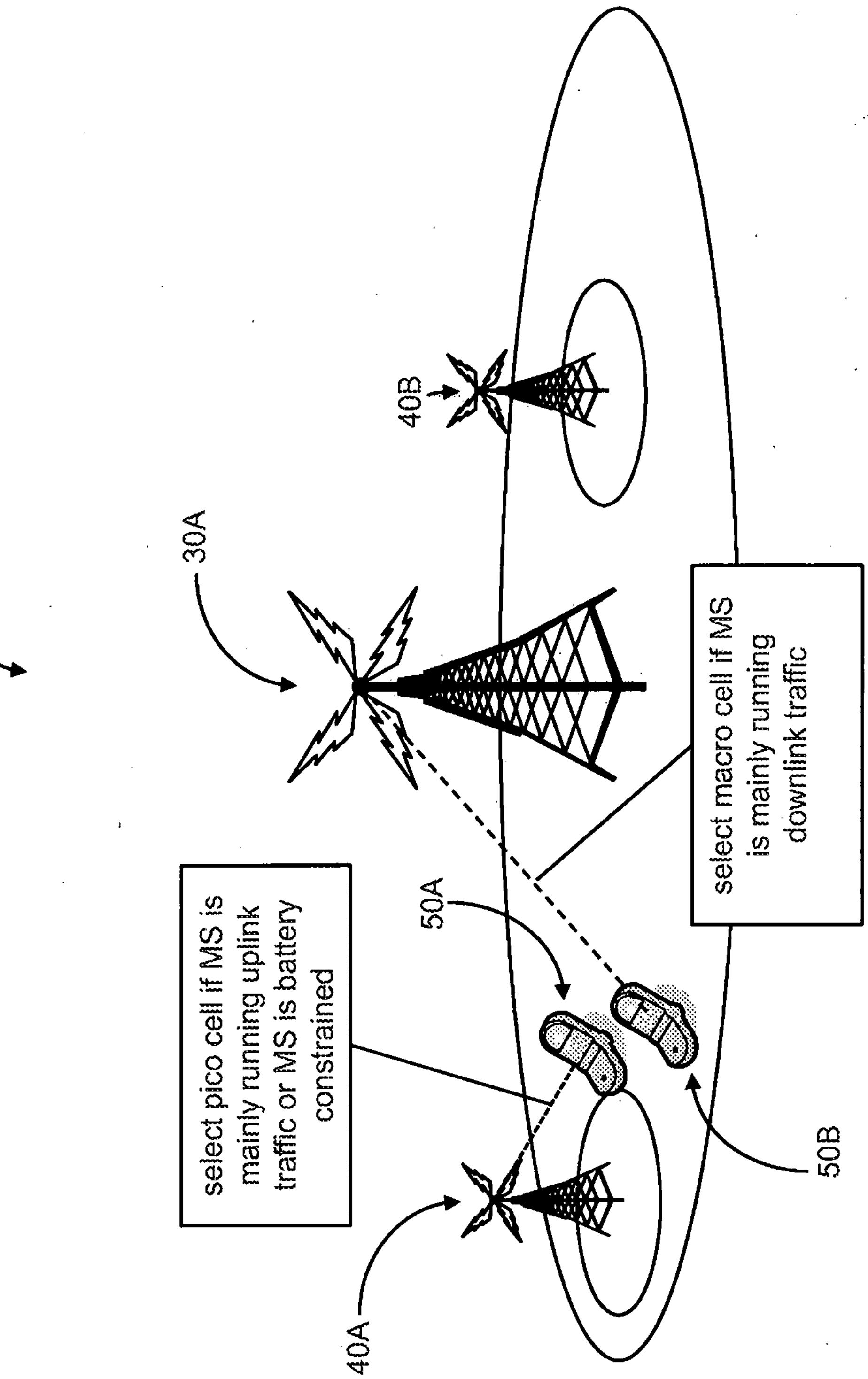

100B
30A
40B
40A
50A
50B
select pico cell if MS is mainly running uplink traffic or MS is battery constrained
select macro cell if MS is mainly running downlink traffic

Figure 4

Figure 5

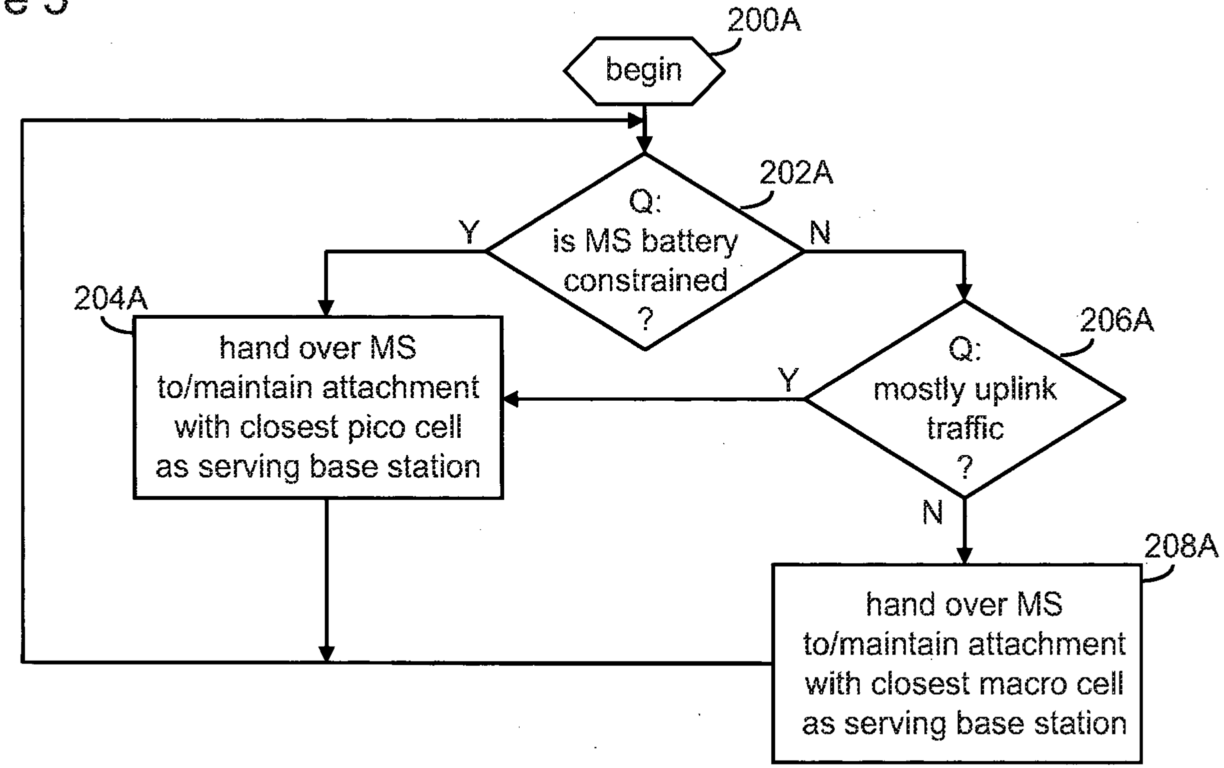
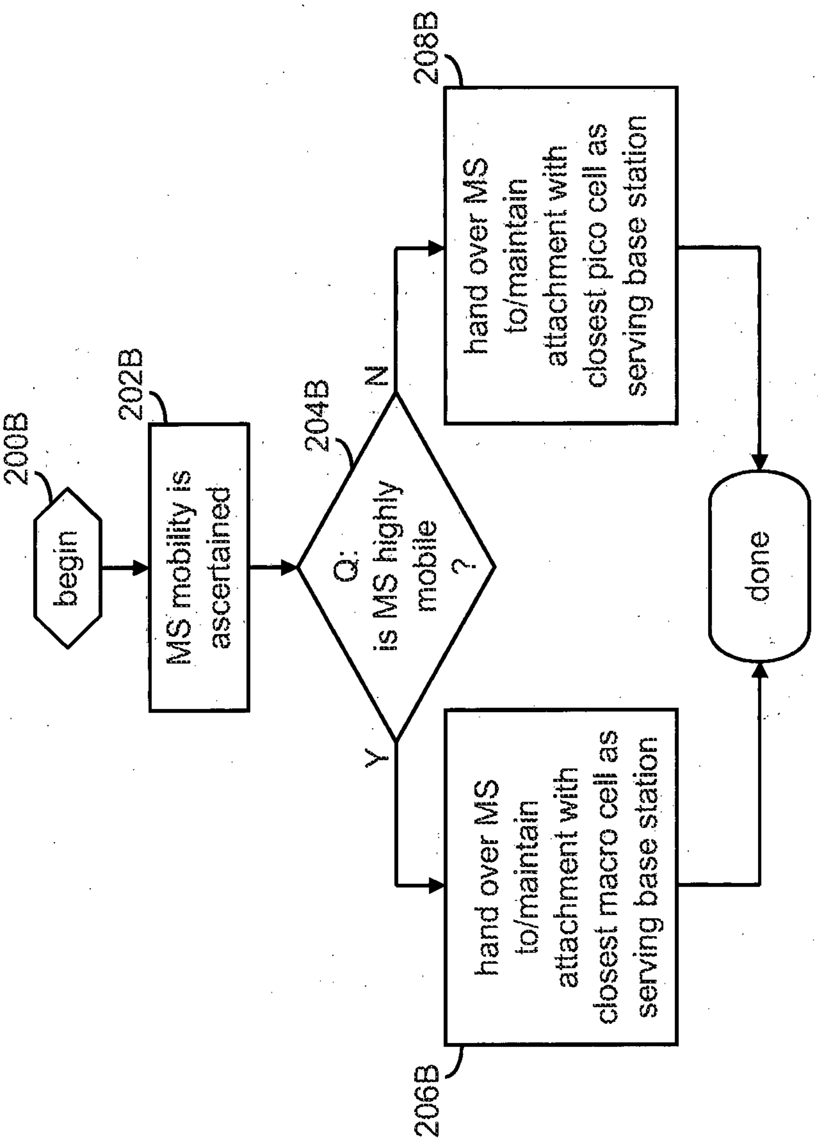

200A
begin
202A
Q:
is MS battery
constrained
?
Y
N
204A
hand over MS
to/maintain attachment
with closest pico cell
as serving base station
206A
Q:
mostly uplink
traffic
?
Y
N
208A
hand over MS
to/maintain attachment
with closest macro cell
as serving base station

Figure 6


200B
begin
202B
MS mobility is ascertained
204B
Q: is MS highly mobile ?
Y
N
206B
hand over MS to/maintain attachment with closest macro cell as serving base station
208B
hand over MS to/maintain attachment with closest pico cell as serving base station
done

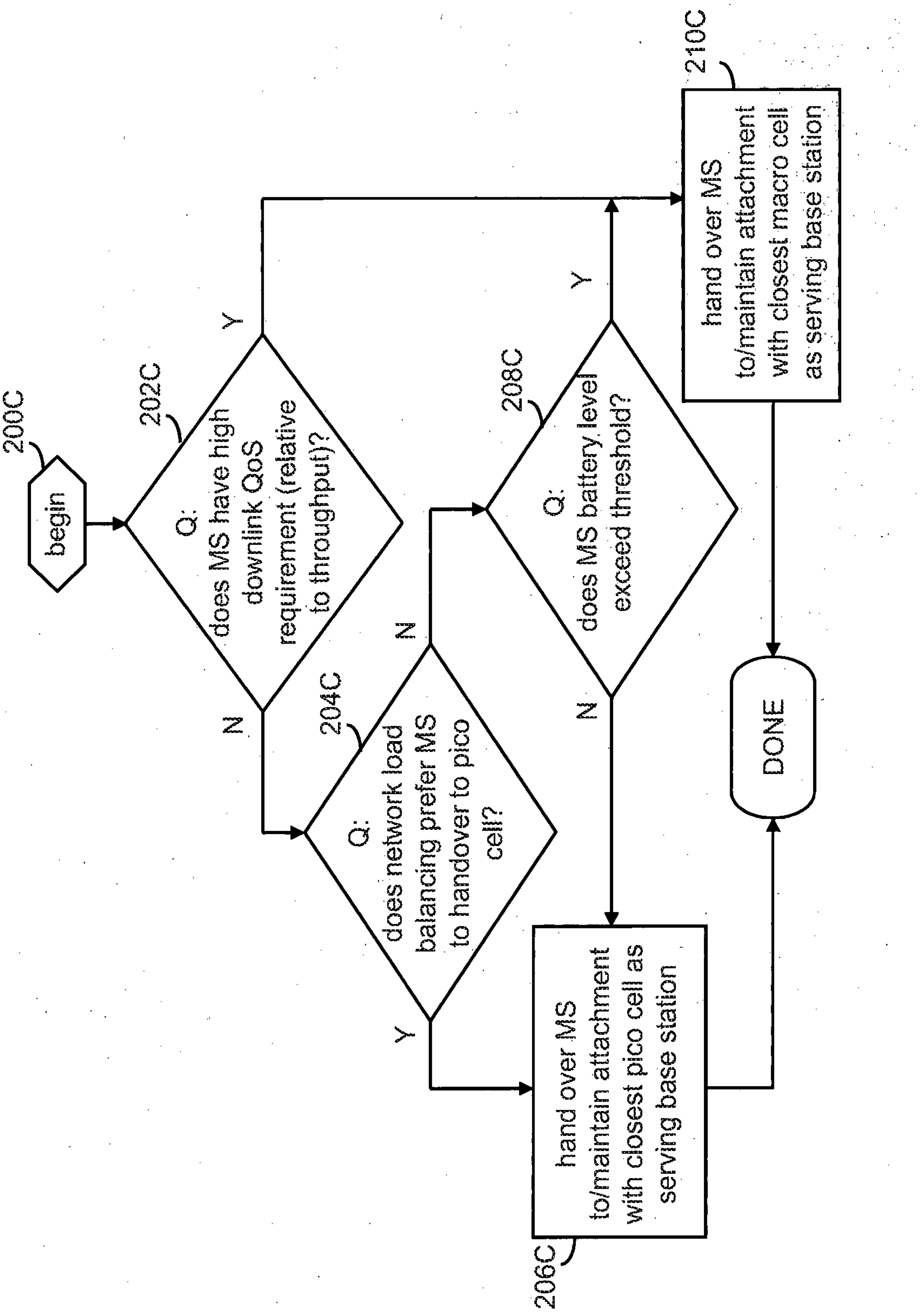

200C
begin
202C
Q:
does MS have high downlink QoS requirement (relative to throughput)?
Y
N
204C
Q:
does network load balancing prefer MS to handover to pico cell?
Y
N
206C
hand over MS to/maintain attachment with closest pico cell as serving base station
208C
Q:
does MS battery level exceed threshold?
Y
N
210C
hand over MS to/maintain attachment with closest macro cell as serving base station
DONE

Figure 7

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 12494145 B **[0038]**