SERVING BASE STATION SELECTION IN A WIRELESS COMMUNICATION NETWORK

[0001] The present application claims priority to provisional U.S. Application Serial No. 61/025,645, entitled "METHOD AND APPARATUS FOR SERVER SELECTION IN A COMMUNICATION NETWORK," filed February 1, 2008, assigned to the assignee hereof and incorporated herein by reference.

BACKGROUND

I. Field

[0002] The present disclosure relates generally to communication, and more specifically to techniques for selecting a serving base station for a terminal in a wireless communication network.

II. Background

[0003] Wireless communication networks are widely deployed to provide various communication content such as voice, video, packet data, messaging, broadcast, etc. These wireless networks may be multiple-access networks capable of supporting multiple users by sharing the available network resources. Examples of such multiple-access networks include Code Division Multiple Access (CDMA) networks, Time Division Multiple Access (TDMA) networks, Frequency Division Multiple Access (FDMA) networks, Orthogonal FDMA (OFDMA) networks, and Single-Carrier FDMA (SC-FDMA) networks.

[0004] A wireless communication network may include a number of base stations that can support communication for a number of terminals. A terminal may be within the coverage of zero or more base stations at any given moment. If more than one base station is available, then it is desirable to select a suitable base station to serve the terminal such that good performance can be achieved for the terminal while improving network capacity.

SUMMARY

[0005] Techniques for selecting a serving base station for a terminal in a wireless communication network are described herein. In an aspect, a base station may be selected as a serving base station for the terminal even though the selected base station may have a lower signal-to-noise-and-interference ratio (SINR) than that of another base station. This serving base station selection scheme may provide certain advantages, e.g., reduced interference in the network.

[0006] In one design, multiple candidate base stations for a terminal may be identified. Each candidate base station may be a candidate for selection as a serving base station for the terminal. The multiple candidate base stations may belong in an open-access communication system and may be accessible by any terminals with service subscription. The multiple candidate base stations may include base stations with different transmit power levels and/or may support interference mitigation. In any case, one of the multiple candidate base stations may be selected as the serving base station for the terminal. In one design, the serving base station may be selected based on at least one metric for each candidate base station. The at least one metric may be for pathloss, effective transmit power, effective geometry, projected data rate, control channel reliability, network utility, etc. The selected candidate base station may have a lower SINR than the highest SINR among the multiple candidate base stations.

[0007] Various aspects and features of the disclosure are described in further detail below.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] FIG. 1 shows a wireless communication network.

[0009] FIG. 2 shows data transmission with hybrid automatic retransmission (HARQ).

[0010] FIG. 3 shows a wireless communication network with relay.

[0011] FIG. 4 shows a frame structure supporting relay.

[0012] FIGS. 5 and 6 show a process and an apparatus, respectively, for selecting a serving base station.

[0013] FIGS. 7 and 8 show a process and an apparatus, respectively, for selecting a serving base station with different types of metrics.

[0014] FIG. 9 shows a block diagram of a terminal and a base station.

DETAILED DESCRIPTION

[0015] The techniques described herein may be used for various wireless communication networks such as CDMA, TDMA, FDMA, OFDMA, SC-FDMA and other networks. The terms "network" and "system" are often used interchangeably. A CDMA network may implement a radio technology such as Universal Terrestrial Radio Access (UTRA), cdma2000, etc. UTRA includes Wideband CDMA (WCDMA) and other variants of CDMA. cdma2000 covers IS-2000, IS-95 and IS-856 standards. A TDMA network may implement a radio technology such as Global System for Mobile Communications (GSM). An OFDMA network may implement a radio technology such as Evolved UTRA (E-UTRA), Ultra Mobile Broadband (UMB), IEEE 802.11 (Wi-Fi), IEEE 802.16 (WiMAX), IEEE 802.20, Flash-OFDM®, etc. UTRA and E-UTRA are part of Universal Mobile Telecommunication System (UMTS). 3GPP Long Term Evolution (LTE) is an upcoming release of UMTS that uses E-UTRA, which employs OFDMA on the downlink and SC-FDMA on the uplink. UTRA, E-UTRA, UMTS, LTE and GSM are described in documents from an organization named "3rd Generation Partnership Project" (3GPP). cdma2000 and UMB are described in documents from an organization named "3rd Generation Partnership Project 2" (3GPP2).

[0016] **FIG. 1** shows a wireless communication network 100, which may include a number of base stations and other network entities. For simplicity, FIG. 1 shows only two base stations 120 and 122 and one network controller 150. A base station may be a fixed station that communicates with the terminals and may also be referred to as an access point, a Node B, an evolved Node B (eNB), etc. A base station may provide communication coverage for a particular geographic area. The overall coverage area of a base station may be partitioned into smaller areas, and each smaller area may be served by a respective base station subsystem. The term "cell" can refer to a coverage area of a base station and/or a base station subsystem serving this coverage area, depending on the context in which the term is used.

[0017] A base station may provide communication coverage for a macro cell, a pico cell, a femto cell, or some other type of cell. A macro cell may cover a relatively large geographic area (e.g., several kilometers in radius) and may support communication for all terminals with service subscription in the wireless network. A pico cell may cover a relatively small geographic area and may support communication for all terminals with service subscription. A femto cell may cover a relatively small geographic area (e.g., a

home) and may support communication for a set of terminals having association with the femto cell (e.g., terminals belonging to residents of the home). A base station for a macro cell may be referred to as a macro base station. A base station for a pico cell may be referred to as a pico base station. A base station for a femto cell may be referred to as a femto base station or a home base station.

[0018] Network controller 150 may couple to a set of base stations and provide coordination and control for these base stations. Network controller 150 may communicate with base stations 120 and 122 via a backhaul. Base stations 120 and 122 may also communicate with one another, e.g., directly or indirectly via wireless or wireline interface.

[0019] A terminal 110 may be one of many terminals supported by wireless network 100. Terminal 110 may be stationary or mobile and may also be referred to as an access terminal (AT), a mobile station (MS), a user equipment (UE), a subscriber unit, a station, etc. Terminal 110 may be a cellular phone, a personal digital assistant (PDA), a wireless modem, a wireless communication device, a handheld device, a laptop computer, a cordless phone, a wireless local loop (WLL) station, etc. Terminal 110 may communicate with a base station via the downlink and uplink. The downlink (or forward link) refers to the communication link from the base station to the terminal, and the uplink (or reverse link) refers to the communication link from the terminal to the base station.

[0020] Wireless network 100 may support HARQ in order to improve reliability of data transmission. For HARQ, a transmitter may send a transmission of data and may send one or more additional transmissions if needed until the data is decoded correctly by a receiver, or the maximum number of transmissions has been sent, or some other termination condition is encountered.

[0021] **FIG. 2** shows an example data transmission on the downlink with HARQ. The transmission timeline may be partitioned into units of frames. Each frame may cover a predetermined time duration, e.g., 1 milliseconds (ms). A frame may also be referred to as a subframe, a slot, etc.

[0022] Base station 120 may have data to send to terminal 110. Base station 120 may process a data packet and send a transmission of the packet on the downlink. Terminal 110 may receive the downlink transmission and decode the received transmission. Terminal 110 may send an acknowledgement (ACK) if the packet is decoded correctly or a negative acknowledgement (NAK) if the packet is decoded in

error. Base station 120 may receive the ACK/NAK feedback, send another transmission of the packet if a NAK is received, and either send a transmission of a new packet or terminate if an ACK is received. Transmission of packet and ACK/NAK feedback may continue in similar manner.

[0023] M HARQ interlaces with indices of 0 through $M-1$ may be defined for each of the downlink and uplink, where M may be equal to 4, 6, 8 or some other value. Each HARQ interlace may include frames that are spaced apart by M frames. A packet may be sent on one HARQ interlace, and all transmissions of the packet may be sent in different frames of the same HARQ interlace. Each transmission of the packet may be referred to as an HARQ transmission.

[0024] Wireless network 100 may be a heterogeneous network with different types of base stations, e.g., macro base stations, pico base stations, home base stations, etc. These different types of base stations may transmit at different power levels, have different coverage areas, and have different impact on interference in the wireless network. Wireless network 100 may also support relay stations. A relay station is a station that receives transmission of data for a terminal from an upstream station and sends transmission of the data to a downstream station.

[0025] Terminal 110 may be within the coverage of multiple base stations. One of these multiple base stations may be selected to serve terminal 110. The selection of a serving base station may be referred to as server selection. The base station with the best received signal quality may be selected as the serving base station. Received signal quality may be quantified by a signal-to-noise-and-interference ratio (SINR), a signal-to-noise ratio (SNR), a carrier-to-interference ratio (C/I), etc. SINR and C/I are used to denote received signal quality in much of the description below. Selecting the base station with the best downlink SINR as the serving base station may have the following drawbacks:

- Not efficient when a mix of macro, pico and/or home base stations are present,
- Not possible if the selected base station is a home base station with restricted association, and terminal 110 is not a member of the restricted set, and
- Not efficient with relay stations.

[0026] In an aspect, a serving base station may be selected based on one or more metrics. In general, a metric may be defined based on one or more parameters, which may be measured or specified. Some metrics may serve as constraints while others may

serve as optimization variables. Constraints may be used to determine whether a given candidate base station can be selected as a serving base station. A constraint may be defined by requiring a metric to be above or below a predetermined threshold. The threshold may be set based on base station capability or may be relative to minimum or maximum value in a set of base stations. Optimization variables may be used to determine the most suitable base station for selection. For example, a candidate base station with the best metric may be selected, where "best" may be dependent on how the metric is defined and may refer to the highest or lowest value. The selected candidate base station may have a lower SINR than that of another candidate base station. This serving base station selection scheme may provide certain advantages, e.g., reduced interference in the network.

[0027] A serving base station may be selected based further on one or more conditions. A condition may be used to ensure that a suitable base station is selected. For example, a home base station may be selected only if it meets a condition that terminal 110 can access the home base station. As another example, a base station may be selected only if it can provide the minimum quality of service (QoS) guarantee for QoS traffic of terminal 110.

[0028] In one design, the following metrics may be used to select a serving base station:

- Transmit energy metric – indicative of transmit energy,
- Pathloss – indicative of channel gain between a base station and a terminal,
- Effective geometry – indicative of received signal quality,
- Projected data rate – indicative of data rate supportable for a terminal, and
- Control channel reliability – indicative of reliability of control channels.

Each metric is described in detail below. Other metrics may also be used for server selection.

[0029] Any combination of the metrics given above may be used to select a serving base station for the downlink and/or uplink. In one design, a single base station may be selected to serve terminal 110 on both the downlink and uplink. In this design, if the best base station for the downlink is different from the best base station for the uplink, then it may be desirable to select a serving base station that is not far from the best base stations for the downlink and uplink. In another design, one base station may be selected to serve terminal 110 on the downlink, and another base station may be

selected to serve terminal 110 on the uplink. In this design, the serving base station for each link may be selected based on any of the metrics.

[0030] The transmit energy metric may be determined as follows for additive white Gaussian noise (AWGN) channels and 1×1 antenna configuration with a single transmit antenna and a single receive antenna. The energy at a transmit antenna output and the energy at a receive antenna output may be expressed as:

$$E_{b,tx} = \frac{E_{b,rx}}{h} = \frac{E_{s,rx}}{r}\cdot\frac{1}{h} = \frac{E_{s,rx}}{h\cdot \log_2(1+C/I)}, \qquad \text{Eq (1)}$$

where h is a channel gain from the transmit antenna output to the receive antenna output,

$E_{b,tx}$ is the energy-per-bit at the transmit antenna output,

$E_{b,rx}$ is the energy-per-bit at the receive antenna output,

$E_{s,rx}$ is the energy-per-symbol at the receive antenna output,

r is spectral efficiency in bit/second/Hertz (bps/Hz),

C is the received signal power, and

I is the received interference power.

[0031] Equation (1) shows the transmit energy metric for AWGN channels and 1×1 antenna configuration. The transmit energy metric may also be determined for fading channels and different antenna configurations.

[0032] For the downlink, the transmit antenna output is at a base station, and the receive antenna output is at terminal 110. For the uplink, the transmit antenna output is at terminal 110, and the receive antenna output is at a base station. C is the received power of a desired signal. I is the received power of interference and thermal noise to the desired signal. C and I may be different components of the total received power P_{rx}, which may be given as $P_{rx} = C + I$.

[0033] An approximation of $\log_2(1+x) \approx x/\ln 2$ may be used in a linear region. Equation (1) may then be expressed as:

$$E_{b,tx} = \frac{E_{s,rx}\cdot \ln 2}{h\cdot C/I} = \frac{\ln 2\cdot (C/S)}{h\cdot C/I} = \frac{\ln 2\cdot I}{h\cdot S} = \frac{\ln 2\cdot I\cdot p}{S}, \qquad \text{Eq (2)}$$

where $E_{s,rx} = C/S$, S is the symbol rate, and $p = 1/h$ is pathloss.

[0034] As shown in equation (2), the transmit energy metric $E_{b,tx}$ is proportional to interference I and pathloss p and is inversely proportional to channel gain h and symbol

rate S. Equation (2) may be used to compute a transmit energy metric for the downlink, $E_{b,tx,DL}$, as well as a transmit energy metric for the uplink, $E_{b,tx,UL}$. The pathloss for the downlink may be estimated based on pilot transmitted by a base station. The pathloss for the uplink may be assumed to be equal to the pathloss for the downlink. The interference on the uplink may be different from the interference on the downlink. The interference on the downlink may be measured by terminal 110 and used to compute $E_{b,tx,DL}$. The interference on the uplink at each candidate base station may be used to compute $E_{b,tx,UL}$. Each base station may broadcast the interference observed by that base station, which may be used to compute $E_{b,tx,UL}$. For both the downlink and uplink, the interference may be dependent on the base station for which the transmit energy metric is being computed. Furthermore, the interference may be different for different HARQ interlaces. In this case, the transmit energy metric may be estimated for each active HARQ interlace in which a candidate base station might schedule data transmission for terminal 110.

[0035] In the example shown in FIG. 1, either base station 120 or 122 may be selected as a serving base station for terminal 110. Base stations 120 and 122 may interfere with one another on the downlink. $E_{b,tx,DL}$ may be computed as follows:

- If interference mitigation is performed between base stations 120 and 122 for the downlink, then the interference I to use in computing $E_{b,tx,DL}$ for base station 120 or 122 would be the sum of ambient noise and interference from other base stations. This condition often leads to the selection of the base station with the lowest pathloss.
- If interference mitigation is not performed between base stations 120 and 122 for the downlink, then the interference I to use in computing $E_{b,tx,DL}$ for base station 120 would be the sum of ambient noise and interference from base station 122 as well as other base stations. Similarly, the interference I to use in computing $E_{b,tx,DL}$ for base station 122 would include the interference from base station 120.

$E_{b,tx,UL}$ may also be computed by taking into account whether or not interference mitigation is performed on the uplink.

[0036] In one design, a base station with the lowest $E_{b,tx,DL}$ may be selected to reduce interference on the downlink. A base station with the lowest $E_{b,tx,UL}$ may be selected to reduce interference on the uplink. $E_{b,tx}$ is proportional to pathloss, as shown in equation (2). A base station with the lowest pathloss may be selected to reduce

interference and improve network capacity. This base station may be selected even if its downlink SINR may be weak, e.g., subject to a constraint of not being thermal limited on the downlink. The use of $E_{b,tx}$ (instead of SINR or C/I) may favor selection of a lower power base station with less pathloss, which may be more efficient in serving terminal 110.

[0037] The effective geometry may be determined as follows. A nominal geometry for a base station may be expressed as:

$$G_{nom,k} = \frac{C_{avg,k}}{I_{avg,k}}, \qquad \text{Eq (3)}$$

where $C_{avg,k}$ is the average received signal power for base station k,

$I_{avg,k}$ is the average received interference power for base station k, and

$G_{nom,k}$ is the nominal geometry for base station k.

[0038] An effective geometry for the downlink may be expressed as:

$$\log(1+G_{DL,eff,k}) = \frac{F_k}{\mathrm{M}} \cdot \sum_{m=1}^{\mathrm{M}} \log\left(1+\frac{C_{avg,k}}{I_{m,k}}\right), \qquad \text{Eq (4)}$$

where $I_{m,k}$ is the received interference power for base station k on HARQ interlace m.

F_k is a typical fraction of resources allocated by base station k, and

$G_{DL,eff,k}$ is the effective downlink geometry for base station k.

[0039] F_k is the fraction of resources that might be allocated by base station k to a typical terminal. F_k may be a value between zero and one (or $0 \le F_k \le 1$) and may be broadcast by base station k or known by terminal 110. For example, F_k may be equal to one for a home base station and may be a value less than one for a macro base station. F_k may also be based on the number of terminals in the cell. F_k may also be set individually for each terminal and may be communicated to the terminal, e.g., via signaling.

[0040] Equation (4) converts the geometry $C_{avg,k}/I_{m,k}$ for each HARQ interlace to capacity using a capacity function of $\log(1+C/I)$. The capacities of all M HARQ interlaces are summed and divided by M to obtain an average downlink capacity. The effective downlink geometry is then computed based on the average downlink capacity and the typical amount of resources that might be allocated. Equation (4) assumes that

all M HARQ interlaces may be used for terminal 110. The summation may also be performed over a subset of the M HARQ interlaces.

[0041] An effective geometry for the uplink may be expressed as:

$$\log(1+G_{UL,eff,k}) = \frac{F_k}{\mathrm{M}} \cdot \sum_{m=1}^{\mathrm{M}} \log\left(1 + D \cdot \frac{pCoT_k}{IoT_{m,k}}\right), \qquad \text{Eq (5)}$$

where $IoT_{m,k}$ is an interference-over-thermal for base station k on HARQ interlace m,

$pCoT_k$ is a carrier-over-thermal for uplink pilot at base station k,

D is an expected data power spectral density (PSD) relative to pilot PSD, and

$G_{UL.eff,k}$ is the effective uplink geometry for base station k.

[0042] $IoT_{m,k}$ may be broadcast by base station k or estimated by terminal 110 based on downlink pilot measurement. $pCoT_k$ for terminal 110 at base station k may be adjusted with a power control mechanism to achieve the desired performance for the uplink. D may be determined based on the expected data PSD and the uplink pilot PSD for terminal 110 at base station k. D may also be assigned by base station k (e.g., via Layer 1 or Layer 3 signaling) or may be determined by terminal 110 running a distributed power control algorithm. D may also be dependent on power amplifier (PA) headroom of terminal 110, an interference mitigation scheme being used, etc. A carrier-over-thermal for data, CoT_k, may be given as $CoT_k = D \cdot pCoT_k$.

[0043] Equation (5) converts the geometry for each HARQ interlace to capacity using a capacity function. Equation (5) then averages the capacities of all M HARQ interlaces and computes the effective uplink geometry based on the average uplink capacity.

[0044] Equations (4) and (5) provide the effective downlink and uplink geometries for over-the-air transmissions on the downlink and uplink, respectively. A base station may send data via a backhaul to a network entity. The effective downlink and uplink geometries may be computed to take into account the bandwidth of the backhaul, as follows:

$$\log(1+G_{DL,eff,k}) = \frac{F_k}{\mathrm{M}} \cdot \sum_{m=1}^{\mathrm{M}} \min\left(B_k,\ \log\left(1+\frac{C_{avg,k}}{I_{m,k}}\right)\right), \text{ and} \qquad \text{Eq (6)}$$

$$\log(1+G_{UL,eff,k}) = \frac{F_k}{\mathrm{M}} \cdot \sum_{m=1}^{\mathrm{M}} \min\left(B_k,\ \log\left(1+D\cdot\frac{CoT_k}{IoT_{m,k}}\right)\right), \qquad \text{Eq (7)}$$

where B_k is a normalized backhaul bandwidth for base station k and may be given in units of bps/Hz.

[0045] The projected data rates for each candidate base station may be determined based on the effective geometries, as follows:

$$R_{DL,k} = W_k \cdot \log(1+G_{DL,eff,k}), \text{ and} \qquad \text{Eq (8)}$$

$$R_{UL,k} = W_k \cdot \log(1+G_{UL,eff,k}), \qquad \text{Eq (9)}$$

where W_k is an available bandwidth for base station k,

$R_{DL,k}$ is a projected data rate for the downlink for base station k, and

$R_{UL,k}$ is a projected data rate for the uplink for base station k.

[0046] W_k may be the entire system bandwidth for base station k. Alternatively, W_k may be a fraction of the system bandwidth and may be broadcast by base station k. The projected data rates may also be determined in other manners, e.g., using parameters other than effective geometries.

[0047] Terminal 110 may determine the downlink and uplink transmit energy metrics $E_{b,tx,DL}$ and $E_{b,tx,UL}$ for each candidate base station based on equation (2). Terminal 110 may also determine the effective downlink and uplink geometries $G_{DL,eff,k}$ and $G_{UL,eff,k}$ and/or the downlink and uplink projected data rates $R_{DL,k}$ and $R_{UL,k}$ for each candidate base station. The various parameters used to determine the transmit energy metrics, the effective geometries, and the projected data rates may be measured by terminal 110, broadcast by the candidate base stations, or obtained in other manners.

[0048] A macro base station may reserve certain HARQ interlaces based on information reported by terminals in order to improve the effective downlink geometry of a pico or home base station. This may result in selection of the pico or home base station over the macro base station, e.g., based on the transmit energy metric.

[0049] The metrics for each candidate base station may be determined based on parameters for that base station, as described above. This assumes a non-relay deployment in which the base stations can communicate via a backhaul with other network entities. For a relay deployment, data may be forwarded via one or more relay

stations before reaching the backhaul. The metrics may be determined by taking into account the capabilities of the relay stations.

[0050] **FIG. 3** shows a wireless communication network 102 with relay. For simplicity, FIG. 3 shows only one base station 130 and one relay station 132. Terminal 110 may communicate directly with base station 130 via a direct access link 140. Base station 130 may communicate with network controller 150 via a wireline backhaul 146. Alternatively, terminal 110 may communicate with relay station 132 via a relay access link 142. Relay station 132 may communicate with base station 130 via a relay backhaul link 144.

[0051] **FIG. 4** shows a frame structure 400 that may be used for network 102. Each frame may be partitioned into multiple slots 1 through S. In the example shown in FIG. 4, slot 1 in each frame may be used for relay backhaul link 144. The remaining slots 2 through S in each frame may be used for direct access link 140 and relay access link 142. In general, any number of slots may be used for each link.

[0052] Referring back to FIG. 3, terminal 110 may have a projected data rate of R_d for direct access link 140 to base station 130 and a projected data rate of R_a for relay access link 142 to relay station 132. Relay station 132 may have a data rate of R_b for relay backhaul link 144 to base station 130. R_a and R_b may be given by spectral efficiency, and R_r for relay station 132 may then be expressed as:

$$R_r = \frac{R_a \cdot R_b}{R_a + R_b} . \qquad \text{Eq (10)}$$

[0053] Equation (10) assumes that there is only one terminal being served and that the split between relay access link 142 and relay backhaul link 144 is done in an optimal manner. If the split between relay access link 142 and relay backhaul link 144 is predetermined (e.g., set by base station 130 based on some criterion), then data rates (instead of spectral efficiencies) for the relay access and backhaul links may be computed. The projected data rate R_r may then be given as $R_r = \min(R_a, R_b)$ and may be compared to the data rate R_d for direct access link 140. When there are multiple relay stations, the contribution of R_a may be scaled to account for spatial division multiple access (SDMA) over relay access link 142. For example, $N*R_a$ may be used if there are N relay stations transmitting simultaneously. In any case, as shown in equation (10), both relay access link 142 and relay backhaul link 144 may be taken into account in computing the projected data rate for relay station 132. The transmit energy

metric $E_{b,tx}$ for relay station 132 may also be computed as the sum of $E_{b,tx}$ for relay access link 142 and $E_{b,tx}$ for relay backhaul link 144.

[0054] The downlink and uplink transmit energy metrics, the effective downlink and uplink geometries, the projected downlink and uplink data rates, and/or other metrics may be determined for each candidate base station. The metrics may be used for server selection in various manners. In some designs, the metrics may be used directly to select a serving base station. For example, in one design, the base station with the highest $R_{DL,k}$ and/or the highest $R_{UL,k}$ may be selected to obtain the highest data rate for terminal 110. In another design, the base station with the lowest $E_{b,tx,DL}$ and/or the lowest $E_{b,tx,UL}$ may be selected to obtain the least interference on the downlink and uplink, respectively.

[0055] In other designs, multiple metrics may be combined based on a function to obtain an overall metric. The base station with the best overall metric may then be selected. In one design, the base station with the highest $R_{DL,k}$ and/or $R_{UL,k}$ among all base stations with $E_{b,tx,DL}$ and/or $E_{b,tx,UL}$ below predetermined thresholds may be selected. This design may provide the highest data rate for terminal 110 while maintaining interference below target levels. For this design, an overall metric may be defined based on $R_{DL,k}$ and/or $R_{UL,k}$ and may be set to zero if $E_{b,tx,DL}$ and/or $E_{b,tx,UL}$ exceed the predetermined thresholds.

[0056] One or more control channels may be used to support data transmission on the downlink and uplink. A serving base station may be selected such that the desired reliability can be achieved for all control channels, which may ensure reliable data services. The performance of a control channel may be determined by its received signal quality, which may be given by SINR, SNR, C/I, CoT, etc. The received signal quality of each control channel may be measured and compared against a suitable threshold to determine whether the control channel is sufficiently reliable. The reliability of a control channel may also be determined based on an error rate and/or other metrics. A base station may be selected if the control channels are deemed sufficiently reliable. In general, control channel reliability may be ascertained based on received signal quality (e.g., SINR, SNR, C/I, CoT, etc.), control channel performance (e.g., message error rate, erasure rate, etc.), and/or other information. A control channel may be deemed to meet control channel reliability if its received signal quality exceeds a predetermined quality threshold, its error rate or erasure rate is below a predetermined threshold, etc.

[0057] A serving base station may also be selected based on terminal and/or network utility metrics. In one design, a network utility metric may be defined for each candidate base station in accordance with one of the following:

$$U_k = \frac{1}{\mathrm{L}} \cdot \sum_{\ell=1}^{\mathrm{L}} T_{\ell,k} \ , \qquad \text{Eq (11)}$$

$$U_k = \frac{1}{\mathrm{L}} \cdot \sum_{\ell=1}^{\mathrm{L}} \log(T_{\ell,k}) \ , \qquad \text{Eq (12)}$$

$$U_k = \frac{1}{\mathrm{L}} \cdot \sum_{\ell=1}^{\mathrm{L}} \frac{1}{T_{\ell,k}} \ , \qquad \text{Eq (13)}$$

where $T_{\ell,k}$ is the throughput of terminal ℓ served by base station k,

L is the number of terminals served by base station k, and

U_k is a network utility metric for base station k.

[0058] Equation (11) provides an arithmetic mean of the throughputs of all terminals served by base station k and may be used to maximize overall throughput. Equation (12) provides a logarithmic mean of the throughputs of the terminals and may be used to achieve proportional fairness. Equation (13) provides a harmonic mean of the throughputs of the terminals and may be used to achieve equal grade of service (GoS). The mean throughputs for a set of base stations may be summed to obtain a total throughput or an overall utility metric U for these base stations. A serving base station may be selected based on the utility metrics U_k of different candidate base stations, the overall utility metric U, and/or other metrics such as the transmit energy metrics $E_{b,tx,DL}$ and/or $E_{b,tx,UL}$, the effective geometries $G_{DL,eff,k}$ and/or $G_{UL,eff,k}$, the projected data rates $R_{DL,k}$ and/or $R_{UL,k}$, etc.

[0059] In general, server selection may be performed by terminal 110 or a network entity such as a base station or a network controller. The base stations may send information (e.g., via broadcast and/or unicast channels) to allow terminal 110 to compute metrics. Terminal 110 may then select a serving base station based on the computed metrics and the available information. Alternatively, terminal 110 may send the computed metrics and/or other information to the network entity. The network entity may then select a serving base station for terminal 110 based on the available

information. The serving base station may be communicated to terminal 110 via a handover message or some other message.

[0060] A base station may send various types of information that may be used for server selection. In one design, a base station may send one or more of the following, e.g., via a broadcast channel:

- Number and/or indices of available HARQ interlaces on the downlink and uplink,
- Fraction of resources F_k that may be allocated to a terminal,
- Interference levels $I_{m,k}$ for different HARQ interlaces and/or different frequency subbands, e.g., actual and target values,
- Median or tail data rates on the downlink and uplink,
- QoS guarantees, e.g., whether 50 ms latency can be achieved,
- Backhaul bandwidth B_k,
- Effective isotropic radiated power (EIRP),
- Maximum power amplifier (PA) output power,
- Receiver noise figure, and
- Battery power of level of the base station if it is battery powered.

[0061] Some parameters such as M, F_k, $I_{m,k}$ and B_k may be used to compute metrics, as described above. Other parameters such as QoS guarantees, median or tail data rates, etc., may be used as constraints. EIRP and maximum PA output power may be used to estimate pathloss, which may then be used to compute metrics. Noise figure in conjunction with IoT may be used to compute the total interference power. The battery power level of the base station, if it is battery powered, may be used to make handoff decisions for terminals connecting to the base station.

[0062] A base station may also send one or more of the following, e.g., via a unicast channel:

- Expected user experience,
- Bias of handoff boundary to another base station, e.g., in terms of pathloss differential, and
- Expected change in network utility due to a terminal being handed into and out of the base station.

[0063] Terminal 110 may send one or more of the following (e.g., in an extended pilot report) to a network entity performing server selection:

- Pilot strengths of candidate and interfering base stations,
- Pathloss to candidate and interfering base stations,
- Computed metrics, e.g., transmit energy metrics, nominal geometry, effective geometries, and/or projected data rates for each candidate base station,
- Broadcast information received from other base stations, and
- Current performance of terminal 110, e.g., data rate, latency, etc.

[0064] For initial access, terminal 110 may perform server selection based on broadcast information from the candidate base stations and measurements obtained by terminal 110. Terminal 110 may also use the best downlink SINR to establish an initial connection. For handoff, terminal 110 may send extended pilot reports to candidate base stations and may receive unicast and/or broadcast information that may be used for server selection.

[0065] In general, pilot measurements may be made based on any type of pilots transmitted by base stations and relay stations. For example, measurements may be made based on standard pilots transmitted by base stations and used by terminals for synchronization, acquisition, etc. Measurements may also be made based on low reuse pilots or preambles (LRPs), which are pilots transmitted with low time and/or frequency reuse by fewer base stations and/or relay stations on a given time and/or frequency resource. The low reuse pilots may observe less interference and may thus result in more accurate pilot measurements.

[0066] **FIG. 5** shows a design of a process 500 for selecting a serving base station for a terminal. Process 500 may be performed by the terminal or a network entity, e.g., a base station or a network controller.

[0067] Multiple candidate base stations for the terminal may be identified, with each candidate base station being a candidate for selection as a serving base station for the terminal (block 512). The multiple candidate base stations may belong in an open-access communication system and may be accessible by any terminals with service subscription. The multiple candidate base stations may include base stations with different transmit power levels and/or may support interference mitigation. In any case, one of the multiple candidate base stations may be selected as the serving base station for the terminal (block 514). The selected candidate base station may have a lower SINR than a highest SINR among the multiple candidate base stations. The difference between the highest SINR and the lower SINR of the selected candidate base station

may be any value and may be larger than a hysteresis normally used for handover, e.g., at least 5 decibels (dB). The selected candidate base station may have a lower transmit power level than the highest transmit power level among the multiple candidate base stations.

[0068] In one design, the serving base station may be selected based at least one metric for each candidate base station. The at least one metric may comprise pathloss, effective transmit power, effective geometry, projected data rate, etc. The serving base station may be selected based further on a utility metric for each candidate base station. The utility metric may be determined based on throughputs of terminals served by the candidate base station, e.g., as shown in equation (11), (12) or (13). The serving base station may be selected based further on control channel reliability and/or other metrics.

[0069] In one design of block 514, a transmit energy metric (e.g., $E_{b,tx,DL}$ or $E_{b,tx,UL}$) may be determined for each candidate base station based on the pathloss and possibly an interference level for the candidate base station, e.g., as shown in equation (2). A candidate base station with the lowest transmit energy metric or the lowest pathloss may be selected as the serving base station.

[0070] In another design of block 514, an effective geometry metric (e.g., $G_{DL,eff,k}$ or $G_{UL,eff,k}$) may be determined for each candidate base station based on received signal quality for the candidate base station. The received signal quality may be determined based on C/I, e.g., as shown in equation (4), based on CoT and IoT, e.g., as shown in equation (5), or based on other parameters. A candidate base station with a largest effective geometry metric may be selected as the serving base station.

[0071] In yet another design of block 514, a projected data rate metric (e.g., $R_{DL,k}$ or $R_{UL,k}$) may be determined for each candidate base station based on the effective geometry and/or other parameters for the candidate base station. A candidate base station with a largest projected data rate metric may be selected as the serving base station.

[0072] In one design, the capacities of each candidate base station for multiple resource sets may be determined based on received signal qualities for the multiple resource sets. The multiple resource sets may correspond to multiple HARQ instances, multiple frequency subbands, multiple time intervals, etc. An effective geometry or a projected data rate may be determined for each candidate base station based on the capacities for the multiple resource sets.

[0073] The multiple candidate base stations may comprise a relay station. A metric may be determined for the relay station based on (i) a first parameter value for a first link between the terminal and the relay station and (ii) a second parameter value for a second link between the relay station and a base station, e.g., as shown in equation (10).

[0074] In one design, the server selection may be performed by the terminal. The terminal may determine at least one metric for each candidate base station based on measurements made by the terminal and information received from at least one candidate base station. The terminal may select the serving base station based on the at least one metric for each candidate base station. In another design, the server selection may be performed by a network entity, e.g., a designated base station. The terminal may send measurements, computed metrics, identities of the candidate base stations, and/or other information to the network entity to assist with server selection. A handover message indicating the serving base station may be sent to the terminal, e.g., via the prior or new serving base station.

[0075] The at least one metric for each candidate base station may include a first metric for the downlink (e.g., $E_{b,tx,DL}$, $G_{DL,eff,k}$ or $R_{DL,k}$) and a second metric for the uplink (e.g., $E_{b,tx,UL}$, $G_{UL,eff,k}$ or $R_{UL,k}$). A first candidate base station having the best first metric for the downlink may be identified among the multiple candidate base stations. A second candidate base station having the best second metric for the uplink may also be identified. In one design, the first and second candidate base stations may be selected as the serving base stations for the downlink and uplink, respectively. In another design, a single serving base station may be selected for both the downlink and uplink. The first or second candidate base station may be selected as the serving base station based on the first and second metrics. For example, the candidate base station with the best downlink and an uplink that is within a certain range of the best uplink may be selected. Alternatively, the candidate base station with the best uplink and a downlink that is within a certain range of the best downlink may be selected.

[0076] In one design, the terminal may communicate with the selected base station using interference mitigation in order to improve SINR. Interference mitigation may be used for system access by the terminal, for data transmission between the terminal and the selected base station, etc. Interference mitigation may be achieved by sending interference mitigation request messages to interfering base stations and/or interfering terminals to request them to reduce interference on certain specified resources. The messages may be sent over the air from the serving base station to interfering terminals

or from the terminal to interfering base stations. The messages may also be sent via a backhaul between base stations. The interfering base stations or interfering terminals may reduce interference on the specified resources by (i) not sending transmissions on these resources, (ii) sending transmissions on these resources at lower transmit power, (iii) sending transmissions on these resources with beamsteering to steer power away from the terminal, and/or (iv) sending transmissions in other manners to reduce interference on the resources. Interference mitigation may be especially applicable when the selected base station has low SINR.

[0077] **FIG. 6** shows a design of an apparatus 600 for selecting a serving base station for a terminal. Apparatus 600 includes a module 612 to identity multiple candidatc base stations for thc terminal, with each candidate base station being a candidate for selection as a serving base station for the terminal, and the multiple candidate base stations including at least two candidate base stations having different transmit power levels, and a module 614 to select one of the multiple candidate base stations as the serving base station for the terminal, with the selected candidate base station having a lower SINR than a highest SINR among the multiple candidate base stations.

[0078] **FIG. 7** shows a design of a process 700 for selecting a serving base station for a terminal based on different metrics. Multiple candidate base stations for the terminal may be identified, with each candidate base station being a candidate for selection as a serving base station for the terminal (block 712). A first metric may be determined for each candidate base station and may be used as a constraint to determine whether the candidate base station is selectable as the serving base station (block 714). The first metric may be for control channel reliability, etc. A second metric may also be determined for each candidate base station and may be used as a variable to identify a most suitable candidate base station for selection as the serving base station (block 716). The second metric may be determined based on pathloss, effective transmit power, effective geometry, projected data rate, and/or other parameters. One of the multiple candidate base stations may be selected as the serving base station for the terminal based on the first and second metrics for each candidate base station (block 718). The selected candidate base station may have a lower SINR than a highest SINR among the multiple candidate base stations

[0079] **FIG. 8** shows a design of an apparatus 800 for selecting a serving base station for a terminal. Apparatus 800 includes a module 812 to identify multiple

candidate base stations for the terminal, with each candidate base station being a candidate for selection as a serving base station for the terminal, a module 814 to determine a first metric for each candidate base station, with the first metric being used as a constraint to determine whether the candidate base station is selectable as the serving base station, a module 816 to determine a second metric for each candidate base station, with the second metric being used as a variable to identify a most suitable candidate base station for selection as the serving base station, and a module 818 to select one of the multiple candidate base stations as the serving base station for the terminal based on the first and second metrics for each candidate base station, with the selected candidate base station having a lower SINR than a highest SINR among the multiple candidate base stations.

[0080] The modules in FIGS. 6 and 8 may comprise processors, electronics devices, hardware devices, electronics components, logical circuits, memories, etc., or any combination thereof.

[0081] **FIG. 9** shows a block diagram of a design of terminal 110 and base station 120. In this design, base station 120 is equipped with T antennas 934a through 934t, and terminal 110 is equipped with R antennas 952a through 952r, where in general $T \geq 1$ and $R \geq 1$.

[0082] At base station 120, a transmit processor 920 may receive data for one or more terminals from a data source 912, process (e.g., encode and modulate) the data for each terminal based on one or more modulation and coding schemes, and provide data symbols for all terminals. Transmit processor 920 may also receive broadcast and control information (e.g., information used for server selection) from a controller/ processor 940, process the information, and provide overhead symbols. A transmit (TX) multiple-input multiple-output (MIMO) processor 930 may multiplex the data symbols, the overhead symbols, and pilot symbols. Processor 930 may process (e.g., precode) the multiplexed symbols and provide T output symbol streams to T modulators (MOD) 932a through 932t. Each modulator 932 may process a respective output symbol stream (e.g., for OFDM, CDMA, etc.) to obtain an output sample stream. Each modulator 932 may further process (e.g., convert to analog, amplify, filter, and upconvert) the output sample stream to obtain a downlink signal. T downlink signals from modulators 932a through 932t may be transmitted via T antennas 934a through 934t, respectively.

[0083] At terminal 110, R antennas 952a through 952r may receive the downlink signals from base station 120 and provide received signals to demodulators (DEMOD) 954a through 954r, respectively. Each demodulator 954 may condition (e.g., filter, amplify, downconvert, and digitize) a respective received signal to obtain received samples and may further process the received samples (e.g., for OFDM, CDMA, etc.) to obtain received symbols. A MIMO detector 960 may perform MIMO detection on the received symbols from all R demodulators 954a through 954r (if applicable) and provide detected symbols. A receive processor 970 may process (e.g., demodulate and decode) the detected symbols, provide decoded data for terminal 110 to a data sink 972, and provide decoded broadcast and control information to a controller/processor 990. A channel processor 994 may make measurements for parameters (e.g., channel gain h, pathloss p, signal power C, interference I, etc.) used for server selection.

[0084] On the uplink, at terminal 110, data from a data source 978 and control information (e.g., information used for server selection or identifying a selected serving base station) from controller/processor 990 may be processed by a transmit processor 980, precoded by a TX MIMO processor 982 (if applicable), conditioned by modulators 954a through 954r, and transmitted via antennas 952a through 952r. At base station 120, the uplink signals from terminal 110 may be received by antennas 934, conditioned by demodulators 932, detected by a MIMO detector 936, and processed by a receive processor 938 to obtain the data and control information transmitted by terminal 110.

[0085] Controllers/processors 940 and 990 may direct the operation at base station 120 and terminal 110, respectively. Controller/processor 940 at base station 120 or controller/processor 990 at terminal 110 may implement or direct process 500 in FIG. 5, process 700 in FIG. 7, and/or other processes for the techniques described herein. Memories 942 and 992 may store data and program codes for base station 120 and terminal 110, respectively. A scheduler 944 may schedule terminals for transmissions on the downlink and/or uplink and may assign resources to the scheduled terminals. A communication (Comm) unit 946 may support communication with other base stations and network controller 150 via the backhaul.

[0086] Those of skill in the art would understand that information and signals may be represented using any of a variety of different technologies and techniques. For example, data, instructions, commands, information, signals, bits, symbols, and chips that may be referenced throughout the above description may be represented by

voltages, currents, electromagnetic waves, magnetic fields or particles, optical fields or particles, or any combination thereof.

[0087] Those of skill would further appreciate that the various illustrative logical blocks, modules, circuits, and algorithm steps described in connection with the disclosure herein may be implemented as electronic hardware, computer software, or combinations of both. To clearly illustrate this interchangeability of hardware and software, various illustrative components, blocks, modules, circuits, and steps have been described above generally in terms of their functionality. Whether such functionality is implemented as hardware or software depends upon the particular application and design constraints imposed on the overall system. Skilled artisans may implement the described functionality in varying ways for each particular application, but such implementation decisions should not be interpreted as causing a departure from the scope of the present disclosure.

[0088] The various illustrative logical blocks, modules, and circuits described in connection with the disclosure herein may be implemented or performed with a general-purpose processor, a digital signal processor (DSP), an application specific integrated circuit (ASIC), a field programmable gate array (FPGA) or other programmable logic device, discrete gate or transistor logic, discrete hardware components, or any combination thereof designed to perform the functions described herein. A general-purpose processor may be a microprocessor, but in the alternative, the processor may be any conventional processor, controller, microcontroller, or state machine. A processor may also be implemented as a combination of computing devices, e.g., a combination of a DSP and a microprocessor, a plurality of microprocessors, one or more microprocessors in conjunction with a DSP core, or any other such configuration.

[0089] The steps of a method or algorithm described in connection with the disclosure herein may be embodied directly in hardware, in a software module executed by a processor, or in a combination of the two. A software module may reside in RAM memory, flash memory, ROM memory, EPROM memory, EEPROM memory, registers, hard disk, a removable disk, a CD-ROM, or any other form of storage medium known in the art. An exemplary storage medium is coupled to the processor such that the processor can read information from, and write information to, the storage medium. In the alternative, the storage medium may be integral to the processor. The processor and the storage medium may reside in an ASIC. The ASIC may reside in a user

terminal. In the alternative, the processor and the storage medium may reside as discrete components in a user terminal.

[0090] In one or more exemplary designs, the functions described may be implemented in hardware, software, firmware, or any combination thereof. If implemented in software, the functions may be stored on or transmitted over as one or more instructions or code on a computer-readable medium. Computer-readable media includes both computer storage media and communication media including any medium that facilitates transfer of a computer program from one place to another. A storage media may be any available media that can be accessed by a general purpose or special purpose computer. By way of example, and not limitation, such computer-readable media can comprise RAM, ROM, EEPROM, CD-ROM or other optical disk storage, magnetic disk storage or other magnetic storage devices, or any other medium that can be used to carry or store desired program code means in the form of instructions or data structures and that can be accessed by a general-purpose or special-purpose computer, or a general-purpose or special-purpose processor. Also, any connection is properly termed a computer-readable medium. For example, if the software is transmitted from a website, server, or other remote source using a coaxial cable, fiber optic cable, twisted pair, digital subscriber line (DSL), or wireless technologies such as infrared, radio, and microwave, then the coaxial cable, fiber optic cable, twisted pair, DSL, or wireless technologies such as infrared, radio, and microwave are included in the definition of medium. Disk and disc, as used herein, includes compact disc (CD), laser disc, optical disc, digital versatile disc (DVD), floppy disk and blu-ray disc where *disks* usually reproduce data magnetically, while *discs* reproduce data optically with lasers. Combinations of the above should also be included within the scope of computer-readable media.

[0091] The previous description of the disclosure is provided to enable any person skilled in the art to make or use the disclosure. Various modifications to the disclosure will be readily apparent to those skilled in the art, and the generic principles defined herein may be applied to other variations without departing from the spirit or scope of the disclosure. Thus, the disclosure is not intended to be limited to the examples and designs described herein but is to be accorded the widest scope consistent with the principles and novel features disclosed herein.

[0092] WHAT IS CLAIMED IS:

CLAIMS

1. A method for wireless communication, comprising:

identifying multiple candidate base stations for a terminal, each candidate base station being a candidate for selection as a serving base station for the terminal, wherein at least two of the multiple candidate base stations have different transmit power levels; and

selecting a candidate base station from among the multiple candidate base stations as the serving base station for the terminal, the selected candidate base station having a lower signal-to-noise-and-interference ratio (SINR) than a highest SINR among the multiple candidate base stations.

2. The method of claim 1, wherein the selected candidate base station has a lower transmit power level than a highest transmit power level among the multiple candidate base stations.

3. The method of claim 1, wherein a difference between the highest SINR and the lower SINR is at least 5 decibels (dB).

4. The method of claim 1, wherein the selecting a candidate base station comprises selecting a candidate base station with a lowest pathloss as the serving base station.

5. The method of claim 1, wherein the selecting a candidate base station comprises determining a transmit energy metric for each candidate base station based on pathloss for the

candidate base station, and selecting a candidate base station with a lowest transmit energy metric as the serving base station.

6. The method of claim 5, wherein the determining the transmit energy metric comprises determining the transmit energy metric for each candidate base station based further on an interference level for the candidate base station.

7. The method of claim 1, wherein the selecting a candidate base station comprises determining an effective geometry metric for each candidate base station based on received signal quality for the candidate base station, and selecting a candidate base station with a largest effective geometry metric as the serving base station.

8. The method of claim 7, wherein the selecting a candidate base station further comprises determining the received signal quality for each candidate base station based on a carrier-to-interference ratio (C/I) for the candidate base station or a carrier-over-thermal (CoT) and an interference-over-thermal (IoT) for the candidate base station.

9. The method of claim 7, wherein the determining an effective geometry metric for each candidate base station comprises determining capacities of each candidate base station for multiple resource sets based on received signal qualities for the multiple resource sets, and determining the effective geometry metric for each candidate base station based on the capacities of the candidate base station for the multiple resource sets.

10. The method of claim 9, wherein the multiple resource sets correspond to multiple hybrid automatic retransmission (HARQ) instances, or multiple frequency subbands, or multiple time intervals.

11. The method of claim 1, wherein the selecting a candidate base station comprises determining a projected data rate metric for each candidate base station based on an effective geometry for the candidate base station, and selecting a candidate base station with a largest projected data rate metric as the serving base station.

12. The method of claim 11, wherein the determining a projected data rate metric for each candidate base station comprises determining at least one projected data rate for at least one resource set for each candidate base station, and determining the projected data rate for each candidate base station based on the at least one projected data rate for the at least one resource set for the candidate base station.

13. The method of claim 12, wherein the determining the at least one projected data rate comprises determining a projected data rate for each resource set based on received signal quality for the resource set and a capacity function.

14. The method of claim 12, wherein the at least one resource set corresponds to at least one hybrid automatic retransmission (HARQ) instance, or at least one frequency subband, or at least one time interval.

15. The method of claim 1, wherein the multiple candidate base stations comprise a relay station, and wherein the selecting a candidate base station comprises determining a metric for each candidate base station, the metric for the relay station being determined based on a first parameter value for a first link between the terminal and the relay station and a second parameter value for a second link between the relay station and a base station, and selecting a candidate base station based on the metric for each candidate base station.

16. The method of claim 1, wherein the selecting a candidate base station comprises determining a utility metric for each candidate base station based on throughputs of terminals served by the candidate base station, and selecting a candidate base station based on the utility metric for each candidate base station.

17. The method of claim 1, wherein the selecting a candidate base station comprises selecting a candidate base station based on control channel reliability for each candidate base station.

18. The method of claim 1, wherein the selecting a candidate base station comprises determining at least one metric for each candidate base station by the terminal based on measurements made by the terminal and information received from at least one candidate base station, and selecting the serving base station by the terminal based on the at least one metric for each candidate base station.

19. The method of claim 1, wherein the selected candidate base station is the serving base station for the terminal for downlink, the method further comprising: selecting another candidate base station from among the multiple candidate base stations as a serving base station for the terminal for uplink.

20. The method of claim 1, wherein the multiple candidate base stations belong in an open-access communication system and are accessible by the terminal.

21. The method of claim 1, wherein the serving base station is selected by the terminal.

22. The method of claim 1, wherein the serving base station is selected by a designated base station.

23. The method of claim 22, further comprising:

receiving a report comprising the multiple candidate base stations from the terminal.

24. The method of claim 22, further comprising:

sending to the terminal a handover message indicating the serving base station.

25. A method for wireless communication, comprising:

identifying multiple candidate base stations for a terminal, each candidate base station being a candidate for selection as a serving base station for the terminal; and

selecting a candidate base station from among the multiple candidate base stations as the serving base station for the terminal, the selected candidate base station having a lower signal-to-noise-and-interference ratio (SINR) than a highest SINR among the multiple candidate base stations, the terminal communicating with the selected candidate base station using interference mitigation to improve SINR.

26. The method of claim 25, wherein interference mitigation is used for the terminal for system access with the selected candidate base station.

27. The method of claim 25, further comprising:

detecting for the multiple candidate base stations based on low reuse pilots transmitted by the candidate base stations.

28. The method of claim 25, further comprising:

receiving a report comprising the multiple candidate base stations from the terminal.

29. The method of claim 25, wherein the interference mitigation is achieved based on an interference mitigation request message sent by the terminal to at least one interfering base station or sent by the serving base station to at least one interfering terminal.

30. The method of claim 25, wherein the interference mitigation is achieved based on an interference mitigation request message exchanged between at least two base stations.

31. The method of claim 25, wherein the selected candidate base station has a lowest pathloss among the multiple candidate base stations.

32. The method of claim 25, wherein the selected candidate base station has a lower transmit power level than a highest transmit power level among the multiple candidate base stations.

33. A method for wireless communication, comprising:

detecting for candidate base stations for a terminal based on low reuse pilots transmitted by the candidate base stations, each candidate base station being a candidate for selection as a serving base station for the terminal; and

selecting a candidate base station from among the candidate base stations as the serving base station for the terminal, wherein the selected candidate base station has a lower signal-to-noise-and-interference ratio (SINR) than a highest SINR among the candidate base stations.

34. The method of claim 33, wherein at least two of the candidate base stations have different transmit power levels.

35. The method of claim 33, further comprising:

receiving a report comprising the candidate base stations from the terminal, wherein the serving base station is selected by a designated base station based on the report.

36. An apparatus for wireless communication, comprising:

at least one processor configured to identify multiple candidate base stations for a terminal, each candidate base station being a candidate for selection as a serving base station for the terminal, wherein at least two of the multiple candidate base stations have different transmit power levels, and to select a candidate base station from among the multiple candidate base stations as the serving base station for the terminal, the selected candidate base station having a lower signal-to-noise-and-interference ratio (SINR) than a highest SINR among the multiple candidate base stations.

37. The apparatus of claim 36, wherein the at least one processor is configured to select a candidate base station with a lowest pathloss as the serving base station.

38. The apparatus of claim 36, wherein the at least one processor is configured to determine a transmit energy metric for each candidate base station based on pathloss for the candidate base station, and to select a candidate base station with a lowest transmit energy metric as the serving base station.

39. The apparatus of claim 36, wherein the at least one processor is configured to determine an effective geometry metric for each candidate base station based on received signal quality for the candidate base station, and to select a candidate base station with a largest effective geometry metric as the serving base station.

40. The apparatus of claim 36, wherein the at least one processor is configured to determine a projected data rate metric for each candidate base station based on an effective

geometry for the candidate base station, and to select a candidate base station with a largest projected data rate metric as the serving base station.

41. An apparatus for wireless communication, comprising:

means for identifying multiple candidate base stations for a terminal, each candidate base station being a candidate for selection as a serving base station for the terminal, wherein at least two of the multiple candidate base stations have different transmit power levels; and

means for selecting a candidate base station from among the multiple candidate base stations as the serving base station for the terminal, the selected candidate base station having a lower signal-to-noise-and-interference ratio (SINR) than a highest SINR among the multiple candidate base stations.

42. The apparatus of claim 41, wherein the means for selecting a candidate base station comprises means for selecting a candidate base station with a lowest pathloss as the serving base station.

43. The apparatus of claim 41, wherein the means for selecting a candidate base station comprises means for determining a transmit energy metric for each candidate base station based on pathloss for the candidate base station, and means for selecting a candidate base station with a lowest transmit energy metric as the serving base station.

44. The apparatus of claim 41, wherein the means for selecting a candidate base station comprises means for determining an effective geometry metric for each candidate base station

based on received signal quality for the candidate base station, and means for selecting a candidate base station with a largest effective geometry metric as the serving base station.

45. The apparatus of claim 41, wherein the means for selecting a candidate base station comprises means for determining a projected data rate metric for each candidate base station based on an effective geometry for the candidate base station, and means for selecting a candidate base station with a largest projected data rate metric as the serving base station.

46. A non-transitory computer-readable medium comprising:

code for causing at least one computer to identify multiple candidate base stations for a terminal, each candidate base station being a candidate for selection as a serving base station for the terminal, wherein at least two of the multiple candidate base stations have different transmit power levels, and

code for causing the at least one computer to select a candidate base station from among the multiple candidate base stations as the serving base station for the terminal, the selected candidate base station having a lower signal-to-noise-and-interference ratio (SINR) than a highest SINR among the multiple candidate base stations.

47. A method for wireless communication, comprising:

identifying multiple candidate base stations for a terminal, each candidate base station being a candidate for selection as a serving base station for the terminal;

determining a first metric for each candidate base station, the first metric being used as a constraint to determine whether the candidate base station is selectable as the serving base

station; determining a second metric for each candidate base station, the second metric being used as a variable to identify a most suitable candidate base station for selection as the serving base station; and

selecting one of the multiple candidate base stations as the serving base station for the terminal based on the first and second metrics for each candidate base station, the selected candidate base station having a lower signal-to-noise-and-interference ratio (SINR) than a highest SINR among the multiple candidate base stations.

48. The method of claim 47, wherein the determining the second metric for each candidate base station comprises determining the second metric for each candidate base station based on at least one of pathloss, effective transmit power, effective geometry, and projected data rate for the candidate base station.

49. The method of claim 47, wherein the selecting one of the multiple candidate base stations comprises determining whether a candidate base station is selectable based on the first metric for the candidate base station and a predetermined threshold.

50. An apparatus for wireless communication, comprising:

at least one processor configured to identify multiple candidate base stations for a terminal, each candidate base station being a candidate for selection as a serving base station for the terminal, to determine a first metric for each candidate base station, the first metric being used as a constraint to determine whether the candidate base station is selectable as the serving base station, to determine a second metric for each candidate base station, the second metric

being used as a variable to identify a most suitable candidate base station for selection as the serving base station, and to select one of the multiple candidate base stations as the serving base station for the terminal based on the first and second metrics for each candidate base station, the selected candidate base station having a lower signal-to-noise-and-interference ratio (SINR) than a highest SINR among the multiple candidate base stations.

51. The apparatus of claim 50, wherein the at least one processor is configured to determine the second metric for each candidate base station based on at least one of pathloss, effective transmit power, effective geometry, and projected data rate for the candidate base station.

52. The apparatus of claim 50, wherein the at least one processor is configured to determine whether a candidate base station is selectable based on the first metric for the candidate base station and a predetermined threshold.