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(54) SIGNAL PROCESSING METHOD AND RELEVANT DEVICE

SIGNALVERARBEITUNGSVERFAHREN UND ZUGEHÖRIGE VORRICHTUNG

PROCÉDÉ DE TRAITEMENT DE SIGNAL ET DISPOSITIF ASSOCIÉ

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(56) References cited:
EP-A1- 1 944 984
WO-A1-2012/116489
WO-A1-2015/109467
US-A1- 2013 336 156

- **CMCC: "RSSI measurements and reporting", 3GPP DRAFT; R2-153217_RSSI MEASUREMENTS AND REPORTING, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE , vol. RAN WG2, no. Beijing, China; 20150824 - 20150828 13 August 2015 (2015-08-13), XP050991920, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_91/Docs/ [retrieved on 2015-08-13]**
- **QUALCOMM INCORPORATED: "Considerations on RRM measurements for LAA-LTE", 3GPP DRAFT; R2-152708 LAA RRM, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE , vol. RAN WG2, no. Fukuoka, Japan; 20150525 - 20150529 24 May 2015 (2015-05-24), XP050972115, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/Meetings_3GPP_SYNC/RAN2/Docs/ [retrieved on 2015-05-24]**

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- "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Study on Licensed-Assisted Access to Unlicensed Spectrum; (Release 13)", 3GPP STANDARD; 3GPP TR 36.889, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE, vol. RAN WG1, no. V13.0.0, 18 June 2015 (2015-06-18), pages 1-87, XP050965916, [retrieved on 2015-06-18]

- None

Description

TECHNICAL FIELD

[0001] The present invention relates to the field of wireless communications technologies, and in particular, to an unlicensed frequency signal processing method, a user equipment and a base station.

BACKGROUND

[0002] Development of mobile communications technologies and an increasing quantity of user equipments are accompanied with increasingly high load on limited licensed frequencies of mobile communications networks. To alleviate load on a licensed frequency, an unlicensed frequency may be used to provide a service such as data for user equipment. The unlicensed frequency is a type of frequency that can be directly used in conformity with relevant regulations of a department such as a government without a license. When an unlicensed frequency is used, listening needs to be performed before a signal is sent. That is, a signal can be transmitted on the unlicensed frequency only when it is detected through listening that the unlicensed frequency is idle. More user equipments using a frequency bring higher load on the frequency and a shorter time for which the frequency can be used by each user equipment. Therefore, a base station selects a frequency that has relatively low load and that is relatively idle from unlicensed frequencies as far as possible, to provide a communications service for user equipment. A received signal strength indicator (Received Signal Strength Indicator, RSSI) is used to indicate total signal strength on a frequency. A larger RSSI value indicates that load on the frequency is higher, and a smaller RSSI value indicates that the load on the frequency is lower and the frequency is relatively idle. Therefore, the base station may select, by detecting an RSSI value of a signal on each candidate unlicensed frequency, an unlicensed frequency that has relatively low load and that is relatively idle, and provide a communications service for user equipment on the selected unlicensed frequency.

[0003] However, when the base station detects the RSSI value of the signal on the unlicensed frequency, the base station may detect only a signal that is sent on the unlicensed frequency by a neighboring base station that is relatively close to the base station. However, the base station may fail to detect a signal that is sent by a hidden base station that is relatively far from the base station but is relatively close to user equipment served by the base station. When the base station selects an unlicensed frequency according to the RSSI value obtained through detection, the RSSI value may be less than an actual value. Consequently, the selected unlicensed frequency may be not idle. Therefore, when the user equipment uses the unlicensed frequency selected by the base station to perform communication, the user equipment is likely to be interfered by the hidden base station. Therefore, how to improve accuracy of the RSSI value according to which the base station serving the user equipment selects an idle unlicensed frequency is a problem urgently to be resolved.

[0004] 3GPP Proposal R2-153217 and 3GPP Proposal R2-1527083 disclose the UE performs RSSI measurement according to the RSSI measurement configuration from the base station and reporting the average RSSI and RSSI probability. WO 2012/116489 A1 discloses how the information element specifies the measurement quantities for the inter-RAT (unlicensed) band, such as a window and measurement frequency.

SUMMARY

[0005] Embodiments of the present invention disclose a signal processing method and a related device, so as to improve accuracy of an RSSI value according to which a base station serving user equipment selects an idle unlicensed frequency. The subject matter of the invention is as defined in the appended claims 1 to 8. Further aspects are described in the following for supporting the understanding of the invention.

[0006] A first aspect discloses a signal processing method, including:

obtaining, by user equipment, configuration information used to detect a received signal strength indicator RSSI value of a signal on an unlicensed frequency, where the configuration information includes sampling parameter information and at least one statistical window that are of the signal on the unlicensed frequency, the sampling parameter information includes a sampling interval, and the at least one statistical window is a time length in which statistics on RSSI values of the signal on the unlicensed frequency at sampling moments are determined;
sampling, by the user equipment, the signal on the unlicensed frequency at the sampling interval, and obtaining the RSSI values of the signal on the unlicensed frequency at the sampling moments;
determining, by the user equipment, statistics on the RSSI values of the signal on the unlicensed frequency at the sampling moments included in the at least one statistical window, and obtaining an RSSI value statistical result of the signal on the unlicensed frequency; and
reporting, by the user equipment, the RSSI value statistical result of the signal on the unlicensed frequency to the

base station.

[0007] With reference to an implementation of the first aspect, in a first possible implementation of the first aspect, the configuration information further includes a reporting condition and the reporting condition indicates single reporting, and the reporting, by the user equipment, the RSSI value statistical result of the signal on the unlicensed frequency to the base station includes:

reporting, by the user equipment to the base station, an RSSI value statistical result of the signal on the unlicensed frequency that corresponds to a single statistical window of the at least one statistical window; and
after the reporting, by the user equipment to the base station, an RSSI value statistical result of the signal on the unlicensed frequency that corresponds to a single statistical window of the at least one statistical window, the method further includes:
controlling, by the user equipment, to stop sampling the signal on the unlicensed frequency at the sampling interval.

[0008] With reference to the implementation of the first aspect, in a second possible implementation of the first aspect, the configuration information further includes a reporting condition and the reporting condition indicates reporting according to a preset reporting period, and the reporting, by the user equipment, the RSSI value statistical result of the signal on the unlicensed frequency to the base station includes:

determining, by the user equipment, a quantity of statistical windows included in the preset reporting period; and
reporting, by the user equipment to the base station, an RSSI value statistical result of the signal on the unlicensed frequency that corresponds to the quantity of statistical windows of the at least one statistical window.

[0009] With reference to the implementation of the first aspect, in a third possible implementation of the first aspect, the configuration information further includes a reporting condition and the reporting condition is reporting according to a preset event, and the method further includes:

determining, by the user equipment, whether the RSSI value statistical result includes information indicating the preset event; and
if the information indicating the preset event is included, performing, by the user equipment, the reporting the RSSI value statistical result of the signal on the unlicensed frequency to the base station.

[0010] With reference to any one of the first aspect, or the first to the third possible implementations of the first aspect, in a fourth possible implementation of the first aspect, the configuration information further includes at least one RSSI threshold, and the determining, by the user equipment, statistics on the RSSI values of the signal on the unlicensed frequency at the sampling moments according to the at least one statistical window, and obtaining an RSSI value statistical result of the signal on the unlicensed frequency includes:
dividing, by the user equipment, for each of the at least one statistical window according to the at least one RSSI threshold, RSSI values of the signal on the unlicensed frequency at sampling moments included in the statistical window into at least one RSSI value range; and obtaining a ratio of a quantity of RSSI values at sampling moments that are included in the at least one RSSI value range to a total quantity of the RSSI values of the signal on the unlicensed frequency at the sampling moments included in the statistical window, and using the ratio of the at least one RSSI value range as a statistical result.

[0011] With reference to the fourth possible implementation of the first aspect, in a fifth possible implementation of the first aspect, the RSSI value statistical result of the signal on the unlicensed frequency further includes at least one of or a combination of the following information: a total quantity of the RSSI values of the signal on the unlicensed frequency at the sampling moments included in the at least one statistical window, the sampling interval at which the signal on the unlicensed frequency is sampled, an average value of the RSSI values of the signal on the unlicensed frequency at the sampling moments, or signal attribute information of the signal on the unlicensed frequency, where the signal attribute information includes wireless local area network WLAN configuration information or cell configuration information.

[0012] With reference to any one of the first aspect, or the first to the fifth possible implementations of the first aspect, in a sixth possible implementation of the first aspect, the sampling parameter information further includes a sampling window and a sampling window period that correspond to the unlicensed frequency, the sampling window is used to indicate a time length in which the signal on the unlicensed frequency is sampled in each sampling window period, and a time length of the sampling interval is less than the time length of the sampling window, and the sampling, by the user equipment, the signal on the unlicensed frequency at the sampling interval, and obtaining the RSSI values of the signal on the unlicensed frequency at the sampling moments includes:
sampling, by the user equipment, for the signal on the unlicensed frequency, the signal on the unlicensed frequency at

the sampling interval according to the time length of the sampling window and the sampling window period, and obtaining the RSSI values of the signal on the unlicensed frequency at the sampling moments.

[0013] With reference to any one of the first aspect, or the first to the fifth possible implementations of the first aspect, in a seventh possible implementation of the first aspect, the sampling parameter information further includes a measurement time length and a measurement period, and the sampling, by the user equipment, the signal on the unlicensed frequency at the sampling interval, and obtaining the RSSI values of the signal on the unlicensed frequency at the sampling moments includes:

sampling, by the user equipment, for the signal on the unlicensed frequency, the signal on the unlicensed frequency at the sampling interval according to the measurement time length and the measurement period, and obtaining the RSSI values of the signal on the unlicensed frequency at the sampling moments.

[0014] With reference to any one of the first aspect, or the first to the seventh possible implementations of the first aspect, in an eighth possible implementation of the first aspect, any one of the statistical window, the sampling parameter information, or the reporting condition that is included in the configuration information is preset by the user equipment or obtained from the base station serving the user equipment.

[0015] With reference to any one of the first aspect, or the first to the eighth possible implementations of the first aspect, in a ninth possible implementation of the first aspect, the user equipment includes a physical layer and a radio resource control layer, where

the physical layer samples the signal on the unlicensed frequency at the sampling interval, obtains the RSSI values of the signal on the unlicensed frequency at the sampling moments, and sends the RSSI values of the signal on the unlicensed frequency at the sampling moments to the radio resource control layer, and the radio resource control layer determines statistics on the RSSI values of the signal on the unlicensed frequency at the sampling moments according to the at least one statistical window, and obtains the RSSI value statistical result of the signal on the unlicensed frequency;

or,

the physical layer samples the signal on the unlicensed frequency at the sampling interval, obtains the RSSI values of the signal on the unlicensed frequency at the sampling moments, determines statistics on the RSSI values of the signal on the unlicensed frequency at the sampling moments according to the at least one statistical window, obtains the RSSI value statistical result of the signal on the unlicensed frequency, and sends the RSSI value statistical result of the signal on the unlicensed frequency to the radio resource control layer.

[0016] With reference to any one of the first aspect, or the first to the ninth possible implementations of the first aspect, in a tenth possible implementation of the first aspect, the configuration information further includes frequency indication information, and the user equipment determines, according to the frequency indication information, the unlicensed frequency on which the RSSI value statistical result of the signal needs to be obtained.

[0017] A second aspect discloses a signal processing method, including:

sending, by a base station to user equipment, configuration information used to detect a received signal strength indicator RSSI value of a signal on an unlicensed frequency, where the configuration information includes frequency indication information, and the user equipment determines, according to the frequency indication information, the unlicensed frequency on which an RSSI value statistical result of the signal needs to be obtained;

receiving, by the base station, the RSSI value statistical result of the signal on the unlicensed frequency that is obtained by the user equipment according to the configuration information; and

determining, by the base station according to the RSSI value statistical result of the signal on the unlicensed frequency, whether the unlicensed frequency is an idle unlicensed frequency used for communication with the user equipment.

[0018] With reference to an implementation of the second aspect, in a first possible implementation of the second aspect, the configuration information includes sampling parameter information and/or at least one statistical window that are/is used to sample the signal on the unlicensed frequency, the sampling parameter information includes a sampling interval, and the at least one statistical window is a time length in which statistics on RSSI values of the signal on the unlicensed frequency at sampling moments are determined.

[0019] With reference to the second aspect or the first possible implementation of the second aspect, in a second possible implementation of the second aspect, the configuration information further includes a reporting condition used to trigger the user equipment to report the RSSI value statistical result of the signal on the unlicensed frequency, and the reporting condition includes any one of performing single reporting of an RSSI value statistical result of the signal on the unlicensed frequency that corresponds to a single statistical window of the at least one statistical window, performing periodical reporting according to a preset reporting period, or performing event-based reporting according to

information that indicates a preset event and that is included in the RSSI value statistical result of the signal on the unlicensed frequency.

[0020] With reference to the second aspect, or the first or the second possible implementation of the second aspect of the embodiments of the present invention, in a third possible implementation of the second aspect, the configuration information further includes at least one RSSI threshold, and the at least one RSSI threshold is used to divide, for each of the at least one statistical window, RSSI values of the signal on the unlicensed frequency at sampling moments included in the statistical window into at least one RSSI value range, and a ratio of a quantity of RSSI values at sampling moments that are included in the at least one RSSI value range to a total quantity of the RSSI values of the signal on the unlicensed frequency at the sampling moments included in the statistical window is used as the RSSI value statistical result of the signal on the unlicensed frequency.

[0021] With reference to the third possible implementation of the second aspect, in a fourth possible implementation of the second aspect, the RSSI value statistical result of the signal on the unlicensed frequency further includes at least one of or a combination of the following information: a total quantity of the RSSI values of the signal on the unlicensed frequency at the sampling moments included in the at least one statistical window, the sampling interval at which the signal on the unlicensed frequency is sampled, an average value of the RSSI values of the signal on the unlicensed frequency at the sampling moments, or signal attribute information of the signal on the unlicensed frequency, where the signal attribute information includes wireless local area network WLAN information or cell configuration information.

[0022] With reference to any one of the second aspect, or the first to the fourth possible implementations of the second aspect, in a fifth possible implementation of the second aspect, the sampling parameter information further includes a sampling window and a sampling window period that correspond to the unlicensed frequency, the sampling window is used to indicate a time length in which the signal on the unlicensed frequency is sampled in each sampling window period, and a time length of the sampling interval is less than the time length of the sampling window.

[0023] With reference to any one of the second aspect, or the first to the fourth possible implementations of the second aspect, in a sixth possible implementation of the second aspect, the sampling parameter information further includes a measurement time length and a measurement period, the measurement time length is used to indicate a time length in which the signal on the unlicensed frequency is sampled in each measurement period, and a time length of the sampling interval is less than the time length of the measurement time length.

[0024] A third aspect discloses user equipment, including:

an obtaining module, configured to obtain configuration information used to detect a received signal strength indicator RSSI value of a signal on an unlicensed frequency, where the configuration information includes sampling parameter information and at least one statistical window that are of the signal on the unlicensed frequency, the sampling parameter information includes a sampling interval, and the at least one statistical window is a time length in which statistics on RSSI values of the signal on the unlicensed frequency at sampling moments are determined;

a sampling module, configured to: sample the signal on the unlicensed frequency at the sampling interval, and obtain the RSSI values of the signal on the unlicensed frequency at the sampling moments;

a statistics determining module, configured to: determine statistics on the RSSI values of the signal on the unlicensed frequency at the sampling moments included in the at least one statistical window, and obtain an RSSI value statistical result of the signal on the unlicensed frequency; and

a reporting module, configured to report the RSSI value statistical result of the signal on the unlicensed frequency to the base station.

[0025] With reference to an implementation of the third aspect, in a first possible implementation of the third aspect, the configuration information further includes a reporting condition and the reporting condition indicates single reporting, and the reporting module is specifically configured to report, to the base station, an RSSI value statistical result of the signal on the unlicensed frequency that corresponds to a single statistical window of the at least one statistical window; and the user equipment further includes:

a control module, configured to: after the reporting module reports, to the base station, the RSSI value statistical result of the signal on the unlicensed frequency that corresponds to the single statistical window of the at least one statistical window, control to stop sampling the signal on the unlicensed frequency at the sampling interval.

[0026] With reference to the third aspect or the first possible implementation of the third aspect, in a second possible implementation of the third aspect, the configuration information further includes a reporting condition and the reporting condition indicates reporting according to a preset reporting period, and the reporting module includes:

a determining unit, configured to determine a quantity of statistical windows included in the preset reporting period; and

a reporting unit, configured to report, to the base station, an RSSI value statistical result of the signal on the unlicensed frequency that corresponds to the quantity of statistical windows of the at least one statistical window.

[0027] With reference to the third aspect of the embodiments of the present invention, or the first or the second possible implementation of the third aspect, in a third possible implementation of the third aspect, the configuration information further includes a reporting condition and the reporting condition is reporting according to a preset event, and the user equipment further includes:

a judging module, configured to: determine whether the RSSI value statistical result includes information indicating the preset event; and if it is determined that the information indicating the preset event is included, trigger the reporting module to perform the operation of reporting the RSSI value statistical result of the signal on the unlicensed frequency to the base station.

[0028] With reference to the third possible implementation of the third aspect, in a fourth possible implementation of the third aspect, the configuration information further includes at least one RSSI threshold, and the statistics determining module is specifically configured to: divide, for each of the at least one statistical window according to the at least one RSSI threshold, RSSI values of the signal on the unlicensed frequency at sampling moments included in the statistical window into at least one RSSI value range; and obtain a ratio of a quantity of RSSI values at sampling moments that are included in the at least one RSSI value range to a total quantity of the RSSI values of the signal on the unlicensed frequency at the sampling moments included in the statistical window, and use the ratio of the at least one RSSI value range as a statistical result.

[0029] With reference to any one of the third aspect, or the first to the fourth possible implementations of the third aspect, in a fifth possible implementation of the third aspect, the RSSI value statistical result of the signal on the unlicensed frequency further includes at least one of or a combination of the following information: a total quantity of the RSSI values of the signal on the unlicensed frequency at the sampling moments included in the at least one statistical window, the sampling interval at which the signal on the unlicensed frequency is sampled, an average value of the RSSI values of the signal on the unlicensed frequency at the sampling moments, or signal attribute information of the signal on the unlicensed frequency, where the signal attribute information includes wireless local area network WLAN configuration information or cell configuration information.

[0030] With reference to any one of the third aspect, or the first to the fifth possible implementations of the third aspect, in a sixth possible implementation of the third aspect, the sampling parameter information further includes a sampling window and a sampling window period that correspond to the unlicensed frequency, the sampling window is used to indicate a time length in which the signal on the unlicensed frequency is sampled in each sampling window period, and a time length of the sampling interval is less than the time length of the sampling window, and the sampling module is specifically configured to: sample, for the signal on the unlicensed frequency, the signal on the unlicensed frequency at the sampling interval according to the time length of the sampling window and the sampling window period, and obtain the RSSI values of the signal on the unlicensed frequency at the sampling moments.

[0031] With reference to any one of the third aspect, or the first to the fifth possible implementations of the third aspect, in a seventh possible implementation of the third aspect, the sampling parameter information further includes a measurement time length and a measurement period, and the sampling module is specifically configured to: sample, for the signal on the unlicensed frequency, the signal on the unlicensed frequency at the sampling interval according to the measurement time length and the measurement period, and obtain the RSSI values of the signal on the unlicensed frequency at the sampling moments.

[0032] With reference to any one of the third aspect, or the first to the seventh possible implementations of the third aspect, in an eighth possible implementation of the third aspect, any one of the statistical window, the sampling parameter information, or the reporting condition that is included in the configuration information is preset by the user equipment or obtained from the base station serving the user equipment.

[0033] With reference to any one of the third aspect, or the first to the eighth possible implementations of the third aspect, in a ninth possible implementation of the third aspect, the user equipment includes a physical layer and a radio resource control layer, where

the physical layer samples the signal on the unlicensed frequency at the sampling interval, obtains the RSSI values of the signal on the unlicensed frequency at the sampling moments, and sends the RSSI values of the signal on the unlicensed frequency at the sampling moments to the radio resource control layer, and the radio resource control layer determines statistics on the RSSI values of the signal on the unlicensed frequency at the sampling moments according to the at least one statistical window, and obtains the RSSI value statistical result of the signal on the unlicensed frequency;

or,

the physical layer samples the signal on the unlicensed frequency at the sampling interval, obtains the RSSI values of the signal on the unlicensed frequency at the sampling moments, determines statistics on the RSSI values of the signal on the unlicensed frequency at the sampling moments according to the at least one statistical window, obtains the RSSI value statistical result of the signal on the unlicensed frequency, and sends the RSSI value statistical result of the signal on the unlicensed frequency to the radio resource control layer.

[0034] With reference to any one of the third aspect, or the first to the ninth possible implementations of the third aspect, in a tenth possible implementation of the third aspect, the configuration information further includes frequency indication information, and the user equipment determines, according to the frequency indication information, the unlicensed frequency on which the RSSI value statistical result of the signal needs to be obtained.

[0035] A fourth aspect discloses a base station, including:

a communications module, configured to send, to user equipment, configuration information used to detect a received signal strength indicator RSSI value of a signal on an unlicensed frequency, where the configuration information includes frequency indication information, and the user equipment determines, according to the frequency indication information, the unlicensed frequency on which an RSSI value statistical result of the signal needs to be obtained, where

the communications module is further configured to receive the RSSI value statistical result of the signal on the unlicensed frequency that is obtained by the user equipment according to the configuration information; and

a judging module, configured to determine, according to the RSSI value statistical result of the signal on the unlicensed frequency received by the communications module, whether the unlicensed frequency is an idle unlicensed frequency used for communication with the user equipment.

[0036] With reference to an implementation of the fourth aspect, in a first possible implementation of the fourth aspect, the configuration information includes sampling parameter information and/or at least one statistical window that are/is used to sample the signal on the unlicensed frequency, the sampling parameter information includes a sampling interval, and the at least one statistical window is a time length in which statistics on RSSI values of the signal on the unlicensed frequency at sampling moments are determined.

[0037] With reference to the fourth aspect or the first possible implementation of the fourth aspect, in a second possible implementation of the fourth aspect, the configuration information further includes a reporting condition used to trigger the user equipment to report the RSSI value statistical result of the signal on the unlicensed frequency, and the reporting condition includes any one of performing single reporting of an RSSI value statistical result of the signal on the unlicensed frequency that corresponds to a single statistical window of the at least one statistical window, performing periodical reporting according to a preset reporting period, or performing event-based reporting according to information that indicates a preset event and that is included in the RSSI value statistical result of the signal on the unlicensed frequency.

[0038] With reference to the fourth aspect, or the first or the second possible implementation of the fourth aspect, in a third possible implementation of the fourth aspect, the configuration information further includes at least one RSSI threshold, and the at least one RSSI threshold is used to divide, for each of the at least one statistical window, RSSI values of the signal on the unlicensed frequency at sampling moments included in the statistical window into at least one RSSI value range, and a ratio of a quantity of RSSI values at sampling moments that are included in the at least one RSSI value range to a total quantity of the RSSI values of the signal on the unlicensed frequency at the sampling moments included in the statistical window is used as the RSSI value statistical result of the signal on the unlicensed frequency.

[0039] With reference to the fourth aspect, or the third possible implementation of the fourth aspect, in a fourth possible implementation of the fourth aspect, the RSSI value statistical result of the signal on the unlicensed frequency further includes at least one of or a combination of the following information: a total quantity of the RSSI values of the signal on the unlicensed frequency at the sampling moments included in the at least one statistical window, the sampling interval at which the signal on the unlicensed frequency is sampled, an average value of the RSSI values of the signal on the unlicensed frequency at the sampling moments, or signal attribute information of the signal on the unlicensed frequency, where the signal attribute information includes wireless local area network WLAN information or cell configuration information.

[0040] With reference to any one of the fourth aspect, or the first to the fourth possible implementations of the fourth aspect, in a fifth possible implementation of the fourth aspect, the sampling parameter information further includes a sampling window and a sampling window period that correspond to the unlicensed frequency, the sampling window is used to indicate a time length in which the signal on the unlicensed frequency is sampled in each sampling window period, and a time length of the sampling interval is less than the time length of the sampling window.

[0041] With reference to any one of the fourth aspect, or the first to the fourth possible implementations of the fourth aspect, in a fifth possible implementation of the fourth aspect, the sampling parameter information further includes a measurement time length and a measurement period, the measurement time length is used to indicate a time length in which the signal on the unlicensed frequency is sampledin each measurement period, and a time length of the sampling interval is less than the time length of the measurement time length.

[0042] In the embodiments of the present invention, user equipment may obtain configuration information used to detect a received signal strength indicator RSSI value of a signal on an unlicensed frequency, sample the signal on the unlicensed frequency according to a sampling interval in the configuration information, obtain RSSI values of the signal

on the unlicensed frequency at sampling moments, determine statistics on RSSI values of the signal on the unlicensed frequency at sampling moments included in at least one statistical window in the configuration information, and obtain an RSSI value statistical result of the signal on the unlicensed frequency and report the RSSI value statistical result to a base station. The user equipment samples the signal on the unlicensed frequency, and can obtain all signals using the unlicensed frequency within a particular range from the user equipment, thereby avoiding interference of a hidden base station to the user equipment when the user equipment uses a selected idle unlicensed frequency. Further, in the embodiments of the present invention, RSSI values of the signal on the unlicensed frequency at the unlicensed frequency at the sampling moments included in the at least one statistical window, the sampling interval at which the signal on the unlicensed frequency is sampled, an average value of the RSSI values of the signal on the unlicensed frequency at the sampling moments, or signal attribute information of the signal on the unlicensed frequency, where the signal attribute information includes wireless local area network WLAN information or cell configuration information.

[0043] With reference to any one of the fourth aspect of the embodiments of the present invention, or the first to the fourth possible implementations of the fourth aspect of the embodiments of the present invention, in a fifth possible implementation of the fourth aspect of the embodiments of the present invention, the sampling parameter information further includes a sampling window and a sampling window period that correspond to the unlicensed frequency, the sampling window is used to indicate a time length in which the signal on the unlicensed frequency is sampled in each sampling window period, and a time length of the sampling interval is less than the time length of the sampling window.

[0044] With reference to any one of the fourth aspect of the embodiments of the present invention, or the first to the fourth possible implementations of the fourth aspect of the embodiments of the present invention, in a fifth possible implementation of the fourth aspect of the embodiments of the present invention, the sampling parameter information further includes a measurement time length and a measurement period, the measurement time length is used to indicate a time length in which the signal on the unlicensed frequency is sampled in each measurement period, and a time length of the sampling interval is less than the time length of the measurement time length.

[0045] In the embodiments of the present invention, user equipment may obtain configuration information used to detect a received signal strength indicator RSSI value of a signal on an unlicensed frequency, sample the signal on the unlicensed frequency according to a sampling interval in the configuration information, obtain RSSI values of the signal on the unlicensed frequency at sampling moments, determine statistics on RSSI values of the signal on the unlicensed frequency at sampling moments included in at least one statistical window in the configuration information, and obtain an RSSI value statistical result of the signal on the unlicensed frequency and report the RSSI value statistical result to a base station. The user equipment samples the signal on the unlicensed frequency, and can obtain all signals using the unlicensed frequency within a particular range from the user equipment, thereby avoiding interference of a hidden base station to the user equipment when the user equipment uses a selected idle unlicensed frequency. Further, in the embodiments of the present invention, RSSI values of the signal on the unlicensed frequency at multiple sampling moments are obtained, and statistics on the RSSI values of the signal on the unlicensed frequency at the multiple sampling moments are determined to obtain the RSSI value statistical result of the signal on the unlicensed frequency, thereby further improving accuracy of an RSSI value according to which the base station serving the user equipment selects an idle unlicensed frequency.

BRIEF DESCRIPTION OF DRAWINGS

[0046] To describe the technical solutions in the embodiments of the present invention more clearly, the following briefly describes the accompanying drawings required for describing the embodiments. Apparently, the accompanying drawings in the following description show some embodiments of the present invention, and a person of ordinary skill in the art may still derive other drawings from these accompanying drawings without creative efforts.

FIG. 1 is a schematic diagram of a system architecture according to an embodiment of the present invention;
FIG. 2 is a schematic diagram of another system architecture according to an embodiment of the present invention;
FIG. 3 is a schematic diagram of still another system architecture according to an embodiment of the present invention;
FIG. 4 is a schematic flowchart of a signal processing method according to an embodiment of the present invention;
FIG. 5a is a schematic diagram of sampling of a signal on an unlicensed frequency according to the embodiment of the present invention;
FIG. 5b is a schematic diagram of sampling of the signal on the unlicensed frequency according to the embodiment of the present invention;
FIG. 5c is a schematic diagram of sampling of the signal on the unlicensed frequency according to the embodiment of the present invention;
FIG. 6 is a schematic flowchart of another signal processing method according to an embodiment of the present invention;
FIG. 7 is a schematic flowchart of still another signal processing method according to an embodiment of the present

invention;
FIG. 8 is a schematic structural diagram of user equipment according to an embodiment of the present invention;
FIG. 9 is a schematic structural diagram of another user equipment according to an embodiment of the present invention;
FIG. 10 is a schematic structural diagram of a base station according to an embodiment of the present invention;
FIG. 11 is a schematic structural diagram of another user equipment according to an embodiment of the present invention; and
FIG. 12 is a schematic structural diagram of another base station according to an embodiment of the present invention.

DESCRIPTION OF EMBODIMENTS

[0047] The following clearly describes the technical solutions in the embodiments of the present invention with reference to the accompanying drawings in the embodiments of the present invention.

[0048] Referring to FIG. 1 to FIG. 3, each of FIG. 1 to FIG. 3 is a schematic diagram of a system architecture according to an embodiment of the present invention. A signal processing method disclosed in an embodiment of the present invention is applicable to, but not limited to, the foregoing three system architectures. As shown in FIG. 1, single user equipment is connected to a core network by using a single base station. The base station includes two carriers; and one is a licensed carrier corresponding to a licensed frequency, and the other is an unlicensed carrier corresponding to an unlicensed frequency. As shown in FIG. 2, single user equipment is connected to a core network by using multiple base stations. One of the base stations may include two carriers; and similarly, one is a licensed carrier corresponding to a licensed frequency, and the other is an unlicensed carrier corresponding to an unlicensed frequency. As shown in FIG. 3, single user equipment may first be connected to a base station by using a carrier, and then the base station is connected to a base station controller, and the single user equipment is connected to a core network by using the base station controller. Similarly, the base station may include two carriers; and similarly, one is a licensed carrier corresponding to a licensed frequency, and the other is an unlicensed carrier corresponding to an unlicensed frequency. For the unlicensed frequency in FIG. 1 to FIG. 3, in the signal processing method disclosed in the embodiment of the present invention, an RSSI value statistical result of a signal on the unlicensed frequency may be obtained, so that the base station selects an idle unlicensed frequency as a carrier for information exchange between the user equipment and the base station. The signal processing method can improve accuracy of an RSSI value according to which the base station serving the user equipment selects the idle unlicensed frequency. Detailed descriptions are separately provided below.

[0049] Referring to FIG. 4, FIG. 4 is a schematic flowchart of a signal processing method according to an embodiment of the present invention. The signal processing method shown in FIG. 4 is described from the perspective of user equipment. As shown in FIG. 4, the signal processing method includes the following steps.

[0050] S101. The user equipment obtains configuration information used to detect a received signal strength indicator RSSI value of a signal on an unlicensed frequency, where the configuration information includes sampling parameter information and at least one statistical window that are of the signal on the unlicensed frequency, the sampling parameter information includes a sampling interval, and the at least one statistical window is a time length in which statistics on RSSI values of the signal on the unlicensed frequency at sampling moments are determined.

[0051] In this embodiment of the present invention, the sampling parameter information and the statistical window in the configuration information used to detect the received signal strength indicator (Received Signal Strength Indicator, RSSI) value of the signal on the unlicensed frequency may be received from a base station, or may be preset by the user equipment. A manner of receiving the configuration information from the base station may be setting the configuration information by the base station according to a power consumption requirement or a requirement for accuracy of selecting an idle unlicensed frequency. A manner of directly obtaining the configuration information from the user equipment can reduce communications resources, signaling overheads, or the like between the user equipment and the base station. The configuration information includes multiple different unlicensed frequencies. The unlicensed frequencies may correspond to different sampling parameter information, or may correspond to same sampling parameter information. This is not limited in this embodiment of the present invention.

[0052] Specifically, the sampling interval indicates a time interval between every two times of sampling. For example, the sampling interval may be one subframe or one symbol, indicating that sampling is performed once in each subframe or each symbol. Further, each time of sampling includes sampling duration that indicates a measurement time length of each time of sampling by the user equipment. If the sampling duration is equal to the sampling interval, it indicates that the user equipment performs continuous sampling. The sampling duration may be a predefined time length, or a time length configured by the base station.

[0053] S102. The user equipment samples the signal on the unlicensed frequency at the sampling interval, and obtains the RSSI values of the signal on the unlicensed frequency at the sampling moments.

[0054] In this embodiment of the present invention, referring to FIG. 5a, FIG. 5a is a schematic diagram of sampling of a signal on an unlicensed frequency according to an embodiment of the present invention. As shown in FIG. 5a, the

user equipment samples the signal on the unlicensed frequency at the sampling interval, and obtains RSSI values of the signal on the unlicensed frequency at sampling moments. The RSSI values at the sampling moments indicate idle degrees of the unlicensed frequency at the sampling moments, and a smaller RSSI value indicates that the unlicensed frequency is idler at a sampling moment.

[0055] In an implementation of this invention, the sampling parameter information further includes a measurement time length and a measurement period, and the sampling, by the user equipment, the signal on the unlicensed frequency at the sampling interval, and obtaining the RSSI values of the signal on the unlicensed frequency at the sampling moments includes:

sampling, for the signal on the unlicensed frequency, the signal on the unlicensed frequency at the sampling interval according to the measurement time length and the measurement period, and obtaining the RSSI values of the signal on the unlicensed frequency at the sampling moments.

[0056] S103. The user equipment determines statistics on the sampled RSSI values that are of the signal on the unlicensed frequency and that are included in the at least one statistical window, and obtains an RSSI value statistical result of the signal on the unlicensed frequency.

[0057] In this embodiment of the present invention, as shown in FIG. 5a, the user equipment determines statistics on the RSSI values of the signal on the unlicensed frequency at the sampling moments by using a time length corresponding to the statistical window as a unit, and obtains an RSSI value statistical result of the signal on the unlicensed frequency. The RSSI value statistical result of the signal on the unlicensed frequency may include RSSI value statistical results of the signal on the unlicensed frequency that correspond to multiple statistical windows.

[0058] In an embodiment of the present invention, the configuration information further includes at least one RSSI threshold. Correspondingly, in step S103, the determining, by the user equipment, statistics on the sampled RSSI values that are of the signal on the unlicensed frequency and that are included in the at least one statistical window, and obtaining an RSSI value statistical result of the signal on the unlicensed frequency may be: dividing, for each of the at least one statistical window according to the at least one RSSI threshold, RSSI values of the signal on the unlicensed frequency at sampling moments that correspond to the statistical window into at least one RSSI value range; and obtaining a ratio of a quantity of RSSI values included in the at least one RSSI value range of the signal on the unlicensed frequency to a total quantity of the RSSI values at the sampling moments in the statistical window, and using the ratio of the at least one RSSI value range of the signal on the unlicensed frequency as a statistical result.

[0059] For example, a quantity of RSSI values at sampling moments that are included in one statistical window may be determined according to a time length of the statistical window and a time length of the sampling interval. It is set that the configuration information includes one RSSI threshold that is an RSSI threshold A. As shown in FIG. 5a, a single statistical window may include RSSI values at eight sampling moments. That is, an RSSI value statistical result of the signal on the unlicensed frequency that corresponds to the single statistical window may include the eight RSSI values, an average RSSI value of the eight RSSI values, and a ratio of a quantity of RSSI values greater than the RSSI threshold A to the eight RSSI values and/or a ratio of a quantity of RSSI values less than the preset RSSI threshold A to the eight RSSI values. Correspondingly, as shown in FIG. 5a, the configuration information further includes another RSSI threshold B. The RSSI values of the signal on the unlicensed frequency at the sampling moments that correspond to the statistical window may be divided into multiple ranges according to the RSSI threshold A and the RSSI threshold B. As shown in Table 1, an RSSI value less than the RSSI threshold A is an RSSI value R5 at a sampling moment 5, and a ratio is 1/8. RSSI values greater than the RSSI threshold A and less than the RSSI threshold B are RSSI values R6 and R7 at sampling moments 6 and 7, and a ratio is 1/4. RSSI values greater than the RSSI threshold B are RSSI values R1, R2, R3, R4, and R8 at sampling moments 1, 2, 3, 4, and 8, and a ratio is 5/8. In this case, the RSSI value statistical result of the signal on the unlicensed frequency that corresponds to the single statistical window may further include the RSSI values at the sampling moments that are included in the at least one RSSI value range and the ratio of the RSSI values at the sampling moments that are included in the at least one RSSI value range to the total quantity of the RSSI values at the sampling moments in the statistical window.

Table 1

RSSI value range	Less than the RSSI threshold A	Greater than the RSSI threshold A and less than the RSSI threshold B	Greater than the RSSI threshold B
RSSI value included in each RSSI value range	R5	R6, R7	R2, R3, R4, R8
Ratio of the RSSI value included in each RSSI value range	1/8	1/4	5/8

[0060] The example as shown in FIG. 5b is present for illustration purposes only, and the sampling parameter information in the configuration information may further include a sampling window and a sampling window period that correspond to the unlicensed frequency, the sampling window is used to indicate a time length in which the signal on the unlicensed frequency is sampled in each sampling window period, and the time length of the sampling interval is less than the time length of the sampling window. If signals on multiple unlicensed frequencies need to be sampled, a respective sampling window or sampling window period may be configured for each unlicensed frequency. Correspondingly, in step S102, the sampling, by the user equipment, the signal on the unlicensed frequency at the sampling interval, and obtaining the RSSI values of the signal on the unlicensed frequency at the sampling moments may be:
sampling, for the signal on the unlicensed frequency, the signal on the unlicensed frequency at the sampling interval according to the time length of the sampling window and the sampling window period, and obtaining the RSSI values of the signal on the unlicensed frequency at the sampling moments.

[0061] Correspondingly, in step S103, the determining, by the user equipment, statistics on the RSSI values of the signal on the unlicensed frequency at the sampling moments included in the at least one statistical window, and obtaining an RSSI value statistical result of the signal on the unlicensed frequency may be: determining, by the user equipment according to the sampling window period, a quantity of at least one sampling window included in a single statistical window, determining statistics on sampled RSSI values included in each of the quantity of the at least one sampling window, obtaining an RSSI value statistical result of the signal on the unlicensed frequency that corresponds to the single statistical window, and obtaining an RSSI value statistical result of the signal on the unlicensed frequency that corresponds to the at least one statistical window and using the statistical result as the RSSI value statistical result of the signal on the unlicensed frequency. It should be noted that, in this embodiment of the present invention, the multiple different unlicensed frequencies in the configuration information may correspond to different sampling windows and sampling window periods.

[0062] The example as shown in FIG. 5b is present for illustration purposes only and a sampling window included in each sampling window period may include two sampling moments according to the time length of the sampling interval and one statistical window. The single statistical window on which statistics are determined may include two sampling windows. In this case, statistics on RSSI values of the signal on the unlicensed frequency at sampling moments included in the two sampling windows are determined, and an RSSI value statistical result of the signal on the unlicensed frequency is obtained. For example, the RSSI value statistical result of the signal on the unlicensed frequency may include the RSSI values R1, R2, R3, and R4 at the sampling moments 1, 2, 3, and 4, that RSSI values at sampling moments in the statistical window that are greater than the RSSI threshold A and less than the RSSI threshold B are R3 and R4, that RSSI values at sampling moments in the statistical window that are greater than the RSSI threshold B are R1 and R2, and each sampling window included in the statistical window.

[0063] In another optional implementation, a sampling time may be controlled by configuring the measurement time length and the measurement period. In addition, the configuration information further includes frequency indication information, and the user equipment determines, according to the frequency indication information, the unlicensed frequency on which the RSSI value statistical result of the signal needs to be obtained. Multiple unlicensed frequencies may be determined according to the frequency indication information. If the multiple unlicensed frequencies need to be measured, the multiple unlicensed frequencies are in turn measured in the sampling time controlled by using the measurement time length and the measurement period. Correspondingly, in step S102, the sampling, by the user equipment, the signal on the unlicensed frequency at the sampling interval, and obtaining the RSSI values of the signal on the unlicensed frequency at the sampling moments may be: sampling, for the signal on the unlicensed frequency, the signal on the unlicensed frequency in the measurement time length of the measurement period at the sampling interval according to the measurement time length and the measurement period, and obtaining the RSSI values of the signal on the unlicensed frequency at the sampling moments. If multiple unlicensed frequencies need to be measured, the measurement time length is used to sample signals on the multiple unlicensed frequencies in turn. For example, signals on different unlicensed frequencies may be sampled in measurement time lengths of different measurement periods at the sampling interval. Correspondingly, in step S103, the determining statistics on the RSSI values of the signal on the unlicensed frequency at the sampling moments according to the statistical window, and obtaining an RSSI value statistical result of the signal on the unlicensed frequency may be: determining, for each of the at least one statistical window according to the measurement time length and the measurement period, at least one measurement time length included in the statistical window; and determining statistics on sampled RSSI values of the signal on the unlicensed frequency in each of the at least one measurement time length included in each statistical window, and obtaining the RSSI value statistical result of the signal on the unlicensed frequency.

[0064] As shown in FIG. 5c, a measurement time length included in each measurement period may include two sampling moments according to the time length of the sampling interval. Correspondingly, it may be determined according to a time length of a statistical window that one statistical window may include two measurement time lengths. Statistics on RSSI values of the signal on the unlicensed frequency at sampling moments included in the two measurement time lengths are determined, and an RSSI value statistical result of the signal on the unlicensed frequency is obtained. For

example, in the two measurement time lengths included in the statistical window, sampled RSSI values included in the first measurement time length are both greater than the RSSI threshold B, and sampled RSSI values included in the second measurement time length are both less than the RSSI threshold B.

[0065] S104. The user equipment reports the RSSI value statistical result of the signal on the unlicensed frequency to a base station.

[0066] In this embodiment of the present invention, the user equipment may separately report RSSI value statistical results of signals on unlicensed frequencies to the base station, or may report RSSI value statistical results of signals on multiple unlicensed frequencies to the base station at the same time, to trigger the base station to select, according to the RSSI value statistical results of the signals on the multiple unlicensed frequencies, an idle unlicensed frequency. This is not limited in this embodiment of the present invention.

[0067] In this embodiment of the present invention, the RSSI value statistical result of the signal on the unlicensed frequency may include at least one of or a combination of the following information: a total quantity of the RSSI values of the signal on the unlicensed frequency at the sampling moments included in the at least one statistical window, the sampling interval at which the signal on the unlicensed frequency is sampled, an average value of the RSSI values of the signal on the unlicensed frequency at the sampling moments, or signal attribute information of the signal on the unlicensed frequency, where the signal attribute information includes wireless local area network WLAN configuration information or cell configuration information.

[0068] In this embodiment of the present invention, the user equipment has a physical layer and a radio resource control layer. The physical layer samples the signal on the unlicensed frequency at the sampling interval, obtains the RSSI values of the signal on the unlicensed frequency at the sampling moments, and sends the RSSI values of the signal on the unlicensed frequency at the sampling moments to the radio resource control layer, and the radio resource control layer determins statistics on the RSSI values of the signal on the unlicensed frequency at the sampling moments included in the at least one statistical window, and obtains the RSSI value statistical result of the signal on the unlicensed frequency. Alternatively, the physical layer samples the signal on the unlicensed frequency at the sampling interval, obtains the RSSI values of the signal on the unlicensed frequency at the sampling moments, determins statistics on the RSSI values of the signal on the unlicensed frequency at the sampling moments included in the at least one statistical window, obtains the RSSI value statistical result of the signal on the unlicensed frequency, and sends the RSSI value statistical result of the signal on the unlicensed frequency to the radio resource control layer. The radio resource control layer reports the RSSI value statistical result of the signal on the unlicensed frequency to the base station, to trigger the base station to select, according to the RSSI value statistical result of the signal on the unlicensed frequency, an idle unlicensed frequency.

[0069] In an optional implementation, if the configuration information further includes a reporting condition and the reporting condition is reporting according to a preset event, before performing step S104, the user equipment may further determine whether the RSSI value statistical result of the signal on the unlicensed frequency includes information indicating the preset event; and if the RSSI value statistical result includes the information indicating the preset event, the user equipment performs step S104 to report the RSSI value statistical result of the signal on the unlicensed frequency to the base station, to trigger the base station to select, according to the RSSI value statistical result, an idle unlicensed frequency. In this implementation, the RSSI value statistical result of the signal on the unlicensed frequency may be reported to the base station when the RSSI value statistical result includes the information indicating the preset event, so that the base station can learn a current state of the unlicensed frequency in time, and select an idle unlicensed frequency according to the preset event more accurately.

[0070] In this embodiment of the present invention, the information indicating the preset event may be information indicating that a ratio of a quantity of RSSI values at sampling moments in a single statistical window that are greater than or less than the RSSI threshold to a quantity of RSSI values at all sampling moments in the statistical window is greater than a preset ratio, or information indicating that the average value of the sampled RSSI values in the statistical window in the RSSI value statistical result corresponding to the unlicensed frequency is greater than or less than an RSSI value corresponding to a particular licensed frequency.

[0071] In the signal processing method described in FIG. 4, user equipment may obtain configuration information used to detect a received signal strength indicator RSSI value of a signal on an unlicensed frequency, sample the signal on the unlicensed frequency according to a sampling interval in the configuration information, obtain RSSI values of the signal on the unlicensed frequency at sampling moments, determine statistics on RSSI values of the signal on the unlicensed frequency at sampling moments included in at least one statistical window in the configuration information, and obtain an RSSI value statistical result of the signal on the unlicensed frequency and report the RSSI value statistical result to a base station. It can be learnt that, in this embodiment of the present invention, the user equipment samples the signal on the unlicensed frequency, and can obtain all signals using the unlicensed frequency within a particular range from the user equipment, thereby avoiding interference of a hidden base station to the user equipment when the user equipment uses a selected idle unlicensed frequency. Further, in this embodiment of the present invention, RSSI values of the signal on the unlicensed frequency at multiple sampling moments are obtained, and statistics on the RSSI

values of the signal on the unlicensed frequency at the multiple sampling moments are determined to obtain the RSSI value statistical result of the signal on the unlicensed frequency, thereby further improving accuracy of an RSSI value according to which the base station serving the user equipment selects an idle unlicensed frequency.

[0072] Referring to FIG. 6, FIG. 6 is a schematic flowchart of another signal processing method according to an embodiment of the present invention. A difference between the signal processing method shown in FIG. 6 and the signal processing method shown in FIG. 4 lies in that configuration information in the signal processing method shown in FIG. 6 may further include a reporting condition, and user equipment may report an RSSI value statistical result of a signal on an unlicensed frequency to a base station according to the reporting condition. Specifically, the signal processing method may include the following steps.

[0073] S201. The user equipment obtains configuration information used to detect a received signal strength indicator RSSI value of a signal on an unlicensed frequency.

[0074] The configuration information includes sampling parameter information and a statistical window that correspond to the unlicensed frequency, the sampling parameter information includes a sampling interval, and the at least one statistical window is a time length in which statistics on RSSI values of the signal on the unlicensed frequency at sampling moments are determined.

[0075] S202. The user equipment samples the signal on the unlicensed frequency at the sampling interval, and obtains the RSSI values of the signal on the unlicensed frequency at the sampling moments.

[0076] S203. The user equipment determins statistics on RSSI values of the signal on the unlicensed frequency at the sampling moments included in the at least one statistical window, and obtains an RSSI value statistical result of the signal on the unlicensed frequency.

[0077] S204. The user equipment reports the RSSI value statistical result of the signal on the unlicensed frequency to the base station according to a reporting condition.

[0078] In this embodiment of the present invention, the user equipment reports the RSSI value statistical result of the signal on the unlicensed frequency to the base station according to the reporting condition, to trigger the base station to select, according to the RSSI value statistical result of the signal on the unlicensed frequency, an idle unlicensed frequency.

[0079] In this embodiment of the present invention, step S201 to step S203 are the same as step S101 to step S103 in the foregoing embodiment of the present invention. Therefore, reference may be made to the related implementations and explanations in the foregoing embodiment of the present invention, and details are not described in this embodiment of the present invention again.

[0080] In an optional implementation, if the reporting condition in the configuration information is single reporting, in step S204, the reporting, by the user equipment, the RSSI value statistical result of the signal on the unlicensed frequency to the base station according to a reporting condition may be: reporting, by the user equipment to the base station, an RSSI value statistical result of the signal on the unlicensed frequency that corresponds to a single statistical window. The user equipment may further control to stop sampling the signal on the unlicensed frequency at the sampling interval. This implementation can not only improve accuracy of an RSSI value according to which the base station serving the user equipment selects an idle unlicensed frequency, but also can reduce power consumption of the user equipment and the base station during single reporting.

[0081] In another optional implementation, if the reporting condition in the configuration information is reporting according to a preset reporting period, in step S204, the reporting, by the user equipment, the RSSI value statistical result of the signal on the unlicensed frequency to the base station according to a reporting condition may be: determining, by the user equipment, a target quantity of statistical windows included in the preset reporting period; and reporting, to the base station, an RSSI value statistical result of the signal on the unlicensed frequency that corresponds to the target quantity of statistical windows. This implementation can improve accuracy of an RSSI value according to which the base station serving the user equipment selects an idle unlicensed frequency, so that the base station evaluates an idle degree of the unlicensed frequency in each period according to an RSSI value having relatively high accuracy, so as to select an idle unlicensed frequency in each period more accurately.

[0082] For example, if the preset reporting period is six seconds, and a time length of a statistical window is two seconds, it may be determined that the target quantity of statistical windows included in the preset reporting period is 6/2=3, and RSSI value statistical results of the signal on the unlicensed frequency that correspond to the three statistical windows may be reported to the base station.

[0083] In the signal processing method described in FIG. 6, user equipment obtains configuration information used to detect an RSSI value of a signal on an unlicensed frequency, samples a signal on each unlicensed frequency according to a sampling interval included in sampling parameter information in the configuration information, obtains RSSI values of the signal on each unlicensed frequency at sampling moments, determins statistics on the RSSI values of the signal on the unlicensed frequency at the sampling moments according to a statistical window, obtains an RSSI value statistical result of the signal on the unlicensed frequency, and reports the RSSI value statistical result of the signal on the unlicensed frequency to a base station according to single reporting or reporting according to a preset reporting period that is

indicated by a reporting condition in the configuration information. It can be learnt that, in this embodiment of the present invention, not only accuracy of an RSSI value according to which the base station serving the user equipment selects an idle unlicensed frequency can be improved, but also power consumption of the user equipment or the base station can be reduced.

[0084] Referring to FIG. 7, FIG. 7 is a schematic flowchart of still another signal processing method according to an embodiment of the present invention. The signal processing method shown in FIG. 7 is described from a base station side. Specifically, as shown in FIG. 7, the signal processing method may include the following steps.

[0085] S301. A base station sends, to user equipment, configuration information used to detect a received signal strength indicator RSSI value of a signal on an unlicensed frequency.

[0086] In this embodiment of the present invention, the configuration information includes sampling parameter information and/or a statistical window that are/is of the signal on the unlicensed frequency, and the sampling parameter information includes a sampling interval. The user equipment samples the signal on the unlicensed frequency at the sampling interval, and obtains sampled RSSI values of the signal on the unlicensed frequency; the user equipment determins statistics on RSSI values of the signal on the unlicensed frequency at sampling moments included in at least one statistical window, and obtains an RSSI value statistical result of the signal on the unlicensed frequency; and the user equipment sends the RSSI value statistical result of the signal on the unlicensed frequency to the base station.

[0087] S302. The base station receives an RSSI value statistical result of the signal on the unlicensed frequency that is obtained by the user equipment according to the configuration information.

[0088] S303. The base station determines, according to the RSSI value statistical result of the signal on the unlicensed frequency, whether the unlicensed frequency is an idle unlicensed frequency used for communication with the user equipment.

[0089] In this embodiment of the present invention, the configuration information may further include a reporting condition used to trigger the user equipment to report the RSSI value statistical result of the signal on the unlicensed frequency, and the reporting condition includes any one of performing single reporting of an RSSI value statistical result corresponding to a single statistical window, performing periodical reporting according to a preset reporting period, or performing event-based reporting according to information that indicates a preset event and that is included in the RSSI value statistical result.

[0090] In this embodiment of the present invention, the configuration information may further include at least one threshold, and the at least one threshold is used to divide the RSSI values of the signal on the unlicensed frequency at the sampling moments into multiple RSSI value ranges, so that ratios of quantities of RSSI values at sampling moments that are included in the RSSI value ranges are used as the RSSI value statistical result of the signal on the unlicensed frequency.

[0091] In this embodiment of the present invention, the RSSI value statistical result of the signal on the unlicensed frequency further includes at least one of or a combination of the following information: a total quantity of the RSSI values of the signal on the unlicensed frequency at the sampling moments included in the at least one statistical window, the sampling interval at which the signal on the unlicensed frequency is sampled, an average value of the RSSI values of the signal on the unlicensed frequency at the sampling moments, or signal attribute information of the signal on the unlicensed frequency, where the signal attribute information includes wireless local area network WLAN information or cell configuration information.

[0092] In this embodiment of the present invention, the sampling parameter information further includes a sampling window and a sampling window period that correspond to the unlicensed frequency, the sampling window is used to indicate a time length in which the signal on the unlicensed frequency is sampled in each sampling window period, and a time length of the sampling interval is less than the time length of the sampling window. Multiple different unlicensed frequencies in the configuration information may correspond to different sampling windows and sampling window periods.

[0093] In this embodiment of the present invention, the sampling parameter information further includes a measurement time length and a measurement period, the measurement time length is used to indicate a time length in which the signal on the unlicensed frequency is sampled in each measurement period, and a time length of the sampling interval is less than the time length of the measurement time length. Multiple unlicensed frequencies in the configuration information may have a same measurement time length and a same measurement period.

[0094] In this embodiment of the present invention, before performing step S301, the base station may further send a query instruction, to query the user equipment whether the user equipment can obtain the RSSI value statistical result of the signal on the unlicensed frequency and report the RSSI value statistical result to the base station, or whether the user equipment is willing to perform a related operation of obtaining the RSSI value statistical result of the signal on the unlicensed frequency and reporting the RSSI value statistical result to the base station. If the user equipment returns a confirmation message in response to the query instruction, step S301 to step S303 may be performed.

[0095] In the signal processing method described in FIG. 7, a base station may send configuration information used to detect an RSSI value of a signal on an unlicensed frequency to user equipment, and receive an RSSI value statistical result of the signal on the unlicensed frequency that is obtained by the user equipment according to the configuration

information. In this embodiment of the present invention, the user equipment obtains the RSSI value statistical result of the signal on the unlicensed frequency according to the configuration information, so that it can be avoided that the base station serving the user equipment cannot detect a signal of a hidden base station in a process of obtaining the RSSI value statistical result of the signal on the unlicensed frequency and consequently the user equipment is interfered by the hidden base station when the user equipment uses a selected unlicensed frequency. In addition, the base station determines, according to the RSSI value statistical result of the signal on the unlicensed frequency, whether the unlicensed frequency is an idle unlicensed frequency used for communication with the user equipment. Therefore, accuracy of an RSSI value according to which the base station selects an idle unlicensed frequency is improved, and further, accuracy of the determined idle unlicensed frequency can be improved.

[0096] Referring to FIG. 8, FIG. 8 is a schematic structural diagram of user equipment according to an embodiment of the present invention. As shown in FIG. 8, the user equipment may include an obtaining module 410, a sampling module 420, a statistics determining module 430, and a reporting module 440.

[0097] The obtaining module 410 is configured to obtain configuration information used to detect a received signal strength indicator RSSI value of a signal on an unlicensed frequency.

[0098] The configuration information includes sampling parameter information and at least one statistical window that are of the signal on the unlicensed frequency, the sampling parameter information includes a sampling interval, and the at least one statistical window is a time length in which statistics on RSSI values of the signal on the unlicensed frequency at sampling moments are determined.

[0099] In this embodiment of the present invention, the sampling parameter information and the statistical window in the configuration information used to detect the received signal strength indicator (Received Signal Strength Indicator, RSSI) value of the signal on the unlicensed frequency may be received from a base station, or may be preset by the user equipment. A manner of receiving the configuration information from the base station may be setting the configuration information by the base station according to a power consumption requirement or a requirement for accuracy of selecting an idle unlicensed frequency. A manner of directly obtaining the configuration information from the user equipment can reduce communications resources, signaling overheads, or the like between the user equipment and the base station. The configuration information includes multiple different unlicensed frequencies. The unlicensed frequencies may correspond to different sampling parameter information, or may correspond to same sampling parameter information. This is not limited in this embodiment of the present invention. Specifically, the sampling interval indicates a time interval between every two times of sampling. For example, the sampling interval may be one subframe or one symbol, indicating that sampling is performed once in each subframe or each symbol. Further, each time of sampling includes sampling duration that indicates a measurement time length of each time of sampling by the user equipment. If the sampling duration is equal to the sampling interval, it indicates that the user equipment performs continuous sampling. The sampling duration may be a predefined time length, or a time length configured by the base station.

[0100] The sampling module 420 is configured to: sample the signal on the unlicensed frequency at the sampling interval, and obtain the RSSI values of the signal on the unlicensed frequency at the sampling moments.

[0101] The statistics determining module 430 is configured to: determine statistics on the RSSI values of the signal on the unlicensed frequency at the sampling moments included in the at least one statistical window, and obtain an RSSI value statistical result of the signal on the unlicensed frequency.

[0102] The reporting module 440 is configured to report the RSSI value statistical result of the signal on the unlicensed frequency to the base station.

[0103] For example, referring to the schematic diagram of sampling of the signal on the unlicensed frequency shown in FIG. 5a, the sampling module 420 may sample the signal on the unlicensed frequency at the sampling interval, and obtain RSSI values of the signal on the unlicensed frequency at sampling moments. The RSSI values at the sampling moments indicate idle degrees of the unlicensed frequency at the sampling moments, and a smaller RSSI value indicates that the unlicensed frequency is idler at a sampling moment. In addition, the statistics determining module 430 may determine statistics on the RSSI values of the signal on the unlicensed frequency at the sampling moments by using a time length corresponding to the statistical window as a unit, and obtains an RSSI value statistical result of the signal on the unlicensed frequency. The RSSI value statistical result of the signal on the unlicensed frequency may include RSSI value statistical results of the signal on the unlicensed frequency that correspond to multiple statistical windows.

[0104] Also referring to FIG. 9, FIG. 9 is a schematic structural diagram of another user equipment according to an embodiment of the present invention. The user equipment shown in FIG. 9 is obtained by optimizing the user equipment shown in FIG. 8. The user equipment shown in FIG. 9 is specifically as follows.

[0105] In an optional implementation, the configuration information may further include a reporting condition and the reporting condition indicates single reporting, and the reporting module 440 is specifically configured to report, to the base station, an RSSI value statistical result of the signal on the unlicensed frequency that corresponds to a single statistical window of the at least one statistical window.

[0106] Correspondingly, the user equipment shown in FIG. 9 may further include:

a control module 450, configured to: after the reporting module 440 reports, to the base station, the RSSI value statistical

result of the signal on the unlicensed frequency that corresponds to the single statistical window of the at least one statistical window, control to stop sampling the signal on the unlicensed frequency at the sampling interval.

[0107] In an optional implementation, the reporting condition in the configuration information may further indicate reporting according to a preset reporting period, and the reporting module 440 in the user equipment shown in FIG. 9 may include:

a determining unit 441, configured to determine a quantity of statistical windows included in the preset reporting period; and

a reporting unit 442, configured to report, to the base station, an RSSI value statistical result of the signal on the unlicensed frequency that corresponds to the quantity of statistical windows of the at least one statistical window that is determined by the determining unit 441.

[0108] In still another optional implementation, the reporting condition in the configuration information may further indicate reporting according to a preset event, and the user equipment shown in FIG. 9 may further include:

a judging module 460, configured to: determine whether the RSSI value statistical result includes information indicating the preset event; and if it is determined that the RSSI value statistical result includes the information indicating the preset event, trigger the reporting module to perform the operation of reporting the RSSI value statistical result of the signal on the unlicensed frequency to the base station.

[0109] It should be noted that, the modules or units corresponding to the reporting manners described in the foregoing three implementations in this embodiment of the present invention may all exist in the user equipment, or one of the modules or units may exist in the user equipment. An example in which all the modules or units exist is used in FIG. 9 in this embodiment of the present invention, and a corresponding reporting manner is used according to specific content of the reporting condition.

[0110] In this embodiment of the present invention, the configuration information may further include at least one RSSI threshold. Correspondingly, the statistics determining module 430 is specifically configured to: divide, for each of the at least one statistical window according to the at least one RSSI threshold, RSSI values of the signal on the unlicensed frequency at sampling moments included in the statistical window into at least one RSSI value range; and obtain a ratio of a quantity of RSSI values at sampling moments that are included in the at least one RSSI value range to a total quantity of the RSSI values of the signal on the unlicensed frequency at the sampling moments included in the statistical window, and use the ratio of the at least one RSSI value range as a statistical result. Specifically, reference may be made to related descriptions in FIG. 5a in the foregoing embodiment of the present invention, and details are not described herein again.

[0111] In this embodiment of the present invention, the RSSI value statistical result of the signal on the unlicensed frequency may further include at least one of or a combination of the following information: a total quantity of the RSSI values of the signal on the unlicensed frequency at the sampling moments included in the at least one statistical window, the sampling interval at which the signal on the unlicensed frequency is sampled, an average value of the RSSI values of the signal on the unlicensed frequency at the sampling moments, or signal attribute information of the signal on the unlicensed frequency, where the signal attribute information may include wireless local area network WLAN configuration information or cell configuration information.

[0112] The example as shown in FIG. 5b is present for illustration purposes only and the sampling parameter information further includes a sampling window and a sampling window period that correspond to the unlicensed frequency, the sampling window is used to indicate a time length in which the signal on the unlicensed frequency is sampled in each sampling window period, and a time length of the sampling interval is less than the time length of the sampling window, and the sampling module is specifically configured to: sample, for the signal on the unlicensed frequency, the signal on the unlicensed frequency at the sampling interval according to the time length of the sampling window and the sampling window period, and obtain the RSSI values of the signal on the unlicensed frequency at the sampling moments. Specifically, for sampling of the signal on the unlicensed frequency by the sampling module 420 according to the time length of the sampling window and the sampling window period, reference may be made to related descriptions corresponding to FIG. 5b in the foregoing embodiment of the present invention, and details are not described herein again.

[0113] In an implementation of this invention, the sampling parameter information further includes a measurement time length and a measurement period, and the sampling module is specifically configured to: sample, for the signal on the unlicensed frequency, the signal on the unlicensed frequency at the sampling interval according to the measurement time length and the measurement period, and obtain the RSSI values of the signal on the unlicensed frequency at the sampling moments. Specifically, for sampling of the signal on the unlicensed frequency by the sampling module 420 according to the measurement time length and the measurement period, reference may be made to related descriptions corresponding to FIG. 5c in the foregoing embodiment of the present invention, and details are not described herein again.

[0114] In this embodiment of the present invention, any one of the statistical window, the sampling parameter information, or the reporting condition that is included in the configuration information is preset by the user equipment or

obtained from the base station serving the user equipment.

[0115] In this embodiment of the present invention, the user equipment includes a physical layer and a radio resource control layer, where the physical layer may include the sampling module to perform the related operations of the sampling module, and send the RSSI values of the signal on the unlicensed frequency at the sampling moments to the radio resource control layer, and correspondingly, the radio resource control layer may include the statistics determining module, and may determine statistics on the RSSI values of the signal on the unlicensed frequency at the sampling moments according to the at least one statistical window, and obtain the RSSI value statistical result of the signal on the unlicensed frequency;

or,

the physical layer may include the sampling module and the statistics determining module, and may perform the operations of the sampling module to sample the signal on the unlicensed frequency at the sampling interval, and obtain the RSSI values of the signal on the unlicensed frequency at the sampling moments, and perform the operations of the statistics determining module to determine statistics on the RSSI values of the signal on the unlicensed frequency at the sampling moments according to the at least one statistical window, obtain the RSSI value statistical result of the signal on the unlicensed frequency, and send the RSSI value statistical result of the signal on the unlicensed frequency to the radio resource control layer.

[0116] In this embodiment of the present invention, the configuration information may further include frequency indication information, and the user equipment determines, according to the frequency indication information, the unlicensed frequency on which the RSSI value statistical result of the signal needs to be obtained.

[0117] In addition, referring to FIG. 11, FIG. 11 is a schematic structural diagram of another user equipment according to an embodiment of the present invention. The user equipment may include a processor 710, a memory 790, and an antenna 750. The processor 710 invokes program code in the memory 790, and may send processed information by using the antenna 750 over an 802.11 interface 720, an 802.16 interface 730, or a 3GPP interface 740, or receive, by using the antenna 750, information sent by another terminal to the user equipment. Specifically, the memory 790 may store program code corresponding to the obtaining module, the sampling module, the statistics determining module, and the reporting module. The processor 710 may invoke the program code in the memory 790, to perform the operations of the obtaining module, the sampling module, the statistics determining module, and the reporting module by using the 802.11 interface 720, the 802.16 interface 730, or the 3GPP interface 740 (another communications interface may also be used, and this is not limited in this embodiment of the present invention), and the antenna 750, to report an RSSI value statistical result of a signal on an unlicensed frequency to a base station.

[0118] Further, the memory 790 may store program code corresponding to the control module or the judging module. The processor 710 may invoke the program code in the memory 790, to perform the related operations of the control module or the judging module. For a specific optional implementation of an operation of the processor 710, reference may be made to operations and descriptions of related modules in the embodiments of the present invention, and details are not described herein again.

[0119] Specifically, the user equipment described in FIG. 8, FIG. 9, or FIG. 11 in the embodiment of the present invention may perform some or all of the processes in the embodiment of the signal processing method described in the embodiments of the present invention with reference to FIG. 7.

[0120] In the user equipments shown in FIG. 8 and FIG. 9, the obtaining module may obtain configuration information used to detect a received signal strength indicator RSSI value of a signal on an unlicensed frequency, the signal on the unlicensed frequency is sampled according to a sampling interval in the configuration information, RSSI values of the signal on the unlicensed frequency at sampling moments are obtained, statistics on RSSI values of the signal on the unlicensed frequency at sampling moments included in at least one statistical window in the configuration information are determined, and an RSSI value statistical result of the signal on the unlicensed frequency is obtained and is reported to a base station. It can be learnt that, in this embodiment of the present invention, the user equipment samples the signal on the unlicensed frequency, and can obtain all signals using the unlicensed frequency within a particular range from the user equipment, thereby avoiding interference of a hidden base station to the user equipment when the user equipment uses a selected idle unlicensed frequency. Further, in this embodiment of the present invention, RSSI values of the signal on the unlicensed frequency at multiple sampling moments are obtained, and statistics on the RSSI values of the signal on the unlicensed frequency at the multiple sampling moments are determined to obtain the RSSI value statistical result of the signal on the unlicensed frequency, thereby further improving accuracy of an RSSI value according to which the base station serving the user equipment selects an idle unlicensed frequency. Further, in the user equipment shown in FIG. 9, the reporting module may report the RSSI value statistical result of the signal on the unlicensed frequency to the base station according to three reporting manners, that is, single reporting, reporting according to a preset reporting period, and reporting according to a preset event, that are indicated by a reporting condition in the configuration information. Therefore, not only accuracy of an RSSI value according to which the base station serving the user equipment selects an idle unlicensed frequency can be improved, but also power consumption of the user equipment or the base station can be reduced.

[0121] Referring to FIG. 10, FIG. 10 is a schematic structural diagram of a base station according to an embodiment of the present invention. As shown in FIG. 10, the base station may include a communications module 510 and a judging module 520.

[0122] The communications module 510 is configured to send, to user equipment, configuration information used to detect a received signal strength indicator RSSI value of a signal on an unlicensed frequency, where the configuration information includes frequency indication information, and the user equipment determines, according to the frequency indication information, the unlicensed frequency on which an RSSI value statistical result of the signal needs to be obtained.

[0123] The communications module 510 is further configured to receive the RSSI value statistical result of the signal on the unlicensed frequency that is obtained by the user equipment according to the configuration information.

[0124] The judging module 520 is configured to determine, according to the RSSI value statistical result of the signal on the unlicensed frequency received by the communications module 510, whether the unlicensed frequency is an idle unlicensed frequency used for communication with the user equipment.

[0125] In this embodiment of the present invention, the configuration information includes sampling parameter information and/or at least one statistical window that are/is used to sample the signal on the unlicensed frequency, the sampling parameter information includes a sampling interval, and the at least one statistical window is a time length in which statistics on RSSI values of the signal on the unlicensed frequency at sampling moments are determined. Specifically, the sampling interval indicates a time interval between every two times of sampling. For example, the sampling interval may be one subframe or one symbol, indicating that sampling is performed once in each subframe or each symbol. Further, each time of sampling includes sampling duration that indicates a measurement time length of each time of sampling by the user equipment. If the sampling duration is equal to the sampling interval, it indicates that the user equipment performs continuous sampling. The sampling duration may be a predefined time length, or a time length configured by the base station.

[0126] In this embodiment of the present invention, the configuration information further includes a reporting condition used to trigger the user equipment to report the RSSI value statistical result of the signal on the unlicensed frequency, and the reporting condition includes any one of performing single reporting of an RSSI value statistical result of the signal on the unlicensed frequency that corresponds to a single statistical window of the at least one statistical window, performing periodical reporting according to a preset reporting period, or performing event-based reporting according to information that indicates a preset event and that is included in the RSSI value statistical result of the signal on the unlicensed frequency.

[0127] In this embodiment of the present invention, the configuration information may further include at least one RSSI threshold, and the at least one RSSI threshold is used to divide, for each of the at least one statistical window, RSSI values of the signal on the unlicensed frequency at sampling moments included in the statistical window into at least one RSSI value range, and a ratio of a quantity of RSSI values at sampling moments that are included in the at least one RSSI value range to a total quantity of the RSSI values of the signal on the unlicensed frequency at the sampling moments included in the statistical window is used as the RSSI value statistical result of the signal on the unlicensed frequency.

[0128] In this embodiment of the present invention, the RSSI value statistical result of the signal on the unlicensed frequency further includes at least one of or a combination of the following information: a total quantity of the RSSI values of the signal on the unlicensed frequency at the sampling moments included in the at least one statistical window, the sampling interval at which the signal on the unlicensed frequency is sampled, an average value of the RSSI values of the signal on the unlicensed frequency at the sampling moments, or signal attribute information of the signal on the unlicensed frequency, where the signal attribute information includes wireless local area network WLAN information or cell configuration information.

[0129] In this embodiment of the present invention, the sampling parameter information further includes a sampling window and a sampling window period that correspond to the unlicensed frequency, the sampling window is used to indicate a time length in which the signal on the unlicensed frequency is sampled in each sampling window period, and a time length of the sampling interval is less than the time length of the sampling window.

[0130] In this embodiment of the present invention, the sampling parameter information further includes a measurement time length and a measurement period, the measurement time length is used to indicate a time length in which the signal on the unlicensed frequency is sampled in each measurement period, and a time length of the sampling interval is less than the time length of the measurement time length.

[0131] In addition, referring to FIG. 12, FIG. 12 is a schematic structural diagram of another base station according to an embodiment of the present invention. The base station shown in FIG. 12 may include a base station processor 610, a transmitter 620, a receiver 630, a memory 640, and an antenna 650. The memory 640 may store program code corresponding to the communications module and the judging module. The base station processor 610 may invoke the program code in the memory 610, send, to user equipment by using the transmitter 620, configuration information used to detect a received signal strength indicator RSSI value of a signal on an unlicensed frequency, and receive, by using

the receiver 630, an RSSI value statistical result of the signal on the unlicensed frequency that is obtained by the user equipment according to the configuration information. Correspondingly, the base station processor 610 may invoke the program code in the memory 610, to determine whether the unlicensed frequency is an idle unlicensed frequency used for communication with the user equipment. For a specific optional implementation of an operation of the base station processor 610, reference may be made to operations and descriptions of related modules in the embodiments of the present invention, and details are not described herein again.

[0132] Specifically, the base station described in FIG. 10 or FIG. 12 in the embodiment of the present invention may perform some or all of the processes in the embodiment of the signal processing method described in the embodiments of the present invention with reference to FIG. 4 or FIG. 6.

[0133] In the base station shown in FIG. 10, the communications module may send configuration information used to detect an RSSI value of a signal on an unlicensed frequency to user equipment, and receive an RSSI value statistical result of the signal on the unlicensed frequency that is obtained by the user equipment according to the configuration information. In this embodiment of the present invention, the user equipment obtains the RSSI value statistical result of the signal on the unlicensed frequency according to the configuration information, so that it can be avoided that the base station serving the user equipment cannot detect a signal of a hidden base station in a process of obtaining the RSSI value statistical result of the signal on the unlicensed frequency and consequently the user equipment is interfered by the hidden base station when the user equipment uses a selected unlicensed frequency. In addition, the judging module determines, according to the RSSI value statistical result of the signal on the unlicensed frequency, whether the unlicensed frequency is an idle unlicensed frequency used for communication with the user equipment. Therefore, in one aspect, accuracy of an RSSI value according to which the base station selects an idle unlicensed frequency is improved, and further, accuracy of the determined idle unlicensed frequency can be improved.

[0134] A person of ordinary skill in the art may understand that all or some of the steps of the methods in the embodiments may be implemented by a program instructing relevant hardware. The program may be stored in a computer readable storage medium. The storage medium may include a flash memory, a read-only memory (Read-Only Memory, ROM), a random access memory (Random Access Memory, RAM), a magnetic disk, and an optical disc.

[0135] The signal processing method and the related device disclosed in the embodiments of the present invention are described in detail above. The principle and implementation of the present invention are described herein by using specific examples. The description about the embodiments of the present invention is merely provided to help understand the method and core ideas of the present invention. In addition, a person of ordinary skill in the art can make variations and modifications to the present invention in terms of the specific implementations and application scopes according to the ideas of the present invention. Therefore, the content of specification shall not be construed as a limit to the present invention.

Claims

1. A signal processing method, comprising:

obtaining (101), by user equipment, configuration information used to detect a received signal strength indicator, RSSI, value of a signal on an unlicensed frequency, wherein the configuration information comprises sampling parameter information and a statistical window that are of the signal on the unlicensed frequency, the sampling parameter information comprises a sampling interval, and the statistical window is a time length in which statistics on RSSI values of the signal on the unlicensed frequency at sampling moments are determined;

sampling (102), by the user equipment, the signal on the unlicensed frequency at the sampling interval, and obtaining the RSSI values of the signal on the unlicensed frequency at the sampling moments;

determining (103), by the user equipment, statistics on the RSSI values of the signal on the unlicensed frequency at the sampling moments comprised in the statistical window, and obtaining an RSSI value statistical result of the signal on the unlicensed frequency; and

reporting (104), by the user equipment, the RSSI value statistical result of the signal on the unlicensed frequency to the base station;

characterized in that,

the sampling parameter information further comprises a measurement time length in the statistical window and a measurement period in the statistical window, and the sampling, by the user equipment, the signal on the unlicensed frequency at the sampling interval, and obtaining the RSSI values of the signal on the unlicensed frequency at the sampling moments comprises:

sampling, by the user equipment, for the signal on the unlicensed frequency, the signal on the unlicensed frequency at the sampling interval according to the measurement time length and the measurement period, and obtaining the RSSI values of the signal on the unlicensed frequency at the sampling moments.

2. The method according to claim 1, wherein the configuration information further comprises a RSSI threshold, and the determining, by the user equipment, statistics on the RSSI values of the signal on the unlicensed frequency at the sampling moments according to the statistical window, and obtaining an RSSI value statistical result of the signal on the unlicensed frequency comprises:
determining, by the user equipment, for the statistical window according to the RSSI threshold, RSSI values of the signal on the unlicensed frequency at sampling moments comprised in the statistical window into at least one RSSI value range; and obtaining a ratio of a quantity of RSSI values at sampling moments that are comprised in the at least one RSSI value range to a total quantity of the RSSI values of the signal on the unlicensed frequency at the sampling moments comprised in the statistical window, and using the ratio of the at least one RSSI value range as a statistical result.

3. A signal processing method, comprising:

sending (301), by a base station to user equipment, configuration information used to detect a received signal strength indicator, RSSI, value of a signal on an unlicensed frequency, wherein the configuration information comprises frequency indication information used for the user equipment to determine the unlicensed frequency on which an RSSI value statistical result of the signal needs to be obtained, wherein the configuration information comprises a statistical window that is used to sample the signal on the unlicensed frequency, and the statistical window is a time length in which statistics on RSSI values of the signal on the unlicensed frequency at sampling moments are determined;
receiving (302), by the base station, the RSSI value statistical result of the signal on the unlicensed frequency that is obtained by the user equipment according to the configuration information; and
determining (303), by the base station according to the RSSI value statistical result of the signal on the unlicensed frequency, whether the unlicensed frequency is an idle unlicensed frequency used for communication with the user equipment;
characterized in that,
the configuration information further comprises sampling parameter information and the sampling parameter information comprises a measurement time length in the statistical window and a measurement period in the statistical window, and the measurement time length is used to indicate a time length in which the signal on the unlicensed frequency is sampled in the measurement period.

4. The method according to claim 3, wherein the configuration information further comprises a RSSI threshold, and the RSSI threshold is used to determine, for the statistical window, RSSI values of the signal on the unlicensed frequency at sampling moments comprised in the statistical window into at least one RSSI value range, and a ratio of a quantity of RSSI values at sampling moments that are comprised in the at least one RSSI value range to a total quantity of the RSSI values of the signal on the unlicensed frequency at the sampling moments comprised in the statistical window is used as the RSSI value statistical result of the signal on the unlicensed frequency.

5. User equipment, comprising:

an obtaining module (410), configured to obtain configuration information used to detect a received signal strength indicator, RSSI, value of a signal on an unlicensed frequency, wherein the configuration information comprises sampling parameter information and a statistical window that are of the signal on the unlicensed frequency, the sampling parameter information comprises a sampling interval, and the statistical window is a time length in which statistics on RSSI values of the signal on the unlicensed frequency at sampling moments are determined;
a sampling module (420), configured to: sample the signal on the unlicensed frequency at the sampling interval, and obtain the RSSI values of the signal on the unlicensed frequency at the sampling moments;
a statistics determining module (430), configured to: determine statistics on the RSSI values of the signal on the unlicensed frequency at the sampling moments comprised in the statistical window, and obtain an RSSI value statistical result of the signal on the unlicensed frequency; and
a reporting module (440), configured to report the RSSI value statistical result of the signal on the unlicensed frequency to the base station;
characterized in that,
the sampling parameter information further comprises a measurement time length in the statistical window and a measurement period in the statistical window, and the sampling module is specifically configured to: sample, for the signal on the unlicensed frequency, the signal on the unlicensed frequency at the sampling interval according to the measurement time length and the measurement period, and obtain the RSSI values of the

signal on the unlicensed frequency at the sampling moments.

6. The user equipment according to claim5, wherein the configuration information further comprises a RSSI threshold, and the statistics determining module is specifically configured to: determine, for the statistical window according to the RSSI threshold, RSSI values of the signal on the unlicensed frequency at sampling moments comprised in the statistical window into at least one RSSI value range; and obtain a ratio of a quantity of RSSI values at sampling moments that are comprised in the at least one RSSI value range to a total quantity of the RSSI values of the signal on the unlicensed frequency at the sampling moments comprised in the statistical window, and use the ratio of the at least one RSSI value range as a statistical result.

7. Abase station, comprising:

a communications module (510), configured to send, to user equipment, configuration information used to detect a received signal strength indicator, RSSI, value of a signal on an unlicensed frequency, wherein the configuration information comprises frequency indication information used for the user equipment to determine the unlicensed frequency on which an RSSI value statistical result of the signal needs to be obtained, wherein the configuration information comprises a statistical window that is used to sample the signal on the unlicensed frequency, and the statistical window is a time length in which statistics on RSSI values of the signal on the unlicensed frequency at sampling moments are determined, wherein
the communications module is further configured to receive the RSSI value statistical result of the signal on the unlicensed frequency that is obtained by the user equipment according to the configuration information; and
a judging module (520), configured to determine, according to the RSSI value statistical result of the signal on the unlicensed frequency received by the communications module, whether the unlicensed frequency is an idle unlicensed frequency used for communication with the user equipment;
characterized in that,
the configuration information further comprises sampling parameter information and the sampling parameter information comprises a measurement time length in the statistical window and a measurement period in the statistical window, the measurement time length is used to indicate a time length in which the signal on the unlicensed frequency is sampled in the measurement period.

8. The base station according to claim 7, wherein the configuration information further comprises a RSSI threshold, and the RSSI threshold is used to determine, for the statistical window, RSSI values of the signal on the unlicensed frequency at sampling moments comprised in the statistical window into at least one RSSI value range, and a ratio of a quantity of RSSI values at sampling moments that are comprised in the at least one RSSI value range to a total quantity of the RSSI values of the signal on the unlicensed frequency at the sampling moments comprised in the statistical window is used as the RSSI value statistical result of the signal on the unlicensed frequency.

Patentansprüche

1. Signalverarbeitungsverfahren, umfassend:

Erhalten (101), durch das Benutzergerät, von Konfigurationsinformationen, die verwendet werden, um einen empfangenen Signalstärke-Indikatorwert, RSSI, eines Signals auf einer unlizenzierten Frequenz zu erkennen, wobei die Konfigurationsinformationen Abtastparameterinformationen und ein statistisches Fenster umfassen, die von dem Signal auf der unlizenzierten Frequenz stammen, wobei die Abtastparameterinformationen ein Abtastintervall umfassen, und das statistische Fenster eine Zeitlänge ist, in der Statistiken über RSSI-Werte des Signals auf der unlizenzierten Frequenz zu Abtastzeitpunkten bestimmt werden;
Abtasten (102), durch das Benutzergerät, des Signals auf der unlizenzierten Frequenz in dem Abtastintervall, und Erhalten der RSSI-Werte des Signals auf der unlizenzierten Frequenz zu den Abtastzeitpunkten;
Bestimmen (103), durch das Benutzergerät, von Statistiken über die RSSI-Werte des Signals auf der unlizenzierten Frequenz zu den Abtastzeitpunkten, die in dem statistischen Fenster umfasst sind, und Erhalten eines statistischen Ergebnisses des RSSI-Werts des Signals auf der unlizenzierten Frequenz; und
Berichten (104), durch das Benutzergerät, des statistischen Ergebnisses des RSSI-Werts des Signals auf der unlizenzierten Frequenz an die Basisstation;
dadurch gekennzeichnet, dass
die Abtastparameterinformationen ferner eine Messzeitlänge in dem statistischen Fenster und eine Messperiode in dem statistischen Fenster umfassen, und das Abtasten, durch das Benutzergerät, des Signals auf der unli-

zenzierten Frequenz in dem Abtastintervall und das Erhalten der RSSI-Werte des Signals auf der unlizenzierten Frequenz zu den Abtastzeitpunkten umfasst:
Abtasten, durch das Benutzergerät, für das Signal auf der unlizenzierten Frequenz, des Signals auf der unlizenzierten Frequenz in dem Abtastintervall gemäß der Messzeitlänge und der Messperiode, und Erhalten der RSSI-Werte des Signals auf der unlizenzierten Frequenz zu den Abtastzeitpunkten.

2. Verfahren nach Anspruch 1, wobei die Konfigurationsinformationen ferner einen RSSI-Schwellenwert umfassen, und das Bestimmen einer Statistik über die RSSI-Werte des Signals auf der unlizenzierten Frequenz zu den Abtastzeitpunkten gemäß dem statistischen Fenster durch das Benutzergerät und das Erhalten eines statistischen Ergebnisses des RSSI-Werts des Signals auf der unlizenzierten Frequenz umfasst:

Bestimmen, durch das Benutzergerät, für das statistische Fenster gemäß dem RSSI-Schwellenwert, von RSSI-Werten des Signals auf der unlizenzierten Frequenz zu Abtastzeitpunkten, die in dem statistischen Fenster umfasst sind, in mindestens einen RSSI-Wertebereich; und Erhalten eines Verhältnisses einer Anzahl von RSSI-Werten zu Abtastzeitpunkten, die in dem mindestens einen RSSI-Wertebereich umfasst sind, zu einer Gesamtanzahl der RSSI-Werte des Signals auf der unlizenzierten Frequenz zu den Abtastzeitpunkten, die in dem statistischen Fenster umfasst sind, und
Verwenden des Verhältnisses des mindestens einen RSSI-Wertebereichs als ein statistisches Ergebnis.

3. Signalverarbeitungsverfahren, umfassend:

Senden (301), durch eine Basisstation an ein Benutzergerät, von Konfigurationsinformationen, die verwendet werden, um einen Signalstärke-Indikatorwert, RSSI, eines Signals auf einer unlizenzierten Frequenz zu erkennen, wobei die Konfigurationsinformationen Frequenzangabeinformationen umfassen, die für das Benutzergerät verwendet werden, um die unlizenzierte Frequenz zu bestimmen, auf der ein statistisches Ergebnis des RSSI-Werts des Signals erhalten werden muss, wobei die Konfigurationsinformationen ein statistisches Fenster umfassen, das verwendet wird, um das Signal auf der unlizenzierten Frequenz abzutasten, und das statistische Fenster eine Zeitlänge ist, in der Statistiken über RSSI-Werte des Signals auf der unlizenzierten Frequenz zu Abtastzeitpunkten bestimmt werden;
Empfangen (302), durch die Basisstation, des statistischen Ergebnisses des RSSI-Werts des Signals auf der unlizenzierten Frequenz, die durch das Benutzergerät gemäß den Konfigurationsinformationen erhalten wird; und
Bestimmen (303), durch die Basisstation gemäß dem statistischen Ergebnis des RSSI-Werts des Signals auf der unlizenzierten Frequenz, ob die unlizenzierte Frequenz eine freie unlizenzierte Frequenz ist, die zur Kommunikation mit dem Benutzergerät verwendet wird;
dadurch gekennzeichnet, dass
die Konfigurationsinformationen ferner Abtastparameterinformationen umfassen und die Abtastparameterinformationen eine Messzeitlänge in dem statistischen Fenster und eine Messperiode in dem statistischen Fenster umfassen, und die Messzeitlänge verwendet wird, um eine Zeitlänge anzugeben, in der das Signal auf der unlizenzierten Frequenz in der Messperiode abgetastet wird.

4. Verfahren nach Anspruch 3, wobei die Konfigurationsinformationen ferner einen RSSI-Schwellenwert umfassen und der RSSI-Schwellenwert verwendet wird, für das statistische Fenster die RSSI-Werte des Signals auf der unlizenzierten Frequenz zu Abtastzeitpunkten, die in dem statistischen Fenster umfasst sind, in mindestens einen RSSI-Wertebereich zu bestimmen, und ein Verhältnis einer Anzahl von RSSI-Werten zu Abtastzeitpunkten, die in dem mindestens einen RSSI-Wertebereich umfasst sind, zu einer Gesamtmenge der RSSI-Werte des Signals auf der unlizenzierten Frequenz zu den Abtastzeitpunkten, die in dem statistischen Fenster umfasst sind, als das statistische Ergebnis des RSSI-Werts des Signals auf der unlizenzierten Frequenz verwendet wird.

5. Benutzergerät, umfassend:

ein Erhaltungsmodul (410), das dazu konfiguriert ist, Konfigurationsinformationen zu erhalten, die verwendet werden, um einen empfangenen Signalstärke-Indikatorwert, RSSI, eines Signals auf einer unlizenzierten Frequenz zu erkennen, wobei die Konfigurationsinformationen Abtastparameterinformationen und ein statistisches Fenster umfassen, die von dem Signal auf der unlizenzierten Frequenz stammen, wobei die Abtastparameterinformationen ein Abtastintervall umfassen, und das statistische Fenster eine Zeitlänge ist, in der Statistiken über RSSI-Werte des Signals auf der unlizenzierten Frequenz zu Abtastzeitpunkten bestimmt werden;
ein Abtastmodul (420), das dazu konfiguriert ist, das Signal auf der unlizenzierten Frequenz in dem Abtastintervall

abzutasten, und die RSSI-Werte des Signals auf der unlizenzierten Frequenz zu den Abtastzeitpunkten zu erhalten;
ein Statistik-Bestimmungsmodul (430), das dazu konfiguriert ist, Statistiken über die RSSI-Werte des Signals auf der unlizenzierten Frequenz zu den in dem statistischen Fenster umfassten Abtastzeitpunkten zu bestimmen, und ein statistisches Ergebnis des RSSI-Werts des Signals auf der unlizenzierten Frequenz zu erhalten; und
ein Berichtsmodul (440), das dazu konfiguriert ist, das statistische Ergebnis des RSSI-Werts des Signals auf der unlizenzierten Frequenz an die Basisstation zu berichten;
dadurch gekennzeichnet, dass
die Abtastparameterinformationen ferner eine Messzeitlänge in dem statistischen Fenster und eine Messperiode in dem statistischen Fenster umfassen, und das Abtastmodul insbesondere dazu konfiguriert ist, für das Signal auf der unlizenzierten Frequenz das Signal auf der unlizenzierten Frequenz in dem Abtastintervall gemäß der Messzeitlänge und der Messperiode abzutasten und die RSSI-Werte des Signals auf der unlizenzierten Frequenz zu den Abtastzeitpunkten zu erhalten.

6. Benutzergerät nach Anspruch 5, wobei die Konfigurationsinformationen ferner einen RSSI-Schwellenwert umfassen und das Statistikbestimmungsmodul insbesondere dazu konfiguriert ist, für das statistische Fenster gemäß dem RSSI-Schwellenwert RSSI-Werte des Signals auf der unlizenzierten Frequenz zu Abtastzeitpunkten, die in dem statistischen Fenster umfasst sind, in mindestens einen RSSI-Wertebereich zu bestimmen; und ein Verhältnis einer Anzahl von RSSI-Werten zu Abtastzeitpunkten, die in dem mindestens einen RSSI-Wertebereich umfasst sind, zu einer Gesamtmenge der RSSI-Werte des Signals auf der unlizenzierten Frequenz zu den Abtastzeitpunkten, die in dem statistischen Fenster umfasst sind, zu erhalten, und das Verhältnis des mindestens einen RSSI-Wertebereichs als ein statistisches Ergebnis zu verwenden.

7. Basisstation, umfassend:

ein Kommunikationsmodul (510), das dazu konfiguriert ist, an ein Benutzergerät Konfigurationsinformationen zu senden, die verwendet werden, um einen Signalstärke-Indikatorwert, RSSI, eines Signals auf einer unlizenzierten Frequenz zu erkennen, wobei die Konfigurationsinformationen Frequenzangabeinformationen umfassen, die für das Benutzergerät verwendet werden, um die unlizenzierte Frequenz zu bestimmen, auf der ein statistisches Ergebnis des RSSI-Werts des Signals erhalten werden muss, wobei die Konfigurationsinformationen ein statistisches Fenster umfassen, das verwendet wird, um das Signal auf der unlizenzierten Frequenz abzutasten, und das statistische Fenster eine Zeitlänge ist, in der Statistiken über RSSI-Werte des Signals auf der unlizenzierten Frequenz zu Abtastzeitpunkten bestimmt werden, wobei
das Kommunikationsmodul ferner dazu konfiguriert ist, das statistische Ergebnis des RSSI-Werts des Signals auf der unlizenzierten Frequenz zu empfangen, das von dem Benutzergerät gemäß den Konfigurationsinformationen erhalten wird; und
ein Beurteilungsmodul (520), das dazu konfiguriert ist, gemäß dem statistischen Ergebnis des RSSI-Werts des Signals auf der durch das Kommunikationsmodul empfangenen unlizenzierten Frequenz zu bestimmen, ob die unlizenzierte Frequenz eine freie unlizenzierte Frequenz ist, die zur Kommunikation mit dem Benutzergerät verwendet wird;
dadurch gekennzeichnet, dass
die Konfigurationsinformationen ferner Abtastparameterinformationen umfassen und die Abtastparameterinformationen eine Messzeitlänge in dem statistischen Fenster und eine Messperiode in dem statistischen Fenster umfassen, die Messzeitlänge verwendet wird, um eine Zeitlänge anzugeben, in der das Signal auf der unlizenzierten Frequenz in der Messperiode abgetastet wird.

8. Basisstation nach Anspruch 7, wobei die Konfigurationsinformationen ferner einen RSSI-Schwellenwert umfassen, und der RSSI-Schwellenwert verwendet wird, um für das statistische Fenster RSSI-Werte des Signals auf der unlizenzierten Frequenz zu Abtastzeitpunkten, die in dem statistischen Fenster in mindestens einem RSSI-Wertebereich umfasst sind, zu bestimmen, und ein Verhältnis einer Anzahl von RSSI-Werten zu Abtastzeitpunkten, die in dem mindestens einen RSSI-Wertebereich umfasst sind, zu einer Gesamtmenge der RSSI-Werte des Signals auf der unlizenzierten Frequenz zu den Abtastzeitpunkten, die in dem statistischen Fenster umfasst sind, als das statistische Ergebnis des RSSI-Werts des Signals auf der unlizenzierten Frequenz verwendet wird.

Revendications

1. Procédé de traitement de signal, comprenant :

l'obtention (101), par un équipement d'utilisateur, d'informations de configuration utilisées pour détecter une valeur d'indicateur d'intensité de signal reçu, RSSI, d'un signal sur une fréquence sans licence, dans lequel les informations de configuration comprennent des informations de paramètre d'échantillonnage et une fenêtre statistique qui sont celles du signal sur la fréquence sans licence, les informations de paramètre d'échantillonnage comprennent un intervalle d'échantillonnage, et la fenêtre statistique est une longueur temporelle pendant laquelle des statistiques sur des valeurs de RSSI du signal sur la fréquence sans licence à des moments d'échantillonnage sont déterminées ;

l'échantillonnage (102), par l'équipement d'utilisateur, du signal sur la fréquence sans licence à l'intervalle d'échantillonnage, et l'obtention des valeurs de RSSI du signal sur la fréquence sans licence aux moments d'échantillonnage ;

la détermination (103), par l'équipement d'utilisateur, de statistiques sur les valeurs de RSSI du signal sur la fréquence sans licence aux moments d'échantillonnage compris dans la fenêtre statistique, et l'obtention d'un résultat statistique de valeur de RSSI du signal sur la fréquence sans licence ; et

le signalement (104), par l'équipement d'utilisateur, du résultat statistique de valeur de RSSI du signal sur la fréquence sans licence à la station de base ;

caractérisé en ce que

les informations de paramètre d'échantillonnage comprennent en outre une longueur temporelle de mesure dans la fenêtre statistique et une période de mesure dans la fenêtre statistique, et l'échantillonnage, par l'équipement d'utilisateur, du signal sur la fréquence sans licence à l'intervalle d'échantillonnage, et l'obtention des valeurs de RSSI du signal sur la fréquence sans licence aux moments d'échantillonnage comprennent :

l'échantillonnage, par l'équipement d'utilisateur, pour le signal sur la fréquence sans licence, du signal sur la fréquence sans licence à l'intervalle d'échantillonnage en fonction de la longueur temporelle de mesure et de la période de mesure, et l'obtention des valeurs de RSSI du signal sur la fréquence sans licence aux moments d'échantillonnage.

2. Procédé selon la revendication 1, dans lequel les informations de configuration comprennent en outre un seuil de RSSI, et la détermination, par l'équipement d'utilisateur, de statistiques sur les valeurs de RSSI du signal sur la fréquence sans licence aux moments d'échantillonnage en fonction de la fenêtre statistique, et l'obtention d'un résultat statistique de valeur de RSSI du signal sur la fréquence sans licence comprennent :

la détermination, par l'équipement d'utilisateur, pour la fenêtre statistique en fonction du seuil de RSSI, de valeurs de RSSI du signal sur la fréquence sans licence à des moments d'échantillonnage compris dans la fenêtre statistique dans au moins une plage de valeurs de RSSI ; et l'obtention d'un rapport d'une quantité de valeurs de RSSI à des moments d'échantillonnage qui sont compris dans l'au moins une plage de valeurs de RSSI sur une quantité totale des valeurs de RSSI du signal sur la fréquence sans licence aux moments d'échantillonnage compris dans la fenêtre statistique, et

l'utilisation du rapport de l'au moins une plage de valeurs de RSSI comme résultat statistique.

3. Procédé de traitement de signal, comprenant :

l'envoi (301), par une station de base à un équipement d'utilisateur, d'informations de configuration utilisées pour détecter une valeur d'indicateur d'intensité de signal reçu, RSSI, d'un signal sur une fréquence sans licence, dans lequel les informations de configuration comprennent des informations d'indication de fréquence utilisées par l'équipement d'utilisateur pour déterminer la fréquence sans licence sur laquelle un résultat statistique de valeur de RSSI du signal doit être obtenu, dans lequel les informations de configuration comprennent une fenêtre statistique qui est utilisée pour échantillonner le signal sur la fréquence sans licence, et la fenêtre statistique est une longueur temporelle pendant laquelle les statistiques sur les valeurs de RSSI du signal sur la fréquence sans licence à des moments d'échantillonnage sont déterminées ;

la réception (302), par la station de base, du résultat statistique de valeur de RSSI du signal sur la fréquence sans licence qui est obtenu par l'équipement d'utilisateur en fonction des informations de configuration ; et

la détermination (303), par la station de base en fonction du résultat statistique de valeur de RSSI du signal sur la fréquence sans licence, de si la fréquence sans licence est ou n'est pas une fréquence sans licence inactive utilisée pour la communication avec l'équipement d'utilisateur ;

caractérisé en ce que

les informations de configuration comprennent en outre des informations de paramètre d'échantillonnage et les informations de paramètre d'échantillonnage comprennent une longueur temporelle de mesure dans la fenêtre statistique et une période de mesure dans la fenêtre statistique, et la longueur temporelle de mesure est utilisée pour indiquer une longueur temporelle pendant laquelle le signal sur la fréquence sans licence est échantillonné

dans la période de mesure.

4. Procédé selon la revendication 3, dans lequel les informations de configuration comprennent en outre un seuil de RSSI, et le seuil de RSSI est utilisé pour déterminer, pour la fenêtre statistique, des valeurs de RSSI du signal sur la fréquence sans licence à des moments d'échantillonnage compris dans la fenêtre statistique dans au moins une plage de valeurs de RSSI, et un rapport d'une quantité de valeurs de RSSI à des moments d'échantillonnage qui sont compris dans l'au moins une plage de valeurs de RSSI sur une quantité totale des valeurs de RSSI du signal sur la fréquence sans licence aux moments d'échantillonnage compris dans la fenêtre statistique est utilisé comme résultat statistique de valeur de RSSI du signal sur la fréquence sans licence.

5. Équipement d'utilisateur, comprenant :

un module d'obtention (410), configuré pour obtenir des informations de configuration utilisées pour détecter une valeur d'indicateur d'intensité de signal reçu, RSSI, d'un signal sur une fréquence sans licence, dans lequel les informations de configuration comprennent des informations de paramètre d'échantillonnage et une fenêtre statistique qui sont celles du signal sur la fréquence sans licence, les informations de paramètre d'échantillonnage comprennent un intervalle d'échantillonnage, et la fenêtre statistique est une longueur temporelle pendant laquelle des statistiques sur des valeurs de RSSI du signal sur la fréquence sans licence à des moments d'échantillonnage sont déterminées ;
un module d'échantillonnage (420), configuré pour : échantillonner le signal sur la fréquence sans licence à l'intervalle d'échantillonnage, et obtenir les valeurs de RSSI du signal sur la fréquence sans licence aux moments d'échantillonnage ;
un module de détermination de statistiques (430), configuré pour : déterminer des statistiques sur les valeurs de RSSI du signal sur la fréquence sans licence aux moments d'échantillonnage compris dans la fenêtre statistique, et obtenir un résultat statistique de valeur de RSSI du signal sur la fréquence sans licence ; et
un module de signalisation (440), configuré pour signaler le résultat statistique de valeur de RSSI du signal sur la fréquence sans licence à la station de base ;
caractérisé en ce que
les informations de paramètre d'échantillonnage comprennent en outre une longueur temporelle de mesure dans la fenêtre statistique et une période de mesure dans la fenêtre statistique, et le module d'échantillonnage est spécifiquement configuré pour :
échantillonner, pour le signal sur la fréquence sans licence, le signal sur la fréquence sans licence à l'intervalle d'échantillonnage en fonction de la longueur temporelle de mesure et de la période de mesure, et obtenir les valeurs de RSSI du signal sur la fréquence sans licence aux moments d'échantillonnage.

6. Équipement d'utilisateur selon la revendication 5, dans lequel les informations de configuration comprennent en outre un seuil de RSSI, et le module de détermination de statistique est spécifiquement configuré pour : déterminer, pour la fenêtre statistique en fonction du seuil de RSSI, des valeurs de RSSI du signal sur la fréquence sans licence aux moments d'échantillonnage compris dans la fenêtre statistique dans au moins une plage de valeurs de RSSI ; et obtenir un rapport d'une quantité de valeurs de RSSI aux moments d'échantillonnage qui sont compris dans l'au moins une plage de valeurs de RSSI sur une quantité totale des valeurs de RSSI du signal sur la fréquence sans licence aux moments d'échantillonnage compris dans la fenêtre statistique, et utiliser le rapport de l'au moins une plage de valeurs de RSSI comme résultat statistique.

7. Station de base, comprenant :

un module de communication (510), configuré pour envoyer, à un équipement d'utilisateur, des informations de configuration utilisées pour détecter une valeur d'indicateur d'intensité de signal reçu, RSSI, d'un signal sur une fréquence sans licence, dans lequel les informations de configuration comprennent des informations d'indication de fréquence utilisées par l'équipement d'utilisateur pour déterminer la fréquence sans licence sur laquelle un résultat statistique de valeur de RSSI du signal doit être obtenu, dans lequel les informations de configuration comprennent une fenêtre statistique qui est utilisée pour échantillonner le signal sur la fréquence sans licence, et la fenêtre statistique est une longueur temporelle pendant laquelle les statistiques sur les valeurs de RSSI du signal sur la fréquence sans licence à des moments d'échantillonnage sont déterminées, dans laquelle
le module de communication est en outre configuré pour recevoir le résultat statistique de valeur de RSSI du signal sur la fréquence sans licence qui est obtenu par l'équipement d'utilisateur en fonction des informations de configuration ; et

un module de jugement (520), configuré pour déterminer, en fonction du résultat statistique de valeur de RSSI du signal sur la fréquence sans licence reçu par le module de communication, si la fréquence sans licence est ou n'est pas une fréquence sans licence inactive utilisée pour la communication avec l'équipement d'utilisateur ; **caractérisée en ce que**

les informations de configuration comprennent en outre des informations de paramètre d'échantillonnage et les informations de paramètre d'échantillonnage comprennent une longueur temporelle de mesure dans la fenêtre statistique et une période de mesure dans la fenêtre statistique, et la longueur temporelle de mesure est utilisée pour indiquer une longueur temporelle pendant laquelle le signal sur la fréquence sans licence est échantillonné dans la période de mesure.

8. Station de base selon la revendication 7, dans laquelle les informations de configuration comprennent en outre un seuil de RSSI, et le seuil de RSSI est utilisé pour déterminer, pour la fenêtre statistique, des valeurs de RSSI du signal sur la fréquence sans licence à des moments d'échantillonnage compris dans la fenêtre statistique dans au moins une plage de valeurs de RSSI, et un rapport d'une quantité de valeurs de RSSI à des moments d'échantillonnage qui sont compris dans l'au moins une plage de valeurs de RSSI sur une quantité totale des valeurs de RSSI du signal sur la fréquence sans licence aux moments d'échantillonnage compris dans la fenêtre statistique est utilisé comme résultat statistique de valeur de RSSI du signal sur la fréquence sans licence.

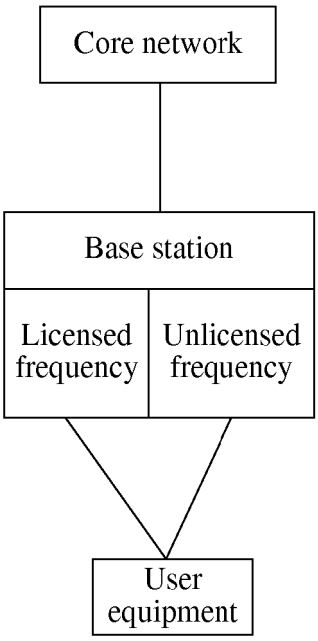
Core network
Base station
Licensed frequency
Unlicensed frequency
User equipment

FIG. 1

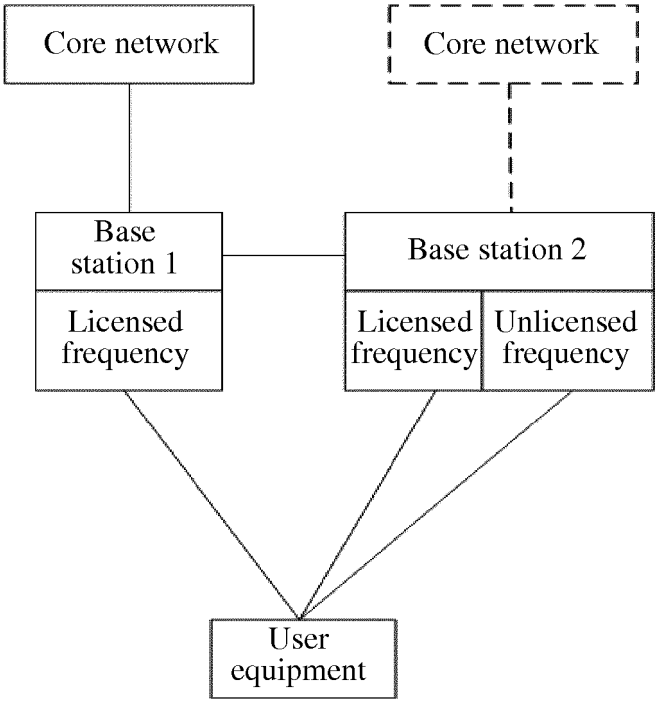
Core network
Core network
Base station 1
Licensed frequency
Base station 2
Licensed frequency
Unlicensed frequency
User equipment

FIG. 2

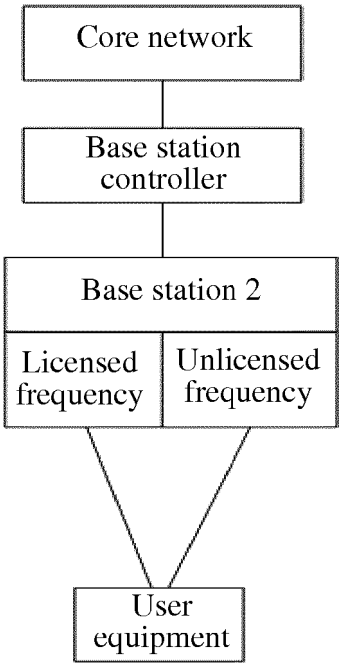
Core network
Base station controller
Base station 2
Licensed frequency
Unlicensed frequency
User equipment

FIG. 3

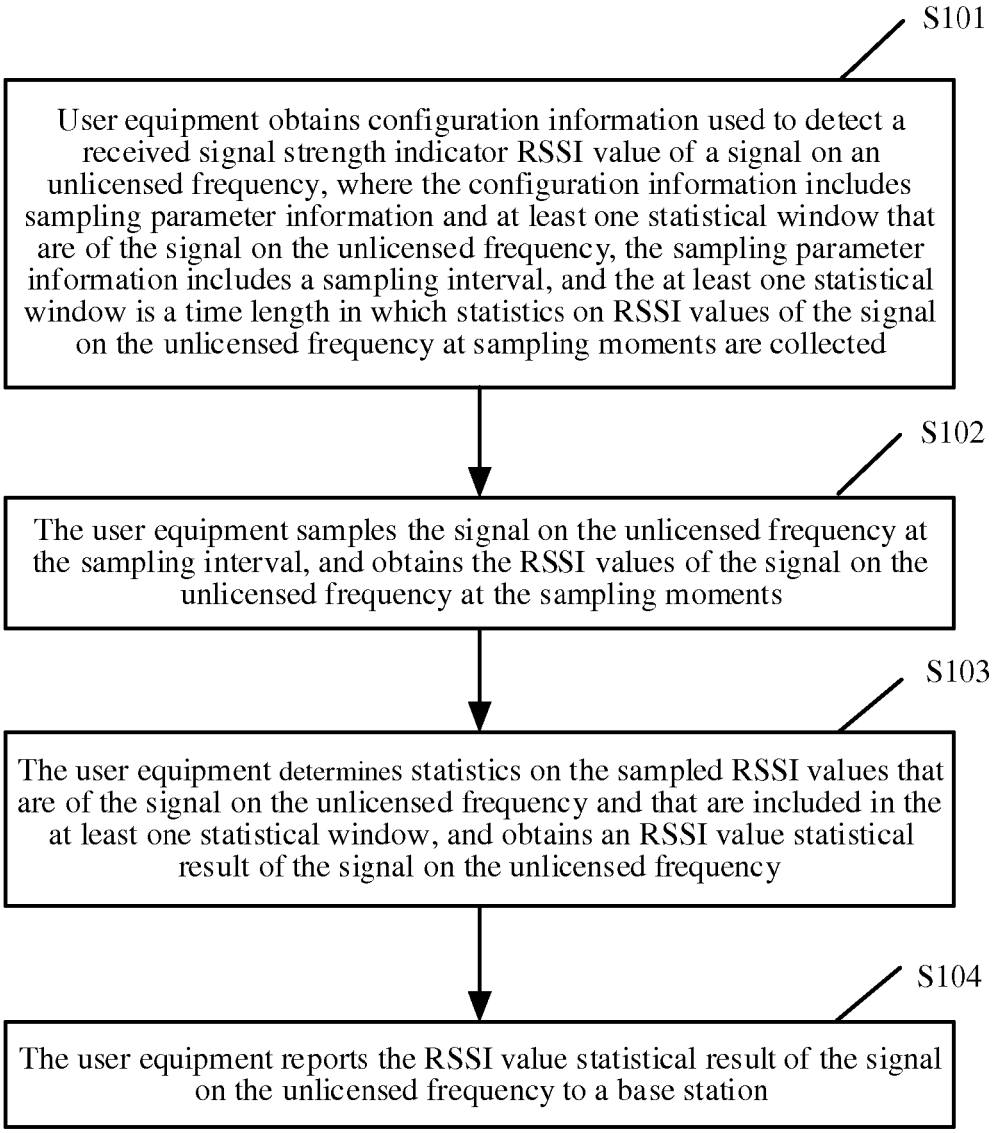
S101
User equipment obtains configuration information used to detect a received signal strength indicator RSSI value of a signal on an unlicensed frequency, where the configuration information includes sampling parameter information and at least one statistical window that are of the signal on the unlicensed frequency, the sampling parameter information includes a sampling interval, and the at least one statistical window is a time length in which statistics on RSSI values of the signal on the unlicensed frequency at sampling moments are collected
S102
The user equipment samples the signal on the unlicensed frequency at the sampling interval, and obtains the RSSI values of the signal on the unlicensed frequency at the sampling moments
S103
The user equipment determines statistics on the sampled RSSI values that are of the signal on the unlicensed frequency and that are included in the at least one statistical window, and obtains an RSSI value statistical result of the signal on the unlicensed frequency
S104
The user equipment reports the RSSI value statistical result of the signal on the unlicensed frequency to a base station

FIG. 4

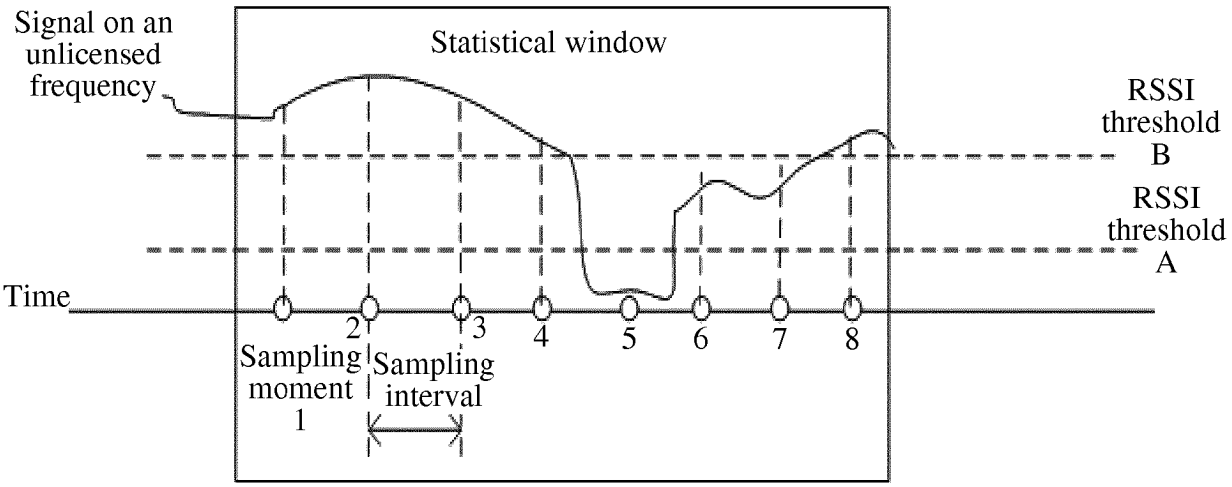
Signal on an unlicensed frequency
Statistical window
RSSI threshold B
RSSI threshold A
Time
1
2
3
4
5
6
7
8
Sampling moment 1
Sampling interval

FIG. 5a

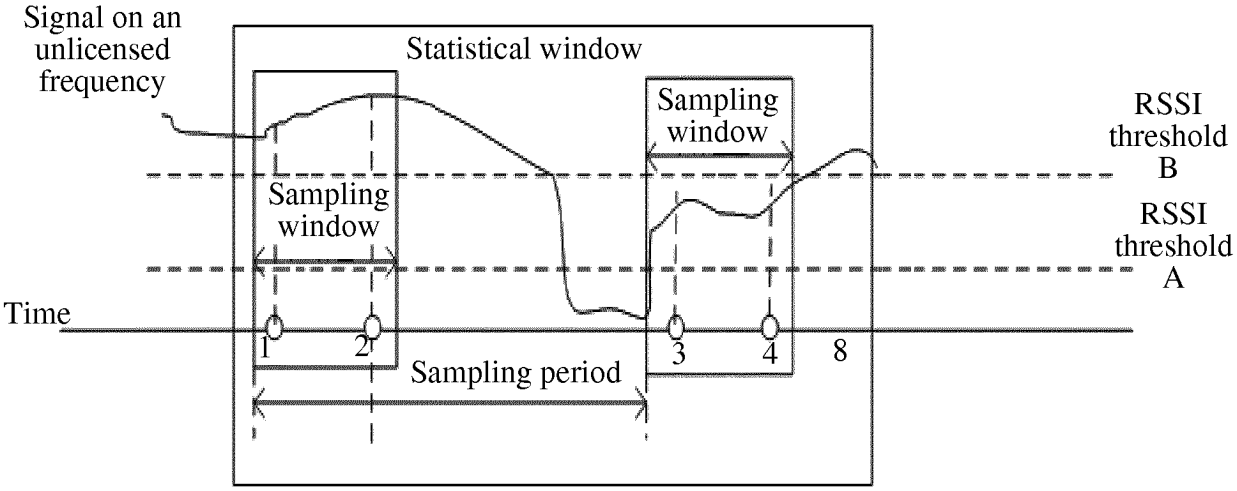
Signal on an unlicensed frequency
Statistical window
Sampling window
Sampling window
RSSI threshold B
RSSI threshold A
Time
1
2
3
4
8
Sampling period

FIG. 5b

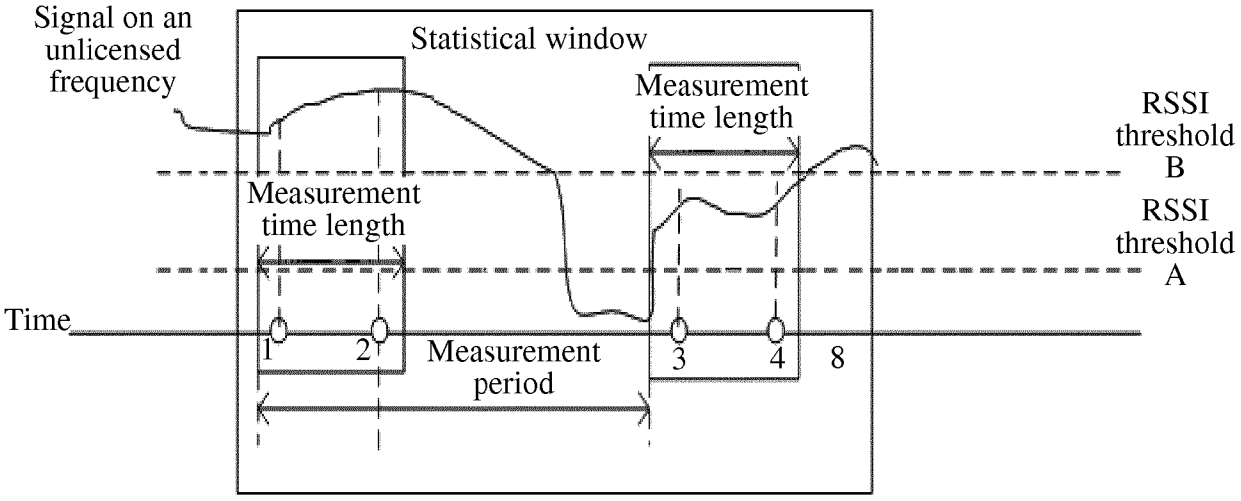
Signal on an unlicensed frequency
Statistical window
Measurement time length
RSSI threshold B
Measurement time length
RSSI threshold A
Time
1
2
Measurement period
3
4
8

FIG. 5c

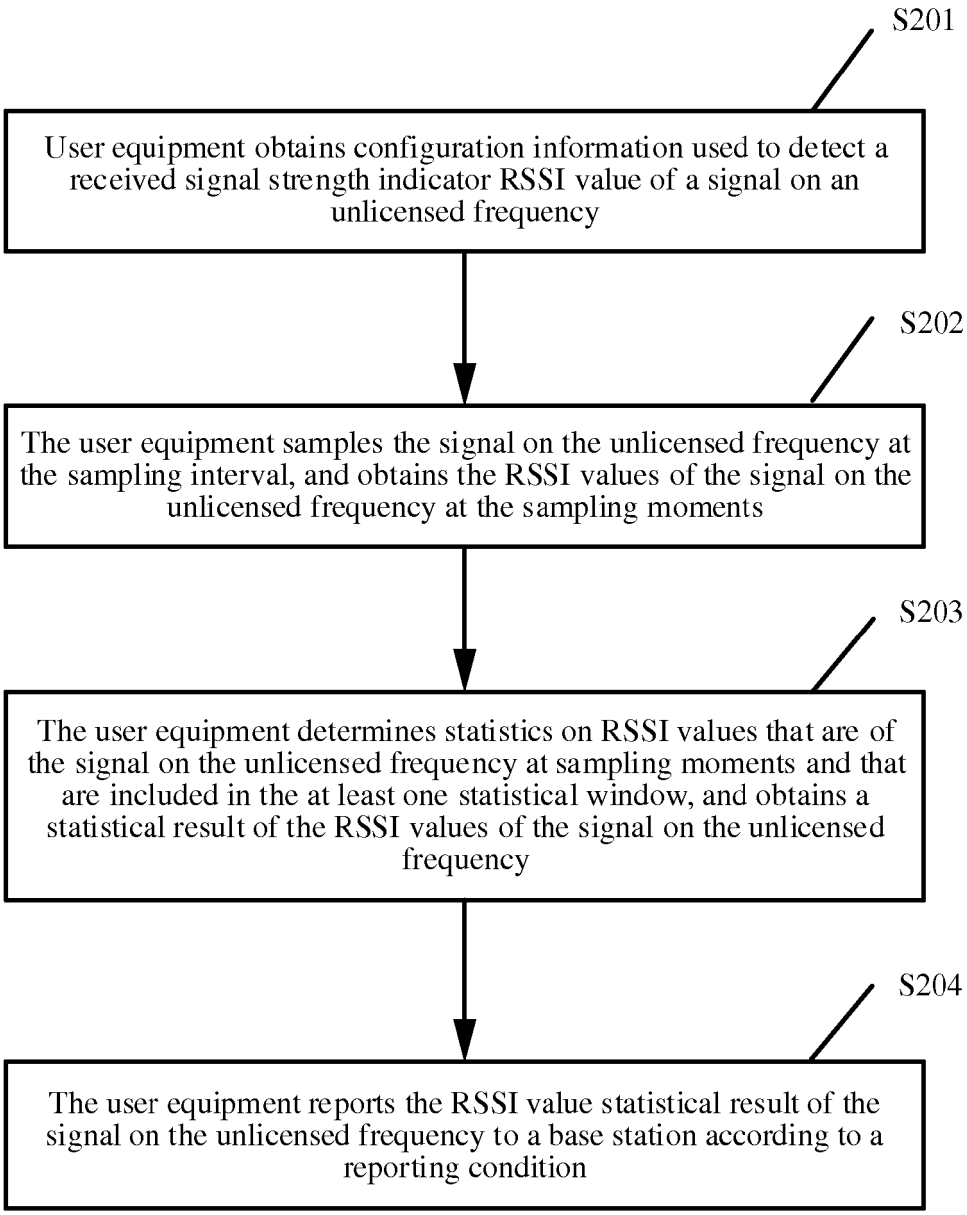
S201
User equipment obtains configuration information used to detect a received signal strength indicator RSSI value of a signal on an unlicensed frequency
S202
The user equipment samples the signal on the unlicensed frequency at the sampling interval, and obtains the RSSI values of the signal on the unlicensed frequency at the sampling moments
S203
The user equipment determines statistics on RSSI values that are of the signal on the unlicensed frequency at sampling moments and that are included in the at least one statistical window, and obtains a statistical result of the RSSI values of the signal on the unlicensed frequency
S204
The user equipment reports the RSSI value statistical result of the signal on the unlicensed frequency to a base station according to a reporting condition

FIG. 6

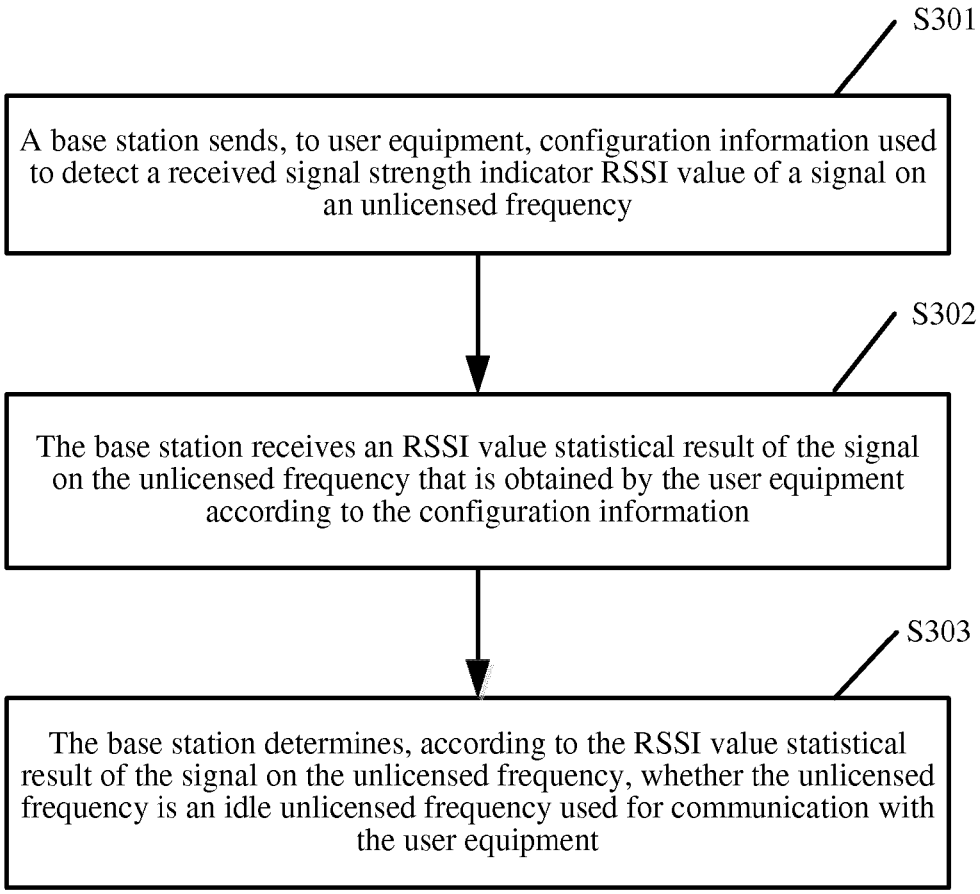
S301
A base station sends, to user equipment, configuration information used to detect a received signal strength indicator RSSI value of a signal on an unlicensed frequency
S302
The base station receives an RSSI value statistical result of the signal on the unlicensed frequency that is obtained by the user equipment according to the configuration information
S303
The base station determines, according to the RSSI value statistical result of the signal on the unlicensed frequency, whether the unlicensed frequency is an idle unlicensed frequency used for communication with the user equipment

FIG. 7

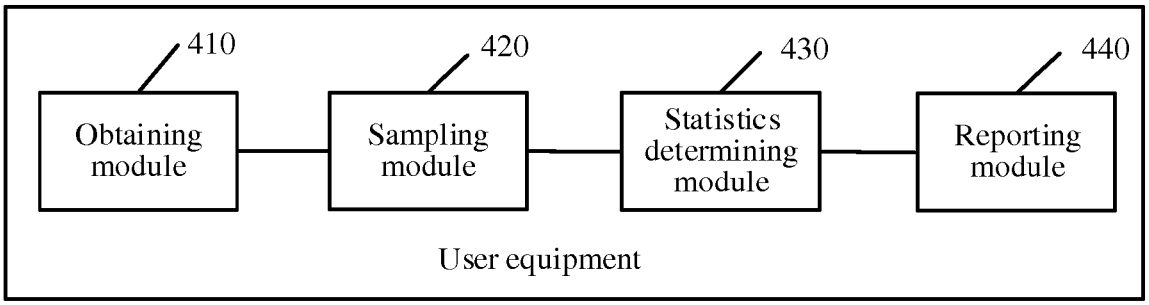
410
Obtaining module
420
Sampling module
430
Statistics determining module
440
Reporting module
User equipment

FIG. 8

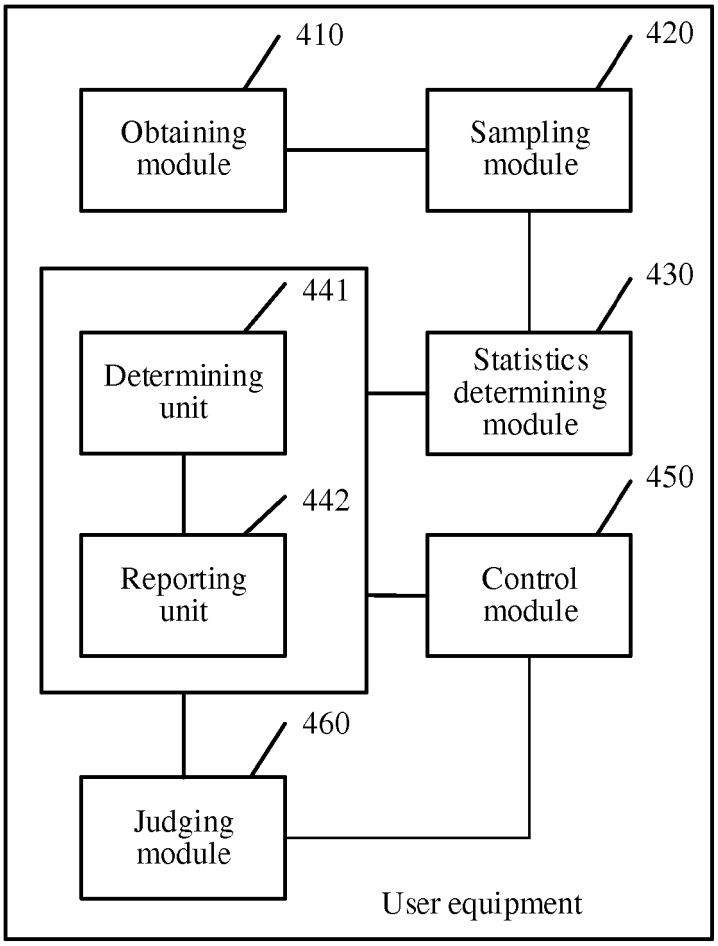
410
420
Obtaining module
Sampling module
441
430
Determining unit
Statistics determining module
442
450
Reporting unit
Control module
460
Judging module
User equipment

FIG. 9

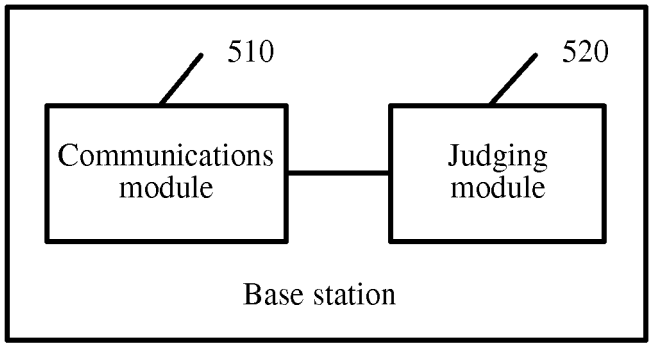
510
520
Communications module
Judging module
Base station

FIG. 10

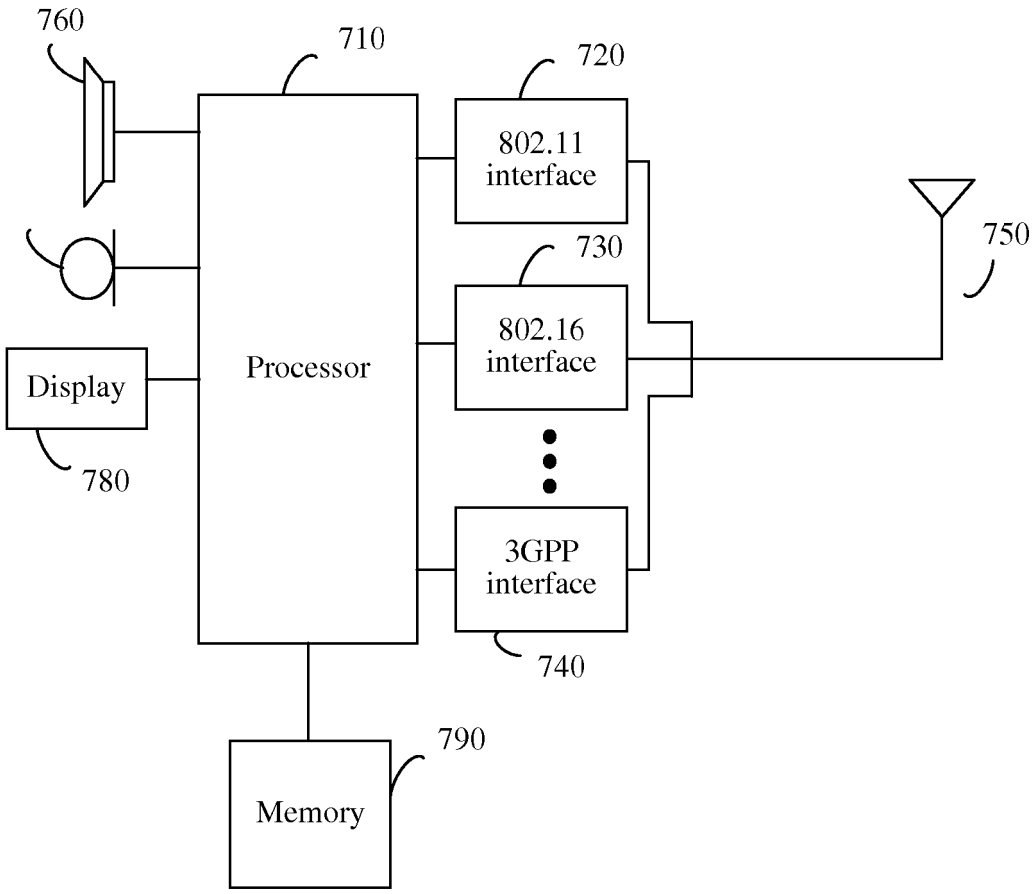
760
710
720
802.11 interface
750
730
802.16 interface
Processor
Display
780
3GPP interface
740
790
Memory

FIG. 11

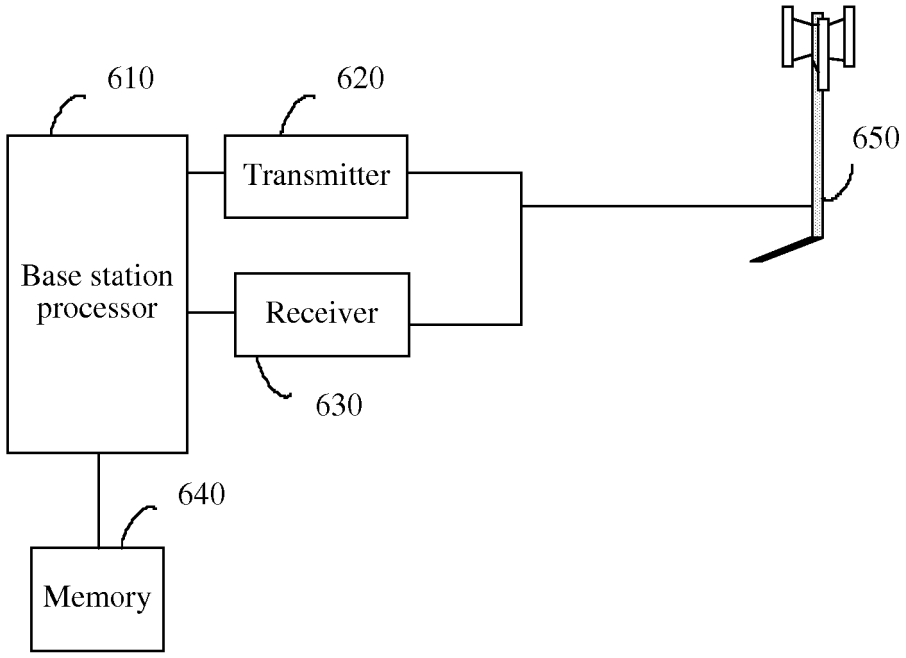
610
620
650
Transmitter
Base station processor
Receiver
630
640
Memory

FIG. 12

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- WO 2012116489 A1 **[0004]**