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(54) **MANAGEMENT DEVICE, MANAGEMENT METHOD, AND MANAGEMENT PROGRAM**

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CPC ***H04W 48/20*** (2013.01); ***H04W 64/00*** (2013.01); ***H04W 76/10*** (2018.02); ***H04W 76/30*** (2018.02)

(58) **Field of Classification Search**
CPC H04W 48/20; H04W 64/00; H04W 76/10; H04W 76/30; H04W 16/32; H04W 36/04
(Continued)

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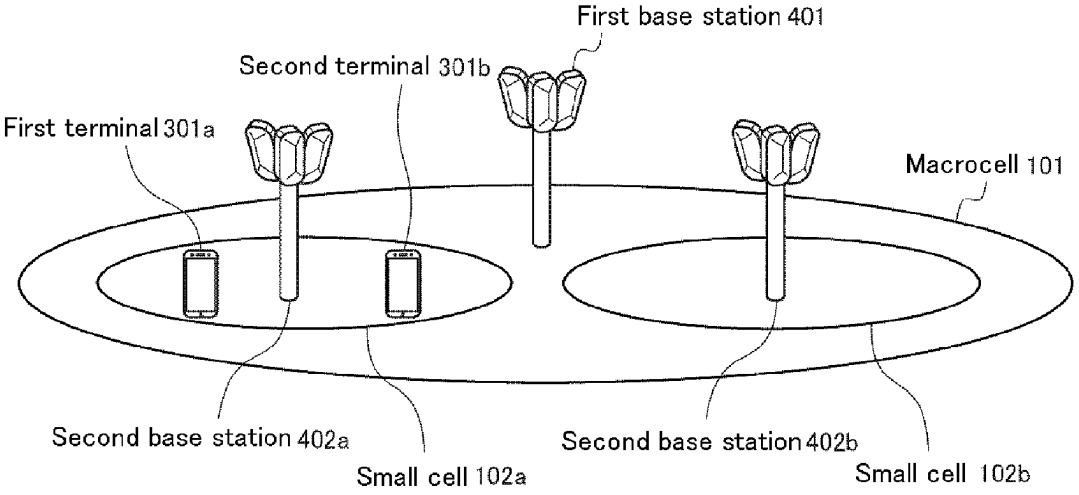
(57) **ABSTRACT**

In order to connect a radio terminal in a heterogeneous network environment to a connection destination in an appropriate frequency band, a management device comprises: a located-area information acquisition unit that acquires located-area information of the radio terminal; a first base station identification unit that uses the located-area information to identify a first base station forming a macrocell; a second base station identification unit that uses the located-area information to perform a first assessment for assessing whether or not the radio terminal is within one of the small cells, and that, when the radio terminal is within one of the small cells, identifies a second base station forming the small cell; and a high-speed communication requirement assessment unit that performs a second assessment for assessing whether or not the radio terminal requires high-speed communication based on at least a predicted traffic demand volume from the radio terminal.

7 Claims, 7 Drawing Sheets



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H04W 76/30 (2018.01)

(58) **Field of Classification Search**
USPC 370/329
See application file for complete search history.

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Fig. 1

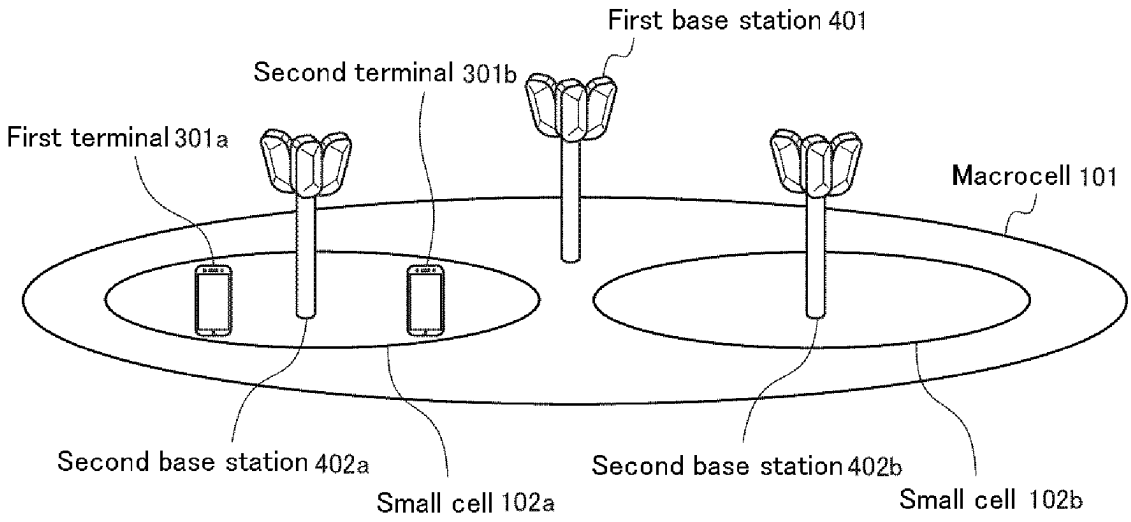

First base station 401
Second terminal 301b
First terminal 301a
Macrocell 101
Second base station 402a
Small cell 102a
Second base station 402b
Small cell 102b

Fig. 2

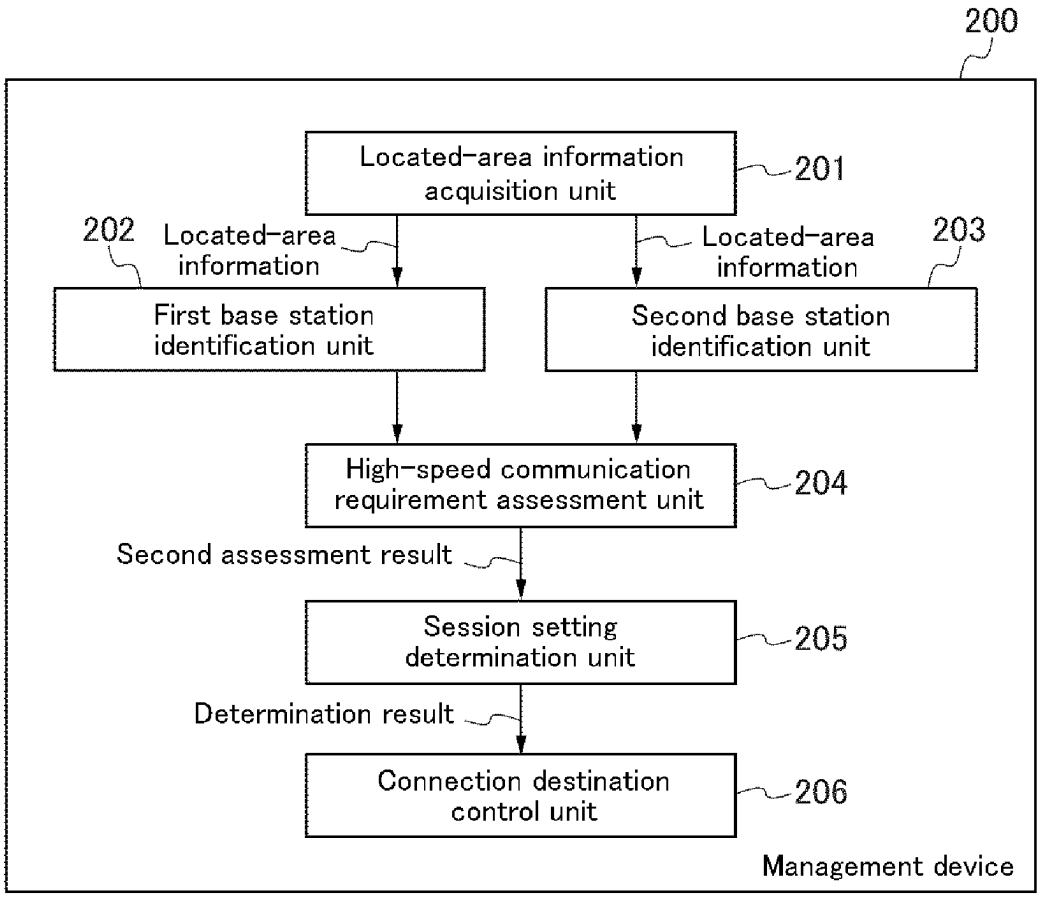

200
Located-area information acquisition unit
201
202
Located-area information
Located-area information
203
First base station identification unit
Second base station identification unit
High-speed communication requirement assessment unit
204
Second assessment result
Session setting determination unit
205
Determination result
Connection destination control unit
206
Management device

Fig. 3

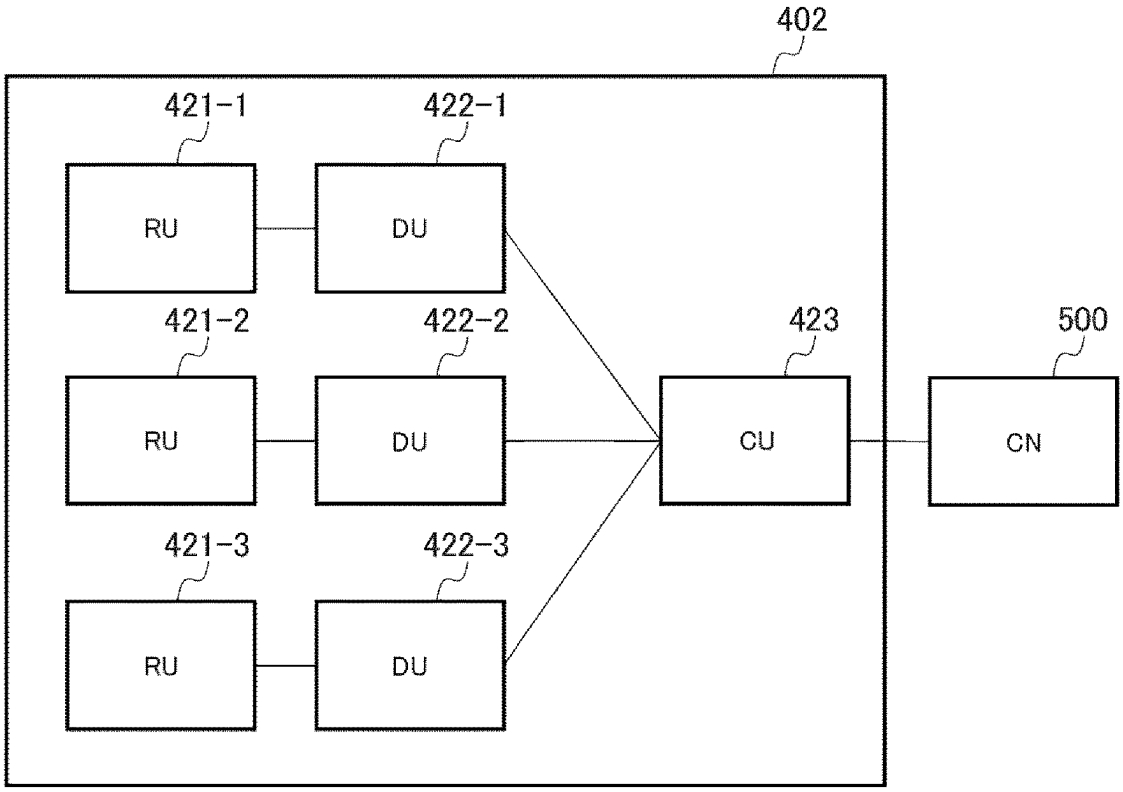


Fig. 4

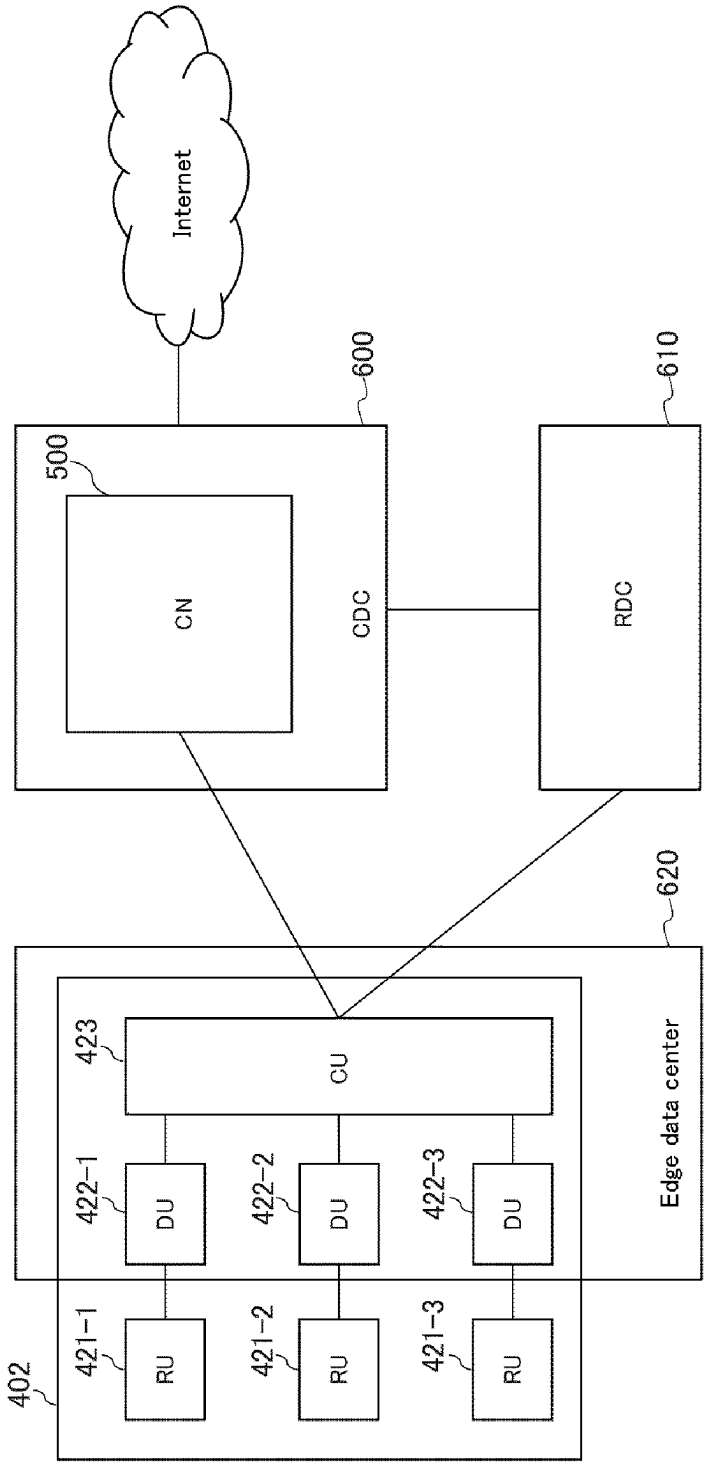

Internet
600
610
500
CN
CDC
RDC
620
423
CU
422-1
DU
422-2
DU
422-3
DU
Edge data center
421-1
RU
421-2
RU
421-3
RU
402

Fig. 5

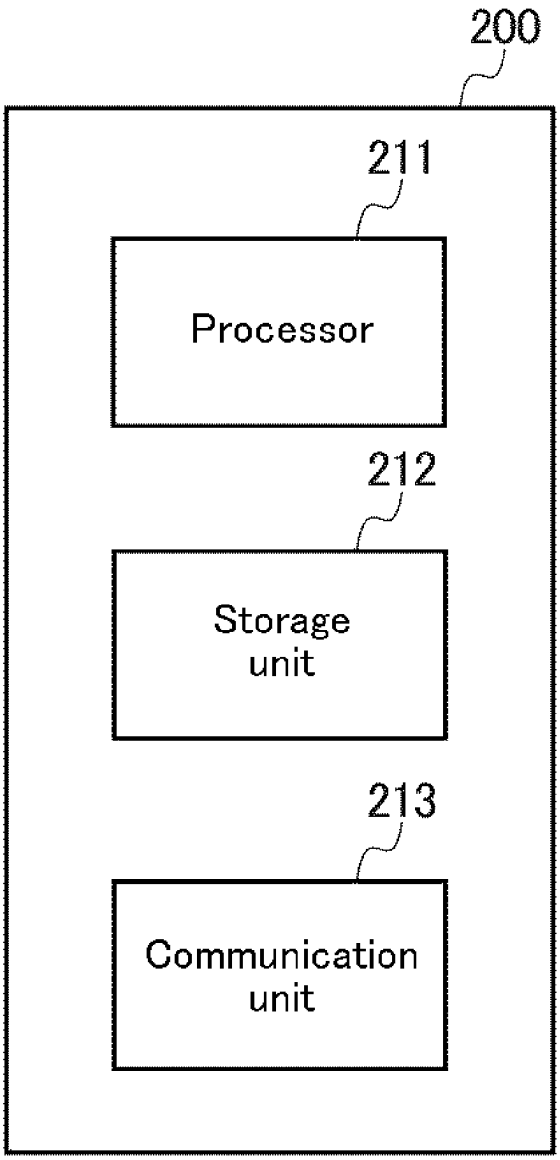


Fig. 6

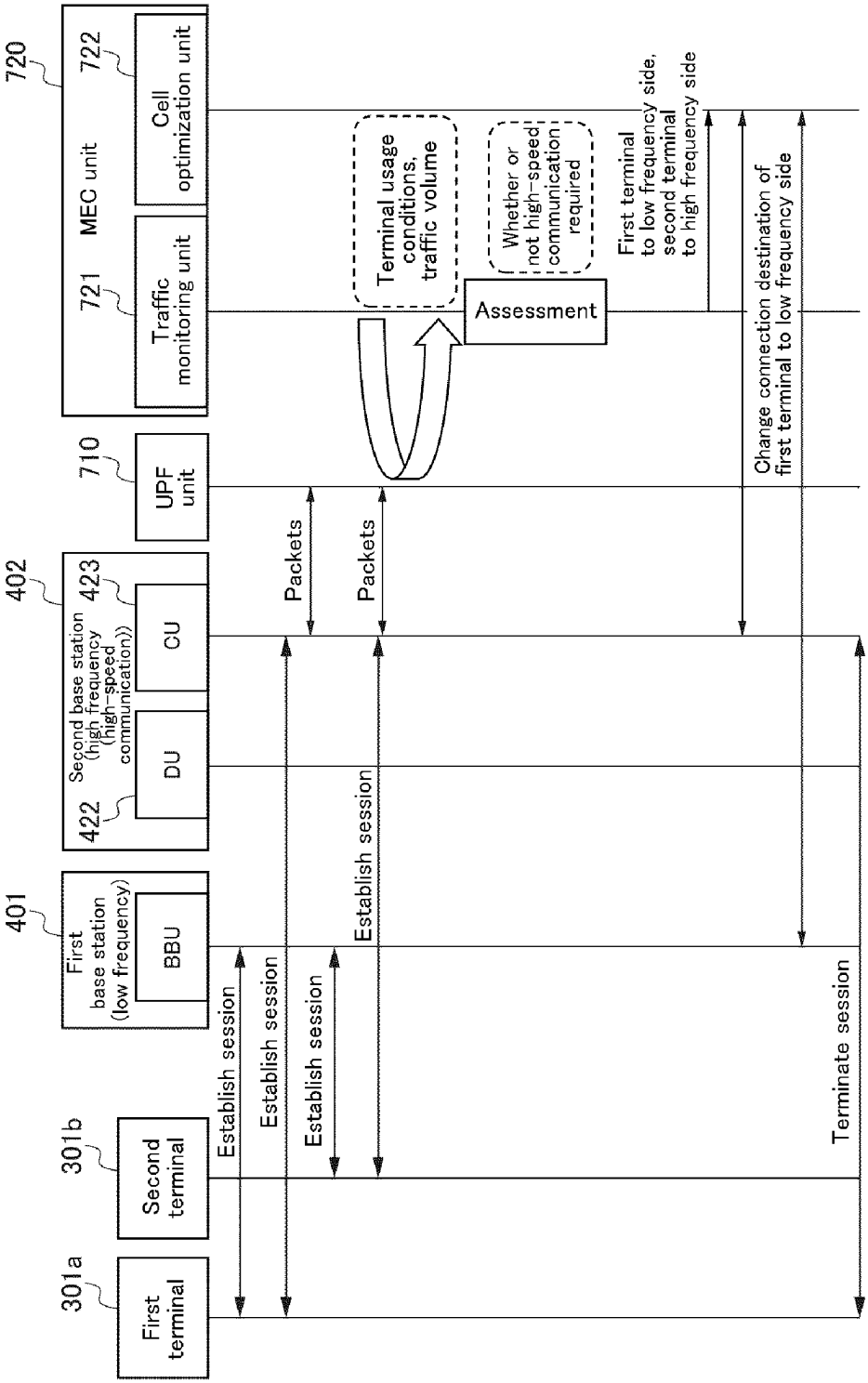
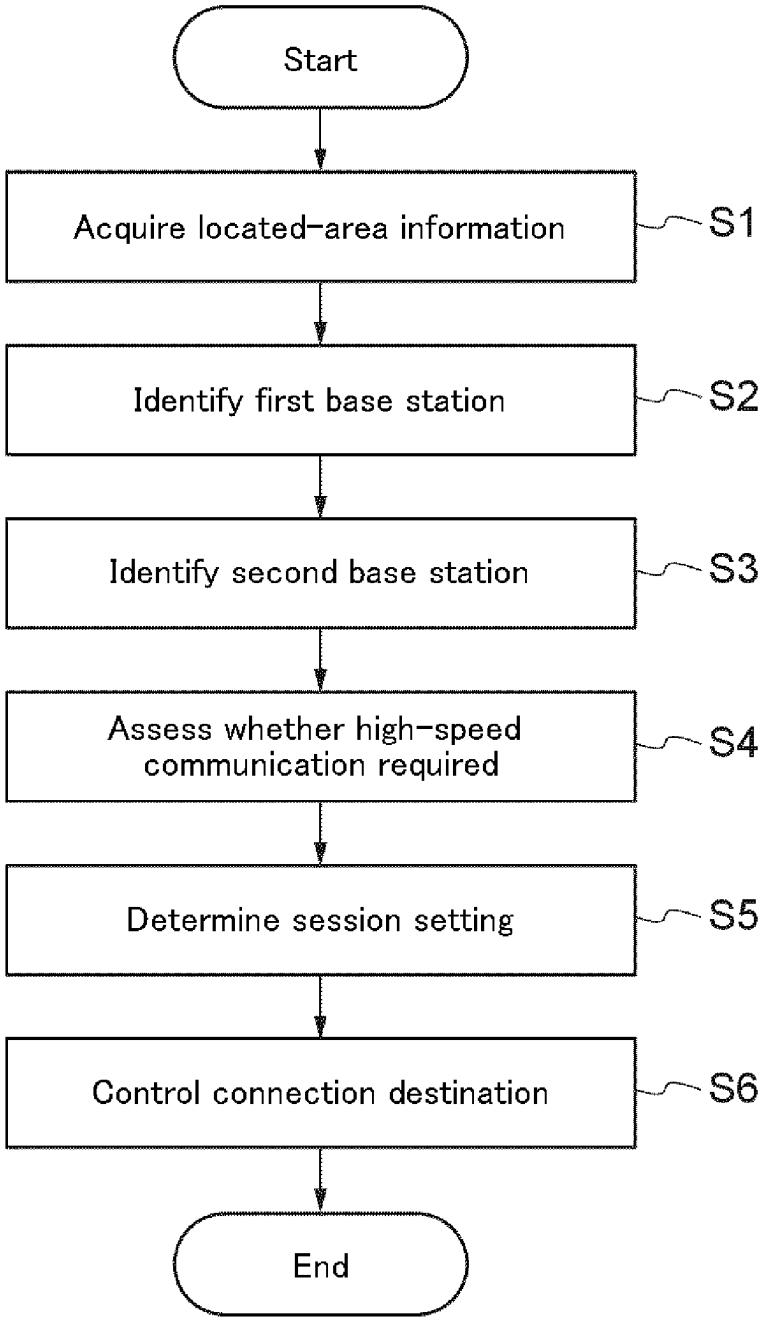

301a
First terminal
301b
Second terminal
401
First base station (low frequency)
BBU
402
Second base station (high frequency (high-speed communication))
422
DU
423
CU
710
UPF unit
720
MEC unit
721
Traffic monitoring unit
722
Cell optimization unit
Establish session
Establish session
Establish session
Establish session
Packets
Packets
Terminal usage conditions, traffic volume
Assessment
Whether or not high-speed communication required
First terminal to low frequency side, second terminal to high frequency side
Change connection destination of first terminal to low frequency side
Terminate session

Fig. 7


Start
Acquire located-area information
S1
Identify first base station
S2
Identify second base station
S3
Assess whether high-speed communication required
S4
Determine session setting
S5
Control connection destination
S6
End

MANAGEMENT DEVICE, MANAGEMENT METHOD, AND MANAGEMENT PROGRAM

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a National Stage of International Application No. PCT/JP2021/030683 filed Aug. 20, 2021.

TECHNICAL FIELD

The present invention relates to a management device, a management method, and a management program for managing the connection destination of a radio terminal.

BACKGROUND

Radio terminals, represented by smartphones in recent years, provide augmented reality (AR: Augmented Reality) services and the like, which require high-capacity, high-speed communication, while also providing social networking services (SNSs: Social networking services) and the like, which do not require high-capacity, high-speed communication.

Conventionally, the base station that is to be the connection destination of a radio terminal is determined based on radio wave conditions.

Patent Document 1, which is an example of conventional art, discloses a heterogeneous network wherein a radio terminal reports, to base stations, measurement information regarding measurement results for reception signals from a base station that is a connection destination and/or adjacent base stations, and said measurement information is used when switching base stations.

CITATION LIST

Patent Literature

Patent Document 1: JP 2014-132795 A

SUMMARY OF INVENTION

Technical Problem

In a heterogeneous network environment, radio terminals are connected to base stations of macrocells, and are connected to base stations of small cells or spot cells by handover in accordance with the radio wave conditions.

However, if the base station that is the connection destination is determined in accordance with only the radio wave conditions, then there is a possibility that even radio terminals not requiring high-capacity, high-speed communication will be connected to the base stations of small cells or spot cells, causing the number of users connected to the base stations of small cells or spot cells to increase excessively.

For this reason, there was a problem in that providing the necessary throughput to radio terminals requiring high-capacity, high-speed communication was difficult.

The present invention was made in consideration of the above, and an objective thereof is to provide technology for connecting radio terminals to connection destinations in appropriate frequency bands in a heterogeneous network environment.

Solution to Problem

One embodiment of the present invention that solves the above-mentioned problem and that achieves the objective is

a management device for managing a connection destination of a radio terminal in a heterogeneous network environment formed by a macrocell using a low frequency band and one or a plurality of small cells using a frequency band higher than the low frequency band, wherein the management device comprises: a located-area information acquisition unit that acquires located-area information of the radio terminal; a first base station identification unit that uses the located-area information to identify a first base station forming the macrocell; a second base station identification unit that uses the located-area information to perform a first assessment for assessing whether or not the radio terminal is within one of the small cells, and that, when the radio terminal has been assessed to be within one of the small cells, identifies a second base station forming the small cell; a high-speed communication requirement assessment unit that performs a second assessment for assessing whether or not the radio terminal requires high-speed communication based on at least a predicted traffic demand volume from the radio terminal; a session setting determination unit that determines that a session between the radio terminal and the second base station is to be established or terminated based on results of the second assessment in the high-speed communication requirement assessment unit; and a connection destination control unit that controls a connection between the radio terminal and the second base station based on results of the determination in the session setting determination unit.

In one embodiment of the present invention, predicted traffic demand volume is determined based on user attribute information, and the user attribute information includes at least one of user information, calendar information, APP information, and hour-of-day information.

In one embodiment of the present invention, a used volume of traffic being used by the radio terminal is further used for the assessment regarding whether or not the radio terminal requires high-speed communication performed by the high-speed communication requirement assessment unit.

In one embodiment of the present invention, if the high-speed communication requirement assessment unit has assessed that high-speed communication is not required, then the session setting determination unit determines that a session between the radio terminal and the second base station is to be terminated.

In one embodiment of the present invention, if the high-speed communication requirement assessment unit has assessed that high-speed communication is required, then the session setting determination unit determines that a session between the radio terminal and the second base station is to be established.

In one embodiment of the present invention, when the first assessment has resulted in an assessment that the radio terminal is not within the small cells, the radio terminal is connected with the first base station.

In one embodiment of the present invention, when the second assessment has resulted in a determination that a session is to be established between the radio terminal and the second base station, the radio terminal is connected with the second base station.

In one embodiment of the present invention, when the second assessment has resulted in a determination that a session between the radio terminal and the second base station is to be terminated, the session between the radio terminal and the second base station is terminated and the radio terminal is connected with the first base station.

Additionally, one embodiment of the present invention is a management method for managing, by using one or a

plurality of processors, a connection destination of a radio terminal in a heterogeneous network environment formed by a macrocell using a low frequency band and one or a plurality of small cells using a frequency band higher than the low frequency band, wherein the management method comprises: acquiring located-area information of the radio terminal; using the located-area information to identify a first base station forming the macrocell; using the located-area information to perform a first assessment for assessing whether or not the radio terminal is within one of the small cells, and when the radio terminal has been assessed to be within one of the small cells, identifying a second base station forming the small cell; performing a second assessment for assessing whether or not the radio terminal requires high-speed communication based on at least a predicted traffic demand volume from the radio terminal; determining that a session between the radio terminal and the second base station is to be established or terminated based on results of the second assessment; and controlling a connection between the radio terminal and the second base station based on results of the determination.

In one embodiment of the present invention, a used volume of traffic being used by the radio terminal is further used in the second assessment.

Additionally, one embodiment of the present invention is a management program for making the one or a plurality of processors execute the above-mentioned management method.

Effects of Invention

According to the present invention, radio terminals can be connected to appropriate connection destinations in a heterogeneous network environment.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is a schematic diagram illustrating a communication system in an embodiment.

FIG. **2** is a diagram illustrating the configuration of a management device applied to the communication system illustrated in FIG. **1**.

FIG. **3** is a diagram illustrating an example of the configuration of a base station.

FIG. **4** is a diagram illustrating an example of the configuration of a radio communication system in an embodiment.

FIG. **5** is a diagram illustrating a configuration for realizing a management device according to an embodiment.

FIG. **6** is a diagram illustrating an assessment logic sequence in the radio communication system in an embodiment.

FIG. **7** is a flow chart illustrating a communication system management method according to an embodiment.

DESCRIPTION OF EMBODIMENTS

Hereinafter, embodiments of the present invention will be explained with reference to the attached drawings.

However, the present invention is not to be construed as being limited by the descriptions of the embodiments below.

FIG. **1** is a schematic diagram illustrating a communication system in an embodiment of the present invention.

There are two small cells **102***a*, **102***b* (hereinafter referred to collectively as small cells **102**) in a macrocell **101** illustrated in FIG. **1**.

The present invention is not limited thereto, and there may be one, or three or more small cells **102** in the macrocell **101**.

In FIG. **1**, the macrocell **101** uses a low frequency band (e.g., 4G).

Additionally, the small cells **102** use a frequency band that is higher than the low frequency band in the macrocell **101**.

The macrocell **101** and the small cells **102** form a heterogeneous network environment.

The macrocell **101** is formed by a first base station **401**.

Additionally, the small cell **102***a* is formed by a second base station **402***a*, and the small cell **102***b* is formed by a second base station **402***b*.

The second base station **402***a* and the second base station **402***b* will be referred to collectively as the base stations **402**.

In FIG. **1**, a first terminal (UE: User Equipment) **301***a* and a second terminal (UE) **301***b* are located within, i.e., are in the service area of, the small cell **102***a* within the macrocell **101**.

The first terminal **301***a* and the second terminal **301***b* will be referred to collectively as the radio terminals **301**.

The first base station **401** is provided with a BBU (Base Band Unit) that performs baseband processing.

The second base stations **402***a*, **402***b* are provided with DUs (Distributed Units), which are distributed nodes, and a CU (Centralized Unit), which is a centralized node. The functions of the BBU are realized by the DUs and the CU.

FIG. **2** is a diagram illustrating the configuration of a management device **200** applied to the management system illustrated in FIG. **1**.

The management device **200** comprises a located-area information acquisition unit **201**, a first base station identification unit **202**, a second base station identification unit **203**, a high-speed communication requirement assessment unit **204**, a session setting determination unit **205**, and a connection destination control unit **206**.

The management device **200** manages the connection destinations of the radio terminals **301** in the heterogeneous network environment.

The management device **200** includes one or a plurality of processors.

The located-area information acquisition unit **201** acquires located-area information of the radio terminals **301**.

The located-area information of the first terminal **301***a* and the second terminal **301***b* is acquired by being detected based on source IPs (Source IPs).

The first base station identification unit **202** uses the located-area information of the radio terminals **301** to identify the first base station **401** forming the macrocell **101**.

The second base station identification unit **203** uses the located-area information of the radio terminals **301** to assess whether or not the radio terminals **301** are within one of the small cells **102**.

Hereinafter, this assessment will be referred to as the first assessment.

When, in the first assessment, it has been assessed that the radio terminals **301** are within one of the small cells **102**, the second base station identification unit **203** identifies the second base station **402** forming the small cell **102**.

When the radio terminals **301** are located in the area of the macrocell **101** and the first assessment has resulted in an assessment that the radio terminals **301** are not within the small cells **102**, the radio terminals **301** may be connected with the first base station **401**.

The high-speed communication requirement assessment unit **204** assesses whether or not the radio terminals **301** require high-speed communication based on at least the predicted traffic demand volumes (i.e., the future traffic

volumes) from the radio terminals **301** (hereinafter, this assessment will be referred to as the second assessment).

In this second assessment, the volumes of the traffic being used by the radio terminals **301** (i.e., the current traffic volumes) may further be used.

In this case, the predicted traffic demand volumes (i.e., the future traffic volumes) are preferably determined based on user information in the radio terminals **301**.

The user information includes at least one of user attribute information, calendar information, APP information and hour-of-day information.

If the user is a person, then the user attribute information includes at least one of the person's age, the person's sex, and terminal attribute information associated with attributes of the radio terminal that the person has.

Additionally, the terminal attribute information is information that can be used to predict whether or not the radio terminal is associated with the presence or absence of demand for communication with a base station capable of high-speed, high-capacity communication.

An example of terminal attribute information is the type of radio terminal.

Examples of types of radio terminals include smartphones, tablet terminals and portable PCs (Personal Computers).

Additionally, if the user is a vehicle, then the user attribute information includes at least one of the vehicle type of the vehicle, information indicating whether or not the vehicle has the functions (ICT functions) of an ICT (Information and Communication Technology) terminal, and terminal attribute information associated with the attributes of the radio terminal that the vehicle has.

Examples of vehicles provided with terminals having ICT functions include vehicles such as connected cars and unmanned robots, and unmanned aerial vehicles such as drones.

Calendar information includes current date information.

This date information may include information associated with the current date in addition to the current date.

The date information is, for example, information indicating that today is the Y-th day in the month X (the current date), and that the Y-th day in the month X is a day on which a major sporting event that is to be distributed in real-time is to be held (information associated with the current date).

APP information includes information regarding the types of applications installed in the radio terminal **301** and the frequency of use of the applications.

Examples of information regarding the types of applications include information regarding applications capable of playing streamed content, such as video watching applications or music playing applications, and information regarding applications in which the main content is text data, such as SNS (Social Networking Service) applications or text site applications.

In general, applications capable of playing streamed content require high-speed, high-capacity communication, and applications for which the main content is text data do not require high-speed, high-capacity communication.

The APP information may be acquired by an MEC unit to be explained below.

The hour-of-day information includes current time information.

This hour-of-day information may include information associated with the current time in addition to the current time.

The hour-of-day information is information indicating, for example, that if the time is between 12 pm and 1 pm, the radio terminal usage frequency will generally be high because many users are on lunch breaks from 12 pm to 1 pm.

Additionally, the hour-of-day information is information indicating, for example, that if the time is between 3 am and 4 am, the radio terminal usage frequency will generally be low because many users are generally sleeping from 3 am to 4 am.

As mentioned above, the user information includes at least one of user attribute information, calendar information, APP information, and hour-of-day information, and is preferably information combining a plurality of these types of information.

If the user information is information combining two or more of user attribute information, calendar information, APP information, and hour-of-day information, then the accuracy of the predicted traffic demand volume can be improved.

The session setting determination unit **205** determines whether to establish or to terminate a session between a radio terminal **301** and a second base station **402** based on the results of the second assessment in the high-speed communication requirement assessment unit **204**.

If the high-speed communication requirement assessment unit **204** has assessed that high-speed communication is not required (second assessment), then the session setting determination unit **205** may determine that the session between the radio terminal **301** and the second base station **402** is to be terminated.

When the second assessment has resulted in a determination that the session between the radio terminal **301** and the second base station **402** is to be terminated, the session between the radio terminal **301** and the second base station **402** may be terminated and the radio terminal **301** may be connected to the first base station **401**.

If the high-speed communication requirement assessment unit **204** has assessed that high-speed communication is required (second assessment), then the session setting determination unit **205** may determine that the session between the radio terminal **301** and the second base station **402** is to be established.

When the second assessment has resulted in a determination that the session between the radio terminal **301** and the second base station **402** is to be established, the radio terminal **301** may be connected to the second base station **402**.

The connection destination control unit **206** controls the connections between the radio terminals **301** and the second base stations **402** based on the results of the determinations in the session setting determination unit **205**.

FIG. **3** is a diagram illustrating an example of the configurations of the base stations **402**.

A base station in a 5G system, known as a gNB, includes RU (Radio Unit) functions, DU (Distributed Unit) functions, and a CU (Central Unit) function.

The DUs **422-1**, **422-2**, **422-3** (hereinafter referred to collectively as DUs **422**) perform processes in layers including at least the physical (PHY) layer.

The CU **423** performs processes in layers including a radio resource control (RRC: Radio Resource Control) layer, which are higher than the layers in which the DUs **422** perform processes.

Multiple DUs **422** may be connected to one CU **423**.

Additionally, one or a plurality of RUs **421-1**, **421-2**, **421-3** (hereinafter referred to collectively as RUs **421**) may be connected to one DU **422**.

The RUs **421**, for example, form one or more beams by beam forming, and use one of the beams to establish a connection with a radio terminal.

That is, the base station **402** is configured to include one CU **423**, one or a plurality of DUs **422** connected to the CU **423**, and one or a plurality of RUs **421** connected to the DUs **422**.

Furthermore, multiple beams are formed by each of the RUs **421** forming one or more beams, and one of the multiple beams that are formed is used to connect the base station **402** with a radio terminal.

The RU functions, the CU function, and the DU functions are known as a radio access network (RAN: Radio Access Network).

The CU **423** in the RAN is connected to a core network (CN: Core Network) **500**.

Additionally, the DU functions and the CU function in the base station **402** may be configured by virtualization.

By virtualizing the DU functions to form a virtualized DU (vDU) and virtualizing the CU function to form a virtualized CU (vCU) in the base station **402**, dedicated servers can be replaced with a general-purpose server, and the base station **402** can be inexpensively and flexibly constructed.

The DU functions and the CU function must be installed on the same dedicated server.

Thus, in the case in which the DU functions and the CU function are not virtualized, the dedicated server needs to be replaced even if a problem has occurred in just one of the DU functions and the CU function.

However, if the DU functions and the CU function are virtualized, then the virtualized DU (vDU) and the virtualized CU (vCU) can be distributively located on different general-purpose servers, allowing the system to be reconstructed after separating out only the server in which the problem has occurred.

For this reason, the impact on service at the time of a malfunction can be suppressed.

Additionally, a general-purpose server on which a virtualized DU (vDU) or a virtualized CU (vCU) is located can be easily changed, thus allowing the load on the general-purpose servers to be flexibly controlled.

Several modes are contemplated for the location of the virtualized DU (vDU) and the virtualized CU (vCU), and the configuration is not limited to that illustrated in FIG. **3**.

FIG. **4** is a diagram illustrating an example of the configuration of a radio communication system in the present embodiment.

As illustrated in FIG. **4**, a group of data centers included in the radio communication system in the present embodiment is classified into a CDC (Central Data Center) **600**, which is a central data center, an RDC (Regional Data Center) **610**, which is a regional data center, and an edge data center **620**.

There are multiple CDCs **600**, for example, distributively located in the area (for example, Japan) covered by the radio communication system.

As CDCs **600**, there are 5GCs (5th-Generation Core networks), which are core networks in 5G systems, EPCs (Evolved Packet Cores), which are core networks in 4G systems, and OSSs (Operation Support Systems)/BSSs (Business Support Systems), etc.

There are, for example, several tens of RDCs **610** distributively located in the area covered by the radio communication system.

For example, in the case in which the area covered by the radio communication system is the entire country of Japan, one or two RDCs **610** may be located in each prefecture.

Several thousand edge data centers **620** are distributively located in the area covered by the radio communication system.

FIG. **4** illustrates an example in which the DUs and the CU of the base station **402** are located in an edge data center **620**.

However, if virtualization technology is applied to the RAN, then the virtualized CU (vCU) may be located in an RDC **610**.

The configuration in the present embodiment may be flexibly located in an edge data center **620** or an RDC **610** in accordance with the location of the virtualized DU (vDU) and the virtualized CU (vCU) in the base station **402**.

Additionally, in the case in which MEC (Multi-access Edge Computing) is to be located in an edge data center **620** or an RDC **610**, part of the configuration in the present embodiment may be provided in the MEC.

FIG. **5** is a diagram illustrating a configuration for realizing the management device **200** according to the present embodiment.

The management device **200** includes a processor **211**, a storage unit **212**, and a communication unit **213**.

There may be one or a plurality of each of the processor **211**, the storage unit **212**, and the communication **213** in the management device **200**.

Additionally, the processor **211**, the storage unit **212**, and the communication unit **213** may be located together in each of the places where the configuration of the management device **200** is located.

The processor **211** is a device for performing processes in accordance with a program installed in the management device **200**, examples of which include an MPU (Micro Processing Unit) and a CPU (Central Processing Unit).

The storage unit **212** is a device in which a program or the like to be executed by the processor **211** is stored, examples of which include a ROM (Read Only Memory), a RAM (Random Access Memory), a solid-state drive (SSD: Solid State Drive), and a hard disk drive (HDD: Hard Disk Drive).

The communication unit **213** is a communication interface for exchanging data, examples of which include an NIC (Network Interface Card) and a wireless LAN module.

SDN (Software-Defined Networking) may also be installed on the communication unit **213**.

FIG. **6** is a diagram illustrating an assessment logic sequence in the radio communication system according to the present embodiment.

FIG. **6** illustrates an assessment logic sequence for the case in which the predicted traffic demand volume in the first terminal **301***a* is high and the predicted traffic demand volume in the second terminal **301***b* is low.

First, the first terminal **301***a* and the second terminal **301***b* each establish a session with the BBU in the first base station **401** and establish a session with the CU **423** in the second base station **402**.

The CU **423** in the second base station **402** exchanges packets with a UPF (User Plane Function) unit **710** in the CN **500**.

Additionally, an MEC (Multi-Access Edge Computing) unit **720** in the CN **500** includes a traffic monitoring unit **721** and a cell optimization unit **722**.

The traffic monitoring unit **721** acquires the usage conditions and the traffic volume in the first terminal **301***a* and the second terminal **301***b*, and assesses whether or not high-speed communication is required based on the usage conditions and the traffic volume that have been acquired.

In this case, the traffic volume includes at least the predicted traffic demand volume (i.e., the future traffic

volume) from the radio terminal **301**, and may further include the used volume of traffic currently being used by the radio terminal **301**.

The cell optimization unit **722** in the MEC unit **720** assigns each of the first terminal **301***a* and the second terminal **301***b* to the low frequency side or to the high frequency side based on the results of the assessment regarding whether or not high-speed communication is required.

In this case, the predicted traffic demand volume in the first terminal **301***a* is high and the predicted traffic demand volume in the second terminal **301***b* is low. Thus, the first terminal **301***a* is assigned to the low frequency side and the second terminal **301***b* is assigned to the high frequency side.

As a result thereof, the session between the first terminal **301***a* and the CU **423** in the second base station **402** is terminated, and the necessary throughput can be provided to the second terminal **301***b*, which requires high-capacity, high-speed communication.

Alternatively, if the predicted traffic demand volume in the first terminal **301***a* is low and the predicted traffic demand volume in the second terminal **301***b* is high, then the session between the second terminal **301***b* and the CU **423** in the second base station **402** is terminated, and the necessary throughput can be provided to the first terminal **301***a*, which requires high-capacity, high-speed communication.

In the description above, the case in which the necessary throughput is provided to radio terminals requiring high-capacity, high-speed communication by establishing and terminating sessions between the radio terminals and the CU in the second base station was described. However, sessions may be established and terminated between the radio terminals and DUs in the second base station.

For example, a DU (or a virtualized DU (vDU)) may be introduced (scaled out) when an event requiring high-capacity, high-speed communication starts in a radio terminal, and a DU (or a virtualized DU (vDU)) may be deleted (scaled in) when the event ends.

As described above, according to the present embodiment, radio terminals can be connected to appropriate connection destinations in a heterogeneous network environment.

The present invention is not limited to being a management device **200**, and the present invention also includes a management method for managing, by using one or a plurality of processors, a connection destination of a radio terminal **301** in a heterogeneous network environment formed by a macrocell using a low frequency band and one or a plurality of small cells using a frequency band higher than the low frequency band.

FIG. **7** is a flow chart illustrating the communication system management method according to an embodiment of the present invention.

The management method included in the present invention comprises: acquiring located-area information of a radio terminal **301** (S**1**: acquire located-area information); using the located-area information to identify a first base station **401** forming a macrocell **101** (S**2**: identify first base station); using the located-area information to perform a first assessment for assessing whether or not the radio terminal **301** is within one of the small cells **102**, and when the radio terminal **301** has been assessed to be within one of the small cells **102**, identifying a second base station **402** forming the small cell **102** (S**3**: identify second base station); performing a second assessment for assessing whether or not the radio terminal **301** requires high-speed communication based on at least a predicted traffic demand volume (i.e. a future traffic volume) from the radio terminal **301** (S**4**: assess whether high-speed communication is required); determining that a session between the radio terminal and the second base station is to be established or terminated based on results of the second assessment (S**5**: determine session setting); and controlling a connection between the radio terminal and the second base station based on results of the determination (S**6**: control connection destination).

The used volume of traffic being used by the radio terminal **301** (i.e., the current traffic volume) may be further used for the assessment regarding whether or not the radio terminal **301** requires high-speed communication performed by the high-speed communication requirement assessment unit **204**.

The present invention is not limited to the management device and the management method described above, and the present invention also includes a management program.

Specifically, a management program for making one or a plurality of processors execute the respective units in the management device **200** is also included in the present invention.

Additionally, the present invention is not limited to the embodiments described above, and includes various modified examples in which constituent elements have been added, removed or replaced with respect to the configurations indicated above.

REFERENCE SIGNS LIST

101 Macrocell
102, **102***a*, **102***b* Small cell
200 Management device
201 Located-area information acquisition unit
202 First base station identification unit
203 Second base station identification unit
204 High-speed communication requirement assessment unit
205 Session setting determination unit
206 Connection destination control unit
211 Processor
212 Storage unit
213 Communication unit
301 Radio terminal
301*a* First terminal
301*b* Second terminal
401 First base station
402, **402***a*, **402***b* Second terminal
421, **421-1**, **421-2**, **421-3** RU
422, **422-1**, **422-2**, **422-3** DU
423 CU
500 CN
600 CDC
610 RDC
620 Edge data center
710 UPF unit
720 MEC unit
721 Traffic monitoring unit
722 Cell optimization unit

The invention claimed is:

1. A management device for managing a connection destination of a radio terminal in a heterogeneous network environment formed by a macrocell using a low frequency band and one or a plurality of small cells using a frequency band higher than the low frequency band, wherein the management device comprises one or more processors configured to:

acquire located-area information of the radio terminal;

use the located-area information to identify a first base station forming the macrocell in which the radio terminal is located;

use the located-area information to perform a first assessment for assessing whether or not the radio terminal is within one of the small cells, and when the radio terminal has been assessed to be within a small cell among the one or the plurality of small cells, identify a second base station forming the small cell in which the radio terminal is located;

perform a second assessment for assessing whether or not the radio terminal requires high-speed communication based on at least a predicted future traffic demand volume from the radio terminal, and a current traffic demand from the radio terminal;

determine that a session between the radio terminal and the second base station is to be established or terminated based on results of the second assessment, comprising:

based on assessing that high-speed communication is not required, determining that a session between the radio terminal and the second base station is to be terminated, and

based on assessing that high-speed communication is required, determining that the session between the radio terminal and the second base station is to be established; and

control a connection between the radio terminal and the second base station based on results of the determination, comprising:

when the second assessment has resulted in a determination that a session between the radio terminal and the second base station is to be terminated, terminating the session between the radio terminal and the second base station and connecting the radio terminal with the first base station forming the macro cell, and

when the second assessment has resulted in a determination that a session is to be established between the radio terminal and the second base station, connecting the radio terminal with the second base station forming the small cell.

2. The management device according to claim **1**, wherein

the predicted future traffic demand volume is determined based on user attribute information, and

the user attribute information includes at least one of user information, calendar information, application (APP) information, and hour-of-day information.

3. The management device according to claim **1**, wherein, when the first assessment has resulted in an assessment that the radio terminal is not within the small cells, the radio terminal is connected with the first base station.

4. The management device according to claim **1**, wherein

the predicted traffic demand volume is determined based on user information about a user of the radio terminal and includes an age of the user, a sex of the user, and attributes of the terminal used by the user.

5. The management device according to claim **1**, wherein

the predicted traffic demand volume is determined based on user attribute information, and

the user attribute information includes at least one of user information, calendar information, and hour-of-day information.

6. The management device according to claim **1**, wherein

the predicted traffic demand volume is determined based on user attribute information, and

the user attribute information includes calendar information, and information about an event associated with the calendar information.

7. A management method for managing, by using one or a plurality of processors, a connection destination of a radio terminal in a heterogeneous network environment formed by a macrocell using a low frequency band and one or a plurality of small cells using a frequency band higher than the low frequency band, wherein the management method comprises:

acquiring located-area information of the radio terminal;

using the located-area information to identify a first base station forming the macrocell in which the radio terminal is located;

using the located-area information to perform a first assessment for assessing whether or not the radio terminal is within one of the small cells, and when the radio terminal has been assessed to be within a small cell among the one or the plurality of small cells, identifying a second base station forming the small cell in which the radio terminal is located;

performing a second assessment for assessing whether or not the radio terminal requires high-speed communication based on at least a predicted future traffic demand volume from the radio terminal, and a current traffic demand from the radio terminal;

determining that a session between the radio terminal and the second base station is to be established or terminated based on results of the second assessment, comprising:

based on assessing that high-speed communication is not required, determining that a session between the radio terminal and the second base station is to be terminated, and

based on assessing that high-speed communication is required, determining that the session between the radio terminal and the second base station is to be established; and

controlling a connection between the radio terminal and the second base station based on results of the determination, comprising:

when the second assessment has resulted in a determination that a session between the radio terminal and the second base station is to be terminated, terminating the session between the radio terminal and the second base station and connecting the radio terminal with the first base station forming the macro cell, and

when the second assessment has resulted in a determination that a session is to be established between the radio terminal and the second base station, connecting the radio terminal with the second base station forming the small cell.

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