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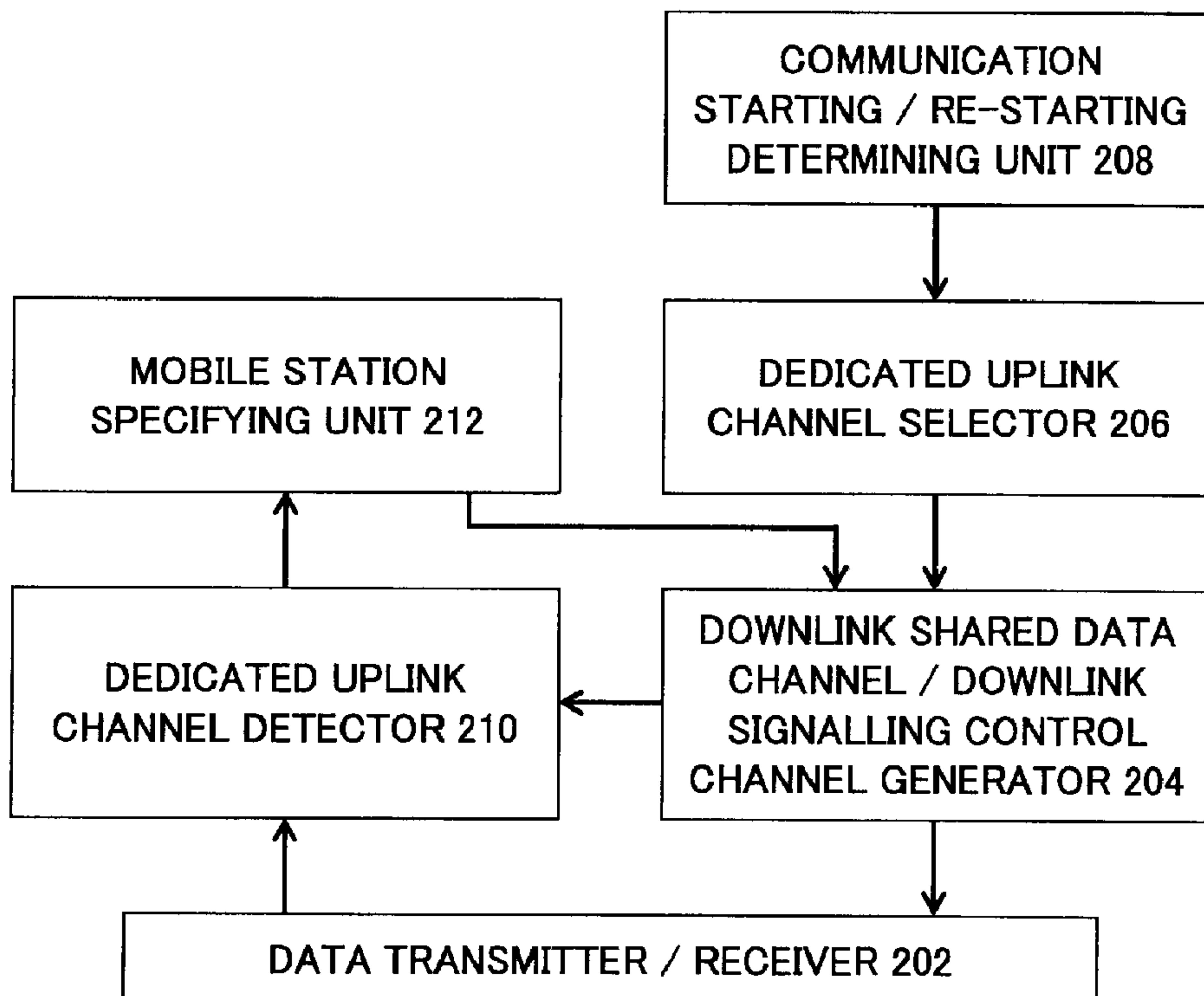
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MOBILE  
(54) Title: MOBILE STATION, RADIO ACCESS NETWORK APPARATUS, AND MOBILE COMMUNICATIONS SYSTEM

## RADIO ACCESS NETWORK APPARATUS 200



### (57) Abrégé/Abstract:

A radio access network apparatus is disclosed. The apparatus communicates with a mobile station using a dedicated uplink channel, a downlink shared data channel, and a downlink signaling control channel. The apparatus includes a dedicated uplink

**(57) Abrégé(suite)/Abstract(continued):**

channel allocating unit which allocates, to a mobile station starting or restarting communications, on a downlink shared data channel, a dedicated uplink channel to be used by the mobile station; a dedicated channel reception detecting unit which detects, on the allocated dedicated uplink channel, a reception of an uplink transmission from the mobile station; and a downlink transmitting unit which, when the dedicated channel reception of the mobile station is detected, transmits a response to the mobile station using the downlink shared data channel and the downlink signaling control channel.

**ABSTRACT OF THE DISCLOSURE**

A radio access network apparatus is disclosed. The apparatus communicates with a mobile station using a dedicated uplink channel, a downlink shared data channel, 5 and a downlink signaling control channel. The apparatus includes a dedicated uplink channel allocating unit which allocates, to a mobile station starting or restarting communications, on a downlink shared data channel, a dedicated uplink channel to be used by the mobile station; 10 a dedicated channel reception detecting unit which detects, on the allocated dedicated uplink channel, a reception of an uplink transmission from the mobile station; and a downlink transmitting unit which, when the dedicated channel reception of the mobile station is detected, 15 transmits a response to the mobile station using the downlink shared data channel and the downlink signaling control channel.

**TITLE OF THE INVENTION**

MOBILE STATION, RADIO ACCESS NETWORK APPARATUS,  
AND MOBILE COMMUNICATIONS SYSTEM

5   **BACKGROUND OF THE INVENTION**

1. Field of the Invention

The present invention relates to mobile stations, radio access network apparatuses, and mobile communications systems.

10   2. Description of the Related Art

As illustrated in FIG. 1, a mobile station UE transmits a Random access preamble to a radio access network apparatus eNB to request for starting a communication when the mobile station starts or restarts 15 a communication with the radio access network apparatus in Long Term Evolution (LTE), which is being considered for 3G systems. Before multiple mobile stations can simultaneously transmit the Random access preambles, the radio access network apparatus reports, to the respective 20 mobile stations, multiple Signatures available for the respective mobile stations. The mobile station randomly selects a Signature from the multiple Signatures reported in advance, and transmits the Random access preamble using the selected Signature. The radio access network apparatus 25 which has detected one or more Signatures returns, on a shared data channel, one or more Random access responses to the detected one or more Signatures.

The radio access network apparatus which has received the Random access preamble cannot identify 30 whether the mobile station is starting a new communication, making a new connection to a cell for handover to, or restarting a communication. Therefore, the following three types of communication setup information are newly assigned on a uniform basis to the respective Signatures 35 received.

Uplink allocation resource (UL grant)

Uplink timing information (UL timing advance)

Cell-specific user-specific identifier (C-RNTI:  
Cell specific radio network temporal identifier)

The mobile station which has transmitted the  
Random access preamble receives the Random access response  
5 from the radio access network apparatus, and receives the  
UL grant, UL timing advance, and C-RNTI that are allocated  
to the Signature transmitted by the mobile station.

**SUMMARY OF THE INVENTION**

10 [Problem(s) to be solved by the Invention]

In this way, when a communication is started using  
the Random access preamble, multiple mobile stations may  
select and use the same Signature, in which case, collision  
occurs among the Signatures and the multiple mobile  
15 stations end up using the same resource for transmitting.  
Thus, there is a problem that, in a radio access network  
apparatus, Scheduled Transmissions ((3) in FIG. 1) are  
simultaneously transmitted from the multiple mobile  
stations using the same uplink radio resource, so that a  
20 correct uplink signal cannot be received.

Moreover, in a Random access response in the LTE,  
the UL grant, Timing advance, and C-RNTI sent to the  
respective Signatures need to be returned in a uniform  
manner regardless of the state of the mobile station. Thus,  
25 even unnecessary information may be allocated for the  
mobile station which already has the C-RNTI of the cell  
for handover to, or a mobile station which already has the  
C-RNTI for restarting data transmission, so that downlink  
radio resources may be wasted.

30

[Means for solving the Problem]

In order to solve the above problem, a radio access  
network apparatus is provided, which communicates with a  
mobile station using a dedicated uplink channel, a downlink  
35 shared data channel, and a downlink signaling control  
channel. The apparatus includes:

a dedicated uplink channel allocating unit which

allocates, to a mobile station starting or restarting communications, on a downlink shared data channel, a dedicated uplink channel to be used by the mobile station;

5 a dedicated uplink channel reception detecting unit which detects, on the allocated dedicated uplink channel, a reception of an uplink transmission from the mobile station; and

10 a downlink transmitting unit which, when the dedicated uplink channel reception of the mobile station is detected, transmits a response, to the mobile station, using a downlink shared data channel and a downlink signaling control channel.

The radio access network apparatus makes it possible to efficiently utilize downlink radio resources.

15 Moreover, the mobile station is provided, which communicates with a radio access network apparatus using a dedicated uplink channel, a downlink shared data channel, and a downlink signaling control channel. The mobile station includes,

20 a dedicated uplink channel allocating information receiving unit which receives, on a downlink shared data channel, allocation information on a dedicated uplink channel to be used;

25 a dedicated uplink channel setting unit which sets the allocated dedicated uplink channel;

an uplink transmit unit for transmitting uplink on the set dedicated uplink channel; and

30 a data receive unit which receives downlink with a user-specific identifier after the end of the uplink transmission.

The mobile station makes it possible to efficiently utilize downlink radio resources.

Furthermore, a mobile communications system is provided, which communicates with a mobile station and a 35 radio access network apparatus using a dedicated uplink channel, a downlink shared data channel, and a downlink signaling control channel. In the mobile communications

system, the radio access network apparatus includes a dedicated uplink channel allocating unit which allocates, to a mobile station starting or restarting communications, on the downlink shared data channel, a 5 dedicated uplink channel to be used by the mobile station; a dedicated uplink channel reception detecting unit which detects, on the allocated dedicated uplink channel, a reception of an uplink transmission from the mobile station; and

10 a downlink transmitting unit which, when the dedicated uplink channel reception of the mobile station is detected, transmits a response, to the mobile station, using a downlink shared data channel and a downlink signaling control channel,

15 and wherein the mobile station includes a dedicated uplink channel allocating information receiving unit which receives on a downlink shared data channel allocation information to be used on a dedicated uplink channel;

20 a dedicated uplink channel setting unit which sets the allocated dedicated uplink channel; and an uplink transmit unit which transmits uplink on the set dedicated uplink channel; and a data receive unit which receives downlink with

25 a user-specific identifier after the end of the uplink transmission.

The mobile communications system makes it possible to efficiently utilize downlink radio resources.  
[Advantage of the Invention]

30 According to the embodiment of the present invention, eliminating unnecessary transmissions of UL grant, UL timing advance, or C-RNTI (Cell specific radio network temporal identifier) makes it possible to implement a mobile station, a radio access network apparatus, and a mobile communications system that allow 35 an efficient use of downlink radio resources.

**BRIEF DESCRIPTION OF THE DRAWINGS**

FIG. 1 illustrates a sequence chart showing a sequence of starting and restarting a communication of a  
5 mobile station;

FIG. 2 is an overview diagram of a mobile communications system which includes a radio access network apparatus and a mobile station;

FIG. 3 is a functional block diagram of a mobile  
10 station according to an embodiment of the present invention; and

FIG. 4 is a functional block diagram of a radio access network apparatus according to an embodiment of the present invention.

15

**DESCRIPTION OF THE PREFERRED EMBODIMENTS**

## [Description of Notations]

100 mobile station

102 data transmitter/receiver

20 104 dedicated uplink channel allocation information receiver

106 dedicated uplink channel setting unit

108 transmit signal generator

200 radio access network apparatus

25 202 data transmitter/receiver

204 downlink shared data channel/downlink signaling control channel generator

206 dedicated uplink channel selector

25 30 208 communications start and restart determining unit

210 dedicated uplink channel detector

212 mobile station specifying unit

## [Best Mode of Carrying Out the Invention]

35 In the following, best modes for carrying out the invention are described based on the following embodiments with reference to the drawings. Throughout the drawings

for explaining the embodiments, the same letters are used for those elements having the same functions, so that repetitive explanations are omitted.

In LTE, a radio access network apparatus, when 5 transmitting a handover request signal to a mobile station, allocates to the mobile station, together with the handover request signal, a user-specific Signature used at the time the mobile station connects to a cell for handover to in order to avoid a Signature collision. The mobile station 10 which has received the handover request signal uses the allocated user-specific Signature to transmit a Random access preamble to the cell for handover to. Now an embodiment of the present invention is considered with respect to a sequence in which the radio access network 15 apparatus which has detected the Random access preamble returns a Random Access Response.

A mobile communications system according to an embodiment of the present invention is described with reference to FIG. 2.

20 A mobile communications system 10 includes a mobile station 100 and a radio access network apparatus 200.

The mobile station 100 and the radio access network apparatus 200 communicate using a dedicated uplink 25 channel, a downlink shared data channel, and a downlink signaling control channel.

Now a mobile station 100 according to an embodiment of the present invention is described with reference to FIG. 3.

30 The mobile station 100 includes a data transmitter/receiver 102 with an antenna; a dedicated uplink channel allocation information receiver 104, which is connected to the data transmitter/receiver 102; a dedicated uplink channel setting unit 106, which is 35 connected to the dedicated uplink channel allocation information receiver 104; and a transmit signal generator 108, which is connected to the dedicated uplink channel

setting unit 106 and the data transmitter/receiver 102.

The data transmitter/receiver 102 transmits and receives data. For example, the mobile station 100 may determine whether the downlink signaling control channel 5 is destined for the mobile station itself based on the C-RNTI received on the downlink signaling control channel. Moreover, information of a radio resource of a downlink data channel destined for the mobile station may be received from the downlink shared radio resource 10 information transmitted on the downlink signaling control channel.

The dedicated uplink channel allocation information receiver 104 receives a dedicated uplink channel allocation information signal indicating 15 dedicated uplink channel allocation information for the mobile station. For example, the dedicated uplink channel allocation information signal is transmitted on the downlink shared data channel as a part of a signal requesting for restarting downlink transmission or a 20 handover request signal. Moreover, the dedicated uplink channel allocation information is communications setting information for setting any one of a mobile station-specific Signature used on the Access preamble, an identifier or a code number that is used for uplink, 25 and an uplink radio resource.

When a shortage occurs with respect to the dedicated uplink channel provided in advance at the radio access network apparatus, that the Random access preamble signal is to be used may be reported to the mobile station 30 in the downlink shared data channel.

The dedicated uplink channel setting unit 106 sets a dedicated uplink channel according to dedicated uplink allocation information received at the uplink shared channel allocation information receiver 104.

35 The transmit signal generator 108 generates a signal to be transmitted on the dedicated uplink channel which is set at the dedicated uplink channel setting unit

106, and transmits the generated signal to the data transmitter and receiver 102. The data transmitter and receiver 102 of the mobile station 100 wirelessly transmit the generated signal to the radio access network apparatus.

5 In this way, the mobile station transmits, to the radio access network apparatus, an access preamble, for example.

The mobile station 100 which has transmitted the generated signal from the data transmitter/receiver 102 receives a downlink signaling control channel and a

10 downlink shared data channel based on the C-RNTI.

Now a radio access network apparatus 200 according to an embodiment of the present invention is described with reference to FIG. 4. For convenience of explanation, a radio access network apparatus which wirelessly communicates with a mobile station is explained. However, more generally, the radio access network apparatus may communicate not only with a mobile station, but also user equipment (UE) including a fixed station.

The radio access network apparatus 200 includes

20 a data transmitter/receiver 202; a downlink shared data channel/downlink signaling control channel generator 204, which is connected to the data transmitter/receiver 202; a dedicated uplink channel selector 206, which is connected to the downlink shared data channel/downlink signaling

25 control channel generator 204; and a communication start/restart determining unit 208, which is connected to the dedicated uplink channel selector 206. Moreover, the radio access network apparatus 200 includes a dedicated uplink channel detector 210, which is connected to the

30 downlink shared data channel/downlink signaling control channel generator 204; and a mobile station specifying unit 212, which is connected to the dedicated uplink channel detector 210.

The communication start/restart determining unit

35 208 determines whether a mobile station to be managed by the radio access network apparatus starts or restarts communications. The communications start means that the

mobile station being instructed to conduct a handover starts communications with the radio access network apparatus for handover to, for example. Moreover, the communications restart means a communications restart 5 when downlink data to the mobile station performing intermittent reception is produced, for example.

For a mobile station which needs communications start or restart, the dedicated uplink channel selector 206 selects dedicated uplink channel allocation 10 information to be used by the mobile station. The dedicated uplink channel allocation information is any one of an uplink radio resource, an uplink identifier or code number, and Signature of an Access preamble, for example.

If a shortage occurs with respect to the dedicated 15 uplink channel provided in advance at the radio access network apparatus, that the Random access preamble signal is to be used for uplink may be reported to the mobile station in the downlink shared data channel.

The downlink shared data channel/downlink 20 signaling control channel generator 204 generates a dedicated uplink channel allocation information signal indicating the dedicated uplink channel allocation selected at the dedicated uplink channel selector 206. For example, the dedicated uplink channel allocation 25 information signal is transmitted on the downlink shared data channel as a part of a signal requesting for restarting downlink data transmission or a handover request signal.

The dedicated uplink channel detector 210 receives the dedicated uplink channel allocation 30 transmitted as a part of the signal generated at the downlink shared data channel/downlink signaling control channel generator 204, and detects the presence/absence of uplink transmission in the dedicated uplink channel. The dedicated uplink channel is detected through a value 35 of correlation with a Signature of access preamble allocated as dedicated uplink channel allocation information, for example.

The mobile station specifying unit 212 specifies the mobile station with the dedicated uplink channel detected at the dedicated uplink channel detector 210. For example, when a mobile station-specific Signature used on 5 an access preamble is allocated as an uplink shared channel, the mobile station is specified using the Signature. Moreover, when a mobile station specific code is allocated as dedicated uplink channel allocation information, the mobile station is specified based on the outcome of 10 identifying the mobile station-specific code.

The mobile station specifying unit 212 transmits the mobile station-specific result to the downlink shared data channel/downlink signaling control channel generator 204. The downlink shared data channel/downlink signaling 15 control channel generator 204 determines whether transmission, to the specified mobile station, is required of two types of communications setting information (UL grant, UL timing advance), or only the UL timing advance, and transmits required information in the downlink shared 20 data channel/downlink signaling control channel using a mobile station-specific identifier (C-RNTI). For example, the radio access network apparatus 200 determines that the two types of communications settings are required at the time of handover, and determines that the UL timing advance 25 only is required at the time of restarting downlink data transmission.

According to the embodiment of the present invention, eliminating unnecessary transmissions of UL grant, UL timing advance, or C-RNTI (Cell specific radio 30 network temporal identifier) makes it possible to implement a mobile station, a radio access network apparatus, and a mobile communications system that allow an efficient use of downlink radio resources.

As described above, in order to reduce the 35 probability of multiple mobile stations selecting the same Signature and thereby, causing collision, a dedicated signature provided in advance is allocated, for a certain

period, to a mobile station already having C-RNTI. Typical examples of such a mobile station are: (1) a mobile station to which is allocated, at the time of handover, a dedicated signature and C-RNTI of a cell for handover to as a part 5 of a handover command from a cell for handover from; and (2) a mobile station already having C-RNTI and to which mobile station is allocated, at the time of restarting downlink data transmission, a dedicated preamble used at the time of establishing uplink synchronization.

10 However, with such a method of decreasing the collision probability, if all of the dedicated channels or dedicated preambles are in use, it is necessary to wait for a dedicated preamble allocation until the dedicated preamble becomes available, causing a delay in the transmit 15 timing of the handover command, and a delay in the restart of the downlink data transmission.

Then, if all the Dedicated preambles are being used (or if there is a shortage), a base station eNB instructs the mobile station UE to transmit a Random access 20 preamble using one Signature randomly selected. More specifically, (1) as a part of a signal transmitted to the mobile station by the base station, some indicator (this may be called a Random access preamble transmission indicator, for example) indicating that the Random access 25 preamble is to be transmitted or (2) a special Dedicated signature representing that a random access preamble is to be used in such a condition may be specified. For example, the Random access preamble transmit identifier (in (1)) may be expressed as a flag bit such as ON or OFF, or the 30 Dedicated signature number may be set to zero (in other words, "0" is specified so that it corresponds to "Random access preamble".)

In this way, even if all dedicated preambles are being used, a mobile station can rapidly establish uplink 35 synchronization and start or restart communications without delaying handover command transmission and downlink data transmission.

On the other hand, the mobile station which has received (1) a Random access preamble transmission indicator, or (2) a Dedicated signature number indicating that a Random access preamble is to be transmitted randomly 5 selects one Signature out of Signatures transmittable as the Random access preamble according to an instruction from the base station.

As described above, while the present invention is described with reference to specific embodiments, the 10 respective embodiments are merely exemplary, so that a skilled person will understand variations, modifications, alternatives, and replacements. While specific numerical value examples are used to facilitate understanding of the present invention, such numerical values are merely 15 examples, so that any appropriate value may be used unless specified otherwise. For convenience of explanation, while the apparatus according to the embodiments of the present invention is explained using functional block diagrams, such an apparatus as described above may be 20 implemented in hardware, software, or a combination thereof. The present invention is not limited to the above embodiments, so that variations, modifications, alternatives, and replacements are included in the present 25 invention without departing from the spirit of the present invention.

The mobile station, radio access network apparatus, and mobile communications system according to the present embodiments may be applied to mobile communications systems.

As described above, while the present invention is described with reference to specific embodiments, the respective embodiments are merely exemplary, so that a skilled person will understand variations, modifications, alternatives, and replacements. While specific numerical 30 value examples are used to facilitate understanding of the present invention, such numerical values are merely 35 examples, so that any appropriate value may be used unless

specified otherwise. Breakdown of the respective embodiments is not essential to the present invention, so that two or more embodiments may be used as needed. For convenience of explanation, while the apparatus according 5 to the embodiments of the present invention is explained using functional block diagrams, such an apparatus as described above may be implemented in hardware, software, or a combination thereof. The present invention is not limited to the above embodiments, so that variations, 10 modifications, alternatives, and replacements are included in the present invention without departing from the spirit of the present invention.

The present international application claims priority based on Japanese Patent Application No. 15 2007-28627, filed on February 7, 2007.

The present international application also claims priority based on Japanese Patent Application No. 2007-167008, filed on June 25, 2007.

## WHAT IS CLAIMED IS:

1. A radio access network apparatus configured to communicate using one or more dedicated uplink channels, comprising:
  - 5 a dedicated uplink channel allocating unit configured to, at the time of handover of a mobile station:
    - when a dedicated uplink channel is available to be provided to the mobile station in advance, allocate the available dedicated uplink channel to the mobile station, and
    - 10 when a dedicated uplink channel is not available to be provided to the mobile station in advance, causes the mobile station to be instructed with a handover command containing instructing information indicating that a random access preamble signal is to be used in uplink.
- 15 2. The radio access network apparatus as claimed in claim 1, wherein the dedicated uplink channel allocating unit is configured to allocate an identifier to be used by the mobile station.
3. The radio access network apparatus as claimed in claim 1 or 2, wherein the dedicated uplink channel allocating unit is configured to allocate a signature to be used by the mobile station for access preamble transmission.
  - 20 4. The radio access network apparatus as claimed in claim 1 or 2, comprising:
    - 25 a dedicated channel reception detecting unit configured to detect a one of the one or more dedicated uplink channels of a received uplink transmission based on a correlation between a signature comprised in the received uplink transmission and a signature allocated to the one of the one or more dedicated uplink channels;
    - 30 a mobile station specifying unit configured to specify a specified mobile station corresponding to the received uplink transmission based on the detected one of the one or more dedicated uplink channels;
    - a downlink signal control channel generator configured to determine whether transmission of communications setting information to the specified mobile station is required in response to the received uplink transmission.
- 35 5. A mobile station configurable to communicate using one of one or more dedicated uplink channels, comprising:

1 a dedicated uplink channel allocating information receiving unit configured to receive with a handover command allocation information indicating an allocated dedicated uplink channel to be used;

5 a dedicated uplink channel setting unit configured to set the allocated dedicated uplink channel;

10 an uplink transmit unit for transmitting uplink on the set dedicated uplink channel; and

15 an instructing unit, which when a dedicated uplink channel is not available to be provided to the mobile station in advance, sends the mobile station a handover command instruction containing information indicating that a random access preamble signal is to be transmitted in uplink.

20 6. The mobile station as claimed in claim 5, wherein the dedicated uplink channel allocating information receiving unit is configured to receive an identifier to be used by the mobile station.

25 7. The mobile station as claimed in claim 5 or 6, wherein the dedicated uplink channel allocating information receiving unit is configured to receive a signature to be used by the mobile station.

30 8. A mobile communications system comprising a radio access network apparatus and a mobile station configurable to communicate with the radio access network apparatus using one of one or more dedicated uplink channels, wherein, at the time of handover of the mobile station:

35 the radio access network apparatus is configured to:

when a dedicated uplink channel is available to be provided to the mobile station in advance, allocate the available dedicated uplink channel to the mobile station, and

when a dedicated uplink channel is not available to be provided to the mobile station in advance, cause the mobile station to be instructed with a handover command containing instructing information indicating that a random access preamble signal is to be used in uplink; and

the mobile station is configured to:

when a received handover command includes handover command allocation information indicating an allocated dedicated uplink channel to be

used, set the allocated dedicated uplink channel and transmit uplink on the set dedicated uplink channel, and

when a received handover command includes an instruction that a random access preamble signal is to be used in uplink, transmit uplink using a random access preamble signal.

5 9. The mobile communications system as claimed in claim 8, wherein the radio access network apparatus is configured to allocate an identifier to be used by the mobile station.

10

10. The mobile communications system as claimed in claim 8 or 9, wherein the radio access network apparatus is configured to allocate a signature to be used by the mobile station for access preamble transmission.

15

11. The mobile communications system as claimed in claim 8 or 9, wherein the radio access network apparatus is configured to:

detect a one of the one or more dedicated uplink channels of a received uplink transmission based on a correlation between a signature comprised in the received uplink transmission and a signature allocated to the one of the one or more dedicated uplink channels;

specify a specified mobile station based on the detected one of the one or more dedicated uplink channels;

determine whether transmission of communications setting information to the specified mobile station is required in response to the received uplink transmission.

20

12. The mobile communications system as claimed in any one of claims 8 to 11, wherein the mobile station is configured to receive an identifier to be used by the mobile station.

25

30 13. The mobile communications system as claimed in any one of claims 8 to 11, wherein the mobile station is configured to receive a signature to be used by the mobile station.

35 14. A radio access network apparatus, comprising:

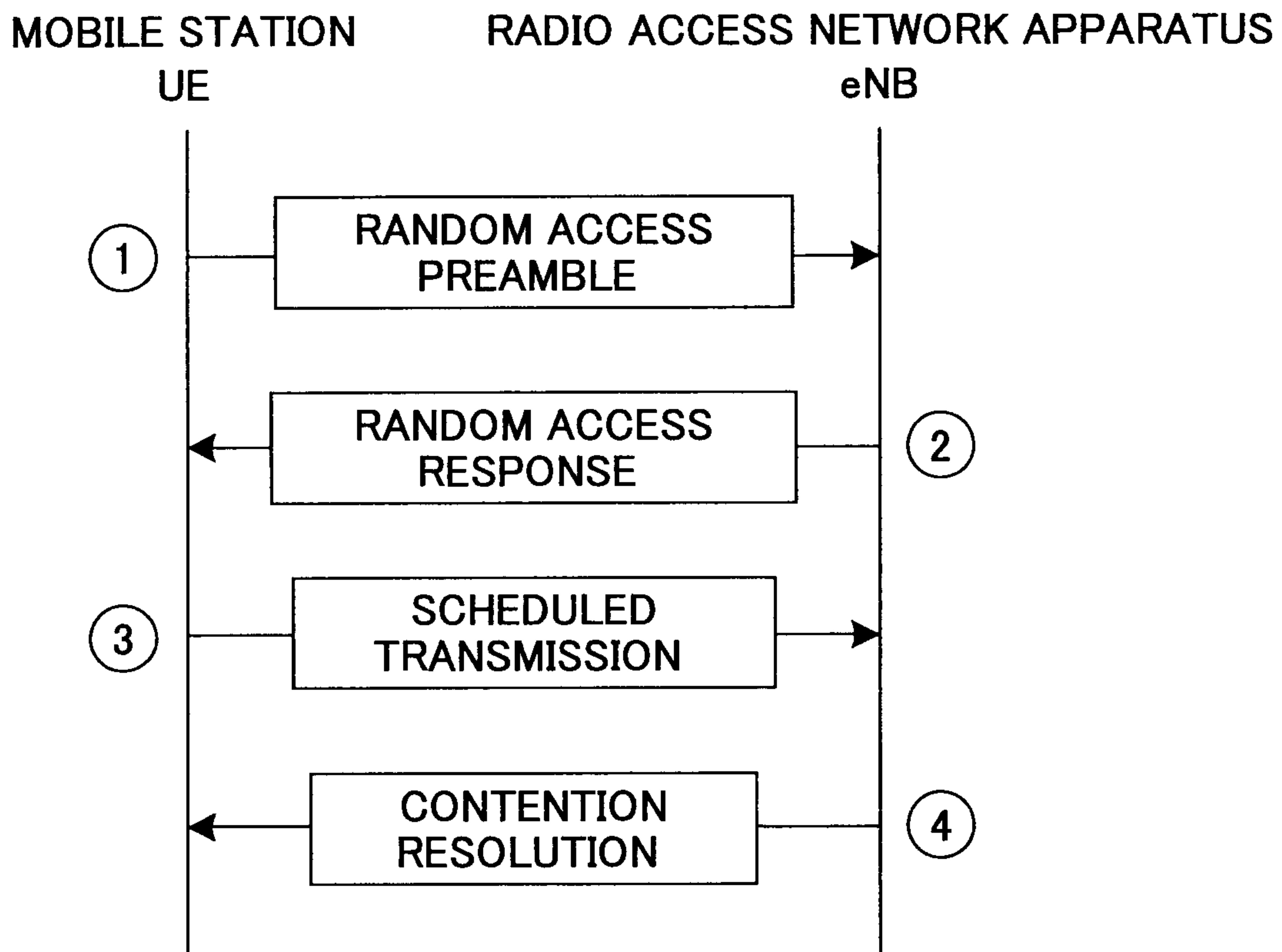
a dedicated uplink channel allocating unit configured to, at the time of handover of a mobile station:

when a dedicated uplink channel is available to be provided to the mobile station in advance, allocate the available dedicated uplink channel to the mobile station, and

5 when a dedicated uplink channel is not available to be provided to the mobile station in advance, causes the mobile station to be instructed with a handover command containing instructing information indicating that a random access preamble signal is to be used in uplink.

- 10 15. The radio access network apparatus as claimed in claim 14, wherein the dedicated uplink channel allocating unit is configured to allocate an identifier to be used by the mobile station.
- 15 16. The radio access network apparatus as claimed in claim 14 or 15, wherein the dedicated uplink channel allocating unit is configured to allocate a signature to be used by the mobile station for access preamble transmission.

**FIG. 1**



**FIG.2**

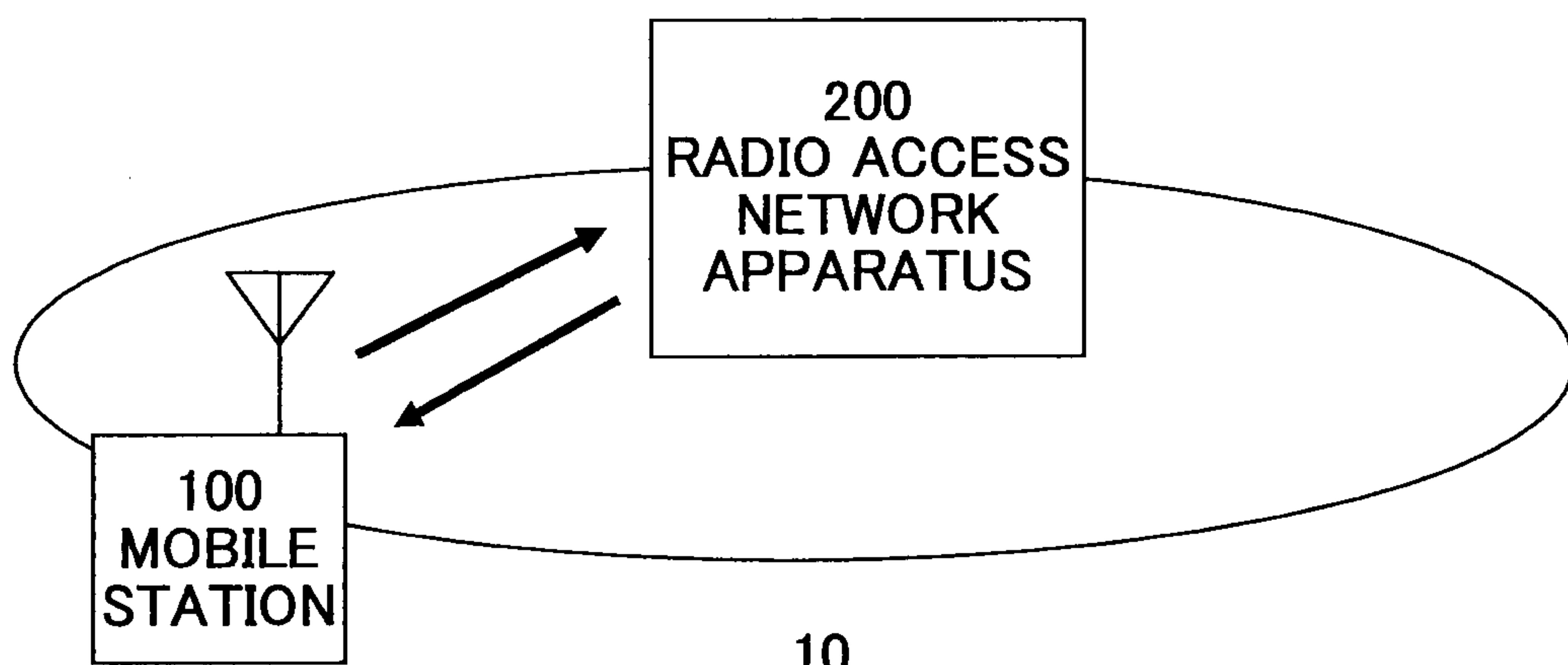


FIG.3

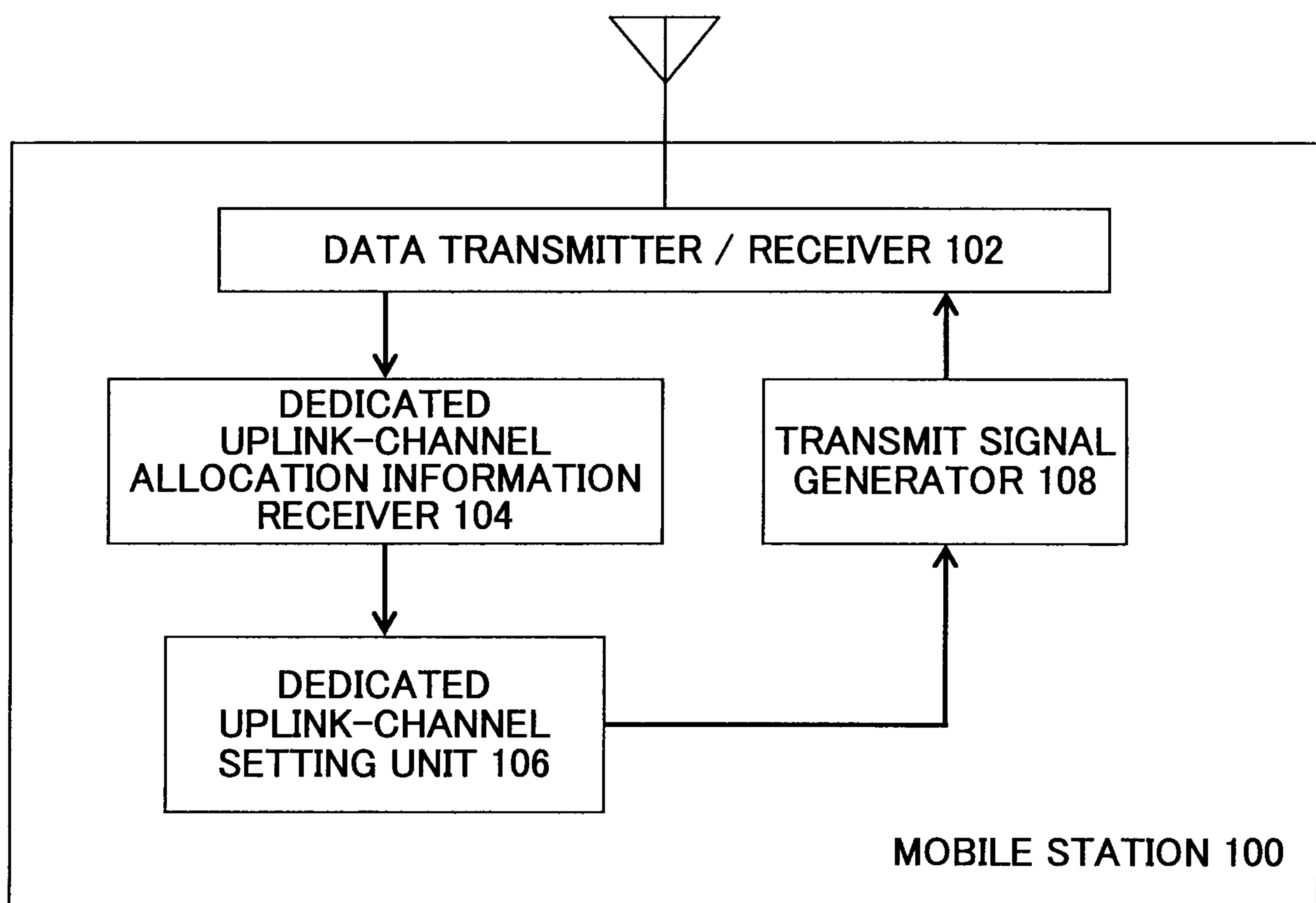
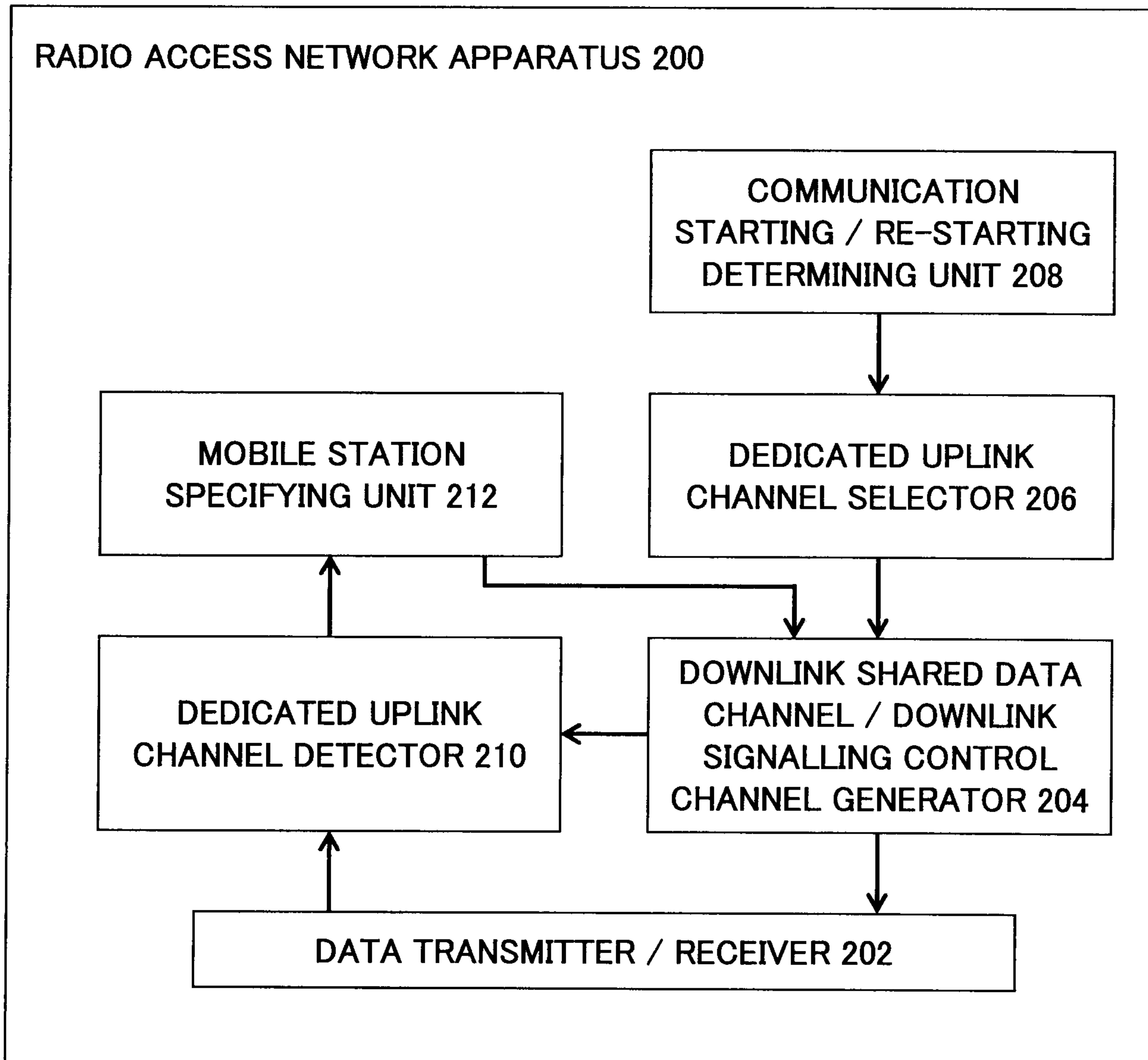


FIG.4



# RADIO ACCESS NETWORK APPARATUS 200

