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(54) **TERMINAL, BASE STATION AND COMMUNICATION METHOD**

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(52) **U.S. Cl.**

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(57) **ABSTRACT**

A terminal includes a communication unit configured to transmit and receive a random access channel, and a controller configured to assume that the random access channel is transmitted and received based on at least one of a configuration of the random access channel set individually for a second terminal with reduced functions that is different from a terminal without a first reduced functions or terminal with reduced functions; a configuration of the random access channel set individually for the first terminal with functions, a reduced or configuration of the random access channel for the terminal without reduced functions, wherein second functions, which are different from first functions reduced in the first terminal with reduced functions, are reduced.

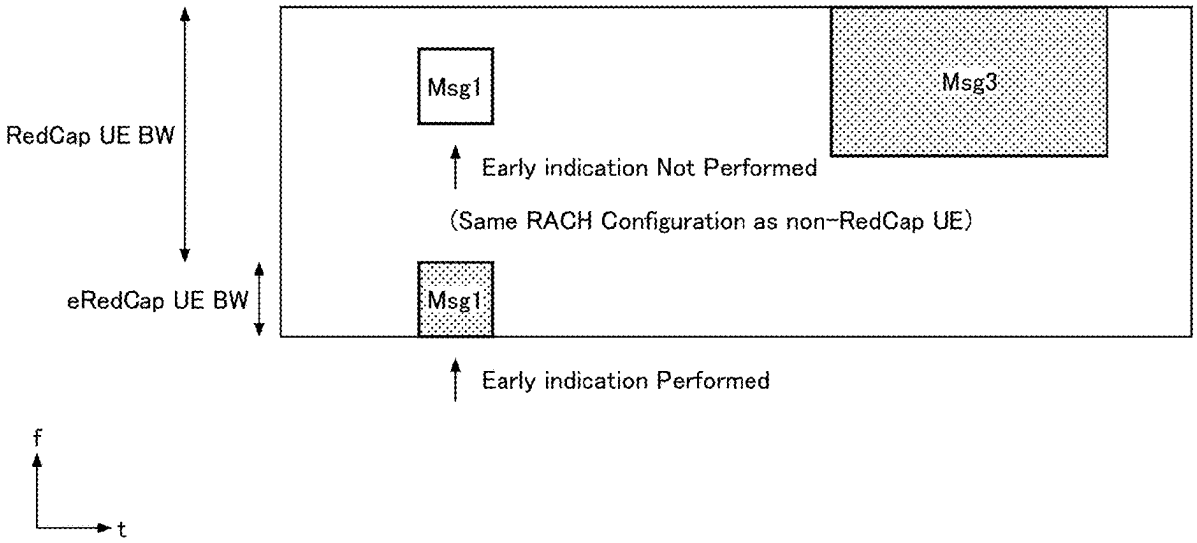


FIG.1

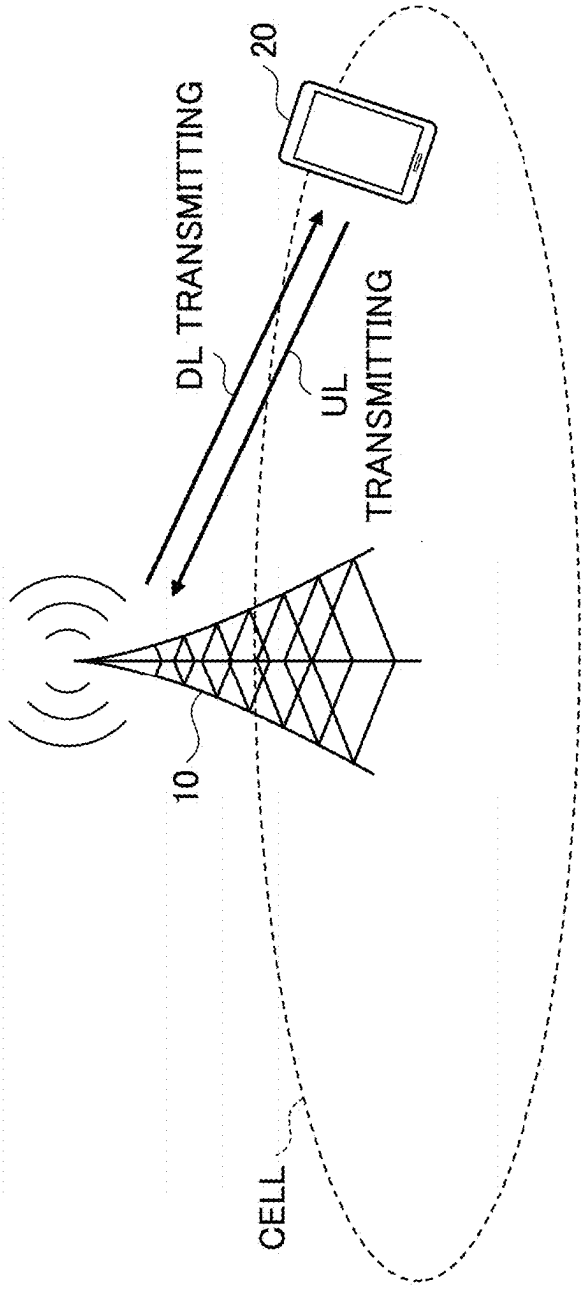


FIG.2

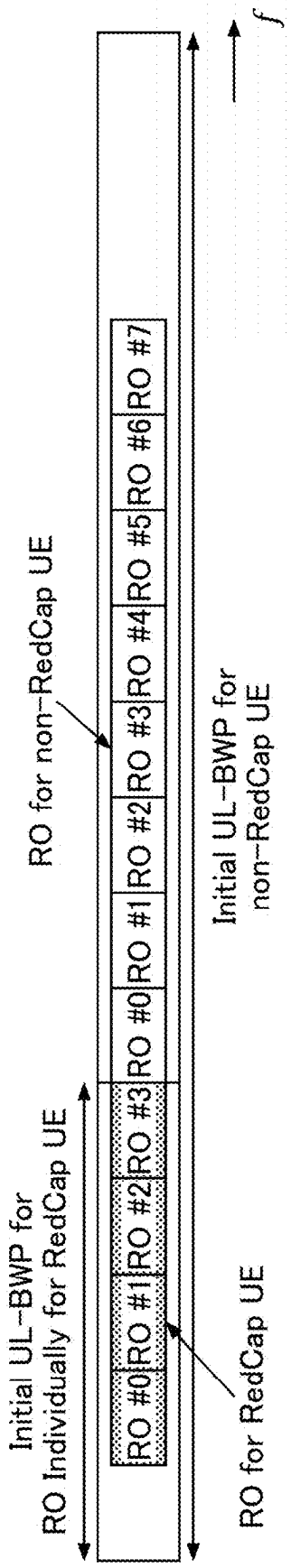

f
RO for non-RedCap UE
RO #0
RO #1
RO #2
RO #3
RO #4
RO #5
RO #6
RO #7
Initial UL-BWP for non-RedCap UE
Initial UL-BWP for RO Individually for RedCap UE
RO #0
RO #1
RO #2
RO #3
RO for RedCap UE

FIG.3

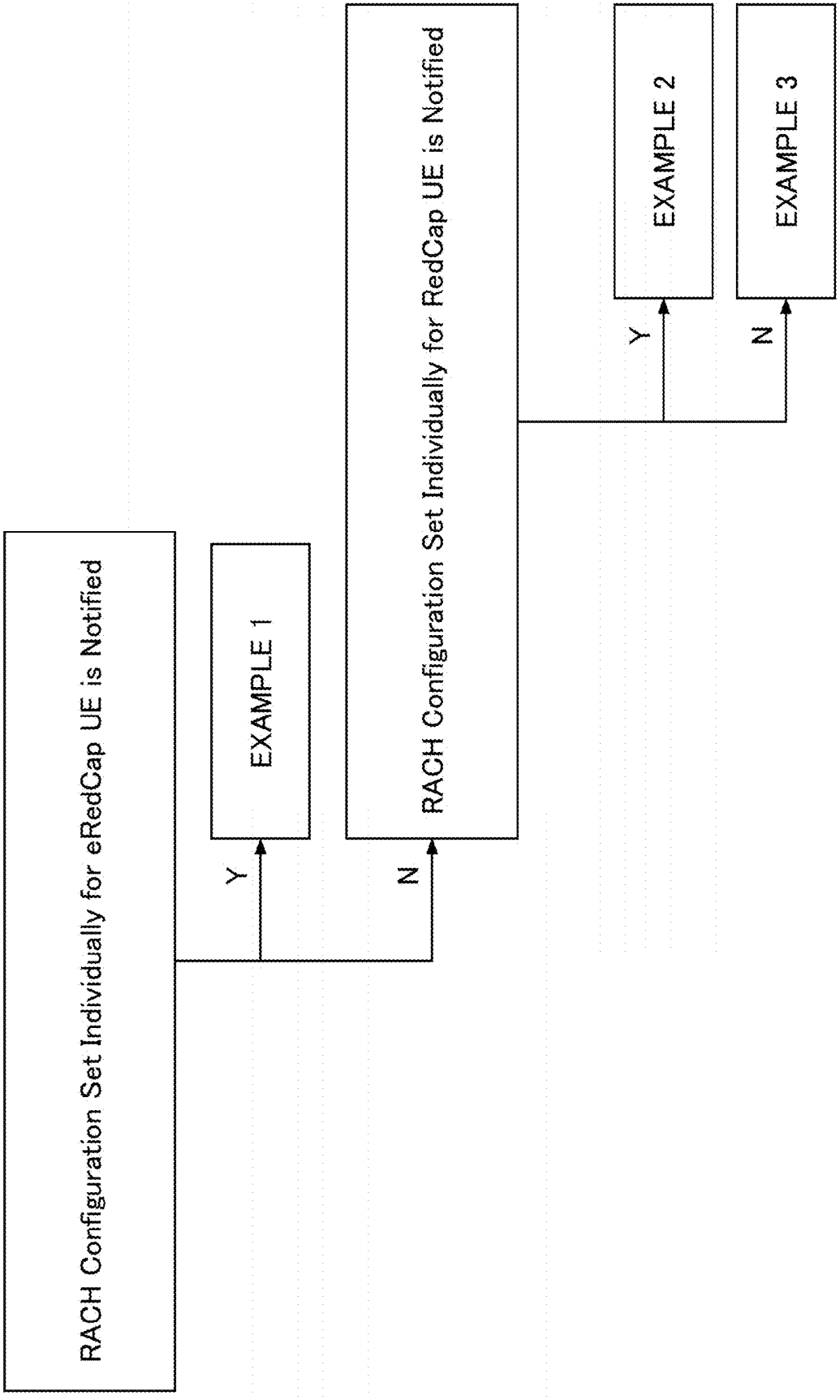

RACH Configuration Set Individually for eRedCap UE is Notified
Y
EXAMPLE 1
N
RACH Configuration Set Individually for RedCap UE is Notified
Y
EXAMPLE 2
N
EXAMPLE 3

FIG.4

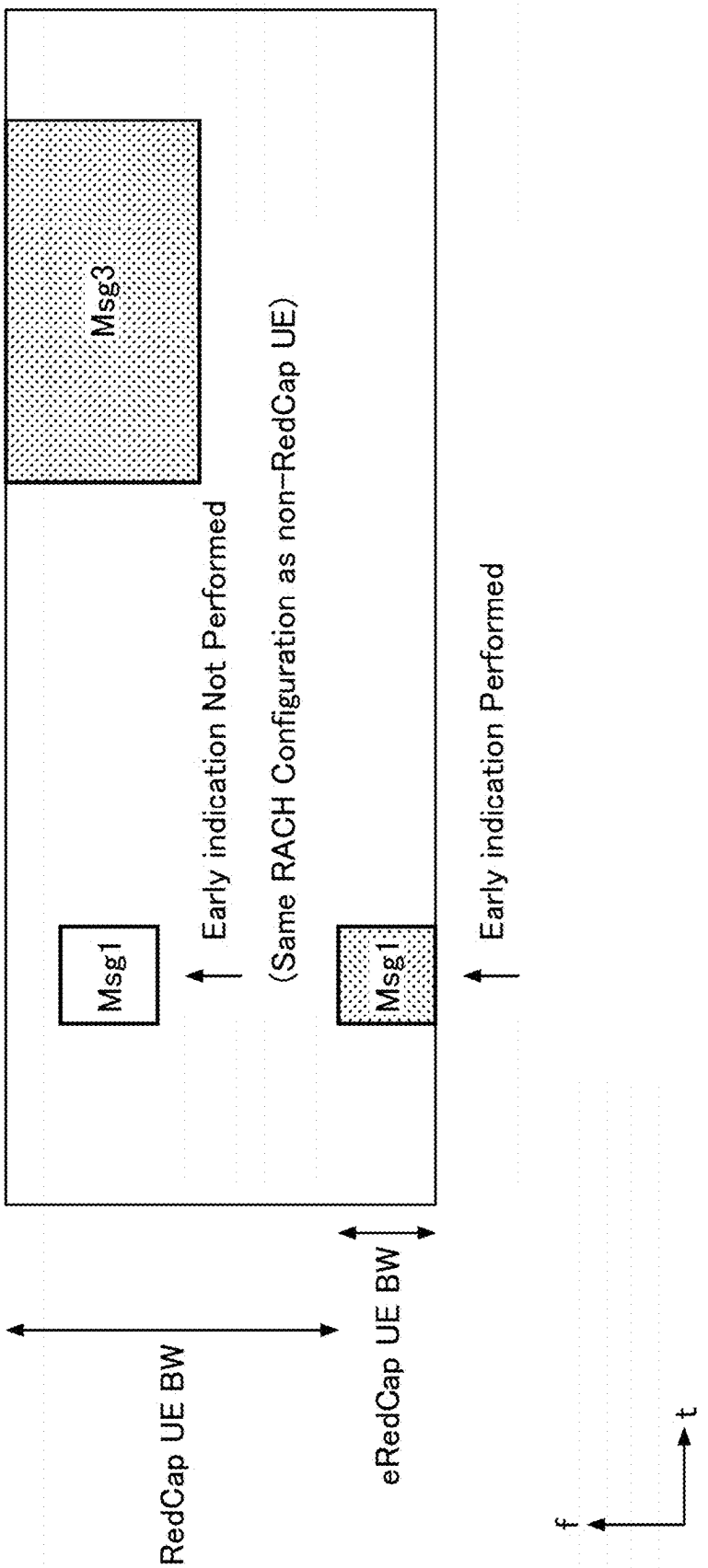

Msg3
Msg1
Early indication Not Performed
(Same RACH Configuration as non-RedCap UE)
Msg1
Early indication Performed
RedCap UE BW
eRedCap UE BW
f
t

FIG.5

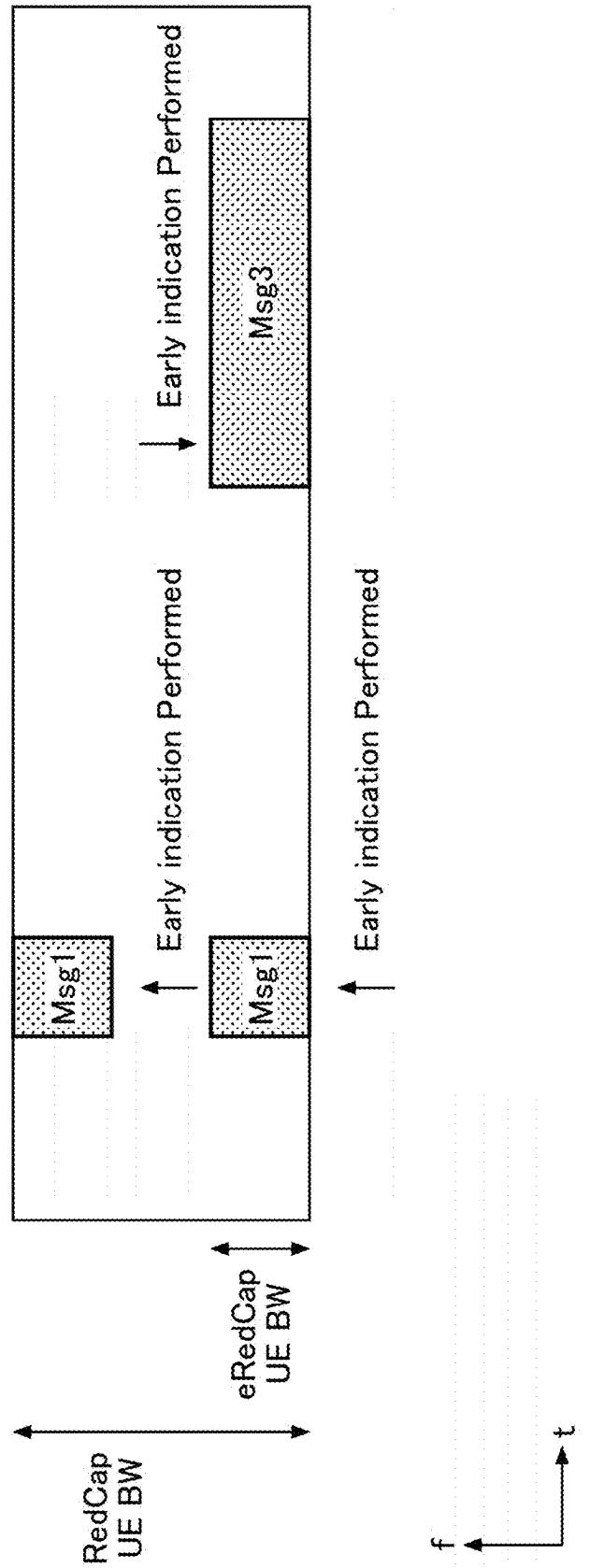

Early indication Performed
Msg3
Early indication Performed
Msg1
Early indication Performed
Msg1
eRedCap
UE BW
RedCap
UE BW
f
t

FIG.6

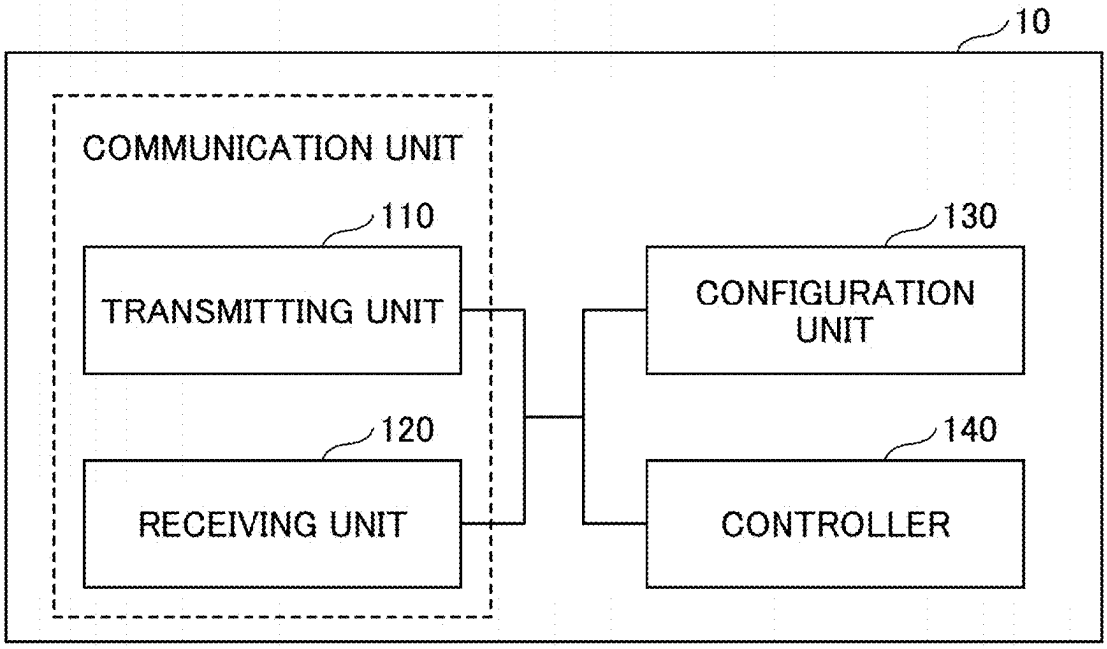

10
COMMUNICATION UNIT
110
TRANSMITTING UNIT
120
RECEIVING UNIT
130
CONFIGURATION UNIT
140
CONTROLLER

FIG.7

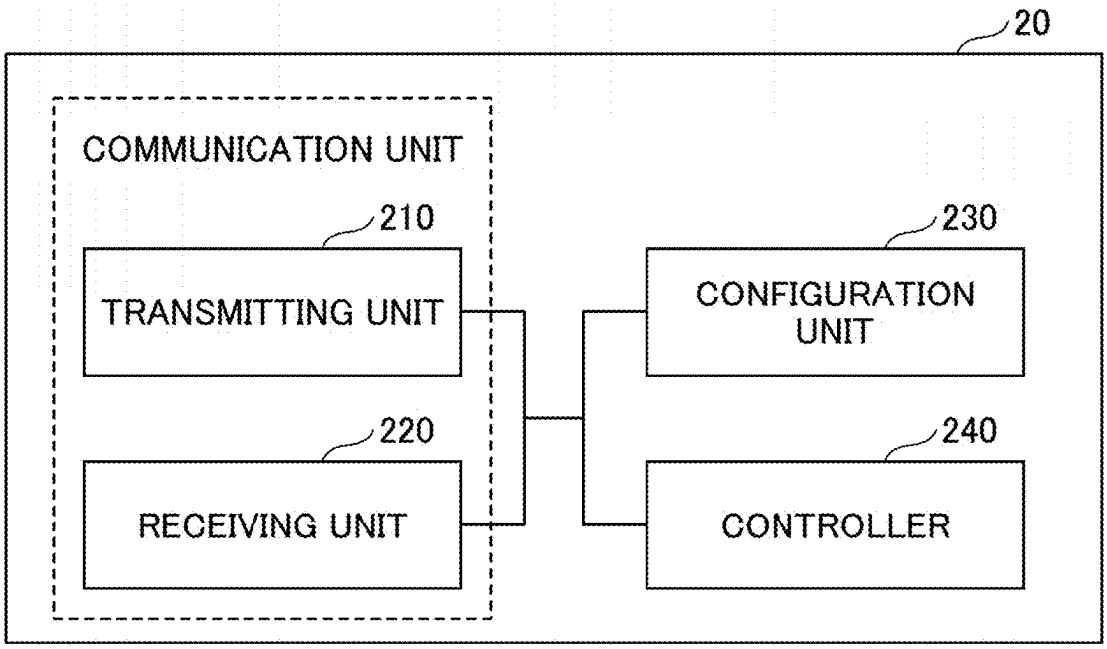
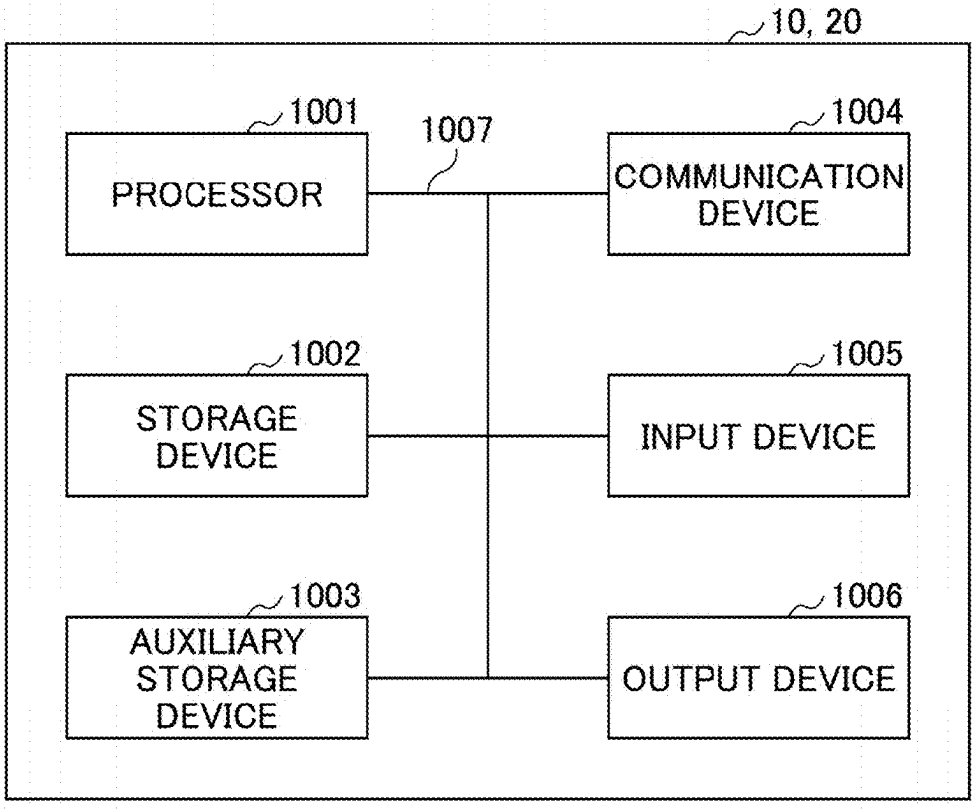
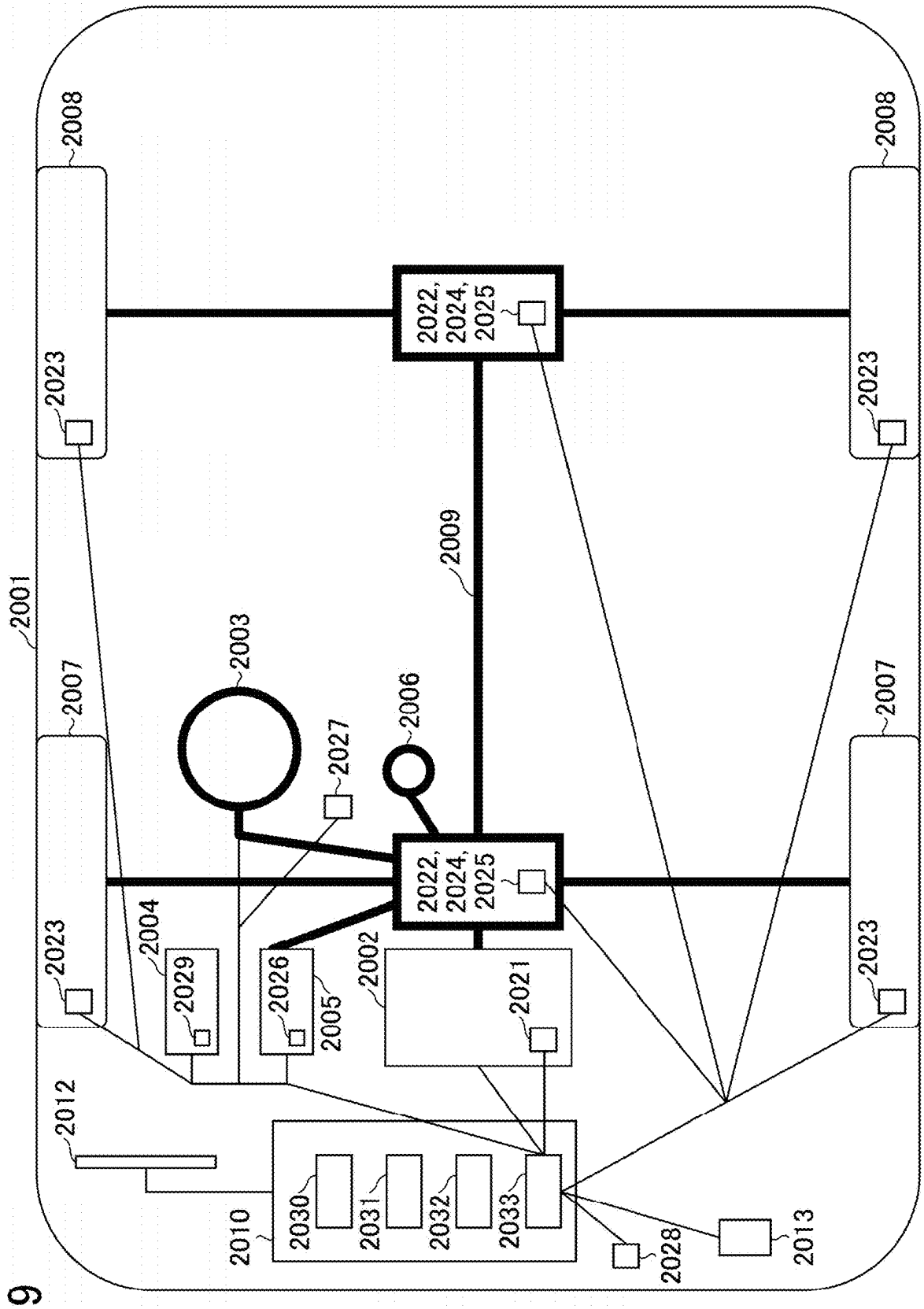

20
COMMUNICATION UNIT
210
TRANSMITTING UNIT
220
RECEIVING UNIT
230
CONFIGURATION UNIT
240
CONTROLLER

FIG.8


10, 20
1001
PROCESSOR
1007
1004
COMMUNICATION DEVICE
1002
STORAGE DEVICE
1005
INPUT DEVICE
1003
AUXILIARY STORAGE DEVICE
1006
OUTPUT DEVICE


2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2012
2013
2021
2022, 2024, 2025
2023
2026
2027
2028
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2031
2032
2033

FIG.9

TERMINAL, BASE STATION AND COMMUNICATION METHOD

TECHNICAL FIELD

[0001] The disclosures herein relate to terminals, base stations and communication methods in a wireless communication system.

BACKGROUND ART

[0002] In NR (New Radio) (also referred to as "5G"), which is a successor system to LTE (Long Term Evolution), as requirements, a technology to satisfy a large-capacity system, a high-speed data transmission rate, a low delay, simultaneous connection of a large number of terminals, a low cost, power saving and the like is being considered (e.g., Non-Patent Literature 1).

[0003] In LTE or NR, a UE category or UE capability for the Internet of Things (IoT) is defined in which functions mandatorily supported by a normal terminal are reduced, for example, a function related to transmission and reception bandwidth and the number of antennas. For example, eMTC (Enhanced Machine Type Communication) and NB-IoT (Narrow Band IoT) are defined in LTE, and a RedCap (Reduced Capability) is defined in NR.

[0004] In addition, consideration has started on advanced systems beyond 5G, or 6G. Further improvement of communication performance and diversification of use cases are assumed in such advanced systems.

CITATION LIST

Non-Patent Literature

[0005] Non-patent literature 1: 3GPP TS 38.300 V16.8.0 (2021 December)

SUMMARY OF THE INVENTION

Problem to be Solved by the Invention

[0006] In an advanced system (e.g., 6G, which is a successor of NR Release 18 and NR), an eRedCap (enhanced Reduced Capability) which is further reduced in functions than the RedCap studied in NR release 17 has been studied. However, conventionally, it has not been clear how to report the terminal capability of the eRedCap in initial access.

[0007] The present invention has been made in view of the above-mentioned point, and it is an object of the present invention to appropriately perform initial access by a terminal with reduced functions in a wireless communication system.

Means of Solving the Problem

[0008] According to the disclosed technology, there is provided a terminal including a communication unit configured to transmit and receive a random access channel, and a controller configured to assume that the random access channel is transmitted and received based on at least one of a configuration of the random access channel set individually for a second terminal with reduced functions that is different from a terminal without reduced functions or a first terminal with reduced functions; a configuration of the random access channel set individually for the first terminal with reduced functions; or a configuration of the random access channel for the terminal without reduced functions, wherein second functions, which are different from first functions reduced in the first terminal with reduced functions, are reduced.

Effects of the Invention

[0009] According to the disclosed technology, a technology to enable the terminal with reduced functions to properly perform initial access in a wireless communication system is provided.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] FIG. **1** is a drawing describing a wireless communication system according to an embodiment of the present invention.

[0011] FIG. **2** is a drawing describing a conventional RedCapUE RACH Occasion.

[0012] FIG. **3** is a drawing describing a relation between examples 1 to 3 of the embodiment of the present invention.

[0013] FIG. **4** is a first drawing describing an early indication according to example 1 of the embodiment of the present invention.

[0014] FIG. **5** is a second drawing describing the early indication according to example 1 of the embodiment of the present invention.

[0015] FIG. **6** is a drawing illustrating an example of a functional configuration of a base station according to the embodiment of the present invention.

[0016] FIG. **7** is a drawing illustrating an example of a functional configuration of a terminal according to the embodiment of the present invention.

[0017] FIG. **8** is a drawing illustrating an example of a hardware configuration of the base station or the terminal according to the embodiment of the present invention.

[0018] FIG. **9** is a drawing illustrating an example of a configuration of a vehicle according to the embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0019] In the following, embodiments of the present invention will be described with reference to the accompanying drawings.

[0020] In an operation of a wireless communication system of the embodiment of the present invention, the existing technology is used as appropriate. However, the existing technology is, for example, the existing LTE, but is not limited to the existing LTE. A term "LTE" used in the present specification has a broad meaning including LTE-Advanced and later systems (e.g., NR) than LTE-Advanced unless otherwise specified.

[0021] In the embodiment of the present invention described below, terms such as SS (Synchronization signal), PSS (Primary SS), SSS (Secondary SS), PBCH (Physical Broadcast Channel), PRACH (Physical Random Access Channel), PDCCH (Physical Downlink Control Channel), PDSCH (Physical Downlink Shared Channel), PUCCH (Physical Uplink Control Channel), and PUSCH (Physical Uplink Shared Channel) used in existing LTE are used. This is for convenience of description, and signals and functions similar to these may be referred to as other names. The above terms in NR correspond to NR-SS, NR-PSS, NR-SSS,

NR-PBCH, NR-PRACH, and the like. However, even signals used in NR are not necessarily referred to as "NR-".

[0022] In the embodiment of the present invention, a duplex system may be a TDD (Time Division Duplex) system, an FDD (Frequency Division Duplex) system, or any other (e.g., Flexible Duplex, etc.) system.

[0023] In the embodiment of the present invention, to "configure" wireless parameters and the like may mean that predetermined values are pre-configured, or that the wireless parameters notified from a base station **10** or a terminal **20** are configured.

(System Configuration)

[0024] FIG. **1** is a drawing describing the wireless communication system according to the embodiment of the present invention. As shown in FIG. **1**, the wireless communication system according to the embodiment of the present invention includes the base station **10** and the terminal **20**. Although one base station **10** and one terminal **20** are shown in FIG. **1**, these are examples and a plurality of each may be used.

[0025] The base station **10** is a communication device that provides one or more cells and performs wireless communication with the terminal **20**. Physical resources of a wireless signal are defined in a time domain and a frequency domain, and the time domain may be defined by the number of OFDM (Orthogonal Frequency Division Multiplexing) symbols, and the frequency domain may be defined by the number of subcarriers or resource blocks. The TTI (Transmission Time Interval) in the time domain may be a slot, or the TTI may be a subframe.

[0026] The base station **10** transmits a synchronization signal and system information to the terminal **20**. The synchronization signals are, for example, NR-PSS and NR-SSS. The system information is, for example, transmitted in NR-PBCH and is also referred to as broadcast information. The synchronization signal and system information may be referred to as SSB (SS/PBCH Block). As shown in FIG. **1**, the base station **10** transmits control signals or data to the terminal **20** in DL (Downlink) and receives control signals or data from the terminal **20** in UL (Uplink). Both the base station **10** and the terminal **20** can transmit and receive signals by beamforming. Both the base station **10** and the terminal **20** can apply MIMO (Multiple Input Multiple Output) communication to DL or UL. Also, both the base station **10** and the terminal **20** may communicate via a secondary cell (SCell) and a primary cell (PCell) by CA (Carrier Aggregation). Further, the terminal **20** may perform communication via the primary cell of the base station **10** by DC (Dual Connectivity) and the primary secondary cell group cell (PSCell: Primary SCG Cell) of the other base station **10**.

[0027] The terminal **20** is a communication device having a wireless communication function such as a smartphone, a mobile phone, a tablet, a wearable terminal, or a machine-to-machine (M2M) communication module. As shown in FIG. **1**, the terminal **20** receives control signals or data from the base station **10** by DL and transmits control signals or data to the base station **10** UL, utilizing various by thereby communication services provided by the wireless communication system. The terminal **20** also receives various reference signals transmitted from the base station **10** and performs measurement of propagation path quality based on reception results of the reference signals. The terminal **20** may be referred to as UE and the base station **10** may be referred to as gNB.

(RedCap of NR Release 17)

[0028] First, RedCap of conventional NR Release 17 will be described. A maximum bandwidth supported by RedCapUE considered in the NR Release 17 is 20 MHz for FR1 (Frequency Range 1) and 100 MHz for FR2 (Frequency Range 2). The RedCapUE is required to coexist with the non-RedCapUE (Hereinafter, it is also referred to as "non-RedCapUE".) in the system.

[0029] The RedCapUE and the non-RedCapUE may also be able to share the same initial DL-BWP (Downlink Bandwidth Part) (including subcarrier spacing, bandwidth and position) set by the MIB (Master Information Block). Additionally, the initial DL-BWP may be configured with a separate or additional subcarrier interval, bandwidth and position for the RedCapUE.

[0030] The RedCapUE may share the initial DL-BWP (Hereinafter, it is also referred to as "DL-BWP #0".) with the non-RedCapUE if it does not exceed the maximum bandwidth supported by the RedCapUE.

[0031] In addition, according to the NR Release 17 specification, the DL-BWP and UL-BWP of the same index are required to have the same center frequency in the case of TDD to avoid RF re-tuning.

[0032] Moreover, the RedCapUE assumes that the initial DL-BWP and the active DL-BWP become less than or equal to the maximum DL bandwidth supported by the RedCapUE after (re) establishing a dedicated RRC connection. The RedCapUE is provided with a DL-BWP by "initialDownlinkBWP" in "DownlinkConfigCommonRedCapSIB" and an UL-BWP by "initialUplinkBWP" in "UplinkConfigCommonRedCapSIB". When "initialUplinkBWP" of "UplinkConfigCommonSIB" shows an UL-BWP greater than the maximum UL-BWP supported by the RedCapUE, the RedCapUE assumes that the UL-BWP is provided by "initialUplinkBWP" of "UplinkConfigCommonRedCapSIB".

[0033] The RedCapUE may be provided with a DL-BWP by "BWP-DownlinkDedicated" in addition to initial DL-BWP. The RedCapUE may be provided with an UL-BWP by "BWP-UplinkDedicated" in addition to initial UL-BWP less than or equal to the maximum UL bandwidth supported by the RedCapUE.

[0034] When the RedCapUE is provided with a "RACH-ConfigCommon-RedCap" or "RACH-ConfigCommonTwoStepRA-RedCap", the RedCapUE performs initial access and random access procedures using the corresponding parameters. Otherwise, the RedCapUE uses the corresponding parameters provided by "RACH-ConfigCommon" or "RACH-ConfigCommonTwoStepRA".

[0035] The RedCapUE is provided with "initialUplinkBWP" of "UplinkConfigCommonRedCapSIB" and sends PUCCH with HARQ-ACK information using PUCCH resource set provided by "pucch-ResourceCommonRedCap" if there is no dedicated PUCCH resource configuration. Note that when "disable-FH-PUCCH" is provided in "PUCCH-ConfigCommonRedCap", PUCCH transmission is disabled.

[0036] For an initial DL-BWP provided by "initialDownlinkBWP" of "DownlinkConfigCommonRedCapSIB", the RedCapUE recognizes that the initial DL-BWP does not

contain an SS/PBCH block or a CORESET with index 0 if it observes PDCCH according to the CSS set of Type1-PDCCH and does not observe PDCCH according to the CSS set of Type2-PDCCH.

[0037] The RedCapUE assumes that when PDCCH is observed according to the CSS set of Type2-PDCCH, when the RedCapUE acquires SIB1 using an SS/PBCH block, the SS/PBCH block and a CORESET of the index 0 are included in the initial DL-BWP, and when an SS/PBCH block is included, and an SS/PBCH block used by the RedCapUE to acquire SIB1 is not included in the initial DL-BWP, the CORESET of the index 0 is not included.

[0038] In case of an active DL-BWP provided by "BWP-DownlinkDedicated", the RedCapUE assumes that an SS/PBCH block is included and the CORESET with the index 0 is not included in the active DL-BWP, except when a function operating in the DL-BWP without receiving an SS/PBCH block is shown.

[0039] Next, an early indication in the RedCapUE for NR release 17 will be described with reference to the drawings.

[0040] The RedCapUE can indicate that it is a "RedCapUE" by sending a dedicated PRACH (both 4 step RACH and 2 step RACH). For example, RACH Occasions (RO) dedicated to the RedCapUE are configured.

[0041] FIG. **2** is a drawing describing a conventional RedCapUE RACH Occasion. The RACH Occasion of a RedCapUE is contained in an individual initial UL-BWP that is different from the RACH Occasion of a non-RedCapUE.

[0042] A proper scheduling after PRACH and restoring coverage for Msg2 and 4 in the individual DL/UL-BWP are thus enabled. However, there is a problem that PRACH resources (ROs or preambles) need to be separated or distinguished between RedCapUEs and non-RedCapUEs.

[0043] Alternatively, a conventional RedCapUE can indicate itself as a "RedCapUE" via a PUSCH of Msg3 or MsgA.

[0044] In this case, there is no need for separation or distinction of PRACH resources between RedCapUEs and non-RedCapUEs. However, there is a problem that a problem about Msg2 coverage can occur, where proper scheduling is only possible after Msg3.

(Concerning RedCap for NR Release 18)

[0045] Next, the status of the RedCap for NR Release 18 is described. In NR Release 18, the eRedCap is being studied to further reduce the complexity of the RedCapUE for NR Release 17. Hereinafter, a terminal with reduced functions for NR Release 17 is referred to as RedCapUE, and a terminal with enhanced reduced functions for NR Release 18 is referred to as eRedCapUE. The RedCapUE is an example of a first terminal with reduced functions. The eRedCapUE is an example of a second terminal with reduced functions. That is, the first terminal with reduced functions is a terminal in which first functions are reduced, and the second terminal with reduced functions is a terminal in which second functions different from (or partially overlapping with) the first functions are reduced.

[0046] Effects on the network, coexistence of the RedCapUE or eRedCapUE with the non-RedCapUE in a cell, effects on UE, effects on specifications, etc. are examined. Potential solutions that may complement each other to reduce device complexity focus on the following.

[0047] The first solution is considered to reduce the UE bandwidth to 5 MHz in FR1. This solution could be specified in conjunction with relaxed UE processing timelines for PDSCH and/or PUSCH and/or CSI.

[0048] The second solution is considered to reduce the UE peak data rate in FR1. This solution may include limited bandwidth for PDSCH and/or PUSCH and/or relaxed UE processing timelines for PDSCH and/or PUSCH and/or CSI.

[0049] Note that, regarding the eRedCapUE, it is considered necessary to be aware of the following. That is, SSBs specified in NR Release 15 are required to be reused and L1 changes are required to be minimized. Also, BWP operation with or without SSB, and with or without RF re-tuning is required to be considered. Furthermore, it is considered that some solutions of FR1 can be applied to FR2. In order to further reduce the complexity of UE, it is considered to define a type of reduced-functionality terminal for a single release 18.

(Conventional Problems)

[0050] As described above, eRedCapUE for NR release 18 is being considered. However, from the following viewpoints, there is a problem that it is not clear whether or not and how to indicate an eRedCapUE in the initial access (prior to reporting the terminal functionality).

[0051] Whether or not to separate eRedCapUE from non-RedCap and/or RedCapUE, and how to separate it.

Outline of the Present Embodiment

[0052] Therefore, in the present embodiment, a RACH notification method set individually for an eRedCapUE or a RedCapUE will be described. Examples 1 to 3 will be described below. The terminal **20** of each embodiment is assumed to be an eRedCapUE unless otherwise specified.

[0053] First, definitions of a RedCapUE, an eRedCapUE, and a non-RedCapUE will be described.

[0054] The definition of RedCapUE may be any of 1)-3) below, or any other definition.

[0055] 1) A UE that has notified the network that its own device is a RedCapUE in any of Msg. 1, 3, or A. For example, Msg. 1 or A may be transmitted by a resource defined or configured for RedCapUE, or a notification field in Msg3 specified or configured for RedCapUE may be used to notify that the apparatus is a RedCapUE.

[0056] 2) A UE that supports a specific UE capability. For example, the specific UE capability may be a UE capability that supports a maximum 20 MHz bandwidth in FR1 and a maximum 100 MHz bandwidth in FR2. The specific UE capability may be a UE capability that supports one or two receiving branches and a UE capability that supports a maximum number of DL-MIMO layers corresponding to the number of receiving branches to be supported. The specific UE capability may be a UE capability that supports either FD-FDD (Full Duplex-Frequency Division Duplex) or Type A HD-FDD (Half Duplex-Frequency Division Duplex) operation in the FDD band of FR1. The specific UE capability may be a UE capability that supports either DL up to 64 QAM (Quadrature Amplitude Modulation) or DL up to 256 QAM in FR1. The specific UE capability may be a UE capability that does not support CA and/or DC.

[0057] 3) A UE that has reported to the network that it supports a specific UE capability shown in 2) above.

[0058] The definition of eRedCapUE may be any of the following 1)-3) or any other definition.

[0059] 1) A UE that has notified the network that its device is an eRedCapUE in any of Msg. 1, 3, or A. For example, Msg. 1 or A may be transmitted by a resource defined or configured for the eRedCapUE, or a notification field in Msg3 defined or configured for the eRedCapUE may be used to notify the network that its device is the eRedCapUE.

[0060] 2) A UE that supports a specific UE capability. For example, the specific UE capability may be a UE capability to support up to 5 MHz bandwidth at FR1. The specific UE capability may also be a UE capability to support PDSCH and/or PUSCH and/or CSI relaxed UE processing timelines. The specific UE capability may also be a UE capability to support reduced UE peak data rates at FR1. The specific UE capability may also be a UE capability to support one or two receiving branches and a UE capability to support a maximum number of DL-MIMO layers corresponding to the number of receiving branches to be supported. The specific UE capability may also be a UE capability to support either FD-FDD (Full Duplex-Frequency Division Duplex) or Type A HD-FDD (Half Duplex-Frequency Division Duplex) operation in the FDD band at FR1. The specific UE capability may also be a UE capability to support either DL up to 64 QAM (Quadrature Amplitude Modulation) or DL up to 256 QAM at FR1. The specific UE capability may also be a UE capability that does not support CA and/or DC.

[0061] 3) A UE that has reported to the network that it supports the specific UE capability shown in 2) above.

[0062] Moreover, the terminal **20** may report a UE capability indicating whether or not it supports a function shown in each embodiment described later. For example, the terminal **20** may report a UE capability indicating whether or it supports a function using an initial DL/UL-BWP different from a non-RedCapUE or RedCapUE. Further, the UE reporting that it supports the function may be an eRedCapUE, or the eRedCapUE may support the function as an option.

[0063] Moreover, the definition of a non-RedCapUE may be a UE that does not apply to either the definition of the RedCapUE or the definition of the eRedCapUE, a UE that supports a function that a normal UE supports mandatorily, or a UE that supports a bandwidth exceeding the maximum bandwidth supported by the RedCapUE.

[0064] FIG. **3** is a drawing describing a relation between examples 1 to 3 of the embodiment of the present invention. In example 1, a case where the RACH configuration set individually for the eRedCapUE is notified will be described. In example 2, a case where the RACH configuration set individually for the eRedCapUE is not notified, but the RACH configuration set individually for the RedCapUE is notified, will be described. In example 3, a case where neither the RACH configuration set individually for the eRedCapUE nor the RACH configuration set individually for the RedCapUE is notified will be described.

[0065] Note that which embodiment is applied to the eRedCapUE may be the same or different according to the following scenarios.

[0066] TDD or FDD.

[0067] FR1 or FR2

Example 1

[0068] In this example, an example will be described in which the RACH configuration set notified individually for the eRedCapUE is notified

[0069] When the RACH configuration set individually for the eRedCapUE (e.g., "RACH-ConfigCommon-eRedCap-r18" or "RACH-ConfigCommonTwoStepRA-eRedCap-r18") is notified, the terminal **20** may perform random access using the RACH configuration. The RACH configuration set individually for the eRedCapUE is a configuration using parameters different from the following conventional RACH configuration parameters.

[0070] "RACH-ConfigCommon-RedCap", "RACH-ConfigCommonTwoStepRA-RedCap", "RACH-ConfigCommon", or "RACH-ConfigCommonTwoStepRA"

[0071] The terminal **20** may assume that the specifications specify whether the RACH configuration set individually for the eRedCapUE can be notified for each of FDD or TDD, and FR1 or FR2.

[0072] When the RACH configuration set individually for the eRedCapUE is notified, the terminal **20** may assume that the specifications specify whether the RACH configuration set individually for the eRedCapUE is to be applied through any of the following cases, or may assume that the configuration is made by broadcast signal and upper layer signaling.

[0073] When the initial DL/UL-BWP used by the eRedCapUE exceeds or does not exceed the maximum bandwidth of the eRedCapUE

[0074] When the initial DL/UL-BWP used by the eRedCapUE is included in or is not included in the initial DL/UL-BWP used by the RedCapUE

[0075] The terminal **20** may assume that the early indication is performed by Msg1, 2, 3, 4, A, or B according to the notification and configuration of the base station **10**, or may assume that it is specified in the specifications.

[0076] FIG. **4** is a first drawing describing an early indication according to example 1 of the embodiment of the present invention. For example, when the terminal **20** is notified that the early instruction of the eRedCapUE is to be performed by Msg1, it may assume that the early instruction of the RedCapUE is to be performed by Msg3. In this case, the base station **10** may assume that the early instruction is to be performed by Msg1 transmission from the eRedCapUE and by Msg3 transmission from the RedCapUE.

[0077] FIG. **5** is a second drawing describing an early indication according to example 1 of the embodiment of the present invention. For example, when the terminal **20** is notified that the early instruction of the eRedCapUE and the RedCapUE is to be performed by Msg1, it may perform the early instruction of the eRedCapUE by Msg3 additionally to Msg1. In this case, the terminal **20** may not distinguish between the eRedCapUE and the RedCapUE at the time of Msg1 transmission (that is, the same RACH configuration as in the non-RedCapUE may be used), but may distinguish between the eRedCapUE and the RedCapUE at the time of Msg3 transmission.

[0078] According to this example, it is possible to configure a RACH set individually for the eRedCapUE.

Example 2

[0079] In this example, an example will be described in which the RACH configuration set individually for the

RedCapUE is instead the notified of RACH configuration set individually for the eRedCapUE.

[0080] When the RACH configuration set individually for the RedCapUE (i.e., "RACH-ConfigCommon-RedCap" or "RACH-ConfigCommonTwoStepRA-RedCap") is notified, the terminal **20** may perform random access using the RACH configuration.

[0081] Specifically, the terminal **20** may perform any of the following options.

<Option 1>

[0082] The terminal **20** may use the RACH configuration regardless of the total bandwidth of ROs on which FDM (Frequency Division Multiplex) is performed.

<Option 2>

[0083] The terminal **20** may use the RACH configuration only if the total bandwidth of the ROs on which FDM is performed does not exceed the maximum bandwidth of the eRedCapUE (e.g., 5 MHz). The terminal **20** may perform the operation shown in Example 1 if the total bandwidth of the ROs on which FDM is performed exceeds the maximum bandwidth of the eRedCapUE (e.g., 5 MHz).

[0084] The terminal **20** may assume that the specifications specify whether the RACH configuration can be applied individually for the RedCapUE to each of FDD or TDD, and FR1 or FR2.

[0085] The terminal **20** may also assume that the specifications specify whether the RACH configuration individually set for the RedCapUE is to be applied in any of the following cases when the RACH configuration set individually for the RedCapUE is notified.

[0086] When the initial DL/UL-BWP used by an eRedCapUE exceeds or does not exceed the maximum bandwidth of an eRedCapUE.

[0087] When the initial DL/UL-BWP used by an eRedCapUE is included in or is not included in the initial DL/UL-BWP used by the RedCapUE.

[0088] According to this example, the RACH configuration of the eRedCapUE can be realized by the RACH configuration set individually for the RedCapUE.

Example 3

[0089] In this example, an example will be described in which neither the RACH configuration set individually for the eRedCapUE nor the RACH configuration set individually for the RedCapUE is notified, that is, only the RACH configuration for the non-RedCapUE is notified.

[0090] When the RACH configuration set individually for the non-RedCapUE (i.e., "RACH-ConfigCommon" or "RACH-ConfigCommonTwoStepRA") is notified, the terminal **20** may perform random access using the RACH configuration.

[0091] Specifically, the terminal **20** may perform any of the following options.

<Option 1>

[0092] The terminal **20** may use the RACH configuration regardless of the bandwidth of the total ROs on which FDM is performed.

<Option 2>

[0093] The terminal **20** may use the RACH configuration only when the total bandwidth of the ROs on which FDM is performed does not exceed the maximum bandwidth of the eRedCapUE (e.g., 5 MHz). The terminal **20** may perform the operation shown in example 1 or example 2 when the total bandwidth of the ROs on which FDM is performed exceeds the maximum bandwidth the eRedCapUE (e.g., 5 MHz).

[0094] The terminal **20** may assume that the specifications specify whether the RACH configuration for the non-RedCapUE can be applied to each of FDD or TDD, and FR1 or FR2.

[0095] The terminal **20** may also assume that the specifications specify whether the RACH configuration for the non-RedCapUE is to be applied in any of the following cases when the RACH configuration for the non-RedCapUE is notified.

[0096] When the initial DL/UL-BWP used by an eRedCapUE exceeds or does not exceed the maximum bandwidth of an eRedCapUE.

[0097] When the initial DL/UL-BWP used by an eRedCapUE is included in or is not included in the initial DL/UL-BWP used by a RedCapUE.

[0098] According to this example, the RACH configuration of the eRedCapUE can be realized by the RACH configuration for the non-RedCapUE.

(Device Configuration)

[0099] Next, an example of the functional configuration of the base station **10** and the terminal **20** that execute the processes and operations described so far will be described.

<Base Station **10**>

[0100] FIG. **6** is a drawing illustrating an example of a functional configuration of the base station **10**. As shown in FIG. **6**, the base station **10** includes a transmitting unit **110**, a receiving unit **120**, a configuration unit **130**, and a controller **140**. The functional configuration shown in FIG. **6** is only an example. As long as the operation according to the embodiment of the present invention can be performed, the functional categories and the names of the functional units may be any. The transmitting unit **110** and the receiving unit **120** may be collectively referred to as a communication unit.

[0101] The transmitting unit **110** includes a function of generating a signal to be transmitted to the terminal **20** and transmitting the signal wirelessly. The receiving unit **120** includes a function of receiving various signals transmitted from the terminal **20** and acquiring, for example, information of a higher layer from the received signal. The transmitting unit **110** also includes a function of transmitting, to the terminal **20**, NR-PSS, NR-SSS, NR-PBCH, DL and UL control signals, DCI by PDCCH, data by PDSCH, and the like.

[0102] The configuration unit **130** stores preset configuration information and various configuration information to be transmitted to the terminal **20** in a storage device provided in the configuration unit **130**, and reads them from the storage device as necessary.

[0103] The controller **140** performs scheduling of DL receiving or UL transmitting by the terminal **20** via the transmitting unit **110**. Further, the controller **140** includes a function of performing LBT. The transmitting unit **110** may include a function related to signal transmission in the

controller **140**, and the receiving unit **120** may include a function related to signal reception in the controller **140**. Further, the transmitting unit **110** may be referred to as a transmitter, and the receiving unit **120** may be referred to as a receiver.

<Terminal **20**>

[0104] FIG. **7** is a drawing illustrating an example of a functional configuration of the terminal **20**. As shown in FIG. **7**, the terminal **20** has a transmitting unit **210**, a receiving unit **220**, a configuration unit **230**, and a controller **240**. The functional configuration shown in FIG. **7** is merely an example. As long as the operation according to the embodiment of the present invention can be executed, the functional categories and names of the functional units may be any. The transmitting unit **210** and the receiving unit **220** may be collectively referred to as a communication unit.

[0105] The transmitting unit **210** generates a transmission signal from the transmission data and transmits the transmission signal wirelessly. The receiving unit **220** receives various signals wirelessly and acquires a signal of a higher layer from the received physical layer signal. The receiving unit **220** has a function of receiving NR-PSS, NR-SSS, NR-PBCH, DL, UL, or SL control signals transmitted from the base station **10**, DCI by PDCCH, data by PDSCH, and the like. For example, the transmitting unit **210** may transmit PSCCH (Physical Sidelink Control Channel), PSSCH (Physical Sidelink Shared Channel), PSDCH (Physical Sidelink Discovery Channel), PSBCH (Physical Sidelink Broadcast Channel), and the like to the other terminal **20** as D2D communication, and the receiving unit **120** may receive PSCCH, PSSCH, PSDCH, PSBCH, and the like from the other terminal **20**.

[0106] The configuration unit **230** stores various configuration information received from the base station **10** or other terminal by the receiving unit **220** in the storage device of the configuration unit **230**, and reads it from the storage device as necessary. The configuration unit **230** also stores preset configuration information. The controller **240** controls the terminal **20**. The controller **240** includes a function of performing LBT.

[0107] The terminal of the present embodiment may be configured as a terminal shown in the following items. In addition, the following communication methods may be implemented.

Configuration Concerning the Present Embodiment

[0108] (Article 1) A terminal including:

[0109] a communication unit configured to transmit and receive a random access channel; and

[0110] a controller configured to assume that the random access channel is transmitted and received based on at least one of: a configuration of the random access channel set individually for a second terminal with reduced functions that is different from a terminal without reduced functions or a first terminal with reduced functions; a configuration of the random access channel set individually for the first terminal reduced with functions; or a configuration of the random access channel for the terminal without reduced functions;

[0111] wherein second functions, which are different from first functions reduced in the first terminal with reduced functions, are reduced.

[0112] (Article 2) The terminal according to article 1, wherein the controller is configured to assume that the random access channel is transmitted and received based on the configuration set individually for the random access channel for the second terminal with reduced functions.

[0113] (Article 3) The terminal according to article 1 or 2, wherein the controller is configured to assume that the random access channel is transmitted and received based on the configuration set individually for the random access channel for the first terminal with reduced functions.

[0114] (Article 4) The terminal according to any one of articles 1 to 3, wherein the controller is configured to assume that the random access channel is transmitted and received based on the configuration set individually for the random access channel for the terminal without reduced functions.

[0115] (Article 5) A base station including:

[0116] a communication unit configured to perform transmission and reception of a random access channel with a terminal; and

[0117] a controller configured to assume that the transmission and reception of the random access channel is performed with the terminal based on at least one of: a configuration of the random access channel set individually for a second terminal with reduced functions that is different from a terminal without reduced functions or a first terminal with reduced functions; a configuration of the random access channel set individually for the first terminal with reduced functions; or a configuration of the random access channel for the terminal without reduced functions;

[0118] wherein in the terminal, second functions, which are different from first functions reduced in the first terminal with reduced functions, are reduced.

[0119] (Article 6) A communication method including:

[0120] transmitting and receiving a random access channel; and

[0121] assuming that the random access channel is transmitted and received based on at least one of: a configuration of the random access channel set individually for a second terminal with reduced functions that is different from a terminal without reduced functions or a first terminal with reduced functions; a configuration of the random access channel set individually for the first terminal with reduced functions; or a configuration of the random access channel for the terminal without reduced functions;

[0122] wherein second functions, which are different from first functions reduced in the first terminal with reduced functions, are reduced.

[0123] According to any of the above configurations, there is provided a technology to enable a terminal with reduced functions to properly perform initial access in a wireless communication system. According to article 1, random access channel transmitting and receiving can be appropriately performed with the second terminal with reduced functions that is different from the terminal without reduced functions or the first terminal with reduced functions. According to article 2, it can be assumed that the random access channel is transmitted and received based on the configuration set individually for the random access channel for the second terminal with reduced functions. According to article 3, it can be assumed that the random access channel is transmitted and received based on the configuration set individually for the random access channel for the first

terminal with reduced functions. According to article 4, it can be assumed that the random access channel is transmitted and received based on the configuration the terminal without reduced functions.

Hardware Configuration

[0124] The block diagrams (FIGS. **6** and **7**) used in the description of the above embodiment show blocks of functional units. These functional blocks (components) are implemented by any combination of at least one of hardware or software. The method of implementing each functional block is not particularly limited. That is, each functional block may be implemented using a single device that is physically or logically coupled, or may be implemented using a plurality of devices that are connected directly or indirectly (e.g., using wired, wireless, etc.) to two or more devices that are physically or logically separated. The functional block may be implemented by combining the one device or the plurality of devices with software.

[0125] The functions include, but are not limited to, determining, judgment, calculating, computing, processing, deriving, investigating, looking up (search, inquiry), ascertaining, receiving, transmitting, output, access, resolving, selecting, choosing, establishing, comparing, assuming, expecting, considering, broadcasting, notifying, communicating, forwarding, configuring, reconfiguring, allocating (mapping), and assigning. For example, the functional block (functional unit) that functions transmission is referred to as a transmitting unit or a transmitter. As described above, the implementation method is not particularly limited.

[0126] For example, the base station **10**, the terminal **20**, and the like in one embodiment of the present disclosure may function as computers that perform the processing of the wireless communication method of the present disclosure. FIG. **8** is a drawing illustrating an example of a hardware configuration of the base station **10** or the terminal **20** according to the embodiment of the present disclosure. Physically, the base station **10** and the terminal **20** may be configured as computer devices including a processor **1001**, a storage device **1002**, an auxiliary storage device **1003**, a communication device **1004**, an input device **1005**, an output device **1006**, a bus **1007**, and the like.

[0127] In the following description, the term "device" may be replaced with a circuit, a unit, and the like. The hardware configuration of the base station **10** and the terminal **20** may be configured to include one or more of the devices shown in the figure, or may be configured not to include some of the devices.

[0128] The functions of the base station **10** and the terminal **20** are achieved by reading predetermined software (programs) into hardware such as the processor **1001** and the storage device **1002**, so that the processor **1001** performs calculations and controls communication by the communication device **1004**, or controls at least one of reading or writing of data in the storage device **1002** or the auxiliary storage device **1003**.

[0129] The processor **1001** controls the entire computer by operating an operating system, for example. The processor **1001** may include a central processing unit (CPU) including an interface with peripheral devices, a control device, an arithmetic unit, a register, and the like. For example, the controller **140**, the controller **240**, and the like may be implemented by the processor **1001**.

[0130] The processor **1001** reads a program (program code), a software module, data, and the like from at least one of the auxiliary storage device **1003** or the communication device **1004** to the storage device **1002**, and executes various processes in accordance with these. As the program, a program that causes the computer to execute at least a part of the operations described in the above-described embodiments is used. For example, the controller **140** of the base station **10** shown in FIG. **6** may be implemented by a control program stored in the storage device **1002** and operated by the processor **1001**. For example, the controller **240** of the terminal **20** shown in FIG. **7** may be implemented by a control program stored in the storage device **1002** and operated by the processor **1001**. Although the above-described various processes are executed by one processor **1001**, they may be executed simultaneously or sequentially by two or more processors **1001**. The processor **1001** may be implemented by one or more chips. The program may be transmitted from a network via a telecommunications line.

[0131] The storage device **1002** is a computer-readable recording medium, and may include, for example, at least one of ROM (Read Only Memory), EPROM (Erasable Programmable ROM), EEPROM (Electrically Erasable Programmable ROM), RAM (Random Access Memory), or the like. The storage device **1002** may be referred to as a register, a cache, a main memory, and the like. The storage device **1002** can store executable programs (program codes), software modules, and the like for implementing the communication method according to one embodiment of the present disclosure.

[0132] The auxiliary storage device **1003** is a computer-readable recording medium, and may include, for example, at least one of an optical disk such as CD-ROM (Compact Disc ROM), a hard disk drive, a flexible disk, a magneto-optical disk (e.g. compact discs, digital versatile discs, Blu-ray (registered trademark) discs), a smart card, a flash memory (e.g., cards, sticks, key drives), a floppy disk (registered trademark), a magnetic strip, or the like. The above-described storage medium may be, for example, a database including at least one of the storage device **1002** and the auxiliary storage device **1003**, a server, or other suitable medium.

[0133] The communication device **1004** is a hardware (transmission and reception device) to communicate between computers via at least one of a wired network or a wireless network, and may also be referred to, for example, as a network device, a network controller, a network card, or a communication module. The communication device **1004** may include, for example, a high-frequency switch, a duplexer, a filter, a frequency synthesizer, and the like to achieve at least one of frequency division duplex (FDD) or time division duplex (TDD). For example, the transmitting and receiving antenna, the amplifier section, the transmitting and receiving section, the transmission line interface, and the like may be implemented by the communication device **1004**. The transmitting and receiving section may be physically or logically separated from the transmitting section and the receiving section.

[0134] The input device **1005** is an input device (e.g., keyboard, mouse, microphone, switch, button, sensor, etc.) that receives an input from the outside. The output device **1006** is an output device (e.g., displays, speakers, LED

lamps, etc.) that performs an output to the outside. The input device **1005** and the output device **1006** may be integrated (e.g., a touch panel).

[0135] The respective devices such as the processor **1001** and the storage device **1002** are connected by a bus **1007** for communicating information. The bus **1007** may be configured using a single bus or may be configured using different buses for each device.

[0136] The base station **10** and the terminal **20** may include hardware such as a microprocessor, a digital signal processor (DSP), an ASIC (Application Specific Integrated Circuit), a PLD (Programmable Logic Device), an FPGA (Field Programmable Gate Array), or the like, by which some or all of the functional blocks may be implemented. For example, the processor **1001** may be implemented using at least one of these types of hardware.

[0137] FIG. **9** is a drawing illustrating an example of a configuration of a vehicle **2001**. As shown in FIG. **9**, the vehicle **2001** includes a drive unit **2002**, a steering unit **2003**, an accelerator pedal **2004**, a brake pedal **2005**, a shift lever **2006**, a front wheel **2007**, a rear wheel **2008**, an axle **2009**, an electronic controller **2010**, various sensors **2021-2029**, an information service unit **2012**, and a communication module **2013**. Each aspect and embodiment described in the present disclosure may be applied to a communication device mounted on the vehicle **2001**, for example, the communication module **2013**.

[0138] The drive unit **2002** includes, for example, an engine, a motor, or an engine and motor hybrid. The steering unit **2003** includes at least a steering wheel (also referred to as a driving wheel) and is configured to steer at least one of the front wheels or the rear wheels based on operation of the steering wheel operated by a user.

[0139] The electronic controller **2010** includes a microprocessor **2031**, a memory (ROM, RAM) **2032**, and a communication port (IO port) **2033**. The electronic controller **2010** receives signals from various sensors **2021-2029** provided in the vehicle **2001**. The electronic controller **2010** may be referred to as an ECU (Electronic Control Unit).

[0140] The signals from the various sensors **2021-2029** include a current signal from a current sensor **2021** for sensing the current of a motor, a rotational speed signal of a front wheel and a rear wheel acquired by a rotational speed sensor **2022**, an air pressure signal of a front wheel and a rear wheel acquired by an air pressure sensor **2023**, a vehicle speed signal acquired by a vehicle speed sensor **2024**, an acceleration signal acquired by an acceleration sensor **2025**, depression amount signal of an accelerator pedal acquired by an accelerator pedal sensor **2029**, a depression amount signal of a brake pedal acquired by a brake pedal sensor **2026**, an operation signal of a shift lever acquired by a shift lever **2027**, and a detection signal for detecting an obstacle, a vehicle, a pedestrian or the like acquired by an object detection sensor **2028**.

[0141] The information service unit **2012** includes various devices such as a car navigation system, an audio system, a speaker, a television, and a radio for providing (outputting) various kinds of information such driving information, traffic information, entertainment information, and the like, and one or more ECUs for controlling these devices. The information service unit **2012** provides various kinds of multimedia information and multimedia services to the occupants of the vehicle **2001** by using information acquired from an external device via the communication module **2013** or the like.

[0142] The information service unit **2012** may include an input device (e.g., keyboard, mouse, microphone, switch, button, sensor, touch panel, etc.) for receiving input from the outside, or may include an output device (e.g., displays, speakers, LED lamps, touch panels, etc.) for performing output to the outside.

[0143] The driver support system unit **2030** is composed of various devices such as a millimeter wave radar, a LiDAR (Light Detection and Ranging), a camera, a positioning locator (e.g., GNSS, etc.), a map information (e.g., high-definition (HD) maps, autonomous vehicle (AV) maps, etc.), a gyro system (e.g., IMU (Inertial Measurement Unit), INS (Inertial Navigation System), etc.), an AI (Artificial Intelligence) chip, and an AI processor to provide functions to prevent accidents and reduce the driver's driving load, and one or more ECUs to control these devices. The driver support system unit **2030** transmits and receives various types of information via the communication module **2013** to achieve a driver support function or an automatic driving function.

[0144] The communication module **2013** can communicate with the microprocessor **2031** and the components of the vehicle **2001** via a communication port. For example, the communication module **2013** transmits and receives data to and from a drive unit **2002**, a steering unit **2003**, an accelerator pedal **2004**, a brake pedal **2005**, a shift lever **2006**, front wheels **2007**, rear wheels **2008**, an axle **2009**, a microprocessor **2031** in the electronic controller **2010**, a memory (ROM, RAM) **2032**, and a sensor **2021-29** provided in the vehicle **2001** via the communication port **2033**.

[0145] The communication module **2013** is a communication device that can be controlled by the microprocessor **2031** in the electronic controller **2010** and can communicate with an external device. For example, it transmits and receives various kinds of information to a and from an external device via wireless communication. The communication module **2013** can be either inside or outside the electronic controller **2010**. The external device may be, for example, a base station, a mobile station, or the like.

[0146] The communication module **2013** may transmit at least one of signals from the above-described various sensors **2021-2029** inputted to the electronic controller **2010**, information obtained based on the signals, or information based on an input from an external (user) obtained via the information service unit **2012** to the external device via wireless communication. The electronic controller **2010**, the various sensors **2021-2029**, the information service unit **2012**, and the like may be referred to as input units that accept inputs. For example, the PUSCH transmitted by the communication module **2013** may include information based on the inputs.

[0147] The communication module **2013** receives various types of information (traffic information, traffic signal information, inter-vehicle information, etc.) transmitted from the external device and displays them on the information service unit **2012** provided in the vehicle **2001**. The information service unit **2012** may be referred to as an output unit that outputs information (For example, based on PDSCH (or data or information decoded from PDSCH) received by the communication module **2013**, information is output to a device such as a display or a speaker.).

[0148] The communication module **2013** also stores various types of information received from the external device in the memory **2032** available by the microprocessor **2031**. Based on the information stored in the memory **2032**, the microprocessor **2031** may control the drive unit **2002**, the steering unit **2003**, the accelerator pedal **2004**, the brake pedal **2005**, the shift lever **2006**, the front wheels **2007**, the rear wheels **2008**, the axle **2009**, the sensor **2021-2029**, and the like provided in the vehicle **2001**.

Supplement to Embodiments

[0149] Although the embodiments of the present invention have been described above, the disclosed invention is not limited to such embodiments, and those skilled in the art will understand various variations, modifications, alternatives, substitutions, and the like. Although specific numerical examples have been used to facilitate understanding of the invention, these numerical values are merely examples and any suitable value may be used unless otherwise specified. The categorization of items in the above description is not essential to the present invention, and matters described in two or more items may be used in combination as necessary, and matters described in one item may be applied to matters described in another item (as long as they do not conflict). The boundaries of functional units or processing units in the functional block diagram do not necessarily correspond to boundaries of physical components. The operations of a plurality of functional units may be physically performed by a single component, or the operations of a single functional unit may be physically performed by a plurality of components. With respect to the processing procedures described in the embodiments, the order of processing may be interchanged as long as there is no conflict. For convenience of processing description, the base station **10** and the terminal **20** have been described using functional block diagrams, but such devices may be implemented in hardware, software, or a combination thereof. The software running on the processor of the base station **10** in accordance with an embodiment of the present invention and the software running on the processor of the terminal **20** in accordance with an embodiment of the present invention may be stored in random access memory (RAM), flash memory, read only memory (ROM), EPROM, EEPROM, registers, hard disk (HDD), removable disk, CD-ROM, database, server, or any other suitable storage medium, respectively.

[0150] The notification of information is not limited to the aspects and embodiments described in the present disclosure and may be performed using other methods. For example, the notification of information may be performed by physical layer signaling (e.g., DCI (Downlink Control Information), UCI (Uplink Control Information)), upper layer signaling (e.g., Radio Resource Control (RRC) signaling, Medium Access Control (MAC) signaling), broadcast information (MIB (Master Information Block), SIB (System Information Block)), other signals, or combinations thereof. The RRC signaling may also be referred to as an RRC message, and may be, for example, an RRC Connection Setup message, an RRC Connection Reconfiguration message, or the like.

[0151] Aspects and embodiments described in this disclosure may include, but are not limited to, systems utilizing LTE (Long Term Evolution), LTE-A (LTE-Advanced), SUPER 3G, IMT-Advanced, 4G (4th generation mobile communication system), 5G (5th generation mobile communication system), 6th generation mobile communication system (6G), xth generation mobile communication system (xG) (xG (x is, for example, an integer, a decimal)), FRA (Future Radio Access), NR (New Radio), New radio access (NX), Future generation radio access (FX), W-CDMA (registered trademark), GSM (registered trademark), CDMA2000, UMB (Ultra Mobile Broadband), IEEE 802.11 (Wi-Fi (registered trademark)), IEEE 802.16 (WiMAX (registered trademark)), IEEE 802.20, UWB (Ultra-WideBand), Bluetooth (registered trademark), other suitable systems, and extensions thereon, and may be applied to at least one of the modified, created, or defined next-generation systems. It may also be applied to a combination of systems (e.g., a combination of at least one of LTE or LTE-A, and 5G, etc.).

[0152] The processing procedures, sequences, flowcharts, etc., of the aspects and embodiments described herein may be interchanged in order as long as there is no conflict. For example, the methods described in this disclosure present the elements of the various steps using an exemplary order and are not limited to the particular order presented.

[0153] The particular operations described herein as being performed by base station **10** may in some cases be performed by its upper node. It will be apparent that in a network of one or more network nodes having base station **10**, the various operations performed for communication with terminal **20** may be performed by at least one of base station **10** or other network nodes (Examples include, but are not limited to, MME or S-GW.) other than base station **10**. Although one other network node other than base station **10** is illustrated above, the other network nodes may be a combination (e.g., MME and S-GW) of a plurality of other network nodes.

[0154] The information, signals, etc. described in the present disclosure may be output from an upper layer (or lower layer) to a lower layer (or upper layer). The information may be input or output via a plurality of network nodes.

[0155] The input or output information may be stored in a specific location (e.g., memory) or managed using a management table. Information and the like input and output may be overwritten, updated, or appended. Information and the like output may be deleted. Information and the like input may be transmitted to other devices.

[0156] Decisions in the present disclosure may be made by a value represented by a single bit (**0** or **1**), a true or false value (Boolean: true or false), or a numerical comparison (e.g., comparison with a predetermined value).

[0157] Software, whether referred to as software, firmware, middleware, microcode, hardware description language, or by any other name, should be broadly interpreted to mean instructions, instruction sets, codes, code segments, program codes, programs, subprograms, software modules, applications, software applications, software packages, routines, subroutines, objects, executables, execution threads, procedures, functions, and the like.

[0158] Software, instructions, information, and the like may also be transmitted and received over a transmission medium. For example, when software is transmitted from a website, server, or other remote source using at least one of wired (coaxial cable, fiber-optic cable, twisted-pair, digital subscriber line (DSL), etc.) or wireless (infrared rays, microwaves, etc.) technologies, at least one of these wired or wireless technologies is included within the definition of a transmission medium.

[0159] Information, signals, and the like described in this disclosure may be represented using any of a variety of different techniques. For example, data, instructions, commands, information, signals, bits, symbols, chips, and the like that may be referred to throughout the above description may be represented by voltages, currents, electromagnetic waves, magnetic fields or magnetic particles, light fields or photons, or any combination thereof.

[0160] The terms described in this disclosure and those necessary to understand the disclosure may be replaced with terms having the same or similar meanings. For example, at least one of the channels or symbols may be a signal (signaling). The signal may also be a message. The component carrier (CC) may also be referred to as a carrier frequency, cell, frequency carrier, etc.

[0161] As used herein, the terms "system" and "network" are used interchangeably.

[0162] Also, the information, parameters, etc. described in the present disclosure may be expressed using absolute values, relative values from predetermined values, or other corresponding information. For example, wireless resources may be indicated by an index.

[0163] The names used for the parameters described above are not in any way limiting. Furthermore, formulas, etc. using these parameters may differ from those explicitly disclosed in the present disclosure. Since the various channels (e.g., PUCCH, PDCCH, etc.) and information elements can be identified by any suitable name, the various names assigned to these various channels and information elements are not in any way limiting.

[0164] In the present disclosure, terms such as "base station (BS)", "wireless base station", "base station", "fixed station", "NodeB", "eNodeB (eNB)", "gNodeB (gNB)", "access point", "transmission point", "reception point", "transmission and reception point", "cell", "sector", "cell group", "carrier", "component carrier", and the like may be used interchangeably. Base stations may also be referred to by terms such as macrocell, small cell, femtocell, picocell, and the like.

[0165] A base station may accommodate one or more (e.g., three) cells. When a base station accommodates multiple cells, the entire coverage area of the base station may be partitioned into a plurality of smaller areas, and each smaller area may also provide communication services by a base station subsystem (e.g., a small indoor Remote Radio Head (RRH)). The term "cell" or "sector" refers to a portion or the entire coverage area of at least one of the base stations or base station subsystem providing communication services in this coverage.

[0166] In this disclosure, the transmission of information by the base station to a terminal may be replaced as the instruction from the base station to the terminal for an information-based control or operation.

[0167] In this disclosure, terms such as "mobile station (MS)", "user terminal", "user equipment (UE)", and "terminal" may be used interchangeably.

[0168] A mobile station may also be referred to by those skilled in the art as a subscriber station, mobile unit, subscriber unit, wireless unit, remote unit, mobile device, wireless device, wireless communication device, remote device, mobile subscriber station, access terminal, mobile terminal, wireless terminal, remote terminal, handset, user agent, mobile client, client, or some other suitable term.

[0169] At least one of the base stations o the mobile station may be referred to as a transmitter, receiver, communication device, etc. At least one of the base stations or the mobile station may be a device mounted on a mobile body, a mobile body itself, etc. The mobile body is an object that can move at any speed. It also naturally includes a case where the mobile body is stopped. Such vehicles include, but are not limited to, vehicles, transport vehicles, automobiles, motorcycles, bicycles, connected cars, excavators, bulldozers, wheel loaders, dump trucks, forklifts, trains, buses, carriages, rickshaws, ships and other watercrafts, airplanes, rockets, satellites, drones (registered trademark), multicopters, quadcopters, balloons, and objects mounted thereon. The mobile body may also be a mobile body that runs autonomously based on an operation command. It may be a vehicle (e.g., cars, airplanes, etc.), an unmanned mobile body (e.g, drones, self-driving cars, etc.), or a robot (manned or unmanned). Note that at least one of the base stations or the mobile station includes devices that do not necessarily move during communication operations. For example, at least one of the base stations or the mobile station may be an Internet of Things (IoT) device such as a sensor.

[0170] The base station in the present disclosure may be replaced with a user terminal. For example, each aspect and embodiment of the present disclosure may be applied to a configuration in which communication between the base station and the user terminal is replaced with communication between a plurality of terminals **20** (for example, it may be referred to as Device-to-Device (D2D) or Vehicle-to-Everything (V2X)). In this case, a configuration in which the terminal **20** has the function of the above-described base station **10** may be adopted. Further, words such as "up" and "down" may be replaced with words (e.g., "side") corresponding to communication between terminals. For example, an uplink channel, a downlink channel, and the like may be replaced with a side channel.

[0171] Similarly, a user terminal in the present disclosure may be replaced with a base station. In this case, a configuration in which the base station has the functions of the user terminal described above may be adopted.

[0172] The term "determining" as used in the present disclosure may encompass a wide variety of actions. The terms "determining" may include considering that judging, calculating, computing, processing, deriving, investigating, looking up (search, inquiry) (e.g., searching in a table, database or another data structure), and ascertaining have performed to be "determined". Moreover, "determining" may include considering that receiving (e.g., receiving information), transmitting (e.g., transmitting information), input, output, and accessing (e.g., accessing data in memory) have performed to be "determined" or "determined". Moreover, "determining" may include considering that resolving, selecting, choosing, establishing, and comparing have performed to be "determined" or "determined". That is, "determining" may include considering that some action is "determined" or "determined". Also, "determining" may be replaced with "assuming", "expecting", "considering", and the like.

[0173] The term "connected", "coupled", or any variation thereof, means any direct or indirect connection or connection between two or more elements, and may include the presence of one or more intermediate elements between two elements that are "connected" or "coupled" to each other. The connection or connection between the elements may be

physical, logical, or a combination thereof. For example, "connect" may be replaced with "access". As used in the present disclosure, two elements may be considered to be "connected" or "coupled" to each other using at least one of one or more wires, cables, or printed electrical connections, and by some non-limiting and non-exclusive examples, electromagnetic energy having wavelengths in the wireless frequency domain, microwave domain, and optical (both visible and invisible) domain, etc.

[0174] The reference signal may also be abbreviated RS (Reference Signal) and may be referred to as a Pilot depending on the applicable standard.

[0175] In the present disclosure, the term "based on"" does not mean "based only" unless otherwise specified. In other words, "based on" means both "based only" and "based at least on".

[0176] Any reference to elements using designations such as "first", "second", etc. as used in the present disclosure does not generally limit the amount or order of those elements. These designations may be used in the present disclosure as a convenient way to distinguish between two or more elements. Thus, references to the first and second elements do not mean that only two elements may be employed or that in any way the first element must precede the second element.

[0177] The term "means" in the foregoing configurations of devices may be replaced with "units", "circuits", "devices", and the like.

[0178] Where "include", "including", and variations thereof are used in the present disclosure, these terms are intended to be inclusive, as is the term "comprising". Furthermore, the term "or" as used in the present disclosure is intended not to be exclusive-OR.

[0179] A wireless frame may include one or more frames in the time domain. Each one or more frames in the time domain may be referred to as a subframe. The subframe may also include one or more slots in the time domain. The subframe may have a fixed time length (e.g., 1 ms) independent of numerology.

[0180] A numerology may be a communication parameter applied to at least one of transmission or reception of a signal or channel. The numerology may indicate at least one of, for example, subcarrier spacing (SCS), bandwidth, symbol length, cyclic prefix length, transmission time interval (TTI), number of symbols per TTI, wireless frame configuration, a particular filtering operation performed by the transceiver in the frequency domain, a particular windowing operation performed by the transmitter and receiver in the time domain, or the like.

[0181] The slot may consist of one or more symbols (OFDM (Orthogonal Frequency Division Multiplexing) symbols, SC-FDMA (Single Carrier Frequency Division Multiple Access) symbols, etc.) in the time domain. The slot may be a time unit based on numerology.

[0182] The slot may include a plurality of minislots. Each minislot may consist of one or more symbols in the time domain. The minislot may also be referred to as a subslot. The minislot may consist of fewer symbols than the slot. PDSCH (or PUSCH) transmitted in time units larger than the minislot may be referred to as PDSCH (or PUSCH) Mapping Type A. PDSCH (or PUSCH) transmitted using the minislot may be referred to as PDSCH (or PUSCH) Mapping Type B.

[0183] The wireless frame, the subframe, the slot, the minislot, and the symbol all represent time units in transmitting signals. The wireless frame, the subframe, the slot, the minislot, and the symbol may be referred to as different names corresponding to them.

[0184] For example, one subframe may be referred to as a transmission time interval (TTI), a plurality of consecutive subframes may be referred to as the TTI, and one slot or one minislot may be referred to as the TTI. That is, at least one of the subframe or the TTI may be the subframe (1 ms) in existing LTE, a period shorter than 1 ms (e.g., 1-13 symbols), or a period longer than 1 ms. Note that the unit representing TTI may be referred to as the slot, the minislot, or the like instead of the subframe.

[0185] Here, TTI means, for example, a minimum time unit for scheduling in wireless communication. For example, in an LTE system, the base station performs scheduling to allocate wireless resources (frequency bandwidth, transmission power, etc., that can be used by each terminal **20**) to each terminal **20** in TTI units. The definition of TTI is not limited to this.

[0186] The TTI may be a transmission time unit for channel-encoded data packets (transport blocks), code blocks, code words, or the like, or it may be a processing unit for scheduling, link adaptation, or the like. When TTI is given, a time interval (e.g., the number of symbols) in which the transport blocks, code blocks, code words, or the like are actually mapped may be shorter than the TTI.

[0187] When one slot or one minislot is referred to as TTI, one or more TTIs (i.e., one or more slots or one or more minislots) may be the minimum time unit for scheduling. The number of the slots (number of the minislots) constituting the minimum time unit for scheduling may be controlled.

[0188] A TTI having a time length of 1 ms may be referred to as a normal TTI (TTI in LTE Rel. 8-12), a normal TTI, a long TTI, a normal subframe, a normal subframe, a long subframe, a slot, or the like. A TTI shorter than the normal TTI may be referred to as a shortened TTI, a short TTI, a partial TTI (partial or fractional TTI), a shortened subframe, a short subframe, a minislot, a subslot, a slot, or the like.

[0189] The long TTI (e.g., normal TTI, subframe, etc.) may be replaced with a TTI having a time length over 1 ms, and the short TTI (e.g., shortened TTI, etc.) may be replaced with a TTI having a TTI length less than the TTI length of the long TTI and over or equal to 1 ms.

[0190] A resource block (RB) is a resource allocation unit in the time domain and the frequency domain, and may include one or more consecutive subcarriers in the frequency domain. The number of subcarriers included in the RB may be the same regardless of the numerology, for example, 12. The number of subcarriers included in an RB may be determined based on the numerology.

[0191] The time domain of the RB may include one or more symbols, and may have a length of one slot, one minislot, one subframe, or one TTI. Each one TTI, one subframe, or the like may consist of one or more resource blocks.

[0192] The one or more RBs may be referred to as a physical resource block (PRB), a sub-carrier group (SCG), a resource element group (REG), a PRB pair, an RB pair, or the like.

[0193] The resource block may consist of one or more resource elements (RE). For example, 1RE may consist of one sub-carrier and one symbol wireless resource area.

[0194] The bandwidth part (BWP) (may be referred to as a partial bandwidth, etc.) may represent a subset of consecutive common resource blocks (RBs) for a certain numerology in a certain carrier. Here, the common RB may be specified by an index of RBs with reference to a common reference point of the carrier. A PRB may be defined in a BWP and numbered within the BWP.

[0195] The BWP may include a BWP for UL (UL BWP) and a BWP for DL (DL BWP). One or more BWPs may be configured within a carrier for the terminal **20**.

[0196] At least one of the configured BWPs may be active, and the terminal **20** need not assume to transmit or receive a predetermined signal or channel outside of the active BWP. The terms "cell" and "carrier" in the present disclosure may be replaced with "BWP".

[0197] The structures of wireless frames, subframes, slots, minislots, symbols, and the like described above are exemplary only. For example, the number of subframes included in a wireless frame, the number of subframes or slots per wireless frame, the number of minislots included in a slot, the number of symbols and RBs included in a slot or minislot, the number of subcarriers included in an RB, and the number of symbols, symbol lengths, and cyclic prefix (CP) lengths in a TTI may be varied.

[0198] In the present disclosure, when articles are added by translation, for example, a, an, and the in English, the present disclosure may include that the nouns following these articles are plural.

[0199] In the present disclosure, the term "A and B are different" may mean "A and B are different from each other". The term may mean "A and B are different from C, respectively". Terms such as "separate" and "combined" may also be interpreted as "different".

[0200] Each of the aspects and embodiments described in the present disclosure may be used alone, in combination, or switched with the implementation. The notification of predetermined information (e.g., "X" notification) is not limited to an explicit one, but may be performed implicitly (e.g., no notification of the prescribed information).

[0201] Although the present disclosure has been described in detail above, it will be apparent to those skilled in the art that the present disclosure is not limited to the embodiments described in the present disclosure. the present invention is not limited to these embodiments, but various variations and modifications may be made without departing from the scope of the present invention. Accordingly, the description of the present disclosure is for illustrative purposes only and does not have any restrictive meaning to the present disclosure.

DESCRIPTION OF CODES

[0202] **10** base station
[0203] **110** transmitting unit
[0204] **120** receiving unit
[0205] **130** configuration unit
[0206] **140** controller
[0207] **20** terminal
[0208] **210** transmitting unit
[0209] **220** receiving unit
[0210] **230** configuration unit
[0211] **240** controller
[0212] **1001** processor
[0213] **1002** storage device
[0214] **1003** auxiliary storage device
[0215] **1004** communication device
[0216] **1005** input device
[0217] **1006** output device
[0218] **2001** vehicle
[0219] **2002** drive unit
[0220] **2003** steering unit
[0221] **2004** accelerator pedal
[0222] **2005** brake pedal
[0223] **2006** shift lever
[0224] **2007** front wheel
[0225] **2008** rear wheel
[0226] **2010** electronic controller
[0227] **2012** information service unit
[0228] **2013** communication module
[0229] **2021** current sensor
[0230] **2022** rotational speed sensor
[0231] **2023** air pressure sensor
[0232] **2024** vehicle speed sensor
[0233] **2025** acceleration sensor
[0234] **2026** brake pedal sensor
[0235] **2027** shift lever sensor
[0236] **2028** object detection sensor
[0237] **2029** accelerator pedal sensor
[0238] **2030** driver support system unit
[0239] **2031** microprocessor
[0240] **2032** memory (ROM, RAM)
[0241] **2033** communication port (IO port)

1. A terminal comprising:

a communication unit configured to transmit and receive a random access channel; and

a controller configured to assume that the random access channel is transmitted and received based on at least one of: a configuration of the random access channel set individually for a second terminal with reduced functions that is different from a terminal without reduced functions or a first terminal with reduced functions; a configuration of the random access channel set individually for the first terminal with reduced functions; or a configuration of the random access channel for the terminal without reduced functions;

wherein second functions, which are different from first functions reduced in the first terminal with reduced functions, are reduced.

2. The terminal according to claim **1**, wherein the controller is configured to assume that the random access channel is transmitted and received based on the configuration set individually for the random access channel for the second terminal with reduced functions.

3. The terminal according to claim **1**, wherein the controller is configured to assume that the random access channel is transmitted and received based on the configuration set individually for the random access channel for the first terminal with reduced functions.

4. The terminal according to claim **1**, wherein the controller is configured to assume that the random access channel is transmitted and received based on the configuration set individually for the random access channel for the terminal without reduced functions.

5. A base station comprising:

a communication unit configured to perform transmission and reception of a random access channel with a terminal; and

a controller configured to assume that the transmission and reception of the random access channel is performed with the terminal based on at least one of: a configuration of the random access channel set individually for a second terminal with reduced functions that is different from a terminal without reduced functions or a first terminal with reduced functions; a configuration of the random access channel set individually for the first terminal with reduced functions; or a configuration of the random access channel for the terminal without reduced functions;

wherein in the terminal, second functions, which are different from first functions reduced in the first terminal with reduced functions, are reduced.

6. A communication method comprising:

transmitting and receiving a random access channel; and

assuming that the random access channel is transmitted and received based on at least one of: a configuration of the random access channel set individually for a second terminal with reduced functions that is different from a terminal without reduced functions or a first terminal with reduced functions; a configuration of the random access channel set individually for the first terminal with reduced functions; or a configuration of the random access channel for the terminal without reduced functions;

wherein second functions, which are different from first functions reduced in the first terminal with reduced functions, are reduced.

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