

or another name. For ease of description, the following embodiments use the BWP as an example for description, but this is not limited in this application.

[00122] It should be noted that with continuous development of technologies, terms in embodiments of this application may change, but all of them fall within the protection scope of this application.

[00123] FIG. 1 is a schematic diagram of a communications system according to this application. The communications system in FIG. 1 may include at least one terminal (for example, a terminal 10, a terminal 20, a terminal 30, a terminal 40, a terminal 50, and a terminal 60) and a network device 70. The network device 70 is configured to provide a communications service for the terminal and access a core network. The terminal may access a network by searching for a synchronization signal, a broadcast signal, or the like sent by the network device 70, to communicate with the network. The terminal 10, the terminal 20, the terminal 30, the terminal 40, and the terminal 60 in FIG. 1 may perform uplink and downlink transmission with the network device 70. For example, the network device 70 may send downlink signals to the terminal 10, the terminal 20, the terminal 30, the terminal 40, and the terminal 60, and may receive uplink signals sent by the terminal 10, the terminal 20, the terminal 30, the terminal 40, and the terminal 60.

[00124] In addition, the terminal 40, the terminal 50, and the terminal 60 may also be considered as a communications system. The terminal 60 may send downlink signals to the terminal 40 and the terminal 50, or may receive uplink signals sent by the terminal 40 and the terminal 50.

[00125] It should be noted that embodiments of this application may be applied to a communications system including one or more network devices, and may also be applied to a communications system including one or more terminals. This is not limited in this application.

[00126] It should be understood that the communications system may include one or more network devices. One network device may send data or control signaling to one or more terminals. A plurality of network devices may simultaneously send data or control signaling to one or more terminals.

[00127] FIG. 2 is a schematic diagram of a random access process of a four-step random access type in a conventional solution. After selecting a proper cell to complete camping, a terminal may initiate random access. As shown in FIG. 42, UE sends a message 1 (message 1,

msg 1) to a network device. The message 1 is a random access preamble (preamble). After detecting the random access preamble, the network device returns a response message, that is, a message 2 (message 2), to the UE. The message 2 includes an uplink resource allocated by the network device to the UE. After receiving the message 2, the UE sends a message 3 on the uplink resource indicated by the message 2. If the network device can correctly decode the message 3 (message 3), the network device returns a message 4 (message 4) to the UE. The message 4 is used to notify the UE of a success in contention. After the foregoing four steps, a random access procedure succeeds.

[00128] FIG. 3 is a schematic diagram of a random access process of a two-step random access type in a conventional solution. In the two-step random access process, UE adds both a random access preamble and data (preamble and data) to a message A. The data part is used for contention resolution, for example, a radio resource control (radio resource control, RRC) message. If there is no conflict between UEs, a network device returns a message B to the UE after successfully decoding the message 1A. The message B includes both a response to the random access preamble and a response to the data. The response to the random access preamble is a random access response (random access response, RAR). The response to the data is usually an RRC message. The two responses may be sent simultaneously or sequentially. The UE may independently decode the two responses. After receiving the message 2B, the UE learns that random access succeeds.

[00129] It may be understood that, if there is a conflict between UEs, the network device may not successfully decode the data in the message A. In this case, the network device does not send the message 2B to the UE. After sending the message 1A, the UE waits for a time window. If the UE does not receive the message 2B, the UE considers that random access fails.

[00130] In a conventional solution, a terminal may generate, based on a random access formula, a random access signal used for random access. For example, the random access formula is as follows:

$$S^{(p,\mu)}(t) = \sum_{k=0}^{L_{RA}-1} a_k^{(p,RA)} e^{j2\pi(k + Kk_1 + \bar{k})\Delta f_{RA}(t-t_0)} \quad (1)$$

where $K = \Delta f / \Delta f_{RA}$, $K = \Delta f / \Delta f_{RA}$, p is an antenna port index, μ is an index of a data subcarrier spacing, L_{RA} is a random access preamble length, $a_k^{(p,RA)}$ is a k^{th} value

spacing, N_{RB}^{RA} represents a total quantity of frequency domain resource blocks allocated to a random access signal, N represents a quantity of subcarriers in one RB, and L_{RA} represents the random access preamble length. $*$ represents multiplication, and may also be denoted as $\times$.

[00156] It may be understood that, in NR, a quantity of subcarriers in one RB may be 12. In the following embodiment, $N=12$ is used as an example for description. However, this application is not limited thereto.

[00157] It may be understood that N_{RB}^{RA} may be known, or may be determined by using the following formula (3), which is not limited in this application:

$$N_{RB}^{RA} = \text{ceil}(L_{RA} * \Delta f_{RA} / (\Delta f * N)) \quad (3)$$

where L_{RA} represents the random access preamble length, N_{RB}^{RA} represents the total quantity of frequency domain resource blocks allocated to the random access signal, N represents the quantity of subcarriers in one RB, Δf represents the data subcarrier spacing, Δf_{RA} represents the random access signal subcarrier spacing, and ceil represents rounding up.

[00158] For example, if $N=12$, $L_{RA}=139$, $\Delta f_{RA}=240$ KHz, and $\Delta f=60$ KHz, $N_{RB}^{RA}=\text{ceil}(139*240/(60*12))=47$, that is, one random access signal occupies 47 RBs in frequency domain.

[00159] Correspondingly, $GP=47*(60*12)-139*240=48000$ KHz may be obtained based on formula (2).

[00160] It may be further understood that, the terminal may alternatively directly determine the subcarrier quantity parameter based on the random access preamble length, the random access signal subcarrier spacing, and the data subcarrier spacing, for example, by using the following formula (4), that is, the terminal does not need to learn the intermediate parameter N_{RB}^{RA} :

$$GP = \text{ceil}(L_{RA} * \Delta f_{RA} / (\Delta f * N)) * (\Delta f * N) - L_{RA} * \Delta f_{RA} \quad (4)$$

where GP represents the total subcarrier quantity frequency domain width, L_{RA} represents the random access preamble length, N_{RB}^{RA} represents the total quantity of frequency domain resource blocks allocated to the random access signal, N represents the quantity of subcarriers in one RB, Δf represents the data subcarrier spacing, Δf_{RA} represents the random

access signal subcarrier spacing, and ceil represents rounding up.

[00161] Optionally, the first subcarrier quantity and the second subcarrier quantity are the same.

5 **[00162]** Specifically, the guard interval 1 and the guard interval 2 may be the same, so that the terminal may implement same impact on data demodulation at two ends of the random access signal, thereby reducing complexity of the terminal.

[00163] Optionally, when the first subcarrier quantity and the second subcarrier quantity are the same, the total subcarrier quantity frequency domain width, the random access signal subcarrier spacing, the data subcarrier spacing, and the subcarrier quantity parameter meet the
10 following relationship:

$$\bar{k} = \frac{(\frac{GP}{2} - \frac{\Delta f}{2})}{\Delta f_{RA}} + 0.5 \quad (5)$$

where GP represents the total subcarrier quantity frequency domain width, Δf represents the data subcarrier spacing, Δf_{RA} represents the random access signal subcarrier spacing, and $\bar{k}$ represents the subcarrier quantity parameter.

15 **[00164]** Specifically, as shown in FIG. 67, that the guard interval 1 and the guard interval are the same means that the guard interval 1 or the guard interval 2 is GP/2, and GP/2 meets the following relationship:

$$GP/2 = \Delta f_{RA} \bar{k} - \Delta f_{RA}/2 + \Delta f/2 \quad (6)$$

[00165] In this way, formula (5) may be derived from formula (6).

20 **[00166]** It may be understood that any transformation performed on formula (5) falls within the protection scope of this application.

[00167] Optionally, the terminal may store the following table (Table 1). For example, the random access preamble length may be 139, and a value of $\bar{k}$ may be shown in the following Table 1. In this way, when learning L_{RA} , Δf , and Δf_{RA} , the terminal may obtain the value of
25 $\bar{k}$ by searching the table.

[00224] Optionally, the subcarrier quantity parameter $\bar{k}$ conforms to:

$$\bar{k} = \frac{(0 - \frac{\Delta f}{2})}{\Delta f_{RA}} + 0.5,$$

where Δf represents the data subcarrier spacing, Δf_{RA} represents the random access signal subcarrier spacing, and $\bar{k}$ represents the subcarrier quantity parameter.

5 [00225] For more detailed descriptions of the transceiver module 810 and the processing module 820, refer to related descriptions in the foregoing method embodiments. Details are not described herein again.

[00226] FIG. 9 shows a communications apparatus 900 according to an embodiment of this application. The apparatus 900 may be the terminal in FIG. 6. The apparatus may use a hardware
10 architecture shown in FIG. 9. The apparatus may include a processor 910 and a transceiver ~~930~~920. Optionally, the apparatus may further include a memory ~~940~~930. The processor 910, the transceiver ~~930~~920, and the memory ~~940~~930 communicate with each other by using an internal connection path. A related function implemented by the processing module 820 in FIG. 8 may be implemented by the processor 910, and a related function implemented by the transceiver
15 module 810 may be implemented by the processor 910 controlling the transceiver ~~920~~930.

[00227] Optionally, the processor 910 may be a general-purpose central processing unit (central processing unit, CPU), a microprocessor, an application-specific integrated circuit (application-specific integrated circuit, ASIC), a dedicated processor, or one or more integrated circuits configured to perform the technical solutions in the embodiments of this application.
20 Alternatively, the processor herein may refer to one or more devices, circuits, and/or processing cores configured to process data (for example, computer program instructions). For example, the processor may be a baseband processor or a central processing unit. The baseband processor may be configured to process a communications protocol and communications data. The central processing unit may be configured to: control a communications apparatus (for example, a base
25 station, a terminal, or a chip), execute a software program, and process data of the software program.

[00228] Optionally, the processor 910 may include one or more processors, for example, one or more central processing units (central processing unit, CPU). When the processor is one CPU, the CPU may be a single-core CPU, or may be a multi-core CPU.

[00229] The transceiver ~~930-920~~ is configured to send and receive data and/or signals. The transceiver may include a transmitter and a receiver. The transmitter is configured to send data and/or a signal, and the receiver is configured to receive data and/or a signal.

[00230] The memory ~~940-930~~ includes, but is not limited to, a random access memory (random access memory, RAM), a read-only memory (read-only memory, ROM), an erasable programmable memory (erasable programmable read only memory, EPROM), and a compact disc read-only memory (compact disc read-only memory, CD-ROM). The memory ~~940-930~~ is configured to store related instructions and data.

[00231] The memory ~~940-930~~ is configured to store program code and data of the terminal, and may be an independent component or integrated into the processor 910.

[00232] Specifically, the processor 910 is configured to control the transceiver to perform information transmission with a ~~network device~~~~terminal~~. For details, refer to the descriptions in the foregoing method embodiments. Details are not described herein again.

[00233] In specific implementation, in an embodiment, the apparatus 900 may further include an output device and an input device. The output device communicates with the processor 910, and may display information in a plurality of manners. For example, the output device may be a liquid crystal display (liquid crystal display, LCD), a light emitting diode (light emitting diode, LED) display device, a cathode ray tube (cathode ray tube, CRT) display device, or a projector (projector). The input device communicates with the processor 910, and may receive a user input in a plurality of manners. For example, the input device may be a mouse, a keyboard, a touchscreen device, or a sensor device.

[00234] It may be understood that FIG. 9 shows only a simplified design of the communications apparatus. In actual application, the apparatus may further include other necessary elements, including but not limited to any quantity of transceivers, processors, controllers, memories, or the like. All elements that can implement the terminal in this application fall within the protection scope of this application.

[00235] In a possible design, the apparatus 900 may be a chip, for example, may be a communications chip that may be used in the terminal, and is configured to implement a related function of the processor 910 in the terminal. The chip may be a field programmable gate array, a special integrated chip, a system chip, a central processing unit, a network processor, a digital signal processing circuit, or a microcontroller for implementing a related function, or may be a

frequency circuit performs radio frequency processing on the baseband signal and then sends a radio frequency signal to the outside in a form of an electromagnetic wave through the antenna. When data is sent to the terminal, the radio frequency circuit receives a radio frequency signal through the antenna, converts the radio frequency signal into a baseband signal, and outputs the baseband signal to the processor. The processor converts the baseband signal into data, and processes the data. For ease of description, FIG. 12 shows only one memory and one processor. An actual terminal product may include one or more processors and one or more memories. The memory may also be referred to as a storage medium, a storage device, or the like. The memory may be disposed independent of the processor, or may be integrated with the processor. This is not limited in this embodiment of this application.

[00266] In this embodiment of this application, the antenna and the radio frequency circuit that have a transceiver function may be considered as a transceiver unit of the terminal, and the processor having a processing function may be considered as a processing unit of the terminal. As shown in FIG. 12, the terminal includes a transceiver unit 1210 and a processing unit 1220. The transceiver unit may also be referred to as a transceiver, ~~a transceiver~~, a transceiver apparatus, or the like. The processing unit may also be referred to as a processor, a processing board, a processing module, a processing apparatus, or the like. Optionally, a component that is in the transceiver unit 1210 and that is configured to implement a receiving function may be considered as a receiving unit, and a component that is in the transceiver unit 1210 and that is configured to implement a sending function may be considered as a sending unit. In other words, the transceiver unit 1210 includes the receiving unit and the sending unit. The transceiver unit sometimes may also be referred to as a transceiver, ~~a transceiver~~, a transceiver circuit, or the like. The receiving unit sometimes may also be referred to as a receiver, ~~a receiver~~, a receiver circuit, or the like. The sending unit sometimes may also be referred to as a transmitter, ~~a transmitter~~, a transmitter circuit, or the like.

[00267] It should be understood that, the transceiver unit 1210 is configured to perform a sending operation and a receiving operation on the terminal side in the foregoing method embodiments, and the processing unit 1220 is configured to perform another operation on the terminal in the foregoing method embodiments other than the receiving and sending operations.

[00268] For example, in an implementation, the processing unit 1220 is configured to perform processing step 602 and step 603 on the terminal side in FIG. 6. The transceiver unit 1210 is

one or more CUs 1502. The CU 1502 may communicate with a next generation core network (NG core, NC). The DU 1501 may include at least one antenna 15011, at least one radio frequency unit 15011~~2~~, at least one processor 15013, and at least one memory 15014. The DU 1501 part is mainly configured for receiving and sending of radio frequency signals, conversion
5 between a radio frequency signal and a baseband signal, and some baseband processing. The CU 1502 may include at least one processor 15022 and at least one memory 15021. The CU 1502 and the DU 1501 may communicate by using an interface. A control plane (control plane) interface may be Fs-C, for example, F1-C, and a user plane (user plane) interface may be Fs-U, for example, F1-U.

10 **[00273]** The CU 1502 part is mainly configured to perform baseband processing, control the base station, and the like. The DU 1501 and the CU 1502 may be physically disposed together, or may be physically disposed separately, that is, a distributed base station. The CU 1502 is a control center of the base station, may also be referred to as a processing unit, and may be configured to complete baseband processing functions. For example, the CU 1502 may be
15 configured to control the base station to perform an operation procedure related to the network device in the foregoing method embodiments.

[00274] Specifically, baseband processing on the CU and the DU may be divided based on wireless network protocol layers. For example, functions of a packet data convergence layer protocol (packet data convergence protocol, PDCP) layer and an upper protocol layer are set on
20 the CU, protocol layers below the PDCP, for example, a radio link control (radio link control, RLC) layer and a medium access control (medium access control, MAC) layer are set on the DU. For another example, the CU implements functions of radio resource control (radio resource control, RRC) and packet data convergence protocol (packet data convergence protocol, PDCP) layers, and the DU implements functions of radio link control (radio link control, RLC), MAC,
25 and physical (physical, PHY) layers.

[00275] In addition, optionally, the base station 150 may include one or more radio frequency units (RUs), one or more DUs, and one or more CUs. The DU may include at least one processor 15013 and at least one memory 15014, the RU may include at least one antenna 15011 and at
least one radio frequency unit ~~15011~~15012, and the CU may include at least one processor 15022
30 and at least one memory 15021.

[00276] For example, in an implementation, the processor 15013 is configured to perform a

processing step on the network device side in FIG. 6. The radio frequency unit ~~15011~~15012 is configured to perform receiving and sending operations in steps 601 and 604 in FIG. 6.

[00277] In an example, the CU 1502 may include one or more boards. A plurality of boards may all support a radio access network of a single access standard (for example, a 5G network), or may respectively support radio access networks of different access standards (for example, an LTE network, a 5G network, or other networks). The memory 15021 and the processor 15022 may serve one or more boards. In other words, a memory and a processor may be deployed on each board. Alternatively, a plurality of boards may share a same memory and a same processor. In addition, a necessary circuit may be further disposed on each board. The DU 1501 may include one or more boards. A plurality of boards may all support a radio access network of a single access standard (for example, a 5G network), or may respectively support radio access networks of different access standards (for example, an LTE network, a 5G network, or other networks). The memory 15014 and the processor 15013 may serve one or more boards. In other words, a memory and a processor may be deployed on each board. Alternatively, a plurality of boards may share a same memory and a same processor. In addition, a necessary circuit may be further disposed on each board.

[00278] All or some of the foregoing embodiments may be implemented by using software, hardware, firmware, or any combination thereof. When software is used to implement the embodiments, all or a part of the embodiments may be implemented in a form of a computer program product. The computer program product includes one or more computer instructions. When the computer instructions are loaded and executed on the computer, the procedure or functions according to the embodiments of this application are all or partially generated. The computer may be a general-purpose computer, a dedicated computer, a computer network, or another programmable apparatus. The computer instructions may be stored in a computer-readable storage medium or may be transmitted from a computer-readable storage medium to another computer-readable storage medium. For example, the computer instructions may be transmitted from a website, computer, server, or data center to another website, computer, server, or data center in a wired (for example, a coaxial cable, an optical fiber, or a digital subscriber line (digital subscriber line, DSL)) or wireless (for example, infrared, radio, or microwave) manner. The computer-readable storage medium may be any usable medium accessible by the computer, or a data storage device, for example, a server or a data center,

CLAIMS

What is claimed is:

1. A method for transmitting a random access signal, comprising:

receiving configuration information, wherein the configuration information is used to
5 indicate a random access preamble length, a random access signal subcarrier spacing, and a data
subcarrier spacing;

determining a subcarrier quantity parameter $\bar{k}$ based on at least one of the random access
preamble length, the random access signal subcarrier spacing, ~~and/or~~ the data subcarrier spacing,
~~wherein the subcarrier quantity parameter comprises a first subcarrier quantity used to indicate a~~
10 ~~frequency resource start location of a random access preamble and a frequency resource start~~
~~location of a physical random access channel, and/or a second subcarrier quantity used to~~
~~indicate a frequency resource end location of the random access preamble and a frequency~~
~~resource end location of the physical random access channel;~~

wherein a value of the random access signal subcarrier spacing is 120 kHz, wherein a value
15 of the data subcarrier spacing is any one of 240 kHz, 480 kHz, 960 kHz, 1920 kHz, 3840 kHz; or

wherein a value of the random access signal subcarrier spacing is 480 kHz , wherein a value
of the data subcarrier spacing is any one of 120kHz, 240 kHz, 480 kHz, 960 kHz, 1920 kHz,
3840 kHz; or

wherein a value of the random access signal subcarrier spacing is 960 kHz , wherein a value
20 of the data subcarrier spacing is any one of 120kHz, 240 kHz, 480 kHz, 960 kHz, 1920 kHz,
3840 kHz;

generating a random access signal based on the subcarrier quantity parameter $\bar{k}$; and
sending the random access signal.

~~2. The method according to claim 1, wherein a value of the random access signal subcarrier~~
25 ~~spacing is any one of 120 kHz, 240 kHz, 480 kHz, 960 kHz, 1920 kHz, and 3840 kHz.~~

~~3. The method according to claim 1 or 2, wherein a value of the data subcarrier spacing is~~
~~any one of 240 kHz, 480 kHz, 960 kHz, 1920 kHz, and 3840 kHz.~~

~~4. The method according to at least one of claims 1 to 3, wherein a value of the subcarrier~~
~~quantity parameter is any one of 15, 7, 5, 3, 1, 0, 1, 2, 3, 19, 23, 83, and 107.~~

5. The method according to any one of claims 1 to 4, wherein the determining a subcarrier quantity parameter based on at least one of the random access preamble length, the random access signal subcarrier spacing, and the data subcarrier spacing comprises:

determining a total subcarrier quantity frequency domain width based on the random access preamble length, the random access signal subcarrier spacing, and the data subcarrier spacing; and

determining the subcarrier quantity parameter based on the total subcarrier quantity frequency domain width, the random access signal subcarrier spacing, and the data subcarrier spacing.

6. The method according to any one of claims 1 to 4, wherein the determining a subcarrier quantity parameter based on at least one of the random access preamble length, the random access signal subcarrier spacing, and the data subcarrier spacing comprises:

determining the subcarrier quantity parameter in the second target parameter based on the random access signal subcarrier spacing and the data subcarrier spacing in the first target parameter.

7. The method according to any one of claims 1 to 6, wherein the first subcarrier quantity and the second subcarrier quantity are the same.

8. The method according to claim 7, wherein the determining the subcarrier quantity parameter based on the total subcarrier quantity frequency domain width, the random access signal subcarrier spacing, and the data subcarrier spacing comprises:

wherein the subcarrier quantity parameter $\bar{k}$ conforms to:

$$k = \text{floor}\left(\frac{\left(\frac{GP}{2} - \frac{\Delta f}{2}\right)}{\Delta f_{RA}} + 0.5\right)$$

$$\bar{k} = \frac{\left(\frac{GP}{2} - \frac{\Delta f}{2}\right)}{\Delta f_{RA}} + 0.5$$

or

$$\bar{k} = \text{floor}\left(\frac{((12N_{RB}^{\mu} - 1) \times \Delta f - (L_{RA} - 1) \times \Delta f_{RA})}{2\Delta f_{RA}}\right) \bar{k} = \text{floor}\left(\frac{((12N_{RB}^{\mu} - 1) \times \Delta f - (L_{RA} - 1) \times \Delta f_{RA})}{2\Delta f_{RA}}\right)$$

wherein $GP = N_{RB}^{RA} * (\Delta f * N) - L_{RA} * \Delta f_{RA}$ GP represents the total subcarrier quantity frequency domain width, Δf represents the data subcarrier spacing, Δf_{RA} represents the

random access signal subcarrier spacing, and $\bar{k}$ represents the subcarrier quantity parameter, $N_{RB_{RA}}$ represents total quantity of frequency domain resource blocks allocated to the random access signal, N represents the number of subcarriers in one resource block RB, $N=12$, L_{RA} represents the length of the random access preamble.

- 5 93. The method according to claim 7 or 81 or 2, wherein L_{RA} , Δf , Δf_{RA} , and $\bar{k}$ meet at least one of the following correspondences:

L_{RA}	Δf_{RA}	Δf	$\bar{k}$
<u>139</u>	<u>120</u>	<u>480</u>	<u>1</u>
<u>139</u>	<u>120</u>	<u>960</u>	<u>23</u>
<u>139</u>	<u>480</u>	<u>480</u>	<u>2</u>
<u>139</u>	<u>480</u>	<u>960</u>	<u>2</u>
<u>139</u>	<u>960</u>	<u>960</u>	<u>2</u>
<u>571</u>	<u>120</u>	<u>480</u>	<u>1</u>
<u>571</u>	<u>480</u>	<u>960</u>	<u>2</u>

L_{RA}	Δf_{RA}	Δf	$\bar{k}$
139	240	240	2
139	480	480	2
139	960	960	2
139	1920	1920	2
139	3840	3840	2
571	240	240	2
571	960	960	2
571	1920	1920	2
571	3840	3840	2
1151	480	480	0
1151	960	960	0
1151	1920	1920	0
1151	3840	3840	0

wherein Δf represents the data subcarrier spacing, Δf_{RA} represents the random access signal subcarrier spacing, $\bar{k}$ represents the subcarrier quantity parameter, and L_{RA} represents the random access preamble length.

5 104. The method according to claim 7 or 81 or 2, wherein L_{RA} , Δf , Δf_{RA} , and $\bar{k}$ meet at least one of the following correspondences:

L_{RA}	Δf_{RA}	Δf	$\bar{k}$
139	960	480	2
571	480	480	2

L_{RA}	Δf_{RA}	Δf	$\bar{k}$
139	120	240	2
139	120	480	1
139	240	480	2
139	120	960	23
139	240	960	1
139	480	960	2
139	120	1920	19
139	240	1920	23
139	480	1920	1
139	960	1920	2
139	120	3840	107
139	240	3840	19
139	480	3840	23
139	960	3840	1
139	1920	3840	2
571	120	240	2
571	120	480	1
571	240	480	2

I_{RA}	Δf_{RA}	Δf	$\bar{k}$
571	120	960	-1
571	240	960	1
571	480	960	2
571	120	1920	-5
571	240	1920	-1
571	480	1920	1
571	960	1920	2
571	120	3840	83
571	240	3840	-5
571	480	3840	-1
571	960	3840	1
571	1920	3840	2
1151	120	240	0
1151	120	480	-1
1151	240	480	0
1151	120	960	-3
1151	240	960	-1
1151	480	960	0
1151	120	1920	-7
1151	240	1920	-3
1151	480	1920	-1
1151	960	1920	0
1151	120	3840	-15
1151	240	3840	-7
1151	480	3840	-3
1151	960	3840	-1
1151	1920	3840	0

wherein Δf represents the data subcarrier spacing, Δf_{RA} represents the random access signal subcarrier spacing, $\bar{k}$ represents the subcarrier quantity parameter, and L_{RA} represents the random access preamble length.

11. The method according to any one of claims 1 to 5, wherein the first subcarrier quantity and the total subcarrier quantity frequency domain width are the same, and the second subcarrier quantity is zero.

12. The method according to claim 11, wherein the determining the subcarrier quantity parameter based on the total subcarrier quantity frequency domain width, the random access signal subcarrier spacing, and the data subcarrier spacing comprises:

the subcarrier quantity parameter $\bar{k}$ conforms to:

$$\bar{k} = \frac{(GP - \frac{\Delta f}{2})}{\Delta f_{RA}} + 0.5,$$

wherein GP represents the total subcarrier quantity frequency domain width, Δf represents the data subcarrier spacing, Δf_{RA} represents the random access signal subcarrier spacing, and $\bar{k}$ represents the subcarrier quantity parameter.

13. The method according to any one of claims 1 to 6, wherein the first subcarrier quantity is zero, and the second subcarrier quantity and the total subcarrier quantity frequency domain width are the same.

14. The method according to claim 13, wherein the determining the subcarrier quantity parameter based on the random access signal subcarrier spacing and the data subcarrier spacing comprises:

the subcarrier quantity parameter $\bar{k}$ conforms to:

$$\bar{k} = \frac{(GP - \frac{\Delta f}{2})}{\Delta f_{RA}} + 0.5,$$

wherein GP represents the total subcarrier quantity frequency domain width, Δf represents the data subcarrier spacing, Δf_{RA} represents the random access signal subcarrier

spacing, and $\bar{k}$ represents the subcarrier quantity parameter.

155. A method for transmitting a random access signal, comprising:

sending configuration information, wherein the configuration information is used to indicate a random access preamble length, a random access signal subcarrier spacing, and a data subcarrier spacing; and

receiving a random access signal, wherein the random access signal is generated based on a subcarrier quantity parameter $\bar{k}$, the subcarrier quantity parameter $\bar{k}$ is determined by at least one of the random access preamble length, the random access signal subcarrier spacing, and/or the data subcarrier spacing, and the subcarrier quantity parameter comprises a first subcarrier quantity used to indicate a frequency resource start location of a random access preamble and a frequency resource start location of a physical random access channel, and/or a second subcarrier quantity used to indicate a frequency resource end location of the random access preamble and a frequency resource end location of the physical random access channel wherein a value of the random access signal subcarrier spacing is 120 kHz, wherein a value of the data subcarrier spacing is any one of 240 kHz, 480 kHz, 960 kHz, 1920 kHz, 3840 kHz; or

wherein a value of the random access signal subcarrier spacing is 480 kHz, wherein a value of the data subcarrier spacing is any one of 120kHz, 240 kHz, 480 kHz, 960 kHz, 1920 kHz, 3840 kHz; or

wherein a value of the random access signal subcarrier spacing is 960 kHz, wherein a value of the data subcarrier spacing is any one of 120kHz, 240 kHz, 480 kHz, 960 kHz, 1920 kHz, 3840 kHz.

6. The method according to claim 5, wherein the subcarrier quantity parameter $\bar{k}$ conforms to:

$$\bar{k} = \text{floor}\left(\frac{\left(\frac{GP}{2} - \frac{\Delta f}{2}\right)}{\Delta f_{RA}} + 0.5\right)$$

$$\bar{k} = \frac{\left(\frac{GP}{2} - \frac{\Delta f}{2}\right)}{\Delta f_{RA}} + 0.5, \text{ or } \bar{k} = \text{floor}\left(\frac{((12N_{RB} - 1) \times \Delta f - (L_{RA} - 1) \times \Delta f_{RA})}{2\Delta f_{RA}}\right)$$

wherein $GP = N_{RB}^{RA} * (\Delta f * N) - L_{RA} * \Delta f_{RA}$, Δf represents the data subcarrier spacing, Δf_{RA} represents the random access signal subcarrier spacing, and $\bar{k}$ represents the subcarrier quantity parameter, N_{RB}^{RA} represents total quantity of frequency domain resource blocks allocated to the random access signal, N represents the number of subcarriers in one resource block RB, N=12, L_{RA} represents the length of the random access preamble.

7. The method according to claim 5 or 6, wherein L_{RA} , Δf , Δf_{RA} , and $\bar{k}$ meet at least one of the following correspondences:

L_{RA}	Δf_{RA}	Δf	$\bar{k}$
139	120	480	1
139	120	960	23
139	480	480	2
139	480	960	2
139	960	960	2
571	120	480	1
571	480	960	2

8. The method according to claim 5 or 6, wherein L_{RA} , Δf , Δf_{RA} , and $\bar{k}$ meet at least one of the following correspondences:

L_{RA}	Δf_{RA}	Δf	$\bar{k}$
139	960	480	2
571	480	480	2

9. An apparatus for transmitting a random access signal, comprising:
a transceiver module, configured to receive configuration information, wherein the configuration information is used to indicate a random access preamble length, a random access signal subcarrier spacing, and a data subcarrier spacing; and

a processing module, configured to determine a subcarrier quantity parameter $\bar{k}$ based on at least one of the random access preamble length, the random access signal subcarrier spacing, and the data subcarrier spacing, wherein a value of the random access signal subcarrier spacing is 120 kHz, wherein a value of the data subcarrier spacing is any one of 240 kHz, 480 kHz, 960 kHz, 1920 kHz, 3840 kHz; or

wherein a value of the random access signal subcarrier spacing is 480 kHz , wherein a value of the data subcarrier spacing is any one of 120kHz, 240 kHz, 480 kHz, 960 kHz, 1920 kHz, 3840 kHz; or

wherein a value of the random access signal subcarrier spacing is 960 kHz , wherein a value of the data subcarrier spacing is any one of 120kHz, 240 kHz, 480 kHz, 960 kHz, 1920 kHz, 3840 kHz~~wherein the subcarrier quantity parameter comprises a first subcarrier quantity used to indicate a frequency resource start location of a random access preamble and a frequency resource start location of a physical random access channel, and/or a second subcarrier quantity used to indicate a frequency resource end location of the random access preamble and a frequency resource end location of the physical random access channel, wherein~~

the processing module is further configured to generate a random access signal based on the subcarrier quantity parameter $\bar{k}$; and

the transceiver module is further configured to send the random access signal.

~~17. The apparatus according to claim 16, wherein a value of the random access signal subcarrier spacing is any one of 120 kHz, 240 kHz, 480 kHz, 960 kHz, 1920 kHz, and 3840 kHz.~~

~~18. The apparatus according to claim 16 or 17, wherein a value of the data subcarrier spacing is any one of 240 kHz, 480 kHz, 960 kHz, 1920 kHz, and 3840 kHz.~~

~~19. The apparatus according to at least one of claims 16 to 18, wherein a value of the subcarrier quantity parameter is any one of 15, 7, 5, 3, 1, 0, 1, 2, 3, 19, 23, 83, and 107.~~

~~20. The apparatus according to any one of claims 16 to 19, wherein the processing module is specifically configured to:~~

~~determine a total subcarrier quantity frequency domain width based on the random access preamble length, the random access signal subcarrier spacing, and the data subcarrier spacing; and~~

~~determine the subcarrier quantity parameter based on the total subcarrier quantity frequency domain width, the random access signal subcarrier spacing, and the data subcarrier spacing.~~

~~21. The apparatus according to any one of claims 16 to 19, wherein the processing module is specifically configured to:~~

~~determine the subcarrier quantity parameter in the second target parameter based on the random access signal subcarrier spacing and the data subcarrier spacing in the first target parameter.~~

22. The apparatus according to any one of claims 16 to 21, wherein the first subcarrier quantity and the second subcarrier quantity are the same.

2310. The apparatus according to claim 229, wherein the subcarrier quantity parameter $\bar{k}$ conforms to:

$$\bar{k} = \text{floor}\left(\frac{\left(\frac{GP}{2} - \frac{\Delta f}{2}\right)}{\Delta f_{RA}} + 0.5\right)$$

$$\bar{k} = \frac{\left(\frac{GP}{2} - \frac{\Delta f}{2}\right)}{\Delta f_{RA}} + 0.5, \text{ or } \bar{k} = \text{floor}\left(\frac{\left((12N_{RB}^{RA}-1) \times \Delta f - (L_{RA}-1) \times \Delta f_{RA}\right)}{2\Delta f_{RA}}\right)$$

wherein $GP = N_{RB}^{RA} * (\Delta f * N) - L_{RA} * \Delta f_{RA}$ GP represents the total subcarrier quantity frequency domain width, Δf represents the data subcarrier spacing, Δf_{RA} represents the random access signal subcarrier spacing, and $\bar{k}$ represents the subcarrier quantity parameter, N_{RB}^{RA} represents total quantity of frequency domain resource blocks allocated to the random access signal, N represents the number of subcarriers in one resource block RB, N=12, L_{RA} represents the length of the random access preamble.

2411. The apparatus according to claim 22 or 239 or 10, wherein L_{RA} , Δf , Δf_{RA} , and $\bar{k}$ meet at least one of the following correspondences:

L_{RA}	Δf_{RA}	Δf	$\bar{k}$
139	120	480	1
139	120	960	23
139	480	480	2
139	480	960	2
139	960	960	2
571	120	480	1
571	480	960	2

L_{RA}	Δf_{RA}	Δf	$\bar{k}$
139	240	240	2

L_{RA}	Δf_{RA}	Δf	$\bar{k}$
139	480	480	2
139	960	960	2
139	1920	1920	2
139	3840	3840	2
571	240	240	2
571	960	960	2
571	1920	1920	2
571	3840	3840	2
1151	480	480	0
1151	960	960	0
1151	1920	1920	0
1151	3840	3840	0

wherein Δf represents the data subcarrier spacing, Δf_{RA} represents the random access signal subcarrier spacing, $\bar{k}$ represents the subcarrier quantity parameter, and L_{RA} represents the random access preamble length.

- 5 2512. The apparatus according to claim 22 or 239 or 10, wherein L_{RA} , Δf , Δf_{RA} , and $\bar{k}$ meet at least one of the following correspondences:

L_{RA}	Δf_{RA}	Δf	$\bar{k}$
<u>139</u>	<u>960</u>	<u>480</u>	<u>2</u>
<u>571</u>	<u>480</u>	<u>480</u>	<u>2</u>

L_{RA}	Δf_{RA}	Δf	$\bar{k}$
139	120	240	2
139	120	480	1
139	240	480	2
139	120	960	23

I_{RA}	Δf_{RA}	Δf	$\bar{k}$
139	240	960	1
139	480	960	2
139	120	1920	19
139	240	1920	23
139	480	1920	1
139	960	1920	2
139	120	3840	107
139	240	3840	19
139	480	3840	23
139	960	3840	1
139	1920	3840	2
571	120	240	2
571	120	480	1
571	240	480	2
571	120	960	-1
571	240	960	1
571	480	960	2
571	120	1920	-5
571	240	1920	-1
571	480	1920	1
571	960	1920	2
571	120	3840	83
571	240	3840	-5
571	480	3840	-1
571	960	3840	1
571	1920	3840	2
1151	120	240	0

L_{RA}	Δf_{RA}	Δf	$\bar{k}$
1151	120	480	-1
1151	240	480	0
1151	120	960	-3
1151	240	960	-1
1151	480	960	0
1151	120	1920	-7
1151	240	1920	-3
1151	480	1920	-1
1151	960	1920	0
1151	120	3840	-15
1151	240	3840	-7
1151	480	3840	-3
1151	960	3840	-1
1151	1920	3840	0

wherein Δf represents the data subcarrier spacing, Δf_{RA} represents the random access signal subcarrier spacing, $\bar{k}$ represents the subcarrier quantity parameter, and L_{RA} represents the random access preamble length.

26. The apparatus according to any one of claims 16 to 20, wherein the first subcarrier quantity and the total subcarrier quantity frequency domain width are the same, and the second subcarrier quantity is zero.

27. The apparatus according to claim 26, wherein the subcarrier quantity parameter $\bar{k}$ conforms to:

$$\bar{k} = \frac{(GP + \frac{\Delta f}{2})}{\Delta f_{RA}} + 0.5,$$

wherein GP represents the total subcarrier quantity frequency domain width, Δf represents the data subcarrier spacing, Δf_{RA} represents the random access signal subcarrier

spacing, and $\bar{k}$ represents the subcarrier quantity parameter.

28. The apparatus according to claim 21, wherein the first subcarrier quantity is zero, and the second subcarrier quantity and the total subcarrier quantity frequency domain width are the same.

29. The apparatus according to claim 28, wherein the subcarrier quantity parameter $\bar{k}$ conforms to:

$$\bar{k} = \frac{(0 - \frac{\Delta f}{2})}{\Delta f_{RA}} + 0.5,$$

wherein Δf represents the data subcarrier spacing, Δf_{RA} represents the random access signal subcarrier spacing, and $\bar{k}$ represents the subcarrier quantity parameter

3013. An apparatus for transmitting a random access signal, comprising:

a sending module, configured to send configuration information, wherein the configuration information is used to indicate a random access preamble length, a random access signal subcarrier spacing, and a data subcarrier spacing; and

a receiving module, configured to receive a random access signal, wherein the random access signal is generated based on a subcarrier quantity parameter $\bar{k}$, the subcarrier quantity parameter is determined by at least one of the random access preamble length, the random access signal subcarrier spacing, and/or the data subcarrier spacing, wherein a value of the random access signal subcarrier spacing is 120 kHz, wherein a value of the data subcarrier spacing is any one of 240 kHz, 480 kHz, 960 kHz, 1920 kHz, 3840 kHz; or

wherein a value of the random access signal subcarrier spacing is 480 kHz, wherein a value of the data subcarrier spacing is any one of 120kHz, 240 kHz, 480 kHz, 960 kHz, 1920 kHz, 3840 kHz; or

wherein a value of the random access signal subcarrier spacing is 960 kHz, wherein a value of the data subcarrier spacing is any one of 120kHz, 240 kHz, 480 kHz, 960 kHz, 1920 kHz, 3840 kHz, and the subcarrier quantity parameter comprises a first subcarrier quantity used to indicate a frequency resource start location of a random access preamble and a frequency resource start location of a physical random access channel, and/or a second subcarrier quantity used to indicate a frequency resource end location of the random access preamble and a

frequency resource end location of the physical random access channel.

14. The apparatus according to claim 13, wherein the subcarrier quantity parameter $\bar{k}$ conforms to:

5

$$\bar{k} = \text{floor}\left(\frac{\left(\frac{GP}{2} - \frac{\Delta f}{2}\right)}{\Delta f_{RA}} + 0.5\right)$$

$$\bar{k} = \frac{\left(\frac{GP}{2} - \frac{\Delta f}{2}\right)}{\Delta f_{RA}} + 0.5, \text{ or } \bar{k} = \text{floor}\left(\frac{\left((12N_{RB}^{RA} - 1) \times \Delta f - (L_{RA} - 1) \times \Delta f_{RA}\right)}{2\Delta f_{RA}}\right)$$

10

wherein $GP = N_{RB}^{RA} * (\Delta f * N) - L_{RA} * \Delta f_{RA}$, Δf represents the data subcarrier spacing, Δf_{RA} represents the random access signal subcarrier spacing, and $\bar{k}$ represents the subcarrier quantity parameter, N_{RB}^{RA} represents total quantity of frequency domain resource blocks allocated to the random access signal, N represents the number of subcarriers in one resource block RB, $N=12$, L_{RA} represents the length of the random access preamble.

15

15. The apparatus according to claim 13 or 14, wherein L_{RA} , Δf , Δf_{RA} , and $\bar{k}$ meet at least one of the following correspondences:

L_{RA}	Δf_{RA}	Δf	$\bar{k}$
<u>139</u>	<u>120</u>	<u>480</u>	<u>1</u>
<u>139</u>	<u>120</u>	<u>960</u>	<u>23</u>
<u>139</u>	<u>480</u>	<u>480</u>	<u>2</u>
<u>139</u>	<u>480</u>	<u>960</u>	<u>2</u>
<u>139</u>	<u>960</u>	<u>960</u>	<u>2</u>
<u>571</u>	<u>120</u>	<u>480</u>	<u>1</u>
<u>571</u>	<u>480</u>	<u>960</u>	<u>2</u>

wherein Δf represents the data subcarrier spacing, Δf_{RA} represents the random access signal subcarrier spacing, $\bar{k}$ represents the subcarrier quantity parameter, and L_{RA} represents the random access preamble length.

16. The apparatus according to claim 13 or 14, wherein L_{RA} , Δf , Δf_{RA} , and $\bar{k}$ meet at

least one of the following correspondences:

L_{RA}	Δf_{RA}	Δf	$\bar{k}$
<u>139</u>	<u>960</u>	<u>480</u>	<u>2</u>
<u>571</u>	<u>480</u>	<u>480</u>	<u>2</u>

5 ~~31~~17. An apparatus, comprising a processor, configured to invoke a program stored in a memory, to perform the method according to any one of claims 1 to ~~14~~8.

~~32~~18. An apparatus, comprising a processor and an interface circuit, wherein the processor is configured to communicate with another apparatus by using the interface circuit, and perform the method according to any one of claims 1 to ~~14~~8.

10 ~~33~~. An apparatus, comprising a processor, configured to invoke a program stored in a memory, to perform the method according to claim 15.

~~34~~. An apparatus, comprising a processor and an interface circuit, wherein the processor is configured to communicate with another apparatus by using the interface circuit, and perform the method according to claim 15.

15 ~~35~~. A terminal, comprising the apparatus according to claim ~~31~~ or ~~32~~.

~~36~~. A network device, comprising the apparatus according to claim ~~33~~ or ~~34~~.

~~37~~19. A computer storage medium, wherein the computer storage medium stores instructions; and when the instructions are run, the method according to any one of claims 1 to ~~15~~8 is implemented.

20 ~~38~~. A computer program product, wherein when the computer program product runs on a processor, the processor is enabled to perform the method according to any one of claims 1 to 15.