COMMUNICATION METHOD, APPARATUS, AND SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priorities to Chinese Patent Application No. 202410288060.1, filed with the China National Intellectual Property Administration on March 12, 2024 and entitled "COMMUNICATION METHOD, APPARATUS, AND SYSTEM", and to Chinese Patent Application No. 202510229040.1, filed with the China National Intellectual Property Administration on February 27, 2025 and entitled "COMMUNICATION METHOD, APPARATUS, AND SYSTEM", both of which are incorporated herein by reference in their entireties.

TECHNICAL FIELD

[0002] This application relates to the field of communication technologies, and in particular, to a communication method, apparatus, and system.

BACKGROUND

[0003] Development of a wireless local area network (wireless local area network, WLAN) makes wireless communication increasingly popular. Standards (namely, the 802.11 protocol suite) defined by the institute of electrical and electronics engineers (Institute of Electrical and Electronics Engineers, IEEE) for the WLAN are also accordingly evolving.

[0004] With continuous development of internet of things technologies, short-range communication technologies such as the WLAN may not adequately meet more application scenarios and requirements. Therefore, a SparkLink (SparkLink or NearLink) communication technology for short-range communication emerges. Currently, the SparkLink communication technology supports a low-frequency band. Because a high-frequency band (for example, a millimeter-wave band) can provide a transmission rate of up to gigabits per second (Gbps), the high-frequency band becomes a very promising band for future short-range wireless communication. However, parameters of the SparkLink communication technology in the low-frequency band cannot be directly applied to the high-frequency band. For example, the high-frequency band has impact such as more pronounced phase noise. If the parameters in the low-frequency band are directly applied to the high-frequency band, transmission performance is poor. Therefore, related implementation of the SparkLink communication technology in the high-

frequency band still needs further research.

SUMMARY

[0005] This application provides a communication method, apparatus, and system, to design a parameter in a high-frequency band based on a parameter in a low-frequency band, so that a subcarrier spacing of the high-frequency band is greater than a subcarrier spacing of the low-frequency band, thereby overcoming adverse effects such as more pronounced phase noise in the high-frequency band, and improving transmission performance.

[0006] **According to a first aspect**, this application provides a communication method, and the method may be applied to a first communication apparatus. For example, the first communication apparatus generates one or more OFDM symbols in a radio frame, and sends the one or more OFDM symbols on a first channel in a first band. A subcarrier spacing of the first channel is 2^N times a subcarrier spacing of a second channel in a second band, the subcarrier spacing of the second channel is 480 kilohertz kHz, and a lowest frequency of the first band is higher than a highest frequency of the second band. A bandwidth of the second channel is 2^P*20 megahertz MHz, and a bandwidth of the first channel is 2^N*2^P*20 MHz, where N is an integer greater than 0, and P is an integer greater than or equal to 0.

[0007] **According to a second aspect**, this application provides a communication method, and the method may be applied to a second communication apparatus. For example, the second communication apparatus receives one or more OFDM symbols in a radio frame on a first channel in a first band, and processes the one or more OFDM symbols. A subcarrier spacing of the first channel is 2^N times a subcarrier spacing of a second channel in a second band, the subcarrier spacing of the second channel is 480 kilohertz kHz, and a lowest frequency of the first channel is higher than a highest frequency of the second channel. A bandwidth of the second channel is 2^P*20 megahertz MHz, and a bandwidth of the first channel is 2^N*2^P*20 MHz, where N is an integer greater than 0, and P is an integer greater than or equal to 0.

[0008] According to the method in the first aspect or the second aspect, the subcarrier spacing of the first channel is 2^N times the subcarrier spacing of the second channel in the second band. In this way, a subcarrier spacing of a low-frequency band is increased by 2^N times to obtain a subcarrier spacing of a high-frequency band, so that the subcarrier spacing of the high-frequency band is greater than the subcarrier spacing of the low-frequency band, thereby overcoming adverse effects such as more pronounced phase noise in the high-frequency band, and improving transmission performance. The bandwidth of the second channel is 2^P*20 MHz, and the bandwidth of the first channel is 2^N*2^P*20 MHz, that is, the bandwidth of the second channel and the

bandwidth of the first channel correspond to a same number of DFT points. In this way, the low-frequency band and the high-frequency band can share a signal processing device, for example, a DFT/IDFT device, to reduce costs and complexity of a baseband chip for processing a low-frequency signal and a high-frequency signal.

[0009] For the first aspect or the second aspect:

[0010] In a possible design, a number of discrete Fourier transform DFT points corresponding to the bandwidth of the first channel is 2^P*64.

[0011] In this way, the number of DFT points corresponding to the bandwidth of the first channel is a multiple of 2, making implementation convenient.

[0012] In a possible design, the subcarrier spacing of the first channel is 3.84 MHz, and the bandwidth of the first channel and the number of DFT points corresponding to the first channel meet any one of the following:

the bandwidth of the first channel is 160 MHz, and the number of DFT points corresponding to the bandwidth of the first channel is 64;

the bandwidth of the first channel is 320 MHz, and the number of DFT points corresponding to the bandwidth of the first channel is 128;

the bandwidth of the first channel is 640 MHz, and the number of DFT points corresponding to the bandwidth of the first channel is 256;

the bandwidth of the first channel is 1280 MHz, and the number of DFT points corresponding to the bandwidth of the first channel is 512; and

the bandwidth of the first channel is 2560 MHz, and the number of DFT points corresponding to the bandwidth of the first channel is 1024.

[0013] In a possible design, the subcarrier spacing of the first channel is 1.92 MHz, and the bandwidth of the first channel and the number of DFT points corresponding to the bandwidth of the first channel meet any one of the following:

the bandwidth of the first channel is 80 MHz, and the number of DFT points corresponding to the bandwidth of the first channel is 64;

the bandwidth of the first channel is 160 MHz, and the number of DFT points corresponding to the bandwidth of the first channel is 128;

the bandwidth of the first channel is 320 MHz, and the number of DFT points corresponding to the bandwidth of the first channel is 256;

the bandwidth of the first channel is 640 MHz, and the number of DFT points corresponding to the bandwidth of the first channel is 512;

the bandwidth of the first channel is 1280 MHz, and the number of DFT points corresponding to the bandwidth of the first channel is 1024; and

the bandwidth of the first channel is 2560 MHz, and the number of DFT points corresponding to the bandwidth of the first channel is 2048.

[0014] In a possible design, a number of discrete Fourier transform DFT points corresponding to the bandwidth of the first channel is 2^P*256.

[0015] In a possible design, the subcarrier spacing of the first channel is 1.92 MHz, and the bandwidth of the first channel and the number of DFT points corresponding to the first channel meet any one of the following:

the bandwidth of the first channel is 320 MHz, and the number of DFT points corresponding to the bandwidth of the first channel is 256;

the bandwidth of the first channel is 640 MHz, and the number of DFT points corresponding to the bandwidth of the first channel is 512;

the bandwidth of the first channel is 1280 MHz, and the number of DFT points corresponding to the bandwidth of the first channel is 1024; and

the bandwidth of the first channel is 2560 MHz, and the number of DFT points corresponding to the bandwidth of the first channel is 2048.

[0016] In a possible design, the first channel includes a left guard interval, a right guard interval, and Q subcarriers located between the left guard interval and the right guard interval, where Q is an integer greater than 1. A bandwidth between the left guard interval and the right guard interval is Q times the subcarrier spacing of the first channel.

[0017] In this way, when the first channel includes a plurality of subchannels, because the bandwidth between the left guard interval and the right guard interval is an integer multiple of the subcarrier spacing of the first channel, interference between subchannels or interference between carriers can be effectively reduced.

[0018] In a possible design, a number of discrete Fourier transform DFT points corresponding to the bandwidth of the first channel is 2^P*64, and the subcarrier spacing of the first channel is 3.84 MHz. The left guard interval is 3.84 MHz; and when Pmod2=1, the right guard interval is 5.12 MHz, or when Pmod2=0, the right guard interval is 6.4 MHz; or the left guard interval is 5.12 MHz; and when Pmod2=1, the right guard interval is 3.84 MHz, or when Pmod2=0, the right guard interval is 5.12 MHz; or the left guard interval is 6.4 MHz; and when Pmod2=1, the right guard interval is 6.4 MHz, or when Pmod2=0, the right guard interval is 3.84 MHz.

[0019] In a possible design, a number of discrete Fourier transform DFT points corresponding to the bandwidth of the first channel is 2^P*64, and the subcarrier spacing of the first channel is 1.92 MHz. The left guard interval is 1.92 MHz; and when Pmod2=1, the right guard interval is 2.56 MHz, or when Pmod2=0, the right guard interval is 3.2 MHz; or the left guard interval is 2.56 MHz; and when Pmod2=1, the right guard interval is 1.92 MHz, or when Pmod2=0, the right guard

interval is 2.56 MHz; or the left guard interval is 3.2 MHz; and when Pmod2=1, the right guard interval is 3.2 MHz, or when Pmod2=0, the right guard interval is 1.92 MHz.

[0020] In a possible design, the Q subcarriers are sorted in ascending order of frequencies, the Q subcarriers include Q1 subcarriers and Q2 subcarriers, the Q1 subcarriers are direct current subcarriers, the Q2 subcarriers are occupied subcarriers, and the occupied subcarriers include a data subcarrier and/or a pilot subcarrier, where Q1 is an odd number greater than or equal to 1, Q2 is an integer greater than or equal to 1, Q1 is less than Q, and Q2 is less than Q.

[0021] In a possible design, when Qmod2=1, the Q2 subcarriers include (Q–2–Q1)/2 contiguous subcarriers to the left of the Q1 subcarriers and (Q–2–Q1)/2 contiguous subcarriers to the right of the Q1 subcarriers, where a rightmost subcarrier in the (Q–2–Q1)/2 contiguous subcarriers to the left of the Q1 subcarriers is adjacent to a leftmost subcarrier in the Q1 subcarriers, and a leftmost subcarrier in the (Q–2–Q1)/2 contiguous subcarriers to the right of the Q1 subcarriers is adjacent to a rightmost subcarrier in the Q1 subcarriers; or

when Qmod2=0, the Q2 subcarriers include (Q–1–Q1)/2 contiguous subcarriers to the left of the Q1 subcarriers and (Q–1–Q1)/2 contiguous subcarriers to the right of the Q1 subcarriers, where a rightmost subcarrier in the (Q–1–Q1)/2 contiguous subcarriers to the left of the Q1 subcarriers is adjacent to a leftmost subcarrier in the Q1 subcarriers, and a leftmost subcarrier in the (Q–1–Q1)/2 contiguous subcarriers to the right of the Q1 subcarriers is adjacent to a rightmost subcarrier in the Q1 subcarriers.

[0022] Q3 subcarriers in the Q subcarriers other than the Q1 subcarriers and the Q2 subcarriers are null subcarriers; and when Qmod2=1, Q3=2, or when Qmod2=1, Q3=1, where mod represents a modulo operation.

[0023] In this way, because a direct current subcarrier is a subcarrier in the middle of the Q subcarriers, direct current impact caused by using the subcarrier in the middle as a data or pilot subcarrier is avoided, and receiving performance is improved. Further, based on the foregoing design, in various cases of the left guard interval and the right guard interval, numbers of direct current subcarriers are the same and are an odd number, numbers of occupied subcarriers are the same, and numbers of occupied subcarriers on both sides of the direct current subcarriers are the same. This helps reduce processing complexity.

[0024] In a possible design, when Qmod2=1, Q3=2, and the Q3 subcarriers include a 1^{st} subcarrier and a 2^{nd} subcarrier in the Q subcarriers, or a 1^{st} subcarrier and a Q^{th} subcarrier in the Q subcarriers, or a $(Q–1)^{th}$ subcarrier and a Q^{th} subcarrier in the Q subcarriers; or when Qmod2=0, Q3=1, and the Q3 subcarriers include a 1^{st} subcarrier or a Q^{th} subcarrier in the Q subcarriers.

[0025] In a possible design, when Qmod2=1, the Q2 subcarriers include (Q–Q1)/2 contiguous subcarriers to the left of the Q1 subcarriers and (Q–Q1)/2 contiguous subcarriers to the right of the

Q1 subcarriers, where a rightmost subcarrier in the (Q–Q1)/2 contiguous subcarriers to the left of the Q1 subcarriers is adjacent to a leftmost subcarrier in the Q1 subcarriers, and a leftmost subcarrier in the (Q–Q1)/2 contiguous subcarriers to the right of the Q1 subcarriers is adjacent to a rightmost subcarrier in the Q1 subcarriers; or when Qmod2=0, the Q2 subcarriers include (Q–1–Q1)/2 contiguous subcarriers to the left of the Q1 subcarriers and (Q–1–Q1)/2 contiguous subcarriers to the right of the Q1 subcarriers, where a rightmost subcarrier in the (Q–1–Q1)/2 contiguous subcarriers to the left of the Q1 subcarriers is adjacent to a leftmost subcarrier in the Q1 subcarriers, and a leftmost subcarrier in the (Q–1–Q1)/2 contiguous subcarriers to the right of the Q1 subcarriers is adjacent to a rightmost subcarrier in the Q1 subcarriers. One subcarrier in the Q subcarriers other than the Q1 subcarriers and the Q2 subcarriers is a null subcarrier, where mod represents a modulo operation.

[0026] In this way, the left guard interval and the right guard interval may be predefined or preconfigured. In this case, it is not necessary to consider whether numbers of occupied subcarriers are the same in various cases for the left guard interval and the right guard interval. Therefore, no null subcarrier is set or one null subcarrier is set. This helps reduce processing complexity and improve resource utilization.

[0027] In a possible design, a number of discrete Fourier transform DFT points corresponding to the bandwidth of the first channel is 2^P*256, and the subcarrier spacing of the first channel is 1.92 MHz.

[0028] The left guard interval is 7.68 MHz; and when Pmod2=1, the right guard interval is 10.24 MHz, or when Pmod2=0, the right guard interval is 12.8 MHz; or

the left guard interval is 10.24 MHz; and when Pmod2=1, the right guard interval is 7.68 MHz, or when Pmod2=0, the right guard interval is 10.24 MHz; or

the left guard interval is 12.8 MHz; and when Pmod2=1, the right guard interval is 12.8 MHz, or when Pmod2=0, the right guard interval is 7.68 MHz.

[0029] In a possible design, the Q subcarriers are sorted in ascending order of frequencies, the Q subcarriers include Q1 subcarriers and Q2 subcarriers, the Q1 subcarriers are direct current subcarriers, the Q2 subcarriers are occupied subcarriers, and the occupied subcarriers include a data subcarrier and/or a pilot subcarrier, where Q1 is an odd number greater than or equal to 1, Q2 is an integer greater than or equal to 1, Q1 is less than Q, and Q2 is less than Q.

[0030] In a possible design, Q=Q'*4, and Q' is an integer greater than or equal to 1.

[0031] When Q'mod2=1, Q2=Q–5–Q1, and the Q2 subcarriers include (Q–5–Q1)/2 contiguous subcarriers to the left of the Q1 subcarriers and (Q–5–Q1)/2 contiguous subcarriers to the right of the Q1 subcarriers, where a rightmost subcarrier in the (Q–5–Q1)/2 contiguous subcarriers to the left of the Q1 subcarriers is adjacent to a leftmost subcarrier in the Q1 subcarriers,

and a leftmost subcarrier in the (Q–5–Q1)/2 contiguous subcarriers to the right of the Q1 subcarriers is adjacent to a rightmost subcarrier in the Q1 subcarriers; or

when Q'mod2=0, Q2=Q–1–Q1, and the Q2 subcarriers include (Q–1–Q1)/2 contiguous subcarriers to the left of the Q1 subcarriers and (Q–1–Q1)/2 contiguous subcarriers to the right of the Q1 subcarriers, where a rightmost subcarrier in the (Q–1–Q1)/2 contiguous subcarriers to the left of the Q1 subcarriers is adjacent to a leftmost subcarrier in the Q1 subcarriers, and a leftmost subcarrier in the (Q–1–Q1)/2 contiguous subcarriers to the right of the Q1 subcarriers is adjacent to a rightmost subcarrier in the Q1 subcarriers.

[0032] Q3 subcarriers in the Q subcarriers other than the Q1 subcarriers and the Q2 subcarriers are null subcarriers; and when Q'mod2=1, Q3=5, or when Q'mod2=0, Q3=1, where mod represents a modulo operation.

[0033] In this way, because a direct current subcarrier is a subcarrier in the middle of the Q subcarriers, direct current impact caused by using the subcarrier in the middle as a data or pilot subcarrier is avoided, and receiving performance is improved. Further, based on the foregoing design, in various cases of the left guard interval and the right guard interval, numbers of direct current subcarriers are the same and are an odd number, numbers of occupied subcarriers are the same, and numbers of occupied subcarriers on both sides of the direct current subcarriers are the same. This helps reduce processing complexity.

[0034] In a possible design, when Q'mod2=1, Q3=5, and the Q3 subcarriers include:

a 1^{st} subcarrier to a 5^{th} subcarrier in the Q subcarriers; or

a 1^{st} subcarrier to a 4^{th} subcarrier, and a Q^{th} subcarrier in the Q subcarriers; or

a 1^{st} subcarrier to a 3^{rd} subcarrier, a $(Q–1)^{th}$ subcarrier, and a Q^{th} subcarrier in the Q subcarriers; or

a 1^{st} subcarrier, a 2^{nd} subcarrier, and a $(Q–2)^{th}$ subcarrier to a Q^{th} subcarrier in the Q subcarriers; or

a 1^{st} subcarrier, and a $(Q–3)^{th}$ subcarrier to a Q^{th} subcarrier in the Q subcarriers; or

a $(Q–4)^{th}$ subcarrier to a Q^{th} subcarrier in the Q subcarriers; or

when Q'mod2=0, Q3=1, and the Q3 subcarriers include a 1^{st} subcarrier or a Q^{th} subcarrier in the Q subcarriers.

[0035] In a possible design, Q=Q'*4, and Q' is an integer greater than or equal to 1. The Q2 subcarriers include (Q–1–Q1)/2 contiguous subcarriers to the left of the Q1 subcarriers and (Q–1–Q1)/2 contiguous subcarriers to the right of the Q1 subcarriers, where a rightmost subcarrier in the (Q–1–Q1)/2 contiguous subcarriers to the left of the Q1 subcarriers is adjacent to a leftmost subcarrier in the Q1 subcarriers, and a leftmost subcarrier in the (Q–1–Q1)/2 contiguous subcarriers to the right of the Q1 subcarriers is adjacent to a rightmost subcarrier in the Q1

subcarriers. Q3 subcarriers in the Q subcarriers other than the Q1 subcarriers and the Q2 subcarriers are null subcarriers, and Q3=1.

[0036] In this way, the left guard interval and the right guard interval may be predefined or preconfigured. In this case, it is not necessary to consider whether numbers of occupied subcarriers are the same in various cases for the left guard interval and the right guard interval. Therefore, no null subcarrier is set or one null subcarrier is set. This helps reduce processing complexity and improve resource utilization.

[0037] In a possible design, the Q subcarriers are sorted in ascending order of frequencies, the Q subcarriers include Q1 subcarriers, and the Q1 subcarriers are direct current subcarriers, where Q1 is an integer greater than or equal to 1, and Q1 is less than Q. When Qmod2=1, the Q1 subcarriers include at least one of a $((Q–1)/2)^{th}$ subcarrier, a $((Q+1)/2)^{th}$ subcarrier, and a $((Q+1)/2+1)^{th}$ subcarrier in the Q subcarriers; or when Qmod2=0, the Q1 subcarriers include at least one of a $(Q/2)^{th}$ subcarrier and a $(Q/2+1)^{th}$ subcarrier in the Q subcarriers.

[0038] In this way, because a direct current subcarrier is a subcarrier in the middle of the Q subcarriers, direct current impact caused by using the subcarrier in the middle as a data or pilot subcarrier is avoided, and receiving performance is improved.

[0039] In a possible design, some or all of (Q–Q1) subcarriers in the Q subcarriers other than the Q1 subcarriers are occupied subcarriers, and the occupied subcarriers include a data subcarrier and a pilot subcarrier.

[0040] In this way, according to the method for combining a plurality of subchannels into one large channel provided in this embodiment of this application, all or some direct current subcarriers that originally belong to a subchannel may be converted into data or pilot subcarriers, or an original small guard interval of a subchannel may be used as a data subcarrier or a pilot subcarrier. This helps improve communication efficiency and band utilization.

[0041] In a possible design, when P=1, a number of occupied subcarriers in the first channel is greater than 76; or when P=2, a number of occupied subcarriers in the first channel is greater than 152; or when P=3, a number of occupied subcarriers in the first channel is greater than 304; or when P=4, a number of occupied subcarriers in the first channel is greater than or equal to 608; or when P=5, a number of occupied subcarriers in the first channel is greater than or equal to 1216.

[0042] In other words, according to the design of this application, the number of occupied subcarriers in the first channel is greater than a product of a number of subchannels included in the first channel and a number of occupied subcarriers (that is, 38) in a single subchannel. This helps improve communication efficiency and band utilization.

[0043] **According to a third aspect**, this application provides a communication apparatus. The communication apparatus has functions for implementing the first aspect or the second aspect.

For example, the communication apparatus includes a corresponding module, unit, or means for performing an operation in the first aspect or the second aspect. The function, unit, or means may be implemented by software, or may be implemented by hardware, or may be implemented by hardware executing corresponding software.

[0044] In a possible design, the communication apparatus includes a processing unit and a communication unit. The communication unit may be configured to receive and send a signal, to implement communication between the communication apparatus and another apparatus. The processing unit may be configured to perform some internal operations of the communication apparatus. Functions performed by the processing unit and the communication unit may correspond to the operations in the first aspect or the second aspect.

[0045] In a possible design, the communication apparatus includes a processor, and the processor may be configured to be coupled to a memory. The memory may store a computer program or instructions necessary for implementing the functions in the first aspect or the second aspect. The processor may execute the computer program or the instructions stored in the memory. When the computer program or the instructions are executed, the communication apparatus is enabled to implement the method according to any possible design or implementation of the first aspect or the second aspect.

[0046] In a possible design, the communication apparatus includes a processor and a memory. The memory may store a computer program or instructions necessary for implementing the functions in the first aspect or the second aspect. The processor may execute the computer program or the instructions stored in the memory. When the computer program or the instructions are executed, the communication apparatus is enabled to implement the method according to any possible design or implementation of the first aspect or the second aspect.

[0047] In a possible design, the communication apparatus includes a processor and an interface circuit. The processor is configured to communicate with another apparatus through the interface circuit, and perform the method according to any possible design or implementation of the first aspect or the second aspect.

[0048] It may be understood that in the third aspect, the processor may be implemented by hardware or software. When the processor is implemented by the hardware, the processor may be a logic circuit, an integrated circuit, or the like. When the processor is implemented by the software, the processor may be a general-purpose processor, and is implemented by reading software code stored in the memory. In addition, there may be one or more processors, and one or more memories. The memory may be integrated with the processor, or the memory and the processor are separately disposed. In a specific implementation process, the memory and the processor may be integrated into one chip, or may be disposed on different chips. A type of the memory and a manner in which

the memory and the processor are disposed are not limited in embodiments of this application.

[0049] **According to a fourth aspect**, this application provides a communication system. The communication system may include a first communication apparatus and a second communication apparatus. The first communication apparatus is configured to perform the method according to the first aspect, and the second communication apparatus is configured to perform the method according to the second aspect.

[0050] **According to a fifth aspect**, this application provides a computer-readable storage medium. The computer storage medium stores a computer program (or computer-readable instructions), and when a computer reads and executes some or all of the computer-readable instructions, the method according to any possible design of the first aspect or the second aspect is performed.

[0051] For example, the computer-readable storage medium may be any usable medium that can be accessed by the computer. By way of example instead of limitation, the computer-readable medium may include a non-transitory computer-readable medium, a random access memory (random access memory, RAM), a read-only memory (read-only memory, ROM), an electrically erasable programmable read-only memory (electrically EPROM, EEPROM), a CD-ROM or another optical disk storage, a magnetic disk storage medium or another magnetic storage device, or any other medium that can carry or store desired program code in a form of instructions or a data structure and that can be accessed by the computer.

[0052] **According to a sixth aspect**, this application provides a computer program product. When a computer reads and executes the computer program product, the method according to any possible design of the first aspect or the second aspect is performed.

[0053] **According to a seventh aspect**, this application provides a chip (or a chip system). The chip includes a processor, the processor is coupled to a memory, the memory stores a computer program, and the processor is configured to invoke a part or all of the computer program in the memory, so that the method according to any possible design of the first aspect or the second aspect is performed.

BRIEF DESCRIPTION OF DRAWINGS

[0054] FIG. 1 is a diagram of a communication protocol architecture of a SparkLink communication technology according to an embodiment of this application;

[0055] FIG. 2 is a diagram of tone plan of a 20 MHz bandwidth according to an embodiment of this application;

[0056] FIG. 3 is a diagram of a structure of a superframe according to an embodiment of this

application;

[0057] FIG. 4 is a diagram of a network architecture to which an embodiment of this application is applicable;

[0058] FIG. 5 is a schematic flowchart corresponding to a communication method according to an embodiment of this application;

[0059] FIG. 6 is a diagram of a spacing between subcarriers corresponding to a subchannel a and a subchannel b according to an embodiment of this application;

[0060] FIG. 7 is a diagram of a first channel according to an embodiment of this application;

[0061] FIG. 8A to FIG. 8C are diagrams of a left guard interval and a right guard interval according to an embodiment of this application;

[0062] FIG. 9 is a diagram of tone plan of a first channel according to an embodiment of this application;

[0063] FIG. 10 is a possible example block diagram of an apparatus according to an embodiment of this application; and

[0064] FIG. 11 is a diagram of a structure of a communication apparatus according to an embodiment of this application.

DESCRIPTION OF EMBODIMENTS

[0065] The following describes the technical solutions in embodiments of this application with reference to the accompanying drawings in embodiments of this application. All aspects, embodiments, or features are presented in this application by describing a system that may include a plurality of devices, components, modules, and the like. It should be appreciated and understood that each system may include another device, component, module, and the like, and/or may not include all devices, components, modules, and the like discussed with reference to the accompanying drawings. In addition, a combination of these solutions may alternatively be used. In addition, in embodiments of this application, terms such as "example" and "for example" represent giving an example, an illustration, or a description. Any embodiment or design scheme described as an "example" in this application should not be explained as being more preferred or having more advantages than another embodiment or design scheme. Exactly, use of the term "example" is intended to present a concept in a specific manner. In embodiments of this application, "of (of)", "corresponding, relevant (corresponding, relevant)", and "corresponding (corresponding)" may be interchangeably used sometimes. It should be noted that meanings expressed by the terms are consistent when differences of the terms are not emphasized.

[0066] Currently, the SparkLink alliance (SparkLink alliance) provides a communication

protocol architecture of a SparkLink communication technology, and access technologies that can be provided by the protocol architecture include a SparkLink basic (SparkLink basic, SLB) access technology and a SparkLink low energy SparkLink low energy, SLE) access technology. FIG. 1 is a diagram of a communication protocol architecture of a SparkLink communication technology according to an embodiment of this application. As shown in FIG. 1, the protocol architecture includes a basic application layer, a basic service layer, and a SparkLink access layer (also referred to as an access layer). The basic application layer and the basic service layer may be collectively referred to as a SparkLink upper layer.

[0067] (1) Basic application layer

[0068] The basic application layer includes various general frameworks. To implement communication between different devices on different platforms, the basic application layer builds frameworks for various possible and general application scenarios.

[0069] (2) Basic service layer

[0070] The basic service layer includes a control plane and a data plane. The control plane provides services such as device discovery and management. The data plane includes channel control data, advertising data, service management data, real-time data, reliable data, and the like, and further includes a transmission control adaptation protocol, a transmission control protocol/internet protocol (transmission control protocol/internet protocol, TCP/IP), a transparent transmission protocol, and the like.

[0071] (3) SparkLink access layer

[0072] The SparkLink access layer includes an SLB module and an SLE module. The SLB module may also be referred to as an SLB access layer, and the SLE module may also be referred to as an SLE access layer. The SLB module performs communication by using the SLB access technology. The SLB access technology has a high-bandwidth communication capability, and may carry a high-bandwidth service, for example, a wireless screen projection service or a video call service. During communication, a data throughput is high, and a data transmission speed is high. However, the SLB access technology has high power consumption, and an access process takes a long time.

[0073] In the SLB access technology, a communication device includes a grant node (grant node) device (referred to as a G node device for short) and a terminal node (terminal node) device (referred to as a T node device for short). The G node represents a node that sends data scheduling information on the access layer, and the T node represents a node that receives data scheduling information on the access layer and sends data based on the data scheduling information. In addition, it is specified that the G node device may send a broadcast, and the T node device may scan information. In addition, during establishment of an SLB connection between the G node

device and the T node device, only the T node device is allowed to discover the G node device through scanning and send a connection request to the G node device to connect to the G node device.

[0074] For example, when a large-screen device (for example, a television) is a G node device and a mobile phone is a T node device, the large-screen device automatically advertises basic SLB connection information to the outside after an SLB communication function is enabled. When the mobile phone has a service requirement for screen projection, the mobile phone starts to scan for surrounding G node devices, receives basic SLB connection information advertised by the G node devices, and displays a device scanning result (for example, a device model and a device name) based on the basic SLB connection information. In response to an operation of selecting, by a user, the large-screen device from the scanning result, the mobile phone sends a connection request to the large-screen device, to establish an SLB connection to the large-screen device.

[0075] The SLE module performs communication by using the SLE access technology. The SLE has a low-energy communication capability. When the SLE module is in an idle state (that is, is not connected to another device), the SLE module may advertise device information and data in three fixed broadcast channels, so that the SLE module can be quickly discovered and connected. This helps save device power. The SLE access technology supports a small bandwidth and a low data transmission speed. Therefore, the SLE access technology is usually used to process a service that requires a small bandwidth, for example, an audio playing service based on a wireless headset, or a service of controlling a smart home device by a mobile phone.

[0076] It may be understood that the communication protocol architecture shown above is merely a possible example. The communication protocol architecture may further include another possible protocol layer. This is not limited in embodiments of this application.

[0077] Based on the communication protocol architecture shown in FIG. 1, the following explains terms related to the SparkLink communication technology. Unless otherwise specified, these explanations are intended to support meanings of the related terms, for ease of understanding of embodiments of this application, and should not be considered as a strict limitation on the terms in the protection scope claimed in this application.

[0078] **(1)** Single-carrier and multi-carrier

[0079] The single-carrier or the multi-carrier may be used for SparkLink communication between different communication devices. A difference between the single-carrier and the multi-carrier lies in different manners of generating a to-be-sent signal. For example, the single-carrier may be discrete Fourier transform spread orthogonal frequency division multiplexing (discrete Fourier transform spread orthogonal frequency division multiplexing, DFT-s-OFDM), and the multi-carrier may be orthogonal frequency division multiplexing (orthogonal frequency division

multiplexing, OFDM).

[0080] For example, OFDM is used for SparkLink communication between two communication devices. In the two communication devices, one communication device is a transmit end, and the other communication device is a receive end. The transmit end may be an OFDM transmitter, and the receive end may be an OFDM receiver. For a processing process of sending a signal by the OFDM transmitter, refer to the conventional technology. A process of processing a signal by the OFDM receiver is an inverse process of the processing process of the OFDM transmitter.

[0081] **(2)** Channel bandwidth of the SparkLink communication technology

[0082] The SparkLink communication technology (for example, the SLB access technology) may operate in a low-frequency band, such as 5150 MHz to 5350 MHz or 5725 MHz to 5850 MHz, with a minimum channel (or carrier) bandwidth of 20 MHz, and supports higher channel bandwidths of 40/60/80/100/160/320 MHz, each aggregated by a plurality of contiguous 20 MHz bandwidths.

[0083] FIG. 2 is a diagram of tone plan of a 20 MHz bandwidth. As shown in FIG. 2, a channel of a 20 MHz operating bandwidth includes 39 contiguous subcarriers, a subcarrier spacing is 480 kHz, and the 39 subcarriers are successively numbered 0, 1, …, and 38 in ascending order of corresponding frequencies, where the subcarrier 19 (that is, the 20^{th} subcarrier) is a direct current subcarrier and does not carry information. In a channel of a 20 MHz bandwidth, part of resources of a lowest frequency and part of resources of a highest frequency are reserved as guard intervals: a left guard interval and a right guard interval. Table 1 shows parameters of a 20 MHz bandwidth.

Table 1: Parameters of a 20 MHz bandwidth

Parameter	20 MHz
fs (sampling frequency)	30.72 MHz
N_{DFT} (number of DFT points)	64
ΔF (subcarrier spacing)	480 kHz
T_{DFT} (symbol period)	1/0.480=2.08 μs
T_s (sampling interval)	1/0.03072=32.55 ns
$T_{GI}=5T_s$ (short guard interval)	5/0.03072=162.76 ns
$T_{GI}=14T_s$ (long guard interval)	14/0.03072=455.73 ns

[0084] In Table 1, the number of DFT points may be understood as a number of sampling points used during DFT processing or a size of a filter during DFT processing, and the number of DFT points may also be replaced with a number of inverse discrete Fourier transform (inverse discrete Fourier transform, IDFT) points, an IDFT size, or a DFT size; the sampling frequency is

equal to a product of the number of DFT points and the subcarrier spacing; the symbol period is determined based on the subcarrier spacing; and the sampling interval is determined based on the sampling frequency. For specific meanings of the parameters shown in Table 1, refer to an existing communication standard. Details are not described again.

[0085] Further, based on parameters of tone plan of a 20 MHz operating bandwidth, parameters in a low-frequency band may be shown in Table 2.

Table 2: Parameters of different bandwidths in a low-frequency band

Parameter	20 MHz	40 MHz	80 MHz	160 MHz	…
fs (sampling frequency, MHz)	30.72	61.44	122.88	245.76	…
N_{DFT} (number of DFT points)	64	128	256	512	…
ΔF (subcarrier spacing, kHz)	480				
T_{DFT} (symbol period, μs)	1/0.480=2.08				
T_s (sampling interval, ns)	1/0.03072=32.55	1/0.06144=16.28	1/0.12288=8.14	1/0.24576=4.07	…
T_{GI}=5/64 T_{DFT} (short guard interval, ns)	1/0.480*10^3*5/64=162.76	1/0.480*10^3*5/64=162.76	1/0.480*10^3*5/64=162.76	1/0.480*10^3*5/64=162.76	…
T_{GI}=14/64 T_{DFT} (long guard interval, ns)	1/0.480*10^3*14/64=455.73	1/0.480*10^3*14/64=455.73	1/0.480*10^3*14/64=455.73	1/0.480*10^3*14/64=455.73	…

[0086] It may be understood that Table 2 shows only 40 MHz (aggregated by two 20 MHz bandwidths), 80 MHz (aggregated by four 20 MHz bandwidths), and 160 MHz (aggregated by eight 20 MHz bandwidths), and parameters of higher operating bandwidths may be deduced by analogy.

[0087] In Table 1 and Table 2, "a number of DFT points corresponding to a 20 MHz bandwidth is 64" is used as an example for description. In another example, a number of DFT points corresponding to a 20 MHz bandwidth may alternatively be greater than 64. For example, the number of DFT points corresponding to the 20 MHz bandwidth is 256 (that is, 64*4). In this case,

a channel of a 20 MHz operating bandwidth includes 39*4 contiguous subcarriers. Table 3 shows parameters of different bandwidths.

Table 3: Parameters of different bandwidths in a low-frequency band

Parameter	20 MHz	40 MHz	80 MHz	160 MHz	…
fs (sampling frequency, MHz)	30.72	61.44	122.88	245.76	…
N_{DFT} (number of DFT points)	256	512	1024	2048	…
ΔF (subcarrier spacing, kHz)	120				
T_{DFT} (symbol period, μs)	1/0.120=8.33				
T_s (sampling interval, ns)	1/0.03072=32.55	1/0.06144=16.28	1/0.12288=8.14	1/0.24576=4.07	…
T_{GI}=18/256 T_{DFT} (guard interval, ns)	1/0.120*10^3*18/256 =585.94	585.94	585.94	585.94	…
T_{GI}=39/256 T_{DFT} (guard interval, ns)	1/0.120*10^3*39/256 =1269.53	1269.53	1269.53	1269.53	…
T_{GI}=64/256 T_{DFT} (guard interval, ns)	1/0.120*10^3*64/256 =2083.33	2083.33	2083.33	2083.33	…
T_{GI}=93/256 T_{DFT} (guard interval, ns)	1/0.120*10^3*93/256 =3027.34	3027.34	3027.34	3027.34	…
T_{GI}=128/256 T_{DFT} (guard interval, ns)	1/0.120*10^3*128/256 =4166.67	4166.67	4166.67	4166.67	…

[0088] It may be understood that Table 3 shows only 40 MHz (aggregated by two 20 MHz bandwidths), 80 MHz (aggregated by four 20 MHz bandwidths), and 160 MHz (aggregated by

eight 20 MHz bandwidths), and parameters of higher operating bandwidths may be deduced by analogy.

[0089] **(3)** Superframe and radio frame

[0090] A TDD manner is used in the SparkLink communication technology. Specifically, in the SparkLink communication technology (for example, the SLB access technology), a superframe is used to implement communication between a G node device and a T node device. The superframe includes 48 radio frames, and each radio frame includes 10 symbols. The symbol may be an OFDM symbol or a DFT-s-OFDM symbol, and the DFT-s-OFDM symbol may be understood as a special OFDM symbol. In addition, the SparkLink communication system further supports a semi-superframe that includes 24 radio frames. In the parameters in the low-frequency band shown in Table 1 or Table 2, a duration of each symbol (that is, a symbol period) is about 2.0833 microseconds (μs), a duration of each radio frame is about 20.833 μs, and a duration of each superframe is about 1 millisecond (ms).

[0091] FIG. 3 is a diagram of a structure of a possible superframe. As shown in FIG. 3, the superframe includes a radio frame 0 to a radio frame 47. For example, 10 OFDM symbols included in the radio frame 0 include four G symbols, three T symbols, two GAP symbols, and one SG symbol; and 10 OFDM symbols included in the radio frame 47 include four G symbols, three T symbols, two GAP symbols, and one ST symbol. The G symbol represents a symbol used by the G node device to send (G link) information to the T node device, the T node represents a symbol used by the T node to send (T link) information to the G node, SG/ST respectively represents symbol resources used for overhead symbols in the G/T symbols, an overhead symbol resource of each radio frame may be flexibly configured as zero, one, or two symbols, and GAP is a switching interval between the G symbol and the T symbol.

[0092] It can be learned from the foregoing descriptions of the SparkLink communication technology that, currently, the SparkLink communication technology supports a low-frequency band. Because a high-frequency band (for example, a millimeter-wave band) can provide a transmission rate of up to Gbps, the high-frequency band becomes a very promising band for future short-range wireless communication. However, parameters of the SparkLink communication technology in the low-frequency band cannot be directly applied to the high-frequency band. For example, the high-frequency band has impact such as more pronounced phase noise. If the parameters in the low-frequency band are directly applied to the high-frequency band, transmission performance is poor.

[0093] Based on this, embodiments of this application study related implementation of the SparkLink communication technology in the high-frequency band. Specifically, embodiments of this application provide a communication method and apparatus, to design a parameter in a high-

frequency band based on a parameter in a low-frequency band, so that a subcarrier spacing of the high-frequency band is greater than a subcarrier spacing of the low-frequency band, thereby overcoming adverse effects such as more pronounced phase noise in the high-frequency band, and improving transmission performance. The method and the apparatus are based on a same concept. Because the method and the apparatus have similar problem-resolving principles, for implementation of the apparatus and the method, refer to each other. Repeated parts are not described again.

[0094] For ease of understanding of embodiments of this application, a network architecture applicable to embodiments of this application is first described in detail by using a network architecture shown in **FIG. 4** as an example. As shown in FIG. 4, the network architecture includes a plurality of communication devices (for example, a first communication device and a second communication device). Both the first communication device and the second communication device are configured with the communication protocol architecture shown in FIG. 1, and can communicate with each other based on the communication protocol architecture by using the SparkLink communication technology.

[0095] The communication device (for example, the first communication device or the second communication device) in embodiments of this application may be a device in various fields, for example, a large-screen device, an artificial intelligence (artificial intelligence, AI) speaker, a high fidelity (high fidelity, HiFi) speaker, a temperature sensor, or a humidity sensor in the smart home field, or a mobile phone, a tablet computer, a wearable device, an augmented reality (augmented reality, AR)/virtual reality (virtual reality, VR) device, a notebook computer, an ultra mobile personal computer (ultra mobile personal computer, UMPC), a netbook, or a personal digital assistant (personal digital assistant, PDA) in the field of intelligent terminals, or a robotic arm, a camera, a joystick, a monitor, a logistics vehicle, or a smart shelf in the field of intelligent manufacturing. A specific type of the communication device is not limited in embodiments of this application.

[0096] For example, the first communication device is a G node device, and the second communication device is a T node device; or the second communication device is a G node device, and the first communication device is a T node device. In a possible implementation, a role of the communication device may be determined based on an input/output status of the communication device. The input/output status includes whether the communication device supports information input by using an apparatus such as a mouse, a keyboard, or a screen, whether the communication device supports information output by using an apparatus such as a screen or a speaker, or the like. For example, a device facilitating information input by a user, for example, a mobile phone or a tablet computer, usually acts as a T node, and serves as a T node device by default in an SLB

connection process; and a device not facilitating information input by a user, for example, a large-screen device or a smart speaker, usually acts as a G node, and serves as a G node device by default in an SLB connection process.

[0097] It may be understood that the communication method provided in embodiments of this application is applicable to communication between a G node device and a T node device, or communication between G node devices, or communication between T node devices. This is not specifically limited.

[0098] A network architecture and a service scenario that are described in embodiments of this application are intended to describe the technical solutions in embodiments of this application more clearly, and do not constitute a limitation on the technical solutions provided in embodiments of this application. A person of ordinary skill in the art may learn that with evolution of the network architecture and emergence of a new service scenario, the technical solutions provided in embodiments of this application are also applicable to similar technical problems.

[0099] Although embodiments of this application are mainly described by using an example in which a SparkLink communication network, especially an SLB communication network, is deployed, a person skilled in the art easily understands that various aspects in embodiments of this application may be extended to other networks that use various standards or protocols, for example, a high performance radio local area network (high performance radio local area network, HIPERLAN), a wireless wide area network (wireless wide area network, WWAN), a wireless personal area network (wireless personal area network, WPAN), or other networks that are known or developed in the future. Therefore, regardless of used coverage and a used wireless access protocol, various aspects provided in embodiments of this application are applicable to any appropriate wireless network.

[00100] The technical solutions in embodiments of this application may be further applied to various communication systems or networks, for example, a WLAN communication system, a wireless fidelity (wireless fidelity, Wi-Fi) system, a long term evolution (long term evolution, LTE) system, an LTE frequency division duplex (frequency division duplex, FDD) system, an LTE time division duplex (time division duplex, TDD) system, a universal mobile telecommunications system (universal mobile telecommunications system, UMTS), a worldwide interoperability for microwave access (worldwide interoperability for microwave access, WiMAX) communication system, a fifth generation (5th generation, 5G) system or a new radio (new radio, NR) system, a sixth generation (6th generation, 6G) system, an internet of things (internet of things, IoT) network, or a vehicle-to-everything (vehicle to x, V2X). The foregoing communication systems applicable to this application are only examples for description, and the communication systems applicable to this application are not limited thereto. This is uniformly described herein, and details are not

described below again.

[00101] Based on the network architecture shown in FIG. 4, the following describes in detail a communication method provided in embodiments of this application with reference to Embodiment 1 and Embodiment 2. The communication method provided in embodiments of this application relates to a first communication apparatus and a second communication apparatus. The first communication apparatus may be the first communication device in FIG. 4, or may be a component in the first communication device, for example, a chip or a chip system disposed in the first communication device. The second communication apparatus may be the second communication device in the communication system shown in FIG. 4, or may be a component in the second communication device, for example, a chip or a chip system disposed in the second communication device.

Embodiment 1

[00102] **FIG. 5** is a schematic flowchart corresponding to a communication method according to an embodiment of this application. As shown in FIG. 5, the method includes the following steps.

[00103] S501: The first communication apparatus generates one or more OFDM symbols in a radio frame.

[00104] For example, the radio frame herein may be any radio frame in a superframe or a semi-superframe used in a SparkLink communication technology. If the first communication apparatus is a G node device, an OFDM symbol is a G symbol. If the first communication apparatus is a T node device, an OFDM symbol is a T symbol. For details, refer to the foregoing descriptions about the superframe, the radio frame, and the OFDM symbol.

[00105] S502: The first communication apparatus sends the one or more OFDM symbols on a first channel in a first band. Correspondingly, the second communication apparatus receives the one or more OFDM symbols on the first channel in the first band.

[00106] S503: The second communication apparatus processes the one or more OFDM signals.

[00107] For example, the first communication apparatus generates the one or more OFDM symbols in the radio frame based on a first number of points, and then sends the one or more OFDM symbols on the first channel in the first band. Correspondingly, the second communication apparatus processes the one or more received OFDM symbols based on the first number of points. The first number of points may be a number of DFT points or a number of IDFT points corresponding to a bandwidth of the first channel in the first band.

[00108] It should be noted that S503 may be an optional step. In addition, specific implementation in which the first communication apparatus generates the OFDM symbol and the second communication apparatus processes the OFDM symbol is not limited in embodiments of

this application.

[00109] A lowest frequency of the first band is higher than a highest frequency of a second band. For example, the first band is a high-frequency band (for example, a millimeter-wave band), and the second band is a low-frequency band. The millimeter-wave band may be understood as a band with a millimeter-level wavelength, for example, a band with a wavelength ranging from 1 millimeter to 10 millimeters. For example, the millimeter-wave band may be a band of 30 gigahertz (GHz) to 300 GHz. For example, the first band is a 60 GHz band, or the first band is a 45 GHz band; and the second band is a 2.45 GHz band, or the second band is a 5 GHz/6 GHz band. For example, the 45 GHz band includes 42.3 GHz to 47.0 GHz and 47.2 GHz to 48.4 GHz, and the 60 GHz band includes 57 GHz to 66 GHz and 56.16 GHz to 73.44 GHz.

[00110] A subcarrier spacing of the first channel is 2^N times a subcarrier spacing of a second channel in the second band, and the subcarrier spacing of the second channel is 480 kHz, where N is an integer greater than 0. A bandwidth of the second channel is 2^P*20 MHz, and the bandwidth of the first channel is 2^N*2^P*20 MHz, that is, the bandwidth of the second channel and the bandwidth of the first channel correspond to a same number of DFT points. For example, the number of DFT points corresponding to the bandwidth of the first channel and the bandwidth of the second channel is 2^P*64, or the number of DFT points corresponding to the bandwidth of the first channel and the bandwidth of the second channel is 2^P*256, where P is an integer greater than or equal to 0.

[00111] With reference to Example 1 to Example 3, the following describes parameters in the high-frequency band (for example, the bandwidth of the first channel and the number of DFT points corresponding to the bandwidth of the first channel) by using examples. In Example 1 and Example 2, for example, "the number of DFT points corresponding to the bandwidth of the first channel and the bandwidth of the second channel is 2^P*64". In Example 3, for example, "the number of DFT points corresponding to the bandwidth of the first channel and the bandwidth of the second channel is 2^P*256". In addition, for ease of description, a concept of a subchannel is introduced in this application. A bandwidth of a subchannel on the first band is a minimum channel bandwidth supported by the first band, and the first channel includes one or more subchannels on the first band. A bandwidth of a subchannel on the second band is a minimum channel bandwidth supported by the second band, and the second channel includes one or more subchannels on the second band. The subchannel may also be referred to as a fundamental channel, and a specific name is not limited. The bandwidth of the subchannel on the second band is 20 MHz, and the bandwidth of the subchannel on the first band is 20*2^N MHz.

[00112] **Example 1**

[00113] In Example 1, it is assumed that N=3, and the subcarrier spacing of the first channel is

eight times the subcarrier spacing of the second channel. In this case, the subcarrier spacing of the first channel is 3.84 MHz. In addition, the bandwidth of the subchannel on the first band is 160 MHz, and the first channel may be aggregated by one or more subchannels (160 MHz). For example, the bandwidth of the first channel may be 160 MHz, 320 MHz, 640 MHz, 1280 MHz, or 2560 MHz.

[00114] Specifically, when P=1, the bandwidth of the first channel is 160 MHz, and the number of DFT points corresponding to the bandwidth of the first channel is 64.

[00115] When P=2, the bandwidth of the first channel is 320 MHz, and the number of DFT points corresponding to the bandwidth of the first channel is 128.

[00116] When P=3, the bandwidth of the first channel is 640 MHz, and the number of DFT points corresponding to the bandwidth of the first channel is 256.

[00117] When P=4, the bandwidth of the first channel is 1280 MHz, and the number of DFT points corresponding to the bandwidth of the first channel is 512.

[00118] When P=5, the bandwidth of the first channel is 2560 MHz, and the number of DFT points corresponding to the bandwidth of the first channel is 1024.

[00119] It may be understood that only several possible bandwidths of the first channel are listed herein. The bandwidth of the first channel may alternatively be other possible bandwidths, which are not described one by one. Herein, an example in which "the bandwidth of the first channel is 160 MHz, and the number of DFT points corresponding to the bandwidth of the first channel is 64" is used. In another possible implementation, when the bandwidth of the first channel is 160 MHz, the number of DFT points corresponding to the bandwidth of the first channel may alternatively be greater than 64, for example, the number of DFT points corresponding to the bandwidth of the first channel is 128.

[00120] **Example 2**

[00121] In Example 2, it is assumed that N=2, and the subcarrier spacing of the first channel is four times the subcarrier spacing of the second channel. In this case, the subcarrier spacing of the first channel is 1.92 MHz. In addition, the bandwidth of the subchannel on the first band is 80 MHz, and the first channel may be aggregated by one or more subchannels (80 MHz). For example, the bandwidth of the first channel may be 80 MHz, 160 MHz, 320 MHz, 640 MHz, 1280 MHz, or 2560 MHz.

[00122] Specifically, when P=1, the bandwidth of the first channel is 80 MHz, and the number of DFT points corresponding to the bandwidth of the first channel is 64.

[00123] When P=2, the bandwidth of the first channel is 160 MHz, and the number of DFT points corresponding to the bandwidth of the first channel is 128.

[00124] When P=3, the bandwidth of the first channel is 320 MHz, and the number of DFT

points corresponding to the bandwidth of the first channel is 256.

[00125] When P=4, the bandwidth of the first channel is 640 MHz, and the number of DFT points corresponding to the bandwidth of the first channel is 512.

[00126] When P=5, the bandwidth of the first channel is 1280 MHz, and the number of DFT points corresponding to the bandwidth of the first channel is 1024.

[00127] When P=6, the bandwidth of the first channel is 2560 MHz, and the number of DFT points corresponding to the bandwidth of the first channel is 2048.

[00128] It may be understood that only several possible bandwidths of the first channel are listed herein. The bandwidth of the first channel may alternatively be other possible bandwidths, which are not described one by one. Herein, an example in which "the bandwidth of the first channel is 80 MHz, and the number of DFT points corresponding to the bandwidth of the first channel is 64" is used. In another possible implementation, when the bandwidth of the first channel is 80 MHz, the number of DFT points corresponding to the bandwidth of the first channel may alternatively be greater than 64, for example, the number of DFT points corresponding to the bandwidth of the first channel is 128.

[00129] The parameters in the high-frequency band provided in Example 1 and Example 2 may be understood as being obtained by performing a clock-on operation based on the parameters in the low-frequency band in Table 2. A multiple of the clock-on is x, where x is a positive number, as shown in Table 4. Further, x may be an integer greater than 1. For example, $x=2^N$.

Table 4: Clock-on operation

Parameter	x*20 MHz	x*40 MHz	x*80 MHz	x*160 MHz	…
fs (sampling frequency, MHz)	x*30.72	x*61.44	x*122.88	x*245.76	…
N_{DFT} (number of DFT points)	64	128	256	512	…
ΔF (subcarrier spacing, kHz)	x*480				
T_{DFT} (symbol period, μs)	1/(x*0.480)				
T_s (sampling interval, ns)	1/(x*0.03072)	1/(x*0.06144)	1/(x*0.12288)	1/(x*0.24576)	…
$T_{GI}=5/64$ T_{DFT} (short	1/(x*0.480)*10^ 3*5/64	1/(x*0.480)*10^ 3*5/64	1/(x*0.480)10^3 *5/64	1/(x*0.480)*10^ 3*5/64	…

Parameter	x*20 MHz	x*40 MHz	x*80 MHz	x*160 MHz	…
guard interval, ns)					
T_{GI}=14/64 T_{DFT} (long guard interval, ns)	1/(x*0.480)*10^3*14/64	1/(x*0.480)*10^3*14/64	1/(x*0.480)*10^3*14/64	1/(x*0.480)*10^3*14/64	…

[00130] Based on Table 4, if N=3 (x=8), parameters in the high-frequency band obtained through the clock-on operation, namely, parameters of different bandwidths in the high-frequency band provided in Example 1, are shown in Table 5.

Table 5: Parameters of different bandwidths in a high-frequency band

Related parameter	160 MHz	320 MHz	640 MHz	1280 MHz	…
fs (sampling frequency, MHz)	245.76 MHz	491.52 MHz	983.04 MHz	1966.08 MHz	…
N_{DFT} (number of DFT points)	64	128	256	512	…
ΔF (subcarrier spacing, MHz)	3.84				
T_{DFT} (symbol period, μs)	0.2604				
T_s (sampling interval, ns)	4.07	2.03	1.02	0.51	…
T_{GI}=5/64 T_{DFT} (short guard interval, ns)	20.35	20.35	20.35	20.35	…
T_{GI}=14/64 T_{DFT} (long guard interval, ns)	56.97	56.97	56.97	56.97	…

[00131] Based on Table 4, if N=2 (x=4), parameters in the high-frequency band obtained through the clock-on operation, namely, parameters of different bandwidths in the high-frequency band provided in Example 2, are shown in Table 6.

Table 6: Parameters of different bandwidths in a high-frequency band

Related parameter	80 MHz	160 MHz	320 MHz	640 MHz	1280 MHz	…
fs (sampling frequency,	122.88 MHz	245.76 MHz	491.52 MHz	983.04 MHz	1966.08 MHz	…

Related parameter	80 MHz	160 MHz	320 MHz	640 MHz	1280 MHz	…
MHz)						
N_{DFT} (number of DFT points)	64	128	256	512	64	…
ΔF (subcarrier spacing, MHz)	1.92 MHz					
T_{DFT} (symbol period, μs)	0.5208					
T_s (sampling interval, ns)	8.13	4.07	2.03	1.02	0.51	…
T_{GI}=5/64 T_{DFT} (short guard interval, ns)	40.69	40.69	40.69	40.69	40.69	…
T_{GI}=14/64 T_{DFT} (long guard interval, ns)	113.93	113.93	113.93	113.93	113.93	…

[00132] **Example 3**

[00133] In Example 3, it is assumed that N=4, and the subcarrier spacing of the first channel is 16 times the subcarrier spacing of the second channel. In this case, the subcarrier spacing of the first channel is 1.92 MHz. In addition, the bandwidth of the subchannel on the first band is 320 MHz, and the first channel may be aggregated by one or more subchannels (320 MHz). For example, the bandwidth of the first channel may be 320 MHz, 640 MHz, 1280 MHz, or 2560 MHz.

[00134] Specifically, when P=1, the bandwidth of the first channel is 320 MHz, and the number of DFT points corresponding to the bandwidth of the first channel is 256.

[00135] When P=2, the bandwidth of the first channel is 640 MHz, and the number of DFT points corresponding to the bandwidth of the first channel is 512.

[00136] When P=3, the bandwidth of the first channel is 1280 MHz, and the number of DFT points corresponding to the bandwidth of the first channel is 1024.

[00137] When P=4, the bandwidth of the first channel is 2560 MHz, and the number of DFT points corresponding to the bandwidth of the first channel is 2048.

[00138] It may be understood that only several possible bandwidths of the first channel are

listed herein. The bandwidth of the first channel may alternatively be other possible bandwidths, which are not described one by one. Herein, an example in which "the bandwidth of the first channel is 320 MHz, and the number of DFT points corresponding to the bandwidth of the first channel is 256" is used. In another possible implementation, when the bandwidth of the first channel is 320 MHz, the number of DFT points corresponding to the bandwidth of the first channel may alternatively be greater than 256, for example, the number of DFT points corresponding to the bandwidth of the first channel is 512.

[00139] The parameters in the high-frequency band provided in Example 3 may be understood as being obtained by performing a clock-on operation based on the parameters in the low-frequency band in Table 3. A multiple of the clock-on is x, where x is a positive number, as shown in Table 7. Further, x may be an integer greater than 1. For example, $x=2^N$.

Table 7: Clock-on operation

Related parameter	x*20 MHz	x*40 MHz	x*80 MHz	x*160 MHz
fs (sampling frequency, MHz)	x*30.72	x*61.44	x*122.88	x*245.76
N_{DFT} (number of DFT points)	256	512	1024	2048
ΔF (subcarrier spacing, kHz)	x*120			
T_{DFT} (symbol period, μs)	1/(x*0.120)			
T_s (sampling interval, ns)	1/(x*0.03072)	1/(x*0.06144)	1/(x*0.12288)	1/(x*0.24576)
$T_{GI}=18/256$ T_{DFT} (guard interval, ns)	1/(x*0.120)*10^3*18/256	1/(x*0.120)*10^3*18/256	1/(x*0.120)*10^3*18/256	1/(x*0.120)*10^3*18/256
$T_{GI}=39/256$ T_{DFT} (guard interval, ns)	1/(x*0.120)*10^3*39/256	1/(x*0.120)*10^3*39/256	1/(x*0.120)*10^3*39/256	1/(x*0.120)*10^3*39/256
$T_{GI}=64/256$ T_{DFT} (guard	1/(x*0.120)*10^3*64/256	1/(x*0.120)*10^3*64/256	1/(x*0.120)*10^3*64/256	1/(x*0.120)*10^3*64/256

Related parameter	x*20 MHz	x*40 MHz	x*80 MHz	x*160 MHz
interval, ns)				
T_{GI}=93/256 T_{DFT} (guard interval, ns)	1/(x*0.120)*10^3*93/256	1/(x*0.120)*10^3*93/256	1/(x*0.120)*10^3*93/256	1/(x*0.120)*10^3*93/256
T_{GI}=128/256 T_{DFT} (guard interval, ns)	1/(x*0.120)*10^3*128/256	1/(x*0.120)*10^3*128/256	1/(x*0.120)*10^3*128/256	1/(x*0.120)*10^3*128/256

[00140] Based on Table 7, if N=4 (x=16), parameters in the high-frequency band obtained through the clock-on operation, namely, parameters of different bandwidths in the high-frequency band provided in Example 3, are shown in Table 8.

Table 8: Parameters of different bandwidths in a high-frequency band

Related parameter	320 MHz	640 MHz	1280 MHz	2560 MHz	…
fs (sampling frequency, MHz)	491.52 MHz	983.04 MHz	1966.08 MHz	3932.16 MHz	…
N_{DFT} (number of DFT points)	256	512	1024	2048	…
ΔF (subcarrier spacing, MHz)	1.92				
T_{DFT} (symbol period, μs)	1/(16*0.120)=0.5208				
T_s (sampling interval, ns)	2.03	1.02	0.51	0.25	…
T_{GI}=18/256 T_{DFT} (guard interval, ns)	1/(16*0.120)*10^3*18/256=36.62	36.62	36.62	36.62	…
T_{GI}=39/256 T_{DFT} (guard interval, ns)	1/(16*0.120)*10^3*39/256=79.35	79.35	79.35	79.35	…
T_{GI}=64/256 T_{DFT} (guard interval, ns)	1/(16*0.120)*10^3*64/256=130.21	130.21	130.21	130.21	…
T_{GI}=93/256 T_{DFT}	1/(16*0.120)*10^3*93/25	189.21	189.21	189.21	…

Related parameter	320 MHz	640 MHz	1280 MHz	2560 MHz	…
(guard interval, ns)	6=189.21				
T_{GI}=128/256 T_{DFT} (guard interval, ns)	1/(16*0.120) *10^3*128/256=260.42	260.42	260.42	260.42	…

[00141] It may be understood that it can be learned from the foregoing descriptions of the parameters related to the high-frequency band that the symbol period on the high-frequency band is less than the symbol period on the low-frequency band. Therefore, for the high-frequency band, a design of the low-frequency band may be used. For example, each superframe includes 48 radio frames, and each radio frame includes 10 OFDM symbols. Alternatively, for the high-frequency band, a number of radio frames included in the superframe and a number of OFDM symbols included in the radio frame may be flexibly designed. For example, on the basis of ensuring that a duration of the superframe is 1 ms, the number of radio frames included in the superframe and/or the number of OFDM symbols included in the radio frame are/is adaptively adjusted. In other words, the high-frequency band may follow a design of a framework of "superframe–radio frame–OFDM symbol", and a specific proportion relationship between the superframe, the radio frame, and the OFDM symbol is not limited.

[00142] According to the foregoing method, the subcarrier spacing of the first channel is 2^N times the subcarrier spacing of the second channel in the second band. In this way, a subcarrier spacing of a low-frequency band is increased by 2^N times to obtain a subcarrier spacing of a high-frequency band, so that the subcarrier spacing of the high-frequency band is greater than the subcarrier spacing of the low-frequency band, thereby overcoming adverse effects such as more pronounced phase noise in the high-frequency band, and improving transmission performance. The bandwidth of the second channel is 2^P*20 MHz, and the bandwidth of the first channel is 2^N*2^P*20 MHz, that is, the bandwidth of the second channel and the bandwidth of the first channel correspond to a same number of DFT points. In this way, the low-frequency band and the high-frequency band can share a signal processing device, for example, a DFT/IDFT device, to reduce costs and complexity of a baseband chip for processing a low-frequency signal and a high-frequency signal.

Embodiment 2

[00143] Based on the parameters in the high-frequency band designed in Embodiment 1, tone plan of the first channel is further studied in Embodiment 2. For explanations of related terms or

nouns in Embodiment 2, refer to Embodiment 1.

[00144] For example, "the bandwidth of the subchannel on the first band is 160 MHz, and the subcarrier spacing is 3.84 MHz". A remaining range in left and right frequency domains of the subchannel is 160–39*3.84=10.24 MHz. In other words, to fill 160 MHz, there is still an available frequency domain range 10.24 MHz. If left and right remaining frequency domain ranges are the same, that is, both are 5.12 MHz, when the first channel includes a plurality of subchannels, for example, the first channel includes a subchannel a and a subchannel b, as shown in FIG. 6, a spacing between subcarriers corresponding to the subchannel a and the subchannel b is 5.12+5.12=10.24 MHz, which is not an integer multiple of the subcarrier spacing (10.24/3.84 is not equal to an integer), causing interference between subchannels or interference between carriers when an OFDM symbol is sent on the first channel.

[00145] Based on this, in this embodiment of this application, the first channel may include a left guard interval, a right guard interval, and Q subcarriers located between the left guard interval and the right guard interval, where Q is an integer greater than 1, as shown in FIG. 7. A lowest frequency of the left guard interval is a lowest frequency of the first channel, and a highest frequency of the right guard interval is a highest frequency of the first channel. A bandwidth between the left guard interval and the right guard interval is Q times the subcarrier spacing of the first channel, and the bandwidth between the left guard interval and the right guard interval may be understood as a bandwidth between a highest frequency of the left guard interval and a lowest frequency of the right guard interval. In this way, when the first channel includes a plurality of subchannels, because the bandwidth between the left guard interval and the right guard interval is an integer multiple of the subcarrier spacing of the first channel, that is, a spacing between subcarriers corresponding to any two adjacent subchannels is an integer multiple of the subcarrier spacing of the first channel, interference between subchannels or interference between carriers can be effectively reduced.

[00146] For example, as described in Embodiment 1, a number of DFT points of the subchannel on the first band may be 64 (that is, the subchannel on the first band includes 39 subcarriers), or a number of DFT points of the subchannel on the first band may be 256 (that is, the subchannel on the first band includes 39*4 subcarriers). The following separately uses the two cases as examples for description.

[00147] **Case 1: The number of DFT points of the subchannel on the first band is 64.**

[00148] **(1)** Specific values of the left guard interval and the right guard interval are described.

[00149] For example, when the bandwidth between the left guard interval and the right guard interval is an integer multiple of the subcarrier spacing of the first channel, the left guard interval and the right guard interval have a plurality of specific values. The following provides descriptions

with reference to Example 1 and Example 2.

[00150] Example 1

[00151] In Example 1, the subchannel on the first band is 160 MHz, the subcarrier spacing is 3.84 MHz, and the first channel includes 2^P subchannels. An available frequency domain range of a subchannel except the 39 subcarriers is 10.24 MHz. Therefore, an available frequency domain range on the left of the subchannel and an available frequency domain range on the right of the subchannel may include three cases: Case 1 in which the available frequency domain range on the left of the subchannel may be 3.84 MHz, and the available frequency domain range on the right of the subchannel may be 6.4 MHz; Case 2 in which the available frequency domain range on the left of the subchannel may be 5.12 MHz, and the available frequency domain range on the right of the subchannel may be 5.12 MHz; and Case 3 in which the available frequency domain range on the left of the subchannel may be 6.4 MHz, and the available frequency domain range on the right of the subchannel may be 3.84 MHz. It may be understood that, in this embodiment of this application, the three cases are used as an example. There may be another possibility for the available frequency domain range on the left of the subchannel and the available frequency domain range on the right of the subchannel. This is not limited.

[00152] When the first channel includes a plurality of subchannels, the plurality of subchannels are sequentially numbered 0, 1, 2, ..., and 2^P–1 in ascending order of corresponding frequencies. **In a possible implementation,** available frequency domain ranges on the left and right of the plurality of subchannels (namely, the subchannels 0, 1, 2, ..., and 2^P–1) may be cyclically designed based on Case 1, Case 2, and Case 3, as shown in Table 9.

Table 9: Example of the available frequency domain ranges on the left and right of the plurality of subchannels

	Subchannel 0	Subchannel 1	Subchannel 2	Subchannel 3	Subchannel 4	Subchannel 5	Subchannel 6	Subchannel 7	…
Available frequency domain range on the left	3.84 MHz	5.12 MHz	6.4 MHz	3.84 MHz	5.12 MHz	6.4 MHz	3.84 MHz	5.12 MHz	…
Available frequency domain range on the right	6.4 MHz	5.12 MHz	3.84 MHz	6.4 MHz	5.12 MHz	3.84 MHz	6.4 MHz	5.12 MHz	…

[00153] Table 9 is used as an example. When the first channel includes one or more subchannels, the left guard interval of the first channel is 3.84 MHz; and when Pmod2=1, the right guard interval

of the first channel is 5.12 MHz; or when Pmod2=0, the right guard interval of the first channel is 6.4 MHz. Herein, mod represents a modulo operation, "Pmod2=1" may also be replaced with "P is an odd number", and "Pmod2=0" may also be replaced with "P is an even number".

[00154] Specifically, when the first channel includes one subchannel (that is, P=0, and the first channel includes a subchannel 0), the left guard interval of the first channel (that is, an available frequency domain range on the left of the subchannel 0) is 3.84 MHz, and the right guard interval of the first channel (that is, an available frequency domain range on the right of the subchannel 0) is 6.4 MHz, as shown in FIG. 8A.

[00155] When the first channel includes two subchannels (that is, P=1, and the first channel includes a subchannel 0 and a subchannel 1), the left guard interval of the first channel (that is, an available frequency domain range on the left of the subchannel 0) is 3.84 MHz, and the right guard interval of the first channel (that is, an available frequency domain range on the right of the subchannel 1) is 5.12 MHz, as shown in FIG. 8B.

[00156] When the first channel includes four subchannels (that is, P=2, and the first channel includes a subchannel 0 to a subchannel 3), the left guard interval of the first channel (that is, an available frequency domain range on the left of the subchannel 0) is 3.84 MHz, and the right guard interval of the first channel (that is, an available frequency domain range on the right of the subchannel 3) is 6.4 MHz, as shown in FIG. 8C.

[00157] When the first channel includes eight subchannels (that is, P=3, and the first channel includes a subchannel 0 to a subchannel 7), the left guard interval of the first channel (that is, an available frequency domain range on the left of the subchannel 0) is 3.84 MHz, and the right guard interval of the first channel (that is, an available frequency domain range on the right of the subchannel 7) is 5.12 MHz.

[00158] It may be understood that, when the first channel includes more subchannels, reference may be made for understanding, and no enumeration is provided herein.

[00159] **In another possible implementation,** available frequency domain ranges on the left and right of the plurality of subchannels may be cyclically designed based on Case 2, Case 3, and Case 1, as shown in Table 10.

Table 10: Example of the available frequency domain ranges on the left and right of the plurality of subchannels

	Subchannel 0	Subchannel 1	Subchannel 2	Subchannel 3	Subchannel 4	Subchannel 5	Subchannel 6	Subchannel 7	…
Available frequency domain range on	5.12 MHz	6.4 MHz	3.84 MHz	5.12 MHz	6.4 MHz	3.84 MHz	5.12 MHz	6.4 MHz	…

	Subchannel 0	Subchannel 1	Subchannel 2	Subchannel 3	Subchannel 4	Subchannel 5	Subchannel 6	Subchannel 7	…
the left									
Available frequency domain range on the right	5.12 MHz	3.84 MHz	6.4 MHz	5.12 MHz	3.84 MHz	6.4 MHz	5.12 MHz	3.84 MHz	…

[00160] Table 10 is used as an example. When the first channel includes one or more subchannels, the left guard interval of the first channel is 5.12 MHz; and when Pmod2=1, the right guard interval of the first channel is 3.84 MHz; or when Pmod2=0, the right guard interval of the first channel is 5.12 MHz.

[00161] Specifically, when the first channel includes one subchannel (that is, P=0, and the first channel includes a subchannel 0), the left guard interval of the first channel (that is, an available frequency domain range on the left of the subchannel 0) is 5.12 MHz, and the right guard interval of the first channel (that is, an available frequency domain range on the right of the subchannel 0) is 5.12 MHz.

[00162] When the first channel includes two subchannels (that is, P=1, and the first channel includes a subchannel 0 and a subchannel 1), the left guard interval of the first channel (that is, an available frequency domain range on the left of the subchannel 0) is 5.12 MHz, and the right guard interval of the first channel (that is, an available frequency domain range on the right of the subchannel 1) is 3.84 MHz.

[00163] When the first channel includes four subchannels (that is, P=2, and the first channel includes a subchannel 0 to a subchannel 3), the left guard interval of the first channel (that is, an available frequency domain range on the left of the subchannel 0) is 5.12 MHz, and the right guard interval of the first channel (that is, an available frequency domain range on the right of the subchannel 3) is 5.12 MHz.

[00164] When the first channel includes eight subchannels (that is, P=3, and the first channel includes a subchannel 0 to a subchannel 7), the left guard interval of the first channel (that is, an available frequency domain range on the left of the subchannel 0) is 5.12 MHz, and the right guard interval of the first channel (that is, an available frequency domain range on the right of the subchannel 7) is 3.84 MHz.

[00165] It may be understood that, when the first channel includes more subchannels, reference may be made for understanding, and no enumeration is provided herein.

[00166] **In still another possible implementation,** available frequency domain ranges on the left and right of the plurality of subchannels may be cyclically designed based on Case 3, Case 1,

and Case 2, as shown in Table 11.

Table 11: Example of the available frequency domain ranges on the left and right of the plurality of subchannels

	Subchannel 0	Subchannel 1	Subchannel 2	Subchannel 3	Subchannel 4	Subchannel 5	Subchannel 6	Subchannel 7	…
Available frequency domain range on the left	6.4 MHz	3.84 MHz	5.12 MHz	6.4 MHz	3.84 MHz	5.12 MHz	6.4 MHz	3.84 MHz	…
Available frequency domain range on the right	3.84 MHz	6.4 MHz	5.12 MHz	3.84 MHz	6.4 MHz	5.12 MHz	3.84 MHz	6.4 MHz	…

[00167] Table 11 is used as an example. When the first channel includes one or more subchannels, the left guard interval of the first channel is 6.4 MHz; and when Pmod2=1, the right guard interval of the first channel is 6.4 MHz; or when Pmod2=0, the right guard interval of the first channel is 3.84 MHz.

[00168] Specifically, when the first channel includes one subchannel (that is, P=0, and the first channel includes a subchannel 0), the left guard interval of the first channel (that is, an available frequency domain range on the left of the subchannel 0) is 6.4 MHz, and the right guard interval of the first channel (that is, an available frequency domain range on the right of the subchannel 0) is 3.84 MHz.

[00169] When the first channel includes two subchannels (that is, P=1, and the first channel includes a subchannel 0 and a subchannel 1), the left guard interval of the first channel (that is, an available frequency domain range on the left of the subchannel 0) is 6.4 MHz, and the right guard interval of the first channel (that is, an available frequency domain range on the right of the subchannel 1) is 6.4 MHz.

[00170] When the first channel includes four subchannels (that is, P=2, and the first channel includes a subchannel 0 to a subchannel 3), the left guard interval of the first channel (that is, an available frequency domain range on the left of the subchannel 0) is 6.4 MHz, and the right guard interval of the first channel (that is, an available frequency domain range on the right of the subchannel 3) is 3.84 MHz.

[00171] When the first channel includes eight subchannels (that is, P=3, and the first channel includes a subchannel 0 to a subchannel 7), the left guard interval of the first channel (that is, an available frequency domain range on the left of the subchannel 0) is 6.4 MHz, and the right guard

interval of the first channel (that is, an available frequency domain range on the right of the subchannel 7) is 6.4 MHz.

[00172] It may be understood that, when the first channel includes more subchannels, reference may be made for understanding, and no enumeration is provided herein.

[00173] **Example 2**

[00174] In Example 2, the subchannel on the first band is 80 MHz, the subcarrier spacing is 1.92 MHz, and the first channel includes 2^P subchannels. An available frequency domain range of a subchannel except the 39 subcarriers is 5.12 MHz. Therefore, an available frequency domain range on the left of the subchannel and an available frequency domain range on the right of the subchannel may include three cases: Case 1 in which the available frequency domain range on the left of the subchannel may be 1.92 MHz, and the available frequency domain range on the right of the subchannel may be 3.2 MHz; Case 2 in which the available frequency domain range on the left of the subchannel may be 2.56 MHz, and the available frequency domain range on the right of the subchannel may be 2.56 MHz; and Case 3 in which the available frequency domain range on the left of the subchannel may be 3.2 MHz, and the available frequency domain range on the right of the subchannel may be 1.92 MHz. It may be understood that, in this embodiment of this application, the three cases are used as an example. There may be another possibility for the available frequency domain range on the left of the subchannel and the available frequency domain range on the right of the subchannel. This is not limited.

[00175] When the first channel includes a plurality of subchannels, the plurality of subchannels are sequentially numbered 0, 1, 2, ..., and $2^P–1$ in ascending order of corresponding frequencies. **In a possible implementation,** available frequency domain ranges on the left and right of the plurality of subchannels (namely, the subchannels 0, 1, 2, ..., and 2P–1) may be cyclically designed based on Case 1, Case 2, and Case 3, as shown in Table 12.

Table 12: Example of the available frequency domain ranges on the left and right of the plurality of subchannels

	Subchannel 0	Subchannel 1	Subchannel 2	Subchannel 3	Subchannel 4	Subchannel 5	Subchannel 6	Subchannel 7	…
Available frequency domain range on the left	1.92 MHz	2.56 MHz	3.2 MHz	1.92 MHz	2.56 MHz	3.2 MHz	1.92 MHz	2.56 MHz	…
Available frequency domain range on the right	3.2 MHz	2.56 MHz	1.92 MHz	3.2 MHz	2.56 MHz	1.92 MHz	3.2 MHz	2.56 MHz	…

[00176] Table 12 is used as an example. When the first channel includes one or more subchannels, the left guard interval of the first channel is 1.92 MHz; and when Pmod2=1, the right guard interval of the first channel is 2.56 MHz; or when Pmod2=0, the right guard interval of the first channel is 3.2 MHz. Details are not described again.

[00177] **In another possible implementation,** available frequency domain ranges on the left and right of the plurality of subchannels may be cyclically designed based on Case 2, Case 3, and Case 1, as shown in Table 13.

Table 13: Example of the available frequency domain ranges on the left and right of the plurality of subchannels

	Subchannel 0	Subchannel 1	Subchannel 2	Subchannel 3	Subchannel 4	Subchannel 5	Subchannel 6	Subchannel 7	…
Available frequency domain range on the left	2.56 MHz	3.2 MHz	1.92 MHz	2.56 MHz	3.2 MHz	1.92 MHz	2.56 MHz	3.2 MHz	…
Available frequency domain range on the right	2.56 MHz	1.92 MHz	3.2 MHz	2.56 MHz	1.92 MHz	3.2 MHz	2.56 MHz	1.92 MHz	…

[00178] Table 13 is used as an example. When the first channel includes one or more subchannels, the left guard interval of the first channel is 2.56 MHz; and when Pmod2=1, the right guard interval of the first channel is 1.92 MHz; or when Pmod2=0, the right guard interval of the first channel is 2.56 MHz. Details are not described again.

[00179] **In still another possible implementation,** available frequency domain ranges on the left and right of the plurality of subchannels may be cyclically designed based on Case 3, Case 1, and Case 2, as shown in Table 14.

Table 14: Example of the available frequency domain ranges on the left and right of the plurality of subchannels

	Subchannel 0	Subchannel 1	Subchannel 2	Subchannel 3	Subchannel 4	Subchannel 5	Subchannel 6	Subchannel 7	…
Available frequency domain range on the left	3.2 MHz	1.92 MHz	2.56 MHz	3.2 MHz	1.92 MHz	2.56 MHz	3.2 MHz	1.92 MHz	…
Available frequency	1.92 MHz	3.2	2.56	1.92 MHz	3.2	2.56	1.92 MHz	3.2	…

	Subchannel 0	Subchannel 1	Subchannel 2	Subchannel 3	Subchannel 4	Subchannel 5	Subchannel 6	Subchannel 7	…
domain range on the right		MHz	MHz		MHz	MHz		MHz	

[00180] Table 14 is used as an example. When the first channel includes one or more subchannels, the left guard interval of the first channel is 3.2 MHz; and when Pmod2=1, the right guard interval of the first channel is 3.2 MHz; or when Pmod2=0, the right guard interval of the first channel is 1.92 MHz. Details are not described again.

[00181] It may be understood that Example 1 and Example 2 are respectively described by using an example in which "the subcarrier spacing is 3.84 MHz ($x=2^N=8$)" and "the subcarrier spacing is 1.92 MHz ($x=2^N=4$)". In this embodiment of this application, when the subcarrier spacing is another possible value or the first channel includes another number of subchannels, reference may be made for both the left guard interval and the right guard interval of the first channel. In other words, the available frequency domain ranges on the left and right of the plurality of subchannels of the first channel may be shown in Table 15.

Table 15: Example of the available frequency domain ranges on the left and right of the plurality of subchannels

		Subchannel i	Subchannel i+1	Subchannel i+2	Subchannel i+3	Subchannel i+4	Subchannel i+5	…
Available frequency domain range on the left	…	x*480 kHz	x*640 kHz	x*800 kHz	x*480 kHz	x*640 kHz	x*800 kHz	…
Available frequency domain range on the right	…	x*800 kHz	x*640 kHz	x*480 kHz	x*800 kHz	x*640 kHz	x*480 kHz	…

[00182] In Table 15, the subchannel i may be the subchannel 0 in the plurality of subchannels, or may be the subchannel 1 in the plurality of subchannels, or may be the subchannel 2 in the plurality of subchannels. This is not specifically limited.

[00183] **(2)** The Q subcarriers are described.

[00184] When the first channel includes one subchannel, Q=39, a direct current subcarrier may be a 20^{th} subcarrier in the 39 subcarriers, and 38 subcarriers other than the direct current subcarrier are occupied subcarriers. The occupied subcarriers include a data subcarrier and/or a pilot subcarrier, that is, the data subcarrier and the pilot subcarrier are collectively referred to as the

occupied subcarriers. In this case, tone plan of the first channel is similar to tone plan of the 20 MHz bandwidth in the low-frequency band in FIG. 2.

[00185] The following describes a direct current subcarrier and an occupied subcarrier of the first channel when the first channel includes a plurality of subchannels (for example, a subchannel 0, a subchannel 1, a subchannel 2, ..., and a subchannel 2^P–1).

[00186] The Q subcarriers are sorted in ascending order of frequencies, that is, frequencies of a 1^{st} subcarrier to a Q^{th} subcarrier are sorted in ascending order. The Q subcarriers include Q1 subcarriers, and the Q1 subcarriers are direct current subcarriers, where Q1 is an integer greater than or equal to 1, and Q1 is less than Q. Some or all of (Q–Q1) subcarriers in the Q subcarriers other than the Q1 subcarriers are occupied subcarriers. For example, the Q subcarriers further include Q2 subcarriers, and the Q2 subcarriers are occupied subcarriers.

[00187] For example, the Q1 subcarriers are one or more subcarriers in the middle of the Q subcarriers. A number of direct current subcarriers is not limited in embodiments of this application. The following describes the direct current subcarrier and the occupied subcarrier with reference to Implementation 1 and Implementation 2.

[00188] **Implementation 1**

[00189] When Qmod2=1 (that is, Q is an odd number), the Q1 subcarriers include at least one of a $((Q–1)/2)^{th}$ subcarrier, a $((Q+1)/2)^{th}$ subcarrier, and a $((Q+1)/2+1)^{th}$ subcarrier in the Q subcarriers. For example, the Q1 subcarriers include the $((Q–1)/2)^{th}$ subcarrier, the $((Q+1)/2)^{th}$ subcarrier, and the $((Q+1)/2+1)^{th}$ subcarrier, that is, the Q1 subcarriers are three subcarriers in the middle of the Q subcarriers. Alternatively, when Qmod2=0 (that is, Q is an even number), the Q1 subcarriers include at least one of a $(Q/2)^{th}$ subcarrier and a $(Q/2+1)^{th}$ subcarrier in the Q subcarriers. For example, the Q1 subcarriers include the $(Q/2)^{th}$ subcarrier and the $(Q/2+1)^{th}$ subcarrier, that is, the Q1 subcarriers are two subcarriers in the middle of the Q subcarriers. In this way, because a direct current subcarrier is a subcarrier in the middle of the Q subcarriers, direct current impact caused by using the subcarrier in the middle as a data or pilot subcarrier is avoided, and receiving performance is improved.

[00190] In other words, according to the method for combining a plurality of subchannels into one large channel provided in this embodiment of this application, all or some direct current subcarriers that originally belong to a subchannel may be converted into data or pilot subcarriers, and some or all direct current subcarriers of a large channel may be obtained by using an original small guard interval of a subchannel, or an original small guard interval of a subchannel may be used as a data subcarrier or a pilot subcarrier. This helps improve communication efficiency and band utilization.

[00191] For example, as shown in FIG. 9, an example in which the first channel includes four

subchannels is used. Tone plan of each subchannel is similar to tone plan of the 20 MHz bandwidth in the low-frequency band in FIG. 2, that is, a 20th subcarrier in each subchannel is a direct current subcarrier, and a number of occupied subcarriers is 38. However, according to the design in this embodiment of this application, the 20th subcarrier in each subchannel is not used as a direct current subcarrier, but may be used as a data subcarrier or a pilot subcarrier.

[00192] Because the spacing between subcarriers corresponding to any two adjacent subchannels in the plurality of subchannels is an integer multiple of the subcarrier spacing, the design in this embodiment of this application is used. The spacing between subcarriers corresponding to any two adjacent subchannels may include at least one of a direct current subcarrier, a data subcarrier, and a pilot subcarrier. For example, for the subchannel 1 and the subchannel 2 (namely, two adjacent subchannels in the middle of the first channel), a spacing between subcarriers corresponding to the subchannel 1 and the subchannel 2 includes a direct current subcarrier, and optionally further includes a data subcarrier and/or a pilot subcarrier. As shown in FIG. 9, the spacing between the subcarriers corresponding to the subchannel 1 and the subchannel 2 includes three subcarriers, and the three subcarriers may be used as direct current subcarriers, or a middle subcarrier may be used as a direct current subcarrier, and the other subcarriers are used as data subcarriers or pilot subcarriers. In addition to two adjacent subchannels in the middle, the spacing between subcarriers corresponding to any other two adjacent subchannels includes a data subcarrier and/or a pilot subcarrier. As shown in FIG. 9, a spacing between subcarriers corresponding to the subchannel 0 and the subchannel 1 includes three subcarriers, and the three subcarriers may be used as data subcarriers or pilot subcarriers; and a spacing between subcarriers corresponding to the subchannel 2 and the subchannel 3 includes three subcarriers, and the three subcarriers may be used as data subcarriers or pilot subcarriers. In this way, the number of occupied subcarriers in the first channel is greater than a product of a number of subchannels included in the first channel and a number of occupied subcarriers (that is, 38) in a single subchannel. This helps improve communication efficiency and band utilization.

[00193] The guard interval shown in Table 9 is used as an example. When P=1, the first channel includes two subchannels, and the number of occupied subcarriers in the first channel is greater than 76. In this case, Q=81. For example, if the first channel includes three direct current subcarriers, a maximum number of occupied subcarriers in the first channel is 78. For another example, if the first channel includes one direct current subcarrier, a maximum number of occupied subcarriers in the first channel is 80.

[00194] When P=2, the first channel includes four subchannels, and the number of occupied subcarriers in the first channel is greater than 152. In this case, Q=164. For example, if the first channel includes two direct current subcarriers, a maximum number of occupied subcarriers in the

first channel is 162.

[00195] When P=3, the first channel includes eight subchannels, and the number of occupied subcarriers in the first channel is greater than 304. In this case, Q=331. For example, if the first channel includes three direct current subcarriers, a maximum number of occupied subcarriers in the first channel is 328.

[00196] When P=4, the first channel includes 16 subchannels, and the number of occupied subcarriers in the first channel is greater than or equal to 608. In this case, Q=664. For example, if the first channel includes two direct current subcarriers, a maximum number of occupied subcarriers in the first channel is 662.

[00197] When P=5, the first channel includes 32 subchannels, and the number of occupied subcarriers in the first channel is greater than or equal to 1216. In this case, Q=1331. For example, if the first channel includes three direct current subcarriers, a maximum number of occupied subcarriers in the first channel is 1328.

[00198] Implementation 2

[00199] Based on Example 1, for example, the first channel includes two subchannels, that is, the bandwidth of the first channel is 320 MHz. There are three cases (case) in total for the left guard interval and the right guard interval of the first channel: Case A, Case B, and Case C. Case A: The left guard interval is 3.84 MHz, the right guard interval is 5.12 MHz, and the Q subcarriers in the first channel are 81 subcarriers. Case B: The left guard interval is 5.12 MHz, the right guard interval is 3.84 MHz, and the Q subcarriers in the first channel are 81 subcarriers. Case C: The left guard interval is 6.4 MHz, the right guard interval is 6.4 MHz, and the Q subcarriers in the first channel are 80 subcarriers.

[00200] For Case A or Case B, assuming that three subcarriers in the middle of the Q subcarriers are direct current subcarriers (that is, Q1=3), the occupied subcarriers include 39 subcarriers to the left of the direct current subcarriers and 39 subcarriers to the right of the direct current subcarriers. In this case, a number of occupied subcarriers to the left of the direct current subcarriers is the same as a number of occupied subcarriers to the right of the direct current subcarriers.

[00201] For Case C, assuming that three subcarriers in the middle of the Q subcarriers are direct current subcarriers (that is, Q1=3), the occupied subcarriers include 39 subcarriers to the left of the direct current subcarriers and 38 subcarriers to the right of the direct current subcarriers, or the occupied subcarriers include 38 subcarriers to the left of the direct current subcarriers and 39 subcarriers to the right of the direct current subcarriers. In this case, a number of occupied subcarriers to the left of the direct current subcarriers is different from a number of occupied subcarriers to the right of the direct current subcarriers. To enable the numbers of occupied subcarriers on both sides of the direct current subcarriers to be the same, to reduce processing

complexity, a null subcarrier may be designed. For example, a leftmost subcarrier in the first channel is a null subcarrier, and in the remaining 79 subcarriers, three middle subcarriers are direct current subcarriers (that is, Q1=3), and 39 subcarriers to the left of the direct current subcarriers and 38 subcarriers to the right of the direct current subcarriers are occupied subcarriers. For another example, a rightmost subcarrier in the first channel is a null subcarrier, and in the remaining 79 subcarriers, three middle subcarriers are direct current subcarriers (that is, Q1=3), and 39 subcarriers to the left of the direct current subcarriers and 38 subcarriers to the right of the direct current subcarriers are occupied subcarriers.

[00202] The following further provides descriptions with reference to Solution a and Solution b.

[00203] (1) Solution a

[00204] It can be learned from the foregoing descriptions of the three cases that, when numbers of direct current subcarriers in different cases are the same, numbers of occupied subcarriers are different. For example, the number of occupied subcarriers in Case A or Case B is 78, and the number of occupied subcarriers in Case C is 76. For a same bandwidth, numbers of occupied subcarriers in different cases are different, causing high processing complexity. Therefore, to reduce processing complexity and ensure that the numbers of occupied subcarriers in different cases are the same, Solution a provided in this embodiment of this application is as follows:

[00205] When Qmod2=1 (that is, Q is an odd number), Q2=Q–2–Q1, and the Q2 subcarriers (namely, occupied subcarriers) include (Q–2–Q1)/2 contiguous subcarriers to the left of the Q1 subcarriers and (Q–2–Q1)/2 contiguous subcarriers to the right of the Q1 subcarriers. A rightmost subcarrier in the (Q–2–Q1)/2 contiguous subcarriers to the left of the Q1 subcarriers is adjacent to a leftmost subcarrier in the Q1 subcarriers, and a leftmost subcarrier in the (Q–2–Q1)/2 contiguous subcarriers to the right of the Q1 subcarriers is adjacent to a rightmost subcarrier in the Q1 subcarriers. Q3 subcarriers in the Q subcarriers other than the Q1 subcarriers and the Q2 subcarriers are null subcarriers. Q1 is an odd number. For example, Q1 is an integer such as 1, 3, 5...

[00206] Q3=Q–Q1–Q2=2. In other words, there are two null subcarriers in the Q subcarriers. For example, the Q3 subcarriers include a 1^{st} subcarrier and a Q^{th} subcarrier (namely, left 1 and right 1) in the Q subcarriers, or a 1^{st} subcarrier and a 2^{nd} subcarrier (namely, left 2 and right 0) in the Q subcarriers, or a $(Q–1)^{th}$ subcarrier and a Q^{th} subcarrier (namely, left 0 and right 2) in the Q subcarriers.

[00207] When Qmod2=0 (that is, Q is an even number), Q2=Q–1–Q1, and the Q2 subcarriers (namely, occupied subcarriers) include (Q–1–Q1)/2 contiguous subcarriers to the left of the Q1 subcarriers and (Q–1–Q1)/2 contiguous subcarriers to the right of the Q1 subcarriers. A rightmost

subcarrier in the (Q–1–Q1)/2 contiguous subcarriers to the left of the Q1 subcarriers is adjacent to a leftmost subcarrier in the Q1 subcarriers, and a leftmost subcarrier in the (Q–1–Q1)/2 contiguous subcarriers to the right of the Q1 subcarriers is adjacent to a rightmost subcarrier in the Q1 subcarriers. Q3 subcarriers in the Q subcarriers other than the Q1 subcarriers and the Q2 subcarriers are null subcarriers.

[00208] Q3=Q–Q1–Q2=1. In other words, there is one null subcarrier in the Q subcarriers. For example, the Q3 subcarriers are a 1st subcarrier (namely, left 1 and right 0) or a Qth subcarrier (namely, left 0 and right 1) in the Q subcarriers.

[00209] For Q1=3, based on Example 1, for example, the first channel includes two subchannels, that is, the bandwidth of the first channel is 320 MHz. There are three cases in total for the left guard interval and the right guard interval of the first channel: Case A, Case B, and Case C. For Case A or Case B, the Q subcarriers in the first channel are 81 subcarriers. For Case C, the Q subcarriers in the first channel are 80 subcarriers. Further, numbers of direct current subcarriers, numbers of occupied subcarriers, and numbers of null subcarriers in Case A, Case B, and Case C are shown in Table 16.

Table 16: Three cases

Case corresponding to 320 MHz	Left guard interval (MHz)	Right guard interval (MHz)	Number of direct current subcarriers	Number of occupied subcarriers	Number of null subcarriers
A	3.84	5.12	3	38 (left of the DC) +38 (right of the DC)	2 (left 1 and right 1; or left 2 and right 0; or left 0 and right 2)
B	5.12	3.84	3	38 (left of the DC) +38 (right of the DC)	2 (left 1 and right 1; or left 2 and right 0; or left 0 and right 2)
C	6.4	6.4	3	38 (left of the DC) +38 (right of the DC)	1 (left 1 and right 0; or left 0 and right 1)

[00210] It can be learned from Table 16 that, when the bandwidth of the first channel is 320 MHz, in Case A, Case B, and Case C, the numbers of direct current subcarriers are the same and are an odd number, the numbers of occupied subcarriers are the same, and the numbers of occupied subcarriers on both sides of the direct current subcarriers are the same. This helps reduce processing complexity.

[00211] For Q1=3, based on Example 1, for example, the first channel includes four subchannels, that is, the bandwidth of the first channel is 640 MHz. There are three cases in total for the left guard interval and the right guard interval of the first channel: Case A, Case B, and Case C. For Case A, Case B, or Case C, the Q subcarriers in the first channel are 164 subcarriers. Further, numbers of direct current subcarriers, numbers of occupied subcarriers, and numbers of null subcarriers in Case A, Case B, and Case C are shown in Table 17.

Table 17: Three cases

Case corresponding to 640 MHz	Left guard interval (MHz)	Right guard interval (MHz)	Number of direct current subcarriers	Number of occupied subcarriers	Number of null subcarriers
A	3.84	6.4	3	80 (left of the DC) +80 (right of the DC)	1 (left 1 and right 0; or left 0 and right 1)
B	5.12	5.12	3	80 (left of the DC) +80 (right of the DC)	1 (left 1 and right 0; or left 0 and right 1)
C	6.4	3.84	3	80 (left of the DC) +80 (right of the DC)	1 (left 1 and right 0; or left 0 and right 1)

[00212] It can be learned from Table 17 that, when the bandwidth of the first channel is 640 MHz, in Case A, Case B, and Case C, the numbers of direct current subcarriers are the same and are an odd number, the numbers of occupied subcarriers are the same, and the numbers of occupied subcarriers on both sides of the direct current subcarriers are the same. This helps reduce processing complexity.

[00213] For Q1=3, based on Example 1, for example, the first channel includes eight subchannels, that is, the bandwidth of the first channel is 1280 MHz. There are three cases (case) in total for the left guard interval and the right guard interval of the first channel: Case A, Case B, and Case C. For Case A or Case B, the Q subcarriers in the first channel are 331 subcarriers. For Case C, the Q subcarriers in the first channel are 330 subcarriers. Further, numbers of direct current subcarriers, numbers of occupied subcarriers, and numbers of null subcarriers in Case A, Case B, and Case C are shown in Table 18.

Table 18: Three cases

Case corresponding to 1280 MHz	Left guard interval (MHz)	Right guard interval (MHz)	Number of direct current subcarriers	Number of occupied subcarriers	Number of null subcarriers
A	3.84	5.12	3	163 (left of the DC)	2 (left 1 and right

Case corresponding to 1280 MHz	Left guard interval (MHz)	Right guard interval (MHz)	Number of direct current subcarriers	Number of occupied subcarriers	Number of null subcarriers
				+163 (right of the DC)	1; or left 2 and right 0; or left 0 and right 2)
B	5.12	3.84	3	163 (left of the DC) +163 (right of the DC)	2 (left 1 and right 1; or left 2 and right 0; or left 0 and right 2)
C	6.4	6.4	3	163 (left of the DC) +163 (right of the DC)	1 (left 1 and right 0; or left 0 and right 1)

[00214] It can be learned from Table 18 that, when the bandwidth of the first channel is 1280 MHz, in Case A, Case B, and Case C, the numbers of direct current subcarriers are the same and are an odd number, the numbers of occupied subcarriers are the same, and the numbers of occupied subcarriers on both sides of the direct current subcarriers are the same. This helps reduce processing complexity.

[00215] (2) Solution b

[00216] It is assumed that a protocol predefines or preconfigures that some of Case A, Case B, and Case C are used. For example, the protocol predefines or preconfigures that Case A, Case B, or Case C is used. Therefore, whether numbers of occupied subcarriers in different cases are the same may not be considered. In this case, Solution b provided in this embodiment of this application is as follows:

[00217] When Qmod2=1 (that is, Q is an odd number), Q2=Q–Q1, and the Q2 subcarriers (namely, occupied subcarriers) include (Q–Q1)/2 contiguous subcarriers to the left of the Q1 subcarriers and (Q–Q1)/2 contiguous subcarriers to the right of the Q1 subcarriers. A rightmost subcarrier in the (Q–Q1)/2 contiguous subcarriers to the left of the Q1 subcarriers is adjacent to a leftmost subcarrier in the Q1 subcarriers, and a leftmost subcarrier in the (Q–Q1)/2 contiguous subcarriers to the right of the Q1 subcarriers is adjacent to a rightmost subcarrier in the Q1 subcarriers. Q1 is an odd number. For example, Q1 is an integer such as 1, 3, 5... In this case, because both Q and Q1 are odd numbers, numbers of occupied subcarriers on both sides of the direct current subcarriers are the same, and no null subcarrier needs to be set.

[00218] When Qmod2=0 (that is, Q is an even number), Q2=Q–1–Q1, and the Q2 subcarriers (namely, occupied subcarriers) include (Q–1–Q1)/2 contiguous subcarriers to the left of the Q1

subcarriers and (Q–1–Q1)/2 contiguous subcarriers to the right of the Q1 subcarriers. A rightmost subcarrier in the (Q–1–Q1)/2 contiguous subcarriers to the left of the Q1 subcarriers is adjacent to a leftmost subcarrier in the Q1 subcarriers, and a leftmost subcarrier in the (Q–1–Q1)/2 contiguous subcarriers to the right of the Q1 subcarriers is adjacent to a rightmost subcarrier in the Q1 subcarriers. Q1 is an odd number. For example, Q1 is an integer such as 1, 3, 5... In this case, because Q is an even number and Q1 is an odd number, one null subcarrier may be set, so that numbers of occupied subcarriers on both sides of the direct current subcarrier are the same.

[00219] For example, the protocol predefines or preconfigures that Case A is used. Based on Example 1, for example, the first channel includes two subchannels, that is, the bandwidth of the first channel is 320 MHz. The Q subcarriers in the first channel are 81 subcarriers. When Q1=3, three subcarriers in the middle of the Q subcarriers are direct current subcarriers, and 39 subcarriers to the left of the direct current subcarriers and 39 subcarriers to the right of the direct current subcarriers are occupied subcarriers.

[00220] It may be understood that, when the first channel includes more subchannels, reference may be made to the foregoing descriptions. In addition, an example in which Q1=3 is used in the foregoing descriptions. When Q1 is another value, reference may be made for understanding, and no enumeration is provided herein.

[00221] Case 2: The number of DFT points of the subchannel on the first band is 256.

[00222] **(1)** Specific values of the left guard interval and the right guard interval are described.

[00223] For example, when the bandwidth between the left guard interval and the right guard interval is an integer multiple of the subcarrier spacing of the first channel, the left guard interval and the right guard interval have a plurality of specific values. The following provides descriptions with reference to Example 3.

[00224] Example 3

[00225] In Example 3, the subchannel on the first band is 320 MHz, the subcarrier spacing is 1.92 MHz, and the first channel includes 2^P subchannels. An available frequency domain range of the subchannel except the 39*4 subcarriers is 20.48 MHz. Therefore, an available frequency domain range on the left of the subchannel and an available frequency domain range on the right of the subchannel may include three cases: Case 1 in which the available frequency domain range on the left of the subchannel may be 7.68 MHz, and the available frequency domain range on the right of the subchannel may be 12.8 MHz; Case 2 in which the available frequency domain range on the left of the subchannel may be 10.24 MHz, and the available frequency domain range on the right of the subchannel may be 10.24 MHz; and Case 3 in which the available frequency domain range on the left of the subchannel may be 12.8 MHz, and the available frequency domain range on the right of the subchannel may be 7.68 MHz. It may be understood that, in this embodiment

of this application, the three cases are used as an example. There may be another possibility for the available frequency domain range on the left of the subchannel and the available frequency domain range on the right of the subchannel. This is not limited.

[00226] When the first channel includes a plurality of subchannels, the plurality of subchannels are sequentially numbered 0, 1, 2, ..., and 2^P-1 in ascending order of corresponding frequencies. **In a possible implementation,** available frequency domain ranges on the left and right of the plurality of subchannels (namely, the subchannels 0, 1, 2, ..., and 2P–1) may be cyclically designed based on Case 1, Case 2, and Case 3, as shown in Table 19.

Table 19: Example of the available frequency domain ranges on the left and right of the plurality of subchannels

	Subchannel 0	Subchannel 1	Subchannel 2	Subchannel 3	Subchannel 4	Subchannel 5	Subchannel 6	Subchannel 7	…
Available frequency domain range on the left	7.68 MHz	10.24 MHz	12.8 MHz	7.68 MHz	10.24 MHz	12.8 MHz	7.68 MHz	10.24 MHz	…
Available frequency domain range on the right	12.8 MHz	10.24 MHz	7.68 MHz	12.8 MHz	10.24 MHz	7.68 MHz	12.8 MHz	10.24 MHz	…

[00227] Table 19 is used as an example. When the first channel includes one or more subchannels, the left guard interval of the first channel is 7.68 MHz; and when Pmod2=1, the right guard interval of the first channel is 10.24 MHz; or when Pmod2=0, the right guard interval of the first channel is 12.8 MHz. Details are not described again.

[00228] **In another possible implementation,** available frequency domain ranges on the left and right of the plurality of subchannels may be cyclically designed based on Case 2, Case 3, and Case 1, as shown in Table 20.

Table 20: Example of the available frequency domain ranges on the left and right of the plurality of subchannels

	Subchannel 0	Subchannel 1	Subchannel 2	Subchannel 3	Subchannel 4	Subchannel 5	Subchannel 6	Subchannel 7	…
Available frequency domain range on the left	10.24 MHz	12.8 MHz	7.68 MHz	10.24 MHz	12.8 MHz	7.68 MHz	10.24 MHz	12.8 MHz	…
Available	10.24	7.68	12.8	10.24	7.68	12.8	10.24	7.68	…

	Subchannel 0	Subchannel 1	Subchannel 2	Subchannel 3	Subchannel 4	Subchannel 5	Subchannel 6	Subchannel 7	…
frequency domain range on the right	MHz	MHz	MHz	MHz	MHz	MHz	MHz	MHz	

[00229] Table 20 is used as an example. When the first channel includes one or more subchannels, the left guard interval of the first channel is 10.24 MHz; and when Pmod2=1, the right guard interval of the first channel is 7.68 MHz; or when Pmod2=0, the right guard interval of the first channel is 10.24 MHz. Details are not described again.

[00230] **In still another possible implementation,** available frequency domain ranges on the left and right of the plurality of subchannels may be cyclically designed based on Case 3, Case 1, and Case 2, as shown in Table 21.

Table 21: Example of the available frequency domain ranges on the left and right of the plurality of subchannels

	Subchannel 0	Subchannel 1	Subchannel 2	Subchannel 3	Subchannel 4	Subchannel 5	Subchannel 6	Subchannel 7	…
Available frequency domain range on the left	12.8 MHz	7.68 MHz	10.24 MHz	12.8 MHz	7.68 MHz	10.24 MHz	12.8 MHz	7.68 MHz	…
Available frequency domain range on the right	7.68 MHz	12.8 MHz	10.24 MHz	7.68 MHz	12.8 MHz	10.24 MHz	7.68 MHz	12.8 MHz	…

[00231] Table 21 is used as an example. When the first channel includes one or more subchannels, the left guard interval of the first channel is 12.8 MHz; and when Pmod2=1, the right guard interval of the first channel is 12.8 MHz; or when Pmod2=0, the right guard interval of the first channel is 7.68 MHz.

[00232] It may be understood that the foregoing example is described by using an example in which "the subcarrier spacing is 1.92 MHz ($x=2^N=16$)". In this embodiment of this application, when the subcarrier spacing is another possible value or the first channel includes another number of subchannels, reference may be made for both the left guard interval and the right guard interval of the first channel. In other words, the available frequency domain ranges on the left and right of the plurality of subchannels of the first channel may be shown in Table 22.

Table 22: Example of the available frequency domain ranges on the left and right of the plurality of subchannels

		Subchannel i	Subchannel i+1	Subchannel i+2	Subchannel i+3	Subchannel i+4	Subchannel i+5	…
Available frequency domain range on the left	…	x*480 kHz	x*640 kHz	x*800 kHz	x*480 kHz	x*640 kHz	x*800 kHz	…
Available frequency domain range on the right	…	x*800 kHz	x*640 kHz	x*480 kHz	x*800 kHz	x*640 kHz	x*480 kHz	…

[00233] In Table 22, the subchannel i may be the subchannel 0 in the plurality of subchannels, or may be the subchannel 1 in the plurality of subchannels, or may be the subchannel 2 in the plurality of subchannels. This is not specifically limited.

[00234] **(2)** The Q subcarriers are described.

[00235] When the first channel includes one subchannel, Q=39*4=156, that is, the first channel includes four groups of 39 contiguous subcarriers. For example, if a number of direct current subcarriers is 1, a 78^{th} subcarrier in the 156 subcarriers is a direct current subcarrier, a last subcarrier in the 156 subcarriers is a null subcarrier, and subcarriers other than the direct current subcarrier and the null subcarrier are occupied subcarrier; or a 79^{th} subcarrier in the 156 subcarriers is a direct current subcarrier, a 1^{st} subcarrier in the 156 subcarriers is a null subcarrier, and subcarriers other than the direct current subcarrier and the null subcarrier are occupied subcarrier. Herein, an example in which the number of direct current subcarriers is 1 is used. The number of direct current subcarriers is not limited in embodiments of this application.

[00236] The following describes a direct current subcarrier and an occupied subcarrier of the first channel when the first channel includes a plurality of subchannels (for example, a subchannel 0, a subchannel 1, a subchannel 2, ..., and a subchannel 2^P–1).

[00237] The Q subcarriers are sorted in ascending order of frequencies, that is, frequencies of a 1^{st} subcarrier to a Q^{th} subcarrier are sorted in ascending order. The Q subcarriers include Q1 subcarriers, and the Q1 subcarriers are direct current subcarriers, where Q1 is an integer greater than or equal to 1, and Q1 is less than Q. Some or all of (Q–Q1) subcarriers in the Q subcarriers other than the Q1 subcarriers are occupied subcarriers. For example, the Q subcarriers further include Q2 subcarriers, and the Q2 subcarriers are occupied subcarriers.

[00238] For example, the Q1 subcarriers are one or more subcarriers in the middle of the Q

subcarriers. A number of direct current subcarriers is not limited in embodiments of this application. The following describes the direct current subcarrier and the occupied subcarrier with reference to Implementation 3.

[00239] Implementation 3

[00240] Based on Example 3, for example, the first channel includes two subchannels, that is, the bandwidth of the first channel is 640 MHz. There are three cases in total for the left guard interval and the right guard interval of the first channel: Case A, Case B, and Case C. Case A: The left guard interval is 7.68 MHz, the right guard interval is 10.24 MHz, and the Q subcarriers in the first channel are 81*4 subcarriers. Case B: The left guard interval is 10.24 MHz, the right guard interval is 7.68 MHz, and the Q subcarriers in the first channel are 81*4 subcarriers. Case C: The left guard interval is 12.8 MHz, the right guard interval is 12.8 MHz, and the Q subcarriers in the first channel are 80*4 subcarriers.

[00241] For Case A or Case B, it is assumed that nine subcarriers in the middle of the Q subcarriers are direct current subcarriers (that is, Q1=9). To enable the numbers of occupied subcarriers on both sides of the direct current subcarriers to be the same, to reduce processing complexity, a null subcarrier may be designed. For example, a leftmost subcarrier in the first channel is a null subcarrier, and in the remaining 323 subcarriers, nine middle subcarriers are direct current subcarriers (that is, Q1=9), and 157 subcarriers to the left of the direct current subcarriers and 157 subcarriers to the right of the direct current subcarriers are occupied subcarriers. For another example, a rightmost subcarrier in the first channel is a null subcarrier, and in the remaining 323 subcarriers, nine middle subcarriers are direct current subcarriers (that is, Q1=9), and 157 subcarriers to the left of the direct current subcarriers and 157 subcarriers to the right of the direct current subcarriers are occupied subcarriers.

[00242] For Case C, it is assumed that nine subcarriers in the middle of the Q subcarriers are direct current subcarriers (that is, Q1=9). To enable the numbers of occupied subcarriers on both sides of the direct current subcarriers to be the same, to reduce processing complexity, a null subcarrier may be designed. For example, a leftmost subcarrier in the first channel is a null subcarrier, and in the remaining 319 subcarriers, nine middle subcarriers are direct current subcarriers (that is, Q1=9), and 155 subcarriers to the left of the direct current subcarriers and 155 subcarriers to the right of the direct current subcarriers are occupied subcarriers. For another example, a rightmost subcarrier in the first channel is a null subcarrier, and in the remaining 319 subcarriers, nine middle subcarriers are direct current subcarriers (that is, Q1=9), and 155 subcarriers to the left of the direct current subcarriers and 155 subcarriers to the right of the direct current subcarriers are occupied subcarriers.

[00243] The following further provides descriptions with reference to Solution a and Solution

b.

[00244] (1) Solution a

[00245] It can be learned from the foregoing descriptions of the three cases that, when numbers of direct current subcarriers in different cases are the same, numbers of occupied subcarriers are different. For example, the number of occupied subcarriers in Case A or Case B is 314, and the number of occupied subcarriers in Case C is 310. For a same bandwidth, numbers of occupied subcarriers in different cases are different, causing high processing complexity. Therefore, to reduce processing complexity and ensure that the numbers of occupied subcarriers in different cases are the same, Solution a provided in this embodiment of this application is as follows:

[00246] Q=Q'*4. When Q'mod2=1 (that is, Q' is an odd number), Q2=Q–5–Q1, and the Q2 subcarriers (namely, occupied subcarriers) include (Q–5–Q1)/2 contiguous subcarriers to the left of the Q1 subcarriers and (Q–5–Q1)/2 contiguous subcarriers to the right of the Q1 subcarriers. A rightmost subcarrier in the (Q–5–Q1)/2 contiguous subcarriers to the left of the Q1 subcarriers is adjacent to a leftmost subcarrier in the Q1 subcarriers, and a leftmost subcarrier in the (Q–5–Q1)/2 contiguous subcarriers to the right of the Q1 subcarriers is adjacent to a rightmost subcarrier in the Q1 subcarriers. Q3 subcarriers in the Q subcarriers other than the Q1 subcarriers and the Q2 subcarriers are null subcarriers. Q1 is an odd number. For example, Q1 is an integer such as 1, 3, 5...

[00247] Q3=Q–Q1–Q2=5. In other words, there are five null subcarriers in the Q subcarriers. For example, the Q3 subcarriers include:

a 1^{st} subcarrier to a 5^{th} subcarrier (namely, left 5 and right 0) in the Q subcarriers; or

a 1^{st} subcarrier to a 4^{th} subcarrier, and a Q^{th} subcarrier (namely, left 4 and right 1) in the Q subcarriers; or

a 1^{st} subcarrier to a 3^{rd} subcarrier, a $(Q–1)^{th}$ subcarrier, and a Q^{th} subcarrier (namely, left 3 and right 2) in the Q subcarriers; or

a 1^{st} subcarrier, a 2^{nd} subcarrier, and a $(Q–2)^{th}$ subcarrier to a Q^{th} subcarrier (namely, left 2 and right 3) in the Q subcarriers; or

a 1^{st} subcarrier, and a $(Q–3)^{th}$ subcarrier to a Q^{th} subcarrier (namely, left 1 and right 4) in the Q subcarriers; or

a $(Q–4)^{th}$ subcarrier to a Q^{th} subcarrier (namely, left 0 and right 5) in the Q subcarriers.

[00248] Q=Q'*4. When Q'mod2=0 (that is, Q' is an even number), Q2=Q–1–Q1, and the Q2 subcarriers (namely, occupied subcarriers) include (Q–1–Q1)/2 contiguous subcarriers to the left of the Q1 subcarriers and (Q–1–Q1)/2 contiguous subcarriers to the right of the Q1 subcarriers. A rightmost subcarrier in the (Q–1–Q1)/2 contiguous subcarriers to the left of the Q1 subcarriers is adjacent to a leftmost subcarrier in the Q1 subcarriers, and a leftmost subcarrier in the (Q–1–Q1)/2

contiguous subcarriers to the right of the Q1 subcarriers is adjacent to a rightmost subcarrier in the Q1 subcarriers. Q3 subcarriers in the Q subcarriers other than the Q1 subcarriers and the Q2 subcarriers are null subcarriers.

[00249] Q3=Q–Q1–Q2=1. In other words, there is one null subcarrier in the Q subcarriers. For example, the one null subcarrier may be the 1st subcarrier in the Q subcarriers, or may be the Qth subcarrier in the Q subcarriers.

[00250] For Q1=9, based on Example 3, for example, the first channel includes two subchannels, that is, the bandwidth of the first channel is 640 MHz. There are three cases (case) in total for the left guard interval and the right guard interval of the first channel: Case A, Case B, and Case C. For Case A or Case B, the Q subcarriers in the first channel are 81*4 subcarriers. For Case C, the Q subcarriers in the first channel are 80*4 subcarriers. Further, numbers of direct current subcarriers, numbers of occupied subcarriers, and numbers of null subcarriers in Case A, Case B, and Case C are shown in Table 23.

Table 23: Three cases

Case corresponding to 640 MHz	Left guard interval (MHz)	Right guard interval (MHz)	Number of direct current subcarriers	Number of occupied subcarriers	Number of null subcarriers
A	7.68	10.24	9	155 (left of the DC) +155 (right of the DC)	5 (left 5 and right 0; or left 4 and right 1; or left 3 and right 2; or left 2 and right 3; or left 1 and right 4; or left 0 and right 5)
B	10.24	7.68	9	155 (left of the DC) +155 (right of the DC)	5 (left 5 and right 0; or left 4 and right 1; or left 3 and right 2; or left 2 and right 3; or left 1 and right 4; or left 0 and right 5)
C	12.8	12.8	9	155 (left of the	1 (leftmost

Case corresponding to 640 MHz	Left guard interval (MHz)	Right guard interval (MHz)	Number of direct current subcarriers	Number of occupied subcarriers	Number of null subcarriers
				DC) +155 (right of the DC)	subcarrier or rightmost subcarrier)

[00251] It can be learned from Table 23 that, when the bandwidth of the first channel is 640 MHz, in Case A, Case B, and Case C, the numbers of direct current subcarriers are the same and are an odd number, the numbers of occupied subcarriers are the same, and the numbers of occupied subcarriers on both sides of the direct current subcarriers are the same. This helps reduce processing complexity.

[00252] For Q1=9, based on Example 3, for example, the first channel includes four subchannels, that is, the bandwidth of the first channel is 1280 MHz. There are three cases in total for the left guard interval and the right guard interval of the first channel: Case A, Case B, and Case C. For Case A, Case B, or Case C, the Q subcarriers in the first channel are 164*4 subcarriers. Further, numbers of direct current subcarriers, numbers of occupied subcarriers, and numbers of null subcarriers in Case A, Case B, and Case C are shown in Table 24.

Table 24: Three cases

Case corresponding to 640 MHz	Left guard interval (MHz)	Right guard interval (MHz)	Number of direct current subcarriers	Number of occupied subcarriers	Number of null subcarriers
A	7.68	12.8	9	323 (left of the DC) +323 (right of the DC)	1 (leftmost subcarrier or rightmost subcarrier)
B	10.24	10.24	9	323 (left of the DC) +323 (right of the DC)	1 (leftmost subcarrier or rightmost subcarrier)
C	12.8	7.68	9	323 (left of the DC) +323 (right of the DC)	1 (leftmost subcarrier or rightmost subcarrier)

[00253] It can be learned from Table 24 that, when the bandwidth of the first channel is 1280 MHz, in Case A, Case B, and Case C, the numbers of direct current subcarriers are the same and are an odd number, the numbers of occupied subcarriers are the same, and the numbers of occupied subcarriers on both sides of the direct current subcarriers are the same. This helps reduce

processing complexity.

[00254] For Q1=9, based on Example 3, for example, the first channel includes eight subchannels, that is, the bandwidth of the first channel is 2560 MHz. There are three cases in total for the left guard interval and the right guard interval of the first channel: Case A, Case B, and Case C. For Case A or Case B, the Q subcarriers in the first channel are 331*4 subcarriers. For Case C, the Q subcarriers in the first channel are 330*4 subcarriers. Further, numbers of direct current subcarriers, numbers of occupied subcarriers, and numbers of null subcarriers in Case A, Case B, and Case C are shown in Table 25.

Table 25: Three cases

Case corresponding to 1280 MHz	Left guard interval (MHz)	Right guard interval (MHz)	Number of direct current subcarriers	Number of occupied subcarriers	Number of null subcarriers
A	7.68	10.24	9	655 (left of the DC) +655 (right of the DC)	5 (left 5 and right 0; or left 4 and right 1; or left 3 and right 2; or left 2 and right 3; or left 1 and right 4; or left 0 and right 5)
B	10.24	7.68	9	655 (left of the DC) +655 (right of the DC)	5 (left 5 and right 0; or left 4 and right 1; or left 3 and right 2; or left 2 and right 3; or left 1 and right 4; or left 0 and right 5)
C	12.8	12.8	9	655 (left of the DC) +655 (right of the DC)	1 (leftmost subcarrier or rightmost subcarrier)

[00255] It can be learned from Table 25 that, when the bandwidth of the first channel is 2560 MHz, in Case A, Case B, and Case C, the numbers of direct current subcarriers are the same and are an odd number, the numbers of occupied subcarriers are the same, and the numbers of occupied

subcarriers on both sides of the direct current subcarriers are the same. This helps reduce processing complexity.

[00256] (2) Solution b

[00257] It is assumed that a protocol predefines or preconfigures that some of Case A, Case B, and Case C are used. For example, the protocol predefines or preconfigures that Case A, Case B, or Case C is used. Therefore, whether numbers of occupied subcarriers in different cases are the same may not be considered. In this case, Solution b provided in this embodiment of this application is as follows:

[00258] Because Q=Q'*4, that is, Q is an even number, Q2=Q–1–Q1, and the Q2 subcarriers (namely, occupied subcarriers) include (Q–1–Q1)/2 contiguous subcarriers to the left of the Q1 subcarriers and (Q–1–Q1)/2 contiguous subcarriers to the right of the Q1 subcarriers. A rightmost subcarrier in the (Q–1–Q1)/2 contiguous subcarriers to the left of the Q1 subcarriers is adjacent to a leftmost subcarrier in the Q1 subcarriers, and a leftmost subcarrier in the (Q–1–Q1)/2 contiguous subcarriers to the right of the Q1 subcarriers is adjacent to a rightmost subcarrier in the Q1 subcarriers. Q1 is an odd number. For example, Q1 is an integer such as 1, 3, 5... In this case, because Q is an even number and Q1 is an odd number, one null subcarrier may be set, so that numbers of occupied subcarriers on both sides of the direct current subcarrier are the same.

[00259] For example, the protocol predefines or preconfigures that Case A is used. Based on Example 3, for example, the first channel includes two subchannels, that is, the bandwidth of the first channel is 640 MHz. The Q subcarriers in the first channel are 81 subcarriers. When Q1=9, nine subcarriers in the middle of the Q subcarriers are direct current subcarriers, a leftmost or rightmost subcarrier in the Q subcarriers is a null subcarrier, and 157 subcarriers to the left of the direct current subcarriers and 157 subcarriers to the right of the direct current subcarriers are occupied subcarriers.

[00260] It may be understood that, when the first channel includes more subchannels, reference may be made to the foregoing descriptions. In addition, an example in which Q1=9 is used in the foregoing descriptions. When Q1 is another value, reference may be made for understanding, and no enumeration is provided herein.

[00261] It may be understood that:

[00262] (1) In embodiments of this application, the "occupied subcarrier" is a subcarrier that can be occupied, but whether a subcarrier is actually occupied (for example, whether to send data or a pilot on an occupied subcarrier) depends on specific implementation of the first communication apparatus. For example, for the 310 occupied subcarriers shown in Table 23, during specific implementation, the first communication apparatus may occupy the 310 subcarriers (that is, send data and/or pilots on the 310 subcarriers), or may occupy a part of the 310 subcarriers

(that is, send data and/or pilots on the part of the 310 subcarriers, where the other part of the subcarriers are unused subcarriers). In embodiments of this application, the "null subcarrier" is a subcarrier that cannot be occupied.

[00263] The "occupied subcarrier" may also be replaced with another possible name, for example, an available subcarrier. The "null subcarrier" may also be replaced with another possible name, for example, an unavailable subcarrier or a prohibited subcarrier.

[00264] (2) Similar to the descriptions about the first channel in Embodiment 2, in embodiments of this application, the second channel may also include a left guard interval, a right guard interval, and Q subcarriers located between the left guard interval and the right guard interval. A bandwidth between the left guard interval and the right guard interval is Q times the subcarrier spacing of the second channel. For the left guard interval and the right guard interval of the second channel, refer to the descriptions of the left guard interval and the right guard interval of the first channel. For example, the available frequency domain ranges on the left and right of the plurality of subchannels of the second channel may be shown in Table 12 (x=1). For the Q subcarriers in the second channel, refer to the descriptions of the Q subcarriers in the first channel in Embodiment 2.

[00265] (3) In Embodiment 1 and Embodiment 2, "2^P or 2^N" (that is, an index of 2) is used as an example for description. This is not limited in embodiments of this application. In other words, "2^P or 2^N" may also be replaced with any other possible value. In other words, the first channel is not limited to including 2^P subchannels. The first channel may alternatively include three subchannels, or five subchannels, or six subchannels, or seven subchannels. In addition, the subcarrier spacing of the first channel is not limited to 2^N*480 kHz. The subcarrier spacing of the first channel may alternatively be another value greater than 480 kHz. Reference can be made for other similarities.

[00266] (4) In embodiments of this application, unless otherwise stated or if there is a logic conflict, terms and/or descriptions in different embodiments are consistent and may be mutually referenced, and technical features in different embodiments may be combined into a new embodiment based on an internal logical relationship thereof. In addition, in a same embodiment, different implementations or different examples may reference or refer to each other.

[00267] (5) Various numbers in this application are merely used for differentiation for ease of description, but are not used to limit the scope of this application. Step numbers in the foregoing flowcharts are merely examples of execution procedures, and do not constitute a limitation on an execution sequence of the steps. In other words, the step numbers do not mean the execution sequence, and the execution sequence of the steps should be determined based on functions and internal logic of the steps. In addition, not all steps shown in each flowchart are mandatory, and some steps may be added or deleted for each flowchart based on an actual requirement.

[00268] The foregoing mainly describes the solutions provided in embodiments of this application from a perspective of interaction between the first communication apparatus and the second communication apparatus. It may be understood that, to implement the foregoing functions, the first communication apparatus and the second communication apparatus may include corresponding hardware structures and/or software modules for performing the functions. A person skilled in the art should be easily aware that, in combination with units and algorithm steps of the examples described in embodiments disclosed in this specification, embodiments of this application may be implemented by hardware or a combination of hardware and computer software. Whether a function is performed by hardware or hardware driven by computer software depends on particular applications and design constraints of the technical solutions. A person skilled in the art may use different methods to implement the described functions for each particular application, but it should not be considered that the implementation goes beyond the scope of this application.

[00269] In embodiments of this application, the first communication apparatus and the second communication apparatus may be divided into functional units based on the foregoing method examples. For example, each functional unit may be obtained through division based on a corresponding function, or two or more functions may be integrated into one unit. The integrated unit may be implemented in a form of hardware, or may be implemented in a form of a software functional unit.

[00270] In a case in which an integrated unit is used, FIG. 10 is a possible example block diagram of an apparatus according to an embodiment of this application. As shown in FIG. 10, the apparatus 1000 may include a processing unit 1002 and a communication unit 1003. The processing unit 1002 is configured to control and manage an action of the apparatus 1000. The communication unit 1003 is configured to support communication between the apparatus 1000 and another device. The communication unit 1003 is also referred to as a transceiver unit, and may include a receiving unit and/or a sending unit, respectively configured to perform a receiving operation and a sending operation. Optionally, the apparatus 1000 further includes a storage unit 1001, configured to store program code and/or data of the apparatus 1000.

[00271] (1) The apparatus 1000 may be the first communication apparatus in the foregoing embodiments. The processing unit 1002 may support the apparatus 1000 in performing actions of the first communication apparatus in the foregoing method examples. Alternatively, the processing unit 1002 mainly performs internal actions of the first communication apparatus in the method examples. The communication unit 1003 may support communication between the apparatus 1000 and another device.

[00272] In an embodiment, the processing unit 1002 is configured to generate one or more

OFDM symbols in a radio frame; and the communication unit 1003 is configured to send the one or more OFDM symbols on a first channel in a first band. A subcarrier spacing of the first channel is 2^N times a subcarrier spacing of a second channel in a second band, the subcarrier spacing of the second channel is 480 kilohertz kHz, and a lowest frequency of the first band is higher than a highest frequency of the second band. A bandwidth of the second channel is 2^P*20 megahertz MHz, and a bandwidth of the first channel is 2^N*2^P*20 MHz, where N is an integer greater than 0, and P is an integer greater than or equal to 0.

[00273] (2) The apparatus 1000 may be the second communication apparatus in the foregoing embodiments. The processing unit 1002 may support the apparatus 1000 in performing actions of the second communication apparatus in the foregoing method examples. Alternatively, the processing unit 1002 mainly performs internal actions of the second communication apparatus in the method examples. The communication unit 1003 may support communication between the apparatus 1000 and another device.

[00274] In an embodiment, the communication unit 1003 is configured to receive one or more OFDM symbols in a radio frame on a first channel in a first band; and the processing unit 1002 is configured to process the one or more OFDM symbols. A subcarrier spacing of the first channel is 2^N times a subcarrier spacing of a second channel in a second band, the subcarrier spacing of the second channel is 480 kilohertz kHz, and a lowest frequency of the first channel is higher than a highest frequency of the second channel. A bandwidth of the second channel is 2^P*20 megahertz MHz, and a bandwidth of the first channel is 2^N*2^P*20 MHz, where N is an integer greater than 0, and P is an integer greater than or equal to 0.

[00275] It should be understood that division into the units in the apparatus is merely logical function division. During actual implementation, all or some of the units may be integrated into one physical entity, or may be physically separated. In addition, all units in the apparatus may be implemented in a form of invoking software by using a processing element or may be implemented in a form of hardware, or some units may be implemented in a form of invoking software by using a processing element, and some units may be implemented in a form of hardware. For example, each unit may be a separately disposed processing element, or may be integrated into a chip of the apparatus for implementation. In addition, each unit may alternatively be stored in a memory in a form of a program to be invoked by a processing element of the apparatus to perform a function of the unit. In addition, all or some of the units may be integrated, or may be independently implemented. The processing element herein may also be referred to as a processor, and may be an integrated circuit having a signal processing capability. In an implementation process, operations in the foregoing methods or the foregoing units may be implemented by using a hardware integrated logic circuit in the processor element or may be implemented in a form in

which the processing element invokes software.

[00276] In an example, a unit in any one of the foregoing apparatuses may be one or more integrated circuits configured to implement the foregoing methods, for example, one or more application-specific integrated circuits (application-specific integrated circuit, ASIC), one or more microprocessors (digital signal processor, DSP), one or more field programmable gate arrays (field programmable gate array, FPGA), or a combination of at least two of these forms of integrated circuits. For another example, when the units in the apparatus may be implemented in a form in which a processing element schedules a program, the processing element may be a processor, for example, a general-purpose central processing unit (central processing unit, CPU) or another processor that can invoke the program. For another example, the units may be integrated and implemented in a form of a system-on-a-chip (system-on-a-chip, SOC). The foregoing unit configured for receiving is an interface circuit of the apparatus, and is configured to receive a signal from another apparatus. For example, when the apparatus is implemented in a form of a chip, the receiving unit is an interface circuit that is of the chip and that is configured to receive a signal from another chip or apparatus. The foregoing unit configured for sending is an interface circuit of the apparatus, and is configured to send a signal to another apparatus. For example, when the apparatus is implemented in a form of a chip, the sending unit is an interface circuit that is of the chip and that is configured to send a signal to another chip or apparatus.

[00277] Based on a same technical concept, an embodiment of this application further provides a communication apparatus. The apparatus is configured to implement functions of the first communication apparatus or the second communication apparatus in the foregoing embodiments. As shown in FIG. 11, the apparatus may be a communication device or a chip in a communication device. The apparatus includes a processor 1101 and a communication interface 1102, and optionally further includes a memory 1103. FIG. 11 shows only main components of the communication apparatus. In addition to the processor 1101 and the communication interface 1102, the communication apparatus may further include the memory 1103 and an input/output apparatus (not shown in the figure).

[00278] The processor 1101 is configured to execute program code stored in the memory 1103, and is specifically configured to perform an action of the processing unit 1002. Details are not described herein again in this application. The communication interface 1102 is specifically configured to perform an action of the communication unit 1003. Details are not described herein again in this application.

[00279] The processor 1101 may be a CPU, a digital processing unit, or the like. The processor 1101 may be configured to process a communication protocol and communication data, control the entire communication apparatus, execute a software program, and process data of the software

program, for example, but not limited to, perform baseband-related processing. The communication interface 1102 may be configured to receive and send a signal, for example, but not limited to, perform radio frequency receiving and sending. The foregoing components may be separately disposed on chips that are independent of each other, or at least some or all of the components may be disposed on a same chip. For example, the processor 1101 may be further divided into an analog baseband processor and a digital baseband processor. The analog baseband processor and the transceiver may be integrated on a same chip, and the digital baseband processor may be disposed on an independent chip. With continuous development of integrated circuit technologies, more components may be integrated on a same chip. For example, the digital baseband processor may be integrated on a same chip with a plurality of application processors (for example, but not limited to, a geometric processor and a multimedia processor). The chip may be referred to as a system-on-a-chip (system-on-a-chip). Whether the components are independently disposed on different chips or are integrated and disposed on one or more chips usually depends on a specific requirement of a product design. Specific implementation forms of the components are not limited in embodiments of the present invention.

[00280] The communication interface 1102 may be a transceiver, an interface circuit such as a transceiver circuit, a transceiver chip, or the like. Optionally, the communication interface 1102 may include a radio frequency circuit and an antenna. The radio frequency circuit is mainly configured to: perform conversion between a baseband signal and a radio frequency signal, and process the radio frequency signal. The antenna is mainly configured to receive and send a radio frequency signal in a form of an electromagnetic wave. The input/output apparatus, such as a touchscreen, a display, or a keyboard, is mainly configured to: receive data that is input by a user, and output data to the user.

[00281] The memory 1103 is configured to store a program executed by the processor 1101. The memory 1103 may be a non-volatile memory, such as a hard disk drive (hard disk drive, HDD) or a solid-state drive (solid-state drive, SSD), or may be a volatile memory (volatile memory), such as a random access memory (random access memory, RAM). The memory 1103 is any other medium that can carry or store expected program code in a form of an instruction or a data structure and that can be accessed by a computer, but is not limited thereto.

[00282] After the communication apparatus is powered on, the processor 1101 may read the software program in the memory 1103, interpret and execute instructions of the software program, and process data of the software program. When data needs to be sent wirelessly, the processor 1101 performs baseband processing on the to-be-sent data, and then outputs a baseband signal to a radio frequency circuit. The radio frequency circuit performs radio frequency processing on the baseband signal, and then sends a radio frequency signal to the outside through the antenna in a

form of an electromagnetic wave. When data is sent to the communication apparatus, 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 1101. The processor 1101 converts the baseband signal into data, and processes the data.

[00283] In another implementation, the radio frequency circuit and the antenna may be disposed independently of the processor that performs baseband processing. For example, in a distributed scenario, the radio frequency circuit and the antenna may be disposed remotely and independently of the communication apparatus.

[00284] A specific connection medium between the communication interface 1102, the processor 1101, and the memory 1103 is not limited in embodiments of this application. In this embodiment of this application, the memory 1103, the processor 1101, and the communication interface 1102 are connected through a bus 1104 in FIG. 11. The bus is represented by a bold line in FIG. 11. A connection manner between other components is merely described as an example, and is not limited thereto. Buses may be classified into an address bus, a data bus, a control bus, and the like. For ease of representation, only one bold line represents the bus in FIG. 11, but this does not mean that there is only one bus or only one type of bus.

[00285] Optionally, the communication apparatus may be an independent device or may be a part of a large device. For example, the communication apparatus may be:

(1) an independent integrated circuit (integrated circuit, IC), a chip, or a chip system or subsystem;

(2) a set that has one or more ICs, where optionally, the IC set may alternatively include a storage component configured to store data and instructions;

(3) an application-specific integrated circuit (application-specific integrated circuit, ASIC) such as a modem (modem);

(4) a module that can be embedded in another device;

(5) a receiver, an intelligent terminal, a wireless device, a handset, a mobile unit, a vehicle-mounted device, a cloud device, an artificial intelligence device, or the like; or

(6) others.

[00286] Terms "system" and "network" may be interchangeably used in embodiments of this application. In addition, "plurality of" means two or more, and "and/or" describes an association relationship between associated objects, and represents that three relationships may exist. For example, A and/or B may represent the following cases: Only A exists, both A and B exist, and only B exists, where A and B may be singular or plural. A character "/" generally indicates an "or" relationship between the associated objects. In addition, "at least one of the following items (pieces)" or a similar expression thereof indicates any combination of these items, including a

single item (piece) or any combination of a plurality of items (pieces). For example, "at least one of A, B, or C" includes A, B, C, AB, AC, BC, or ABC, and "at least one of A, B, and C" may also be understood as including A, B, C, AB, AC, BC, or ABC. In addition, unless otherwise specified, ordinal numbers such as "first" and "second" mentioned in embodiments of this application are used to distinguish between a plurality of objects, but are not used to limit a sequence, a time sequence, priorities, or importance of the plurality of objects.

[00287] A person skilled in the art should understand that embodiments of this application may be provided as a method, a system, or a computer program product. Therefore, this application may use a form of hardware only embodiments, software only embodiments, or embodiments with a combination of software and hardware. In addition, this application may use a form of a computer program product that is implemented on one or more computer-usable storage media (including but not limited to a disk memory, an optical memory, and the like) that include computer-usable program code.

[00288] This application is described with reference to the flowcharts and/or block diagrams of the method, the device (system), and the computer program product according to this application. It should be understood that computer program instructions can be used to implement each process and/or each block in the flowcharts and/or the block diagrams and a combination of a process and/or a block in the flowcharts and/or the block diagrams. These computer program instructions may be provided for a general-purpose computer, a special-purpose computer, an embedded processor, or a processor of any other programmable data processing device to generate a machine, so that the instructions executed by a computer or a processor of any other programmable data processing device generate an apparatus for implementing a specific function in one or more processes in the flowcharts and/or in one or more blocks in the block diagrams.

[00289] These computer program instructions may be stored in a computer-readable memory that can instruct the computer or any other programmable data processing device to work in a specific manner, so that the instructions stored in the computer-readable memory generate an artifact that includes an instruction apparatus. The instruction apparatus implements a specific function in one or more processes in the flowcharts and/or in one or more blocks in the block diagrams.

[00290] The computer program instructions may alternatively be loaded onto a computer or another programmable data processing device, so that a series of operations and steps are performed on the computer or the another programmable device, so that computer-implemented processing is generated. Therefore, the instructions executed on the computer or the another programmable device provide steps for implementing a specific function in one or more procedures in the flowcharts and/or in one or more blocks in the block diagrams.

CLAIMS

1. A communication method, wherein the method is applied to a first communication apparatus, and the method comprises:

generating one or more orthogonal frequency division multiplexing OFDM symbols in a radio frame; and

sending the one or more OFDM symbols on a first channel in a first band, wherein

a subcarrier spacing of the first channel is 2^N times a subcarrier spacing of a second channel in a second band, the subcarrier spacing of the second channel is 480 kilohertz kHz, and a lowest frequency of the first band is higher than a highest frequency of the second band; and

a bandwidth of the second channel is 2^P*20 megahertz MHz, and a bandwidth of the first channel is 2^N*2^P*20 MHz, wherein N is an integer greater than 0, and P is an integer greater than or equal to 0.

2. A communication method, wherein the method is applied to a second communication apparatus, and the method comprises:

receiving one or more OFDM symbols in a radio frame on a first channel in a first band; and

processing the one or more OFDM symbols, wherein

a subcarrier spacing of the first channel is 2^N times a subcarrier spacing of a second channel in a second band, the subcarrier spacing of the second channel is 480 kilohertz kHz, and a lowest frequency of the first band is higher than a highest frequency of the second band; and

a bandwidth of the second channel is 2^P*20 megahertz MHz, and a bandwidth of the first channel is 2^N*2^P*20 MHz, wherein N is an integer greater than 0, and P is an integer greater than or equal to 0.

3. The method according to claim 1 or 2, wherein a number of discrete Fourier transform DFT points corresponding to the bandwidth of the first channel is 2^P*64.

4. The method according to claim 3, wherein the subcarrier spacing of the first channel is 3.84 MHz, and the bandwidth of the first channel and the number of DFT points corresponding to the first channel meet any one of the following:

the bandwidth of the first channel is 160 MHz, and the number of DFT points corresponding to the bandwidth of the first channel is 64;

the bandwidth of the first channel is 320 MHz, and the number of DFT points corresponding to the bandwidth of the first channel is 128;

the bandwidth of the first channel is 640 MHz, and the number of DFT points corresponding to the bandwidth of the first channel is 256;

the bandwidth of the first channel is 1280 MHz, and the number of DFT points corresponding

to the bandwidth of the first channel is 512; and

the bandwidth of the first channel is 2560 MHz, and the number of DFT points corresponding to the bandwidth of the first channel is 1024.

5. The method according to claim 3, wherein the subcarrier spacing of the first channel is 1.92 MHz, and the bandwidth of the first channel and the number of DFT points corresponding to the bandwidth of the first channel meet any one of the following:

the bandwidth of the first channel is 80 MHz, and the number of DFT points corresponding to the bandwidth of the first channel is 64;

the bandwidth of the first channel is 160 MHz, and the number of DFT points corresponding to the bandwidth of the first channel is 128;

the bandwidth of the first channel is 320 MHz, and the number of DFT points corresponding to the bandwidth of the first channel is 256;

the bandwidth of the first channel is 640 MHz, and the number of DFT points corresponding to the bandwidth of the first channel is 512;

the bandwidth of the first channel is 1280 MHz, and the number of DFT points corresponding to the bandwidth of the first channel is 1024; and

the bandwidth of the first channel is 2560 MHz, and the number of DFT points corresponding to the bandwidth of the first channel is 2048.

6. The method according to claim 1 or 2, wherein a number of discrete Fourier transform DFT points corresponding to the bandwidth of the first channel is 2^P*256.

7. The method according to claim 6, wherein the subcarrier spacing of the first channel is 1.92 MHz, and the bandwidth of the first channel and the number of DFT points corresponding to the first channel meet any one of the following:

the bandwidth of the first channel is 320 MHz, and the number of DFT points corresponding to the bandwidth of the first channel is 256;

the bandwidth of the first channel is 640 MHz, and the number of DFT points corresponding to the bandwidth of the first channel is 512;

the bandwidth of the first channel is 1280 MHz, and the number of DFT points corresponding to the bandwidth of the first channel is 1024; and

the bandwidth of the first channel is 2560 MHz, and the number of DFT points corresponding to the bandwidth of the first channel is 2048.

8. The method according to claim 1 or 2, wherein the first channel comprises a left guard interval, a right guard interval, and Q subcarriers located between the left guard interval and the right guard interval, wherein Q is an integer greater than 1; and

a bandwidth between the left guard interval and the right guard interval is Q times the

subcarrier spacing of the first channel.

9. The method according to claim 8, wherein a number of discrete Fourier transform DFT points corresponding to the bandwidth of the first channel is 2^P*64, and the subcarrier spacing of the first channel is 3.84 MHz; and

the left guard interval is 3.84 MHz; and when Pmod2=1, the right guard interval is 5.12 MHz, or when Pmod2=0, the right guard interval is 6.4 MHz; or

the left guard interval is 5.12 MHz; and when Pmod2=1, the right guard interval is 3.84 MHz, or when Pmod2=0, the right guard interval is 5.12 MHz; or

the left guard interval is 6.4 MHz; and when Pmod2=1, the right guard interval is 6.4 MHz, or when Pmod2=0, the right guard interval is 3.84 MHz, wherein

mod represents a modulo operation.

10. The method according to claim 8, wherein a number of discrete Fourier transform DFT points corresponding to the bandwidth of the first channel is 2^P*64, and the subcarrier spacing of the first channel is 1.92 MHz; and

the left guard interval is 1.92 MHz; and when Pmod2=1, the right guard interval is 2.56 MHz, or when Pmod2=0, the right guard interval is 3.2 MHz; or

the left guard interval is 2.56 MHz; and when Pmod2=1, the right guard interval is 1.92 MHz, or when Pmod2=0, the right guard interval is 2.56 MHz; or

the left guard interval is 3.2 MHz; and when Pmod2=1, the right guard interval is 3.2 MHz, or when Pmod2=0, the right guard interval is 1.92 MHz, wherein

mod represents a modulo operation.

11. The method according to claim 9 or 10, wherein the Q subcarriers are sorted in ascending order of frequencies, the Q subcarriers comprise Q1 subcarriers and Q2 subcarriers, the Q1 subcarriers are direct current subcarriers, the Q2 subcarriers are occupied subcarriers, and the occupied subcarriers comprise a data subcarrier and/or a pilot subcarrier, wherein Q1 is an odd number greater than or equal to 1, Q2 is an integer greater than or equal to 1, Q1 is less than Q, and Q2 is less than Q.

12. The method according to claim 11, wherein

when Qmod2=1, the Q2 subcarriers comprise (Q–2–Q1)/2 contiguous subcarriers to the left of the Q1 subcarriers and (Q–2–Q1)/2 contiguous subcarriers to the right of the Q1 subcarriers, wherein a rightmost subcarrier in the (Q–2–Q1)/2 contiguous subcarriers to the left of the Q1 subcarriers is adjacent to a leftmost subcarrier in the Q1 subcarriers, and a leftmost subcarrier in the (Q–2–Q1)/2 contiguous subcarriers to the right of the Q1 subcarriers is adjacent to a rightmost subcarrier in the Q1 subcarriers; or

when Qmod2=0, the Q2 subcarriers comprise (Q–1–Q1)/2 contiguous subcarriers to the left

of the Q1 subcarriers and (Q–1–Q1)/2 contiguous subcarriers to the right of the Q1 subcarriers, wherein a rightmost subcarrier in the (Q–1–Q1)/2 contiguous subcarriers to the left of the Q1 subcarriers is adjacent to a leftmost subcarrier in the Q1 subcarriers, and a leftmost subcarrier in the (Q–1–Q1)/2 contiguous subcarriers to the right of the Q1 subcarriers is adjacent to a rightmost subcarrier in the Q1 subcarriers; and

Q3 subcarriers in the Q subcarriers other than the Q1 subcarriers and the Q2 subcarriers are null subcarriers; and when Qmod2=1, Q3=2, or when Qmod2=1, Q3=1, wherein mod represents a modulo operation.

13. The method according to claim 11, wherein

when Qmod2=1, the Q2 subcarriers comprise (Q–Q1)/2 contiguous subcarriers to the left of the Q1 subcarriers and (Q–Q1)/2 contiguous subcarriers to the right of the Q1 subcarriers, wherein a rightmost subcarrier in the (Q–Q1)/2 contiguous subcarriers to the left of the Q1 subcarriers is adjacent to a leftmost subcarrier in the Q1 subcarriers, and a leftmost subcarrier in the (Q–Q1)/2 contiguous subcarriers to the right of the Q1 subcarriers is adjacent to a rightmost subcarrier in the Q1 subcarriers; or

when Qmod2=0, the Q2 subcarriers comprise (Q–1–Q1)/2 contiguous subcarriers to the left of the Q1 subcarriers and (Q–1–Q1)/2 contiguous subcarriers to the right of the Q1 subcarriers, wherein a rightmost subcarrier in the (Q–1–Q1)/2 contiguous subcarriers to the left of the Q1 subcarriers is adjacent to a leftmost subcarrier in the Q1 subcarriers, and a leftmost subcarrier in the (Q–1–Q1)/2 contiguous subcarriers to the right of the Q1 subcarriers is adjacent to a rightmost subcarrier in the Q1 subcarriers; and one subcarrier in the Q subcarriers other than the Q1 subcarriers and the Q2 subcarriers is a null subcarrier, wherein

mod represents a modulo operation.

14. The method according to claim 8, wherein a number of discrete Fourier transform DFT points corresponding to the bandwidth of the first channel is $2^{P}*256$, and the subcarrier spacing of the first channel is 1.92 MHz; and

the left guard interval is 7.68 MHz; and when Pmod2=1, the right guard interval is 10.24 MHz, or when Pmod2=0, the right guard interval is 12.8 MHz; or

the left guard interval is 10.24 MHz; and when Pmod2=1, the right guard interval is 7.68 MHz, or when Pmod2=0, the right guard interval is 10.24 MHz; or

the left guard interval is 12.8 MHz; and when Pmod2=1, the right guard interval is 12.8 MHz, or when Pmod2=0, the right guard interval is 7.68 MHz.

15. The method according to claim 14, wherein the Q subcarriers are sorted in ascending order of frequencies, the Q subcarriers comprise Q1 subcarriers and Q2 subcarriers, the Q1 subcarriers are direct current subcarriers, the Q2 subcarriers are occupied subcarriers, and the

occupied subcarriers comprise a data subcarrier and/or a pilot subcarrier, wherein Q1 is an odd number greater than or equal to 1, Q2 is an integer greater than or equal to 1, Q1 is less than Q, and Q2 is less than Q.

16. The method according to claim 15, wherein Q=Q'*4, and Q' is an integer greater than or equal to 1;

when Q'mod2=1, Q2=Q–5–Q1, and the Q2 subcarriers comprise (Q–5–Q1)/2 contiguous subcarriers to the left of the Q1 subcarriers and (Q–5–Q1)/2 contiguous subcarriers to the right of the Q1 subcarriers, wherein a rightmost subcarrier in the (Q–5–Q1)/2 contiguous subcarriers to the left of the Q1 subcarriers is adjacent to a leftmost subcarrier in the Q1 subcarriers, and a leftmost subcarrier in the (Q–5–Q1)/2 contiguous subcarriers to the right of the Q1 subcarriers is adjacent to a rightmost subcarrier in the Q1 subcarriers; or

when Q'mod2=0, Q2=Q–1–Q1, and the Q2 subcarriers comprise (Q–1–Q1)/2 contiguous subcarriers to the left of the Q1 subcarriers and (Q–1–Q1)/2 contiguous subcarriers to the right of the Q1 subcarriers, wherein a rightmost subcarrier in the (Q–1–Q1)/2 contiguous subcarriers to the left of the Q1 subcarriers is adjacent to a leftmost subcarrier in the Q1 subcarriers, and a leftmost subcarrier in the (Q–1–Q1)/2 contiguous subcarriers to the right of the Q1 subcarriers is adjacent to a rightmost subcarrier in the Q1 subcarriers; and

Q3 subcarriers in the Q subcarriers other than the Q1 subcarriers and the Q2 subcarriers are null subcarriers; and when Q'mod2=1, Q3=5, or when Q'mod2=0, Q3=1, wherein mod represents a modulo operation.

17. The method according to claim 15, wherein Q=Q'*4, and Q' is an integer greater than or equal to 1;

the Q2 subcarriers comprise (Q–1–Q1)/2 contiguous subcarriers to the left of the Q1 subcarriers and (Q–1–Q1)/2 contiguous subcarriers to the right of the Q1 subcarriers, wherein a rightmost subcarrier in the (Q–1–Q1)/2 contiguous subcarriers to the left of the Q1 subcarriers is adjacent to a leftmost subcarrier in the Q1 subcarriers, and a leftmost subcarrier in the (Q–1–Q1)/2 contiguous subcarriers to the right of the Q1 subcarriers is adjacent to a rightmost subcarrier in the Q1 subcarriers; and

Q3 subcarriers in the Q subcarriers other than the Q1 subcarriers and the Q2 subcarriers are null subcarriers, and Q3=1.

18. A communication apparatus, comprising a unit configured to perform the method according to any one of claims 1 to 17.

19. A communication apparatus, comprising a processor, wherein the processor is coupled to a memory, the memory stores a computer program, and the processor is configured to invoke a part or all of the computer program in the memory, so that the method according to any one of

claims 1 to 17 is performed.

20. A computer-readable storage medium, wherein the storage medium stores a computer program, and when a part or all of the computer program is executed by a computer, the method according to any one of claims 1 to 17 is performed.

21. A computer program product, wherein when a computer reads and executes the computer program product, the method according to any one of claims 1 to 17 is performed.