COMMUNICATION METHOD AND APPARATUS, READABLE STORAGE MEDIUM, AND COMPUTER PROGRAM PRODUCT

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to Chinese Patent Application No. 202410339542.5, filed with the China National Intellectual Property Administration on March 22, 2024 and entitled "COMMUNICATION METHOD AND APPARATUS, READABLE STORAGE MEDIUM, AND COMPUTER PROGRAM PRODUCT", which is incorporated herein by reference in its entirety.

TECHNICAL FIELD

[0002] This application relates to the field of communication technologies, and in particular, to a communication method and apparatus, a readable storage medium, and a computer program product.

BACKGROUND

[0003] In wireless communication systems, the most important and challenging task is to cope with variability and uncertainty in wireless transmission environments. From the perspective of a transmitter, an efficient communication mode can effectively utilize instantaneous channel information and appropriately preprocess information/signals at the transmitter, so that transmission performed by the transmitter can match the instantaneous channel information. From the perspective of a receiver, it is also necessary to obtain the instantaneous channel information to achieve correct reception and demodulation of data. The transmitter and/or the receiver may obtain the instantaneous channel information by measuring a transmitted reference signal. How to transmit a reference signal to a peer device is an ongoing area of research.

SUMMARY

[0004] This application provides a communication method and apparatus, a readable storage medium, and a computer program product, to perform transmission of a reference signal based on an association relationship between a resource and a sequence type.

[0005] In a possible implementation, one or more sequence types may be configured in a

communication system. In this case, a problem of coexistence of a plurality of sequence types needs to be resolved. Based on this, this application provides a possible implementation. In this implementation, a resource may be associated with a sequence type. A communication apparatus (for example, a first communication apparatus or a second communication apparatus) may determine the sequence type associated with the resource, then generate a reference signal based on a sequence of the type, and perform transmission of the reference signal on the resource. It can be learned that this solution provides a solution for coexistence of a plurality of sequence types.

[0006] In another possible implementation, as relatively strong interference may exist between different sequence types, in a possible implementation, different sequence types may be associated with different resources, so that an interference problem in a scenario in which a plurality of sequence types coexist can be alleviated, and communication performance can be improved.

[0007] According to a first aspect, this application provides a communication method. The method may be performed by a first communication apparatus, and the first communication apparatus may be a terminal device or a chip (or a circuit or a system on chip) inside the terminal device. Alternatively, the first communication apparatus may be a network device or a chip (or a circuit or a system on chip) inside the network device.

[0008] The first communication apparatus obtains a sequence type associated with a first resource. The first communication apparatus performs transmission of a first reference signal on the first resource based on the sequence type associated with the first resource. The first reference signal is generated based on a first sequence. A sequence type of the first sequence is the sequence type associated with the first resource.

[0009] The first communication apparatus performs transmission of the first reference signal on the first resource. For example, the first communication apparatus may send the first reference signal, and a second communication apparatus may receive the first reference signal. Alternatively, the second communication apparatus sends the first reference signal, and the first communication apparatus receives the first reference signal.

[0010] Because the first resource may be associated with the sequence type, the first communication apparatus may determine the sequence type associated with the first resource, and then perform transmission of a reference signal based on a sequence of the type. According to this solution, when a plurality of sequence types are configured for the first communication apparatus, the solution can enable the first communication apparatus to select a corresponding sequence type based on a resource. This solution provides a solution for coexistence of a plurality of sequence types.

[0011] The first resource may be associated with a plurality of sequence types. For example, the sequence type associated with the first resource includes a W sequence type, a Zadoff-Chu

(Zadoff-Chu, ZC) sequence type, a Golay (Golay) sequence pair type, a Golay (Golay) sequence set type, a Gold sequence type, an m sequence type, or the like. The sequence type associated with the first resource may alternatively include a flexible type, and the flexible type includes at least one sequence type. For example, the sequence type associated with the first resource includes a first type, a second type, or a flexible type. The first type is, for example, a W sequence type, the second type is, for example, a ZC sequence type, and the flexible type includes the first type and the second type. A sequence of the ZC sequence type has a good correlation, but has time-frequency ambiguity and a small capacity. A sequence of the W sequence type has advantages of time-frequency joint non-ambiguity and a large capacity, but has a poorer correlation than the ZC sequence in some scenarios. A plurality of types are jointly used, so that more options can be provided for the communication apparatus in different scenarios. In another possible implementation, when a plurality of sequence types coexist, a better sequence type may be selected based on an actual situation, to further improve communication performance. Cross-correlation and cross-ambiguity of the W sequence and the ZC sequence are good, and satisfy Weil's exponential sum bound. Therefore, the W sequence and the ZC sequence have weak mutual interference when used together.

[0012] In a possible implementation, a sequence of the W sequence type is an R^{th}-degree exponential sequence, and R is an integer greater than 2. In this way, an auto-ambiguity function of a sequence of the W sequence type within a specific time-frequency offset range satisfies Weil's exponential sum bound, and the sequence has good auto-correlation, so that better synchronization performance can be achieved when a frequency offset within a specific range exists.

[0013] In a possible implementation, an expression of a sequence corresponding to the W sequence type is $e^{-2\pi j\frac{(an^3+bn^2+cn+d)}{N}}$, where e is Euler's constant, $0 \leq n \leq (L-1)$, L is a constant, a, b, c, and d are all constants, $j=\sqrt{-1}$, and N is a prime number.

[0014] In this way, the sequence of the W sequence type has good auto-correlation, so that better synchronization performance can be achieved when a frequency offset within a specific range exists.

[0015] In a possible implementation, the first communication apparatus obtains a sequence type associated with a second resource. The first communication apparatus performs transmission of a second reference signal on the second resource based on the sequence type associated with the second resource, where the second reference signal is generated based on a second sequence, and a sequence type of the second sequence is the sequence type associated with the second resource.

[0016] The first communication apparatus performs transmission of the second reference signal on the second resource. For example, the first communication apparatus may send the

second reference signal, and the second communication apparatus may receive the second reference signal. Alternatively, the second communication apparatus sends the second reference signal, and the first communication apparatus receives the second reference signal.

[0017] A plurality of resources, for example, the first resource and the second resource, may be configured for the first communication apparatus, and the second resource may also be associated with a sequence type. In this way, the first communication apparatus may generate the second reference signal based on a sequence corresponding to the sequence type associated with the second resource. In this implementation, sequence types corresponding to the plurality of resources may be the same or may be different. In this way, solution flexibility can be improved. In another possible implementation, when a plurality of sequence types coexist, better sequence types may be selected for different resources based on an actual situation, to further improve communication performance.

[0018] The second resource may be associated with a plurality of sequence types. For example, the sequence type associated with the second resource includes a W sequence type, a Zadoff-Chu (Zadoff-Chu, ZC) sequence type, a Golay (Golay) sequence pair type, a Golay (Golay) sequence set type, a Gold sequence type, an m sequence type, or the like. The sequence type associated with the second resource may alternatively include a flexible type, and the flexible type includes at least one sequence type. For example, the sequence type associated with the second resource includes the first type, the second type, or the flexible type. The first type is, for example, a W sequence type, the second type is, for example, a ZC sequence type, and the flexible type includes the first type and the second type. A sequence of the ZC sequence type has a good correlation, but has time-frequency ambiguity and a small capacity. A sequence of the W sequence type has advantages of time-frequency joint ambiguity and a large capacity, but has a poorer correlation than the ZC sequence in some scenarios. A plurality of types are jointly used, so that more options can be provided for the communication apparatus in different scenarios. In another possible implementation, when a plurality of sequence types coexist, a better sequence type may be selected based on an actual situation, to further improve communication performance. Cross-correlation and cross-ambiguity of the W sequence and the ZC sequence are good, and satisfy Weil's exponential sum bound. Therefore, the W sequence and the ZC sequence have weak mutual interference when used together.

[0019] In a possible implementation, the sequence type associated with the first resource is the same as or different from the sequence type associated with the second resource.

[0020] In a possible implementation, the first resource and the second resource may be different. In this way, interference between signals on the two resources can be reduced. For example, the sequence type associated with the first resource is different from the sequence type

associated with the second resource, and the first resource and the second resource may be different. Interference between reference signals of different sequence types may be strong. Therefore, in this implementation, different resources may be configured for the different sequence types, so that the interference between the reference signals of the different sequence types can be reduced, thereby improving communication performance.

[0021] For example, that the first resource is different from the second resource may include at least one of the following: A time domain resource of the first resource does not overlap with, or partially overlaps with, a time domain resource of the second resource; a frequency domain resource of the first resource does not overlap with, or partially overlaps with, a frequency domain resource of the second resource; and a bandwidth of the first resource is partially or completely the same as a bandwidth of the second resource, and a frequency domain unit to which the first reference signal is mapped on the bandwidth of the first resource is different from a frequency domain unit to which the second reference signal is mapped on the bandwidth of the first resource.

[0022] In a possible implementation, the first communication apparatus receives first information. For example, the first communication apparatus may receive the first information from a first network apparatus. The first communication apparatus determines, based on the first information, the sequence type associated with the first resource. In this way, the first network apparatus may configure, for the first communication apparatus by using the first information, the sequence type associated with the first resource, and the first network apparatus may configure a more suitable sequence type for the first resource based on an actual situation, thereby further improving communication performance. The first network apparatus and the first communication apparatus may be a same apparatus, or may be two different apparatuses.

[0023] The first information may be carried in a plurality of types of information. This may be flexibly configured. For example, in a possible implementation, the first information is carried in a radio resource control (radio resource control, RRC) message.

[0024] In a possible implementation, the first information includes indication information of the sequence type associated with the first resource, and/or an identifier of the first sequence. In this way, the first communication apparatus may determine, based on these parameters, the sequence type associated with the first resource. This solution is simple and convenient and easy to implement.

[0025] In a possible implementation, the first information includes: information indicating a quantity of reference signal streams transmitted on the first resource, where the quantity of reference signal streams is associated with the sequence type associated with the first resource; and/or information indicating a power control parameter of a reference signal transmitted on the first resource, where the power control parameter is associated with the sequence type associated

with the first resource. In this way, the first communication apparatus may infer, based on such information, the sequence type associated with the first resource. This solution can reduce signaling overheads.

[0026] In a possible implementation, the first communication apparatus receives second information, where the second information indicates that the flexible type is the first type or the second type. For example, the first communication apparatus receives the second information from the first network apparatus.

[0027] In a possible implementation, the first communication apparatus determines, based on the identifier of the first sequence, that the flexible type is the first type or the second type. It can be learned that in this solution, a resource may be alternatively associated with the flexible type, and the flexible type includes a plurality of types of sequences. Further, the first communication apparatus may determine, based on some information, a type associated with a specifically used sequence. This solution provides more options for configuring a sequence type for a resource, so that solution flexibility can be further improved.

[0028] The second information may be carried in a plurality of types of information. This may be flexibly configured. For example, in a possible implementation, the second information is carried in an RRC message.

[0029] According to a second aspect, this application provides a communication method. The method may be performed by a second communication apparatus, and the second communication apparatus may be a terminal device or a chip (or a circuit or a system on chip) inside the terminal device. Alternatively, the second communication apparatus may be a network device or a chip (or a circuit or a system on chip) inside the network device.

[0030] The second communication apparatus obtains a sequence type associated with a first resource. The second communication apparatus performs transmission of a first reference signal on the first resource based on the sequence type associated with the first resource, where the first reference signal is generated based on a first sequence, and a sequence type of the first sequence is the sequence type associated with the first resource.

[0031] Because the first resource may be associated with the sequence type, the second communication apparatus may determine the sequence type associated with the first resource, and then perform transmission of a reference signal based on a sequence of the type. According to this solution, when a plurality of sequence types are configured for the first communication apparatus, the solution can enable the first communication apparatus to select a corresponding sequence type based on a resource. This solution provides a solution for coexistence of a plurality of sequence types.

[0032] In a possible implementation, the second communication apparatus obtains a sequence

type associated with a second resource. The second communication apparatus performs transmission of a second reference signal on the second resource based on the sequence type associated with the second resource, where the second reference signal is generated based on a second sequence, and a sequence type of the second sequence is the sequence type associated with the second resource.

[0033] The second communication apparatus performs transmission of the second reference signal on the second resource. For example, the first communication apparatus may send the second reference signal, and the second communication apparatus may receive the second reference signal. Alternatively, the second communication apparatus sends the second reference signal, and the first communication apparatus receives the second reference signal.

[0034] For content such as the sequence type associated with the first resource, the sequence type associated with the second resource, a first type, a second type, a flexible type, a W sequence type, a ZC sequence type, the first resource, and the second resource, refer to the related descriptions in the first aspect. Details are not described again.

[0035] The second communication apparatus may be a first network apparatus. In this case, the second communication apparatus may further send first information and/or second information. For related content of the first information and the second information, refer to the related descriptions in the first aspect. Details are not described again.

[0036] The second communication apparatus and the first network apparatus may be two different apparatuses. In this case, the second communication apparatus may alternatively receive the first information and/or the second information from the first network apparatus. Related content is similar to the operation performed after the first communication apparatus receives the first information and/or the second information. Details are not described again.

[0037] According to a third aspect, this application provides a communication method. The method may be performed by a first network apparatus, and the first network apparatus may be a network device or a chip (or a circuit or a system on chip) inside the network device. A second communication apparatus may be the first network apparatus, or the second communication apparatus and the first network apparatus are two different apparatuses.

[0038] The first network apparatus obtains a sequence type associated with a first resource. The first network apparatus sends third information to a second network apparatus, where the third information indicates the sequence type associated with the first resource.

[0039] The third information indicates the sequence type associated with the first resource corresponding to the first network apparatus. The sequence type associated with the first resource corresponding to the first network apparatus may be the same as or different from a sequence type associated with the first resource corresponding to the second network apparatus.

[0040] The first network apparatus may notify the second network apparatus of the sequence type associated with the first resource. Therefore, a parameter may be properly set between the two network apparatuses, to reduce interference on the first resource. For example, the second network apparatus may set a type associated with the first resource to be the same as the sequence type associated with the first resource corresponding to the first network apparatus, or the second network apparatus adjusts a parameter (for example, a power control parameter) associated with the first resource. In this way, communication performance can be further improved.

[0041] In a possible implementation, the third information is used by the second network apparatus to configure the sequence type associated with the first resource as the sequence type indicated by the third information. Because sequence types associated with the first resource corresponding to the first network apparatus and the second network apparatus are the same, interference on the first resource can be reduced, and communication performance can be improved.

[0042] In a possible implementation, the third information is used by the second network apparatus to adjust a power control parameter corresponding to the first resource when the sequence type associated with the first resource corresponding to the second network apparatus is different from the sequence type indicated by the third information. Because the sequence type associated with the first resource corresponding to the first network apparatus is different from the sequence type associated with the first resource corresponding to the second network apparatus, interference on the first resource may be strong. Based on this problem, the second network apparatus adjusts the power control parameter corresponding to the first resource, for example, increases or decreases a transmit power of a reference signal on the first resource, so as to reduce interference.

[0043] In a possible implementation, the third information is further used by the second network apparatus to adjust a power control parameter corresponding to a third resource, where the third resource and the first resource overlap or partially overlap in time domain, and a sequence type associated with the third resource is the same as the sequence type associated with the first resource corresponding to the second network apparatus. Because time domain resources of the first resource and the third resource overlap or partially overlap, the first resource and the third resource correspond to a same sequence type. When the second network apparatus adjusts the power control parameter corresponding to the first resource, and the power control parameter corresponding to the first resource does not match (for example, differs from) the power control parameter corresponding to the third resource, interference is strong. In the solution provided in this embodiment of this application, the second network apparatus may adjust the power control parameter on the third resource, to reduce interference.

[0044] In a possible implementation, the first network apparatus receives fourth information, where the fourth information indicates that the sequence type associated with the first resource corresponding to the second network apparatus is a first type. In this way, the first network apparatus can learn of the sequence type configured for the first resource corresponding to the second network apparatus, and then determine a signal transmission status on the first resource.

[0045] In a possible implementation, the first network apparatus receives fifth information, where the fifth information indicates a power control parameter corresponding to the first resource as adjusted by the second network apparatus. In this way, the first network apparatus can learn of the power control parameter corresponding to the first resource corresponding to the second network apparatus, and then determine a signal transmission status on the first resource.

[0046] In a possible implementation, the first network apparatus adjusts a power control parameter corresponding to a fourth resource, where the fourth resource and the first resource overlap or partially overlap in time domain, and a sequence type associated with the fourth resource is the same as the sequence type associated with the first resource corresponding to the second network apparatus. Because time domain resources of the first resource and the fourth resource overlap or partially overlap, a sequence type associated with the fourth resource corresponding to the first network apparatus is the same as the sequence type associated with the first resource corresponding to the second network apparatus. When the second network apparatus adjusts the power control parameter corresponding to the first resource, and the power control parameter corresponding to the first resource does not match (for example, differs from) the power control parameter corresponding to the fourth resource, interference is strong. In the solution provided in this embodiment of this application, the first network apparatus may adjust the power control parameter on the fourth resource, to reduce interference.

[0047] According to a fourth aspect, this application provides a communication method. The method may be performed by a second network apparatus, and the second network apparatus may be a network device or a chip (or a circuit or a system on chip) inside the network device. A second communication apparatus may be the second network apparatus, or the second communication apparatus and the second network apparatus are two different apparatuses.

[0048] The second network apparatus receives third information, where the third information indicates a sequence type associated with a first resource corresponding to a first network apparatus. In a possible implementation, the second network apparatus may obtain, based on the third information, the sequence type associated with the first resource corresponding to the first network apparatus.

[0049] In a possible implementation, the second network apparatus configures a sequence type associated with the first resource as the sequence type indicated by the third information.

[0050] In a possible implementation, when the sequence type associated with the first resource corresponding to the second network apparatus is different from the sequence type indicated by the third information, the second network apparatus adjusts a power control parameter corresponding to the first resource.

[0051] In a possible implementation, the second network apparatus adjusts a power control parameter corresponding to a third resource, where the third resource and the first resource overlap or partially overlap in time domain, and a sequence type associated with the third resource is the same as the sequence type associated with the first resource corresponding to the second network apparatus.

[0052] In a possible implementation, the second network apparatus sends fourth information. The fourth information indicates that the sequence type associated with the first resource corresponding to the second network apparatus is a first type.

[0053] In a possible implementation, the second network apparatus sends fifth information. The fifth information indicates a power control parameter corresponding to the first resource as adjusted by the second network apparatus.

[0054] In a possible implementation, the fourth information and/or the fifth information are/is used to adjust a power control parameter corresponding to a fourth resource, where the fourth resource and the first resource overlap or partially overlap in time domain, and a sequence type associated with the fourth resource is the same as the sequence type associated with the first resource corresponding to the second network apparatus.

[0055] For related descriptions and beneficial effects, refer to the content in the fourth aspect and the possible implementations of the fourth aspect. Details are not described again.

[0056] According to a fifth aspect, a communication apparatus is provided. The communication apparatus may be the foregoing first communication apparatus, second communication apparatus, first network apparatus, or second network apparatus. The communication apparatus may include a communication unit and a processing unit, to perform any one of the first aspect to the fourth aspect, or perform any one of the possible implementations of the first aspect to the fourth aspect. The communication unit is configured to perform functions related to sending and receiving. The communication unit may be referred to as a transceiver unit. Optionally, the communication unit includes a receiving unit and a sending unit. In a design, the communication apparatus is a communication chip (or a circuit or a system on chip), the processing unit may be one or more processors or processor cores, and the communication unit may be an input/output circuit, an input/output interface, or an antenna port of the communication chip (or the circuit or the system on chip).

[0057] In another design, the communication unit may be a transmitter and a receiver, or the

communication unit may be a transmitter machine and a receiver machine.

[0058] Optionally, the communication apparatus further includes modules that may be configured to perform any one of the first aspect to the fourth aspect, or perform any one of the possible implementations of the first aspect to the fourth aspect.

[0059] According to a sixth aspect, a communication apparatus is provided. The communication apparatus may be the foregoing first communication apparatus, second communication apparatus, first network apparatus, or second network apparatus. The communication apparatus may include a processor, to perform any one of the first aspect to the fourth aspect, or perform any one of the possible implementations of the first aspect to the fourth aspect. Optionally, a memory is further included. Optionally, a transceiver is further included. The memory is configured to store a computer program or instructions. The processor is configured to: invoke the computer program or the instructions from the memory, and run the computer program or the instructions. When the processor executes the computer program or the instructions in the memory, the communication apparatus is enabled to perform any one of the first aspect to the fourth aspect, or perform any one of the possible implementations of the first aspect to the fourth aspect.

[0060] Optionally, there are one or more processors, and there are one or more memories.

[0061] Optionally, the memory may be integrated with the processor, or the memory and the processor are disposed separately.

[0062] Optionally, the transceiver may include a transmitter machine (transmitter) and a receiver machine (receiver).

[0063] According to a seventh aspect, a communication apparatus is provided. The communication apparatus may be the foregoing first communication apparatus, second communication apparatus, first network apparatus, or second network apparatus. The communication apparatus may include a processor, to perform any one of the first aspect to the fourth aspect, or perform any one of the possible implementations of the first aspect to the fourth aspect. For example, the processor performs any one of the first aspect to the fourth aspect or any one of the possible implementations of the first aspect to the fourth aspect by using a logic circuit or by executing a computer program or instructions in a memory. Optionally, the communication apparatus further includes the memory. The processor is coupled to the memory. Optionally, the communication apparatus further includes a communication interface, and the processor is coupled to the communication interface.

[0064] In an implementation, when the communication apparatus is the first communication apparatus, the second communication apparatus, the first network apparatus, or the second network apparatus, the communication interface may be a transceiver or an input/output interface.

Optionally, the transceiver may be a transceiver circuit. Optionally, the input/output interface may be an input/output circuit.

[0065] In another implementation, when the communication apparatus is a chip (or a circuit or a system on chip), the communication interface may be an input/output interface, an interface circuit, an output circuit, an input circuit, a pin, a related circuit, or the like on the chip (or the circuit or the system on chip). The processor may alternatively be embodied as a processing circuit or a logic circuit.

[0066] According to an eighth aspect, a system is provided. The system includes the foregoing first communication apparatus.

[0067] In a possible implementation, the system may further include the foregoing second communication apparatus. Optionally, the system may include a first network apparatus. Optionally, the system may further include a second network apparatus. The second communication apparatus and the first network apparatus may be a same apparatus or two different apparatuses.

[0068] According to a ninth aspect, a system on chip is provided. The system on chip includes at least one processor and an interface circuit. The interface circuit and the at least one processor are interconnected through a line. The processor runs a computer program (which may also be referred to as code or instructions), so that any one of the first aspect to the fourth aspect and any one of the possible implementations of the first aspect to the fourth aspect are performed.

[0069] According to a tenth aspect, a computer program product is provided. The computer program product includes a computer program (which may also be referred to as code or instructions). When the computer program is run, any one of the first aspect to the fourth aspect is performed, or any one of the possible implementations of the first aspect to the fourth aspect is performed.

[0070] According to an eleventh aspect, a computer-readable storage medium is provided. The computer-readable medium stores a computer program (which may also be referred to as code or instructions). When the computer program is run on a computer, any one of the first aspect to the fourth aspect is performed, or any one of the possible implementations of the first aspect to the fourth aspect is performed.

[0071] According to a twelfth aspect, a processing apparatus is provided, and includes an interface circuit and a processing circuit. The interface circuit may include an input circuit and an output circuit. The processing circuit is configured to receive a signal through the input circuit, and transmit a signal through the output circuit, so that any one of the first aspect to the fourth aspect or any one of the possible implementations of the first aspect to the fourth aspect is implemented.

[0072] In a specific implementation process, the processing apparatus may be a chip (or a circuit or a system on chip), the input circuit may be an input pin, the output circuit may be an output pin, and a flip-flop. An input signal received by the input circuit may be received and input by, for example, but not limited to, a receiver, a signal output by the output circuit may be output to, for example, but not limited to, a transmitter and transmitted by the transmitter, and the input circuit and the output circuit may be a same circuit. The circuit is separately used as the input circuit and the output circuit at different moments. Specific implementations of the processor and various circuits are not limited in this application.

[0073] In an implementation, when the communication apparatus is a first communication apparatus, a second communication apparatus, a first network apparatus, or a second network apparatus, the interface circuit may be a radio frequency processing chip (or a circuit or a system on chip) in the first communication apparatus, the second communication apparatus, the first network apparatus, or the second network apparatus, and the processing circuit may be a baseband processing chip (or a circuit or a system on chip) in the first communication apparatus, the second communication apparatus, the first network apparatus, or the second network apparatus.

[0074] In another implementation, the communication apparatus may be some components in a first communication apparatus, a second communication apparatus, a first network apparatus, or a second network apparatus, for example, an integrated circuit product like a system on a chip (or a circuit or a system on chip) or a communication chip (or a circuit or a system on chip). The interface circuit may be an input/output interface, an interface circuit, an output circuit, an input circuit, a pin, a related circuit, or the like on the chip (or the circuit or the system on chip). The processing circuit may be a logic circuit on the chip (or the circuit or the system on chip).

BRIEF DESCRIPTION OF DRAWINGS

[0075] FIG. 1A is a diagram of a comb structure according to an embodiment of this application;

[0076] FIG. 1B is a diagram of a comb structure according to an embodiment of this application;

[0077] FIG. 1C is a diagram of a comb structure according to an embodiment of this application;

[0078] FIG. 2 is a diagram of a system architecture according to an embodiment of this application;

[0079] FIG. 3 is a schematic flowchart of a communication method according to an embodiment of this application;

[0080] FIG. 4 is a diagram of association between resources and sequence types according to an embodiment of this application;

[0081] FIG. 5 is a schematic flowchart of another communication method according to an embodiment of this application;

[0082] FIG. 6A and FIG. 6B show examples of association relationships between resources and sequence types according to an embodiment of this application;

[0083] FIG. 7 is a schematic flowchart of another communication method according to an embodiment of this application;

[0084] FIG. 8A and FIG. 8B show examples of association relationships between resources and sequence types according to an embodiment of this application;

[0085] FIG. 9 is a diagram of a structure of a communication apparatus according to an embodiment of this application; and

[0086] FIG. 10 is a diagram of a structure of a communication apparatus according to an embodiment of this application.

DESCRIPTION OF EMBODIMENTS

[0087] To better understand solutions provided in embodiments of this application, the following first describes some terms and nouns in embodiments of this application.

[0088] (1) Sequence

[0089] The sequence is an ordered set of numbers or elements. A specific sequence can implement specific functions by using a structure and a property of the sequence in different scenarios. In a technical scenario of communication and sensing, a sequence plays an important role. A specific sequence may be carried in a signal and/or data to implement a corresponding communication function and/or sensing function.

[0090] For example, in a communication system, a terminal device needs to access a network after being powered on, but the terminal device does not know prior information of the network, and cannot receive information conventionally. Therefore, the terminal device first needs to perform a network search to determine a frequency resource, timing information, and the like used by the network. To enable the terminal device to obtain such information, a network device (for example, an access network device) periodically sends a synchronization signal carried on a synchronization channel. a signal generated based on one predefined sequence or one of a plurality of predefined sequences. Correspondingly, the terminal device may search for a synchronization signal at a plurality of preset frequencies based on a predefined possible synchronization sequence. When finding a specific synchronization signal, the terminal device considers that a network is

found, and may subsequently perform time synchronization and frequency offset estimation and compensation, and continue to attempt to receive a subsequent signal and system broadcast information. It can be learned that the sequence plays an important role in an initial synchronization process. Detection performance and anti-frequency offset, anti-interference, and anti-noise capabilities of the sequence determine whether the terminal device can successfully access the network, and determine a speed at which the terminal device successfully accesses the network. The detection performance of the sequence may be mainly represented by a correlation of the sequence. Correlation includes auto-correlation and cross-correlation.

[0091] Auto-correlation reflects a degree to which two same sequences match each other at different relative positions. Cross-correlation reflects a degree to which two different sequences match each other at different relative positions. In a communication system, auto-correlation determines whether a start position of a sequence can be accurately detected, and cross-correlation determines a probability of incorrectly identifying a sequence as another sequence.

[0092] (2) Resource

[0093] The resource in embodiments of this application may include, for example, at least one of a time domain resource, a frequency domain resource, a code domain resource, or a space domain resource.

[0094] (2.1) Time domain resource

[0095] The time domain resource may include at least one of a radio frame, a subframe, a slot (slot), a mini-slot (mini-slot), or an orthogonal frequency division multiplexing (orthogonal frequency division multiplexing, OFDM) symbol (symbol).

[0096] One time domain unit may include one radio frame, one subframe, one slot (slot), one mini-slot (mini-slot), or one OFDM symbol (symbol). One time domain unit may alternatively include a resource formed by aggregating a plurality of radio frames, a plurality of subframes, a plurality of slots, a plurality of mini-slots, or a plurality of OFDM symbols. One radio frame may include a plurality of subframes, one subframe may include one or more slots, and one slot may include at least one symbol. Alternatively, one radio frame may include a plurality of slots, and one slot may include at least one symbol. It should be noted that, in embodiments of this application, one OFDM symbol may also be referred to as one symbol for short.

[0097] Based on different subcarrier spacings, symbol lengths may be different. Therefore, slot lengths may be different. For example, a length of one slot corresponding to a subcarrier spacing of 15 kHz is 0.5 ms, and a length of one slot corresponding to a subcarrier spacing of 60 kHz is 0.125 ms.

[0098] In embodiments of this application, the time domain unit may be replaced with a time domain resource unit, a time unit, or the like.

[0099] (2.2) Frequency domain resource

[00100] In frequency domain, the frequency domain resource may include one or more frequency domain units. A frequency domain unit may be a resource block (resource block, RB), a physical resource block (physical resource block, PRB), a subcarrier (subcarrier), a resource block group (resource block group, RBG), a predefined subband (subband), a precoding resource block group (precoding resource block group, PRG), a resource pool (resource pool), a bandwidth part (bandwidth part, BWP), a resource element (resource element, RE) (which may also be referred to as a resource unit), a carrier, or a serving cell. The PRB and the RB may be replaced with each other. Optionally, the resource pool may include one or more resources, and these resources may include at least one of a time domain resource, a frequency domain resource, a code domain resource, or a space domain resource. A quantity and sizes of resources included in the resource pool may be predetermined or configured by using signaling.

[00101] The subcarrier or the RE refers to a minimum frequency domain unit on a specific symbol in a multi-carrier system. A subcarrier spacing (subcarrier spacing, SCS) is a spacing value between center positions or peak positions of two subcarriers adjacent in frequency domain in an OFDM system. In 5G NR, a plurality of subcarrier spacings are introduced. Different carriers may have different subcarrier spacings. A baseline is 15 kHz, and the subcarrier spacing may be 15 kHz × 2n, where n is an integer, and the subcarrier spacing ranges from 3.75 kHz or 7.5 kHz to 480 kHz. In embodiments of this application, the RE may refer to a resource unit of a time-frequency resource, for example, may be considered as a minimum time-frequency resource unit. In this application, the subcarrier and the RE may be used interchangeably, and include the same content.

[00102] A sub-channel is a minimum unit of a frequency domain resource occupied by a physical sidelink shared channel, and one sub-channel may include one or more resource blocks (resource block, RB). A bandwidth of a wireless communication system in frequency domain may include a plurality of RBs. For example, in possible bandwidths of an LTE system, quantities of included physical resource blocks (physical resource block, PRB) may be 6, 15, 25, 50, and the like. In frequency domain, one RB may include several subcarriers. For example, in the LTE system, one RB includes 12 subcarriers, and each subcarrier spacing may be 15 kHz. Certainly, another subcarrier spacing, for example, a subcarrier spacing of 3.75 kHz, 30 kHz, 60 kHz, or 120 kHz, may be alternatively used. This is not limited herein.

[00103] One frequency domain unit may include one RE, one RB, one channel, one sub-channel (sub-channel), one carrier (carrier), one bandwidth part (BWP, bandwidth part), or the like. One frequency domain unit may alternatively include a resource formed by aggregating a plurality of REs, a plurality of RBs, a plurality of sub-channels, a plurality of carriers, or a plurality of BWPs. In embodiments of this application, the channel may be equivalently replaced with a resource

block set (resource block set, RB set), and a frequency domain bandwidth of one RB set may be 20 megahertz (megahertz, MHz).

[00104] In embodiments of this application, the frequency domain unit may be replaced with a frequency domain resource unit, a frequency unit, or the like.

[00105] One frequency domain resource set may include one or more frequency domain units. The frequency domain resource set may also be referred to as a frequency domain resource group, or the like. One frequency domain resource set may include, for example, a resource block set (resource block set, RB set), one RB, one sub-channel, one resource pool, one carrier, or one BWP.

[00106] (2.3) Data and/or signals are mapped at an interval based on a comb value M in frequency domain.

[00107] The data and/or the signals may occupy all resources within a bandwidth of the data, or may occupy some resources. For example, the data and/or the signals may occupy frequency domain resources based on a comb structure. In embodiments of this application, M is used to represent a comb interval (for example, M may be replaced with Ncomb, Comb-M, or another character). In embodiments of this application, for Comb-M, the data and/or the signals appear every M REs in frequency domain, and are not transmitted on the remaining (M–1) REs. Optionally, in embodiments of this application, a frequency domain transmission mode for Comb-M may also be referred to as a comb, a comb structure, a comb structure, or the like. The comb value in embodiments of this application may also be referred to as a comb quantity or a transmission comb value (transmissionComb). In some content of embodiments of this application, a parameter M is used to represent the comb value, which is also denoted as a comb value M in some parts. A comb offset value in embodiments of this application may also be denoted as combOffset, or may be referred to as a comb index, a comb index value, or an offset value.

[00108] As shown in FIG. 1A, an example in which one rectangular box represents one RE is used for illustration in FIG. 1A. In practical application, one rectangular box may alternatively represent a plurality of REs or a plurality of frequency domain units. Refer to FIG. 1A. When a comb value is 2 (Comb=2), a comb offset value is one of {0, 1}. A plurality of REs may be divided into a comb 0 numbered 0 (the comb 0 includes all REs numbered 0 in FIG. 1A) and a comb 1 numbered 1 (the comb 1 includes all REs numbered 1 in FIG. 1A). If the comb offset value is 0, a transmitter may send signals and/or data on a frequency domain resource corresponding to the comb 0, that is, send the signals and/or the data on all the REs numbered 0 in FIG. 1A. If the comb offset value is 1, a transmitter may send signals and/or data on a frequency domain resource corresponding to the comb 1, that is, send the signals and/or the data on all the REs numbered 1 in FIG. 1A (which is not shown in FIG. 1A).

[00109] As shown in FIG. 1B, an example in which one rectangular box represents one RE is

used for illustration in FIG. B. In practical application, one rectangular box may alternatively represent a plurality of REs or a plurality of frequency domain units. When a comb value is 4 (Comb=4), a comb offset value is one of {0, 1, 2, 3}. A plurality of REs are divided into a comb 0 numbered 0 (the comb 0 includes all REs numbered 0 in FIG. 1B), a comb 1 numbered 1 (the comb 1 includes all REs numbered 1 in FIG. 1B), a comb 2 numbered 2 (the comb 2 includes all REs numbered 2 in FIG. 1B), and a comb 3 numbered 3 (the comb 3 includes all REs numbered 3 in FIG. 1B). If the comb offset value is 1, a transmitter may send signals and/or data on a frequency domain resource corresponding to the comb 1, that is, send the signals and/or the data on all the REs numbered 1 in FIG. 1B. If the comb offset value is 2, a terminal device may send signals and/or data on a frequency domain resource corresponding to the comb 2, that is, send the signals and/or the data on all the REs numbered 2 in FIG. 1B (which is not shown in FIG. 1B).

[00110] FIG. 1C is an example diagram of four possible structures of a frequency domain resource for data and/or signals when a comb value is 4 (which is alternatively understood as that a comb value M is 4). The data and/or the signals may be transmitted through a comb structure (a), a comb structure (b), a comb structure (c), or a comb structure (d) in FIG. 1C. A comb offset value corresponding to (a) in FIG. 1C is 0, a comb offset value corresponding to (b) in FIG. 1C is 1, a comb offset value corresponding to (c) in FIG. 1C is 2, and a comb offset value corresponding to (d) in FIG. 1C is 3. Using (a) in FIG. 1C as an example, in a case of Comb-4 (which is alternatively understood as that M is 4), REs occupied by the data and/or the signals appear in frequency domain at an equal interval of 3. In addition, as shown in (a) in FIG. 1C, the data and/or the signals are sent on the first RE, and the following three consecutive REs are not used for transmission (a specific position of a frequency domain resource occupied by the data and/or the signals is shown in (a) in FIG. 1C). Meanings of the other comb structures in FIG. 1C are similar to that of (a) in FIG. 1C, and details are not described.

[00111] For example, a first reference signal and a second reference signal are separately mapped to frequency domain resources based on a comb value M=4. A frequency domain unit to which the first reference signal is mapped is different from a frequency domain unit to which the second reference signal is mapped, and a comb offset value corresponding to the first reference signal is different from a comb offset value corresponding to the second reference signal. For example, frequency domain units to which the first reference signal is mapped are an RE #0, an RE #4, and an RE #8. For a diagram of an RE mapping structure of the first reference signal, refer to (a) in FIG. 1C. The comb offset value corresponding to the first reference signal is 0. Frequency domain units to which the second reference signal is mapped are an RE #1, an RE #5, and an RE #9. For a diagram of an RE mapping structure of the second reference signal, refer to (b) in FIG. 1C. The comb offset value corresponding to the second reference signal is 1.

[00112] In embodiments of this application, a value of M may alternatively be 1. In this case, data is continuously mapped in frequency domain.

[00113] (3) Reference signal

[00114] In embodiments of this application, the reference signal may include (or be) a positioning reference signal (positioning reference signal, PRS), or may be a sounding reference signal (sounding reference signal, SRS), or may be at least one of a sidelink positioning reference signal (sidelink positioning reference signal, SL-PRS), a demodulation reference signal (demodulation reference signal, DMRS), a reference signal (reference signal, RS), a synchronization signal block (synchronization signal block, SSB), a synchronization signal/physical broadcast channel block (Synchronization signal/physical broadcast channel block, SS/PBCH block), a tracking reference signal (tracking reference signal, TRS), a phase tracking reference signal (phase tracking reference signal, PTRS), a beam management reference signal (beam management reference signal, BMRS), a cell reference signal (cell reference signal, CRS), and the like.

[00115] (4) Mapping: may also be described as "occupying" or "using". For example, that a communication system maps a channel on a carrier indicates that the communication system uses or occupies some or all time-frequency resources corresponding to the carrier to transmit information carried on the channel.

[00116] FIG. 2 is an example diagram of an architecture of a communication system 1000 to which an embodiment of this application is applicable. As shown in FIG. 2, the communication system includes a radio access network 100 and a core network 200. Optionally, the communication system 1000 may further include an internet 300. The radio access network 100 may include at least one radio access network device (for example, 110a and 110b in FIG. 2), and may further include at least one terminal device (for example, 120a to 120j in FIG. 2). The terminal device is connected to the radio access network device in a wireless manner, and the radio access network device is connected to the core network in a wireless or wired manner. A core network device and the radio access network device may be different independent physical devices, or functions of the core network device and logical functions of the radio access network device may be integrated into a same physical device, or a part of functions of the core network device and a part of functions of the radio access network device may be integrated into one physical device. A wired or wireless manner may be used for connection between terminal devices and between radio access network devices. FIG. 2 is merely a diagram. The communication system may further include other network devices, for example, may further include a wireless relay device and a wireless backhaul device, which are not shown in FIG. 2.

[00117] The network device in embodiments of this application includes, for example, a radio

access network (radio access network, RAN) device. The radio access network device may be a base station (base station), an evolved NodeB (evolved NodeB, eNodeB), a transmission reception point (transmission reception point, TRP), a transmission point (transmission point, TP), a next generation NodeB (next generation NodeB, gNB) in a 5th generation (5th generation, 5G) mobile communication system, a next generation base station in a 6th generation (6th generation, 6G) mobile communication system, a base station in a future mobile communication system, an access node in a Wi-Fi system, or the like, or may be a module or unit that implements some functions of a base station, for example, may be a central unit (central unit, CU), or may be a distributed unit (distributed unit, DU), or may be a radio unit (radio unit, RU). The CU implements functions of a radio resource control protocol and a packet data convergence protocol (packet data convergence protocol, PDCP) of the base station, and may further implement a function of a service data adaptation protocol (service data adaptation protocol, SDAP). The DU implements functions of a radio link control layer and a medium access control (medium access control, MAC) layer of the base station, and may further implement a function of a part or all of a physical layer. For specific descriptions of the foregoing protocol layers, refer to related technical specifications of the 3rd generation partnership project (3rd generation partnership project, 3GPP). The CU and the DU may be separately arranged, or may be included in a same network element, for example, a baseband unit (baseband unit, BBU). The RU may be included in a radio frequency device or a radio frequency unit, for example, included in a remote radio unit (remote radio unit, RRU), an active antenna unit (active antenna unit, AAU), or a remote radio head (remote radio head, RRH). In different systems, the CU, the DU, or the RU may alternatively have different names, but a person skilled in the art may understand meanings thereof. For example, in an open radio access network (open radio access network, ORAN) system, the CU may also be referred to as an open CU (open CU, O-CU), the DU may also be referred to as an open DU (open DU, O-DU), and the RU may also be referred to as an open RU (open RU, O-RU). Any one of the CU (or a CU control plane (CU control plane, CU-CP) or a CU user plane (CU user plane, CU-UP)), the DU, and the RU in this application may be implemented by using a software module, a hardware module, or a combination of a software module and a hardware module.

[00118] The radio access network device may be a macro base station (such as 110a in FIG. 2), or may be a micro base station or an indoor base station (such as 110b in FIG. 2), or may be a relay node or a donor node. A specific technology and a specific device form used for the radio access network device are not limited in embodiments of this application. For ease of description, the following provides descriptions by using an example in which the radio access network device is a base station.

[00119] The terminal device may also be referred to as a terminal device, user equipment (user

equipment, UE), a mobile station, a mobile terminal device, or the like. The terminal device may be widely used in various scenarios, for example, device-to-device (device-to-device, D2D), vehicle-to-everything (vehicle-to-everything, V2X) communication, machine-type communication (machine-type communication, MTC), internet of things (internet of things, IoT), virtual reality, augmented reality, industrial control, autonomous driving, telemedicine, smart grid, smart furniture, smart office, smart wearable, smart transportation, and smart city. The terminal device may be a mobile phone, a tablet computer, a computer with wireless sending and receiving functions, a wearable device, a vehicle, an uncrewed aerial vehicle, a helicopter, an airplane, a ship, a robot, a robot arm, a smart home device, a sensor, or the like. A specific technology and a specific device form used by the terminal device are not limited in embodiments of this application.

[00120] The terminal device may establish a connection to an operator network through an interface (for example, N1) provided by the operator network, and use a service such as data and/or voice provided by the operator network. The terminal device may further access a domain name system (domain name system, DNS) over the operator network, and use an operator service deployed on the DNS and/or a service provided by a third party. The third party may be a service provider other than the operator network and the terminal device, and may provide another service such as data and/or voice for the terminal device. A specific representation form of the third party may be specifically determined based on an actual application scenario, and is not limited herein.

[00121] The terminal device may also be referred to as a terminal device, user equipment (user equipment, UE), a mobile station, a mobile terminal device, or the like. The terminal device may be widely used in various scenarios, for example, device-to-device (device-to-device, D2D), vehicle-to-everything (vehicle-to-everything, V2X) communication, machine-type communication (machine-type communication, MTC), internet of things (internet of things, IoT), virtual reality, augmented reality, industrial control, autonomous driving, telemedicine, smart grid, smart furniture, smart office, smart wearable, smart transportation, and smart city. The terminal device may be a mobile phone, a tablet computer, a computer with wireless sending and receiving functions, a wearable device, a vehicle, an uncrewed aerial vehicle, a helicopter, an airplane, a ship, a robot, a robot arm, a smart home device, a road side unit (road side unit, RSU), or the like. A specific technology and a specific device form used by the terminal device are not limited in embodiments of this application.

[00122] The base station and the terminal device may be fixed or movable. The base station and the terminal device may be deployed on land, including an indoor or outdoor device, a handheld device, or a vehicle-mounted device; or may be deployed on a water surface; or may be deployed on a plane, a balloon, or an artificial satellite in the air. Application scenarios of the base station and the terminal device are not limited in embodiments of this application.

[00123] Roles of the base station and the terminal device may be relative. For example, a helicopter or an uncrewed aerial vehicle 120i in FIG. 2 may be configured as a mobile base station, and for a terminal device 120j accessing the radio access network 100 through 120i, the terminal device 120i is a base station. However, for the base station 110a, 120i is a terminal device. In other words, communication between 110a and 120i is performed based on a radio air interface protocol. Certainly, communication between 110a and 120i may alternatively be performed based on an interface protocol between base stations. In this case, for 110a, 120i is also a base station. Therefore, both the base station and the terminal device may be collectively referred to as communication apparatuses, 110a and 110b in FIG. 2 may be referred to as communication apparatuses having a function of a base station, and 120a to 120j in FIG. 2 may be referred to as communication apparatuses having a function of a terminal device.

[00124] Communication may be performed between a base station and a terminal device, between base stations, or between terminal devices by using a licensed spectrum, an unlicensed spectrum, or both a licensed spectrum and an unlicensed spectrum; may be performed by using a spectrum below 6 gigahertz (gigahertz, GHz); may be performed by using a spectrum above 6 GHz; or may be performed by using both a spectrum below 6 GHz and a spectrum above 6 GHz. A spectrum resource for wireless communication is not limited in embodiments of this application.

[00125] In embodiments of this application, the function of the base station may alternatively be performed by a module (for example, a chip (or a circuit or a system on chip)) in the base station, or may be performed by a control subsystem including the function of the base station. The control subsystem including the function of the base station herein may be a control center in the foregoing application scenarios such as smart grid, industrial control, smart transportation, and smart city. The function of the terminal device may alternatively be performed by a module (for example, a chip (or a circuit or a system on chip) or a modem) in the terminal device, or may be performed by an apparatus including the function of the terminal device.

[00126] In this application, the base station sends a downlink signal or downlink information to the terminal device, where the downlink information is carried on a downlink channel; and the terminal device sends an uplink signal or uplink information to the base station, where the uplink information is carried on an uplink channel. To communicate with the base station, the terminal device needs to establish a wireless connection to a cell controlled by the base station. The cell to which the terminal device establishes the wireless connection is referred to as a serving cell of the terminal device. When communicating with the serving cell, the terminal device is further interfered by a signal from a neighboring cell.

[00127] The core network in embodiments of this application may include a network device that processes and forwards signaling and data of a user. For example, the core network includes

core network devices such as an access and mobility management function (access and mobility management function, AMF), a session management function (session management function, SMF), a user plane gateway, and a location management device. The user plane gateway may be a server that has functions such as mobility management, routing, and forwarding specific to user plane data, and is usually located on a network side, for example, a serving gateway (serving gateway, SGW), a packet data network gateway (packet data network gateway, PGW), or a user plane function (user plane function, UPF) entity. The AMF and the SMF are equivalent to a mobility management entity (mobility management entity, MME) in a long term evolution (long term evolution, LTE) system. The AMF is mainly responsible for admission, and the SMF is mainly responsible for session management. Certainly, the core network may also include other network elements, which are not listed one by one herein.

[00128] FIG. 2 is merely a diagram. The wireless communication system may further include another device, for example, may further include a core network device, a wireless relay device, and/or a wireless backhaul device, which are not shown in FIG. 2.

[00129] Possible scenarios used in embodiments of this application include, for example, a long term evolution (long term evolution, LTE) or new radio (new radio, NR) wireless application scenario and a future possible 6th generation mobile network (the 6th generation, 6G) wireless application scenario. In these scenarios, a communication system includes a base station and user equipment. The base station and the user equipment need to implement specific functions such as synchronization, channel estimation, and sensing by using a sequence. For example, the base station receives a pilot sequence (a sounding reference signal (sounding reference signal, SRS) or a demodulation reference signal (demodulation reference signal, DMRS)) from the user equipment, to implement sounding and/or estimation on an uplink channel. Optionally, the base station may apply a sounding/estimation result to a downlink channel based on channel reciprocity. Alternatively, the user equipment receives a pilot sequence from the base station, to implement sounding and estimation on a downlink channel.

[00130] For example, in a wireless communication system, before transmission, a transmitter needs to perform channel measurement to obtain instantaneous channel information (which is referred to as channel information for short below). Specifically, channel measurement may be performed at the transmitter, or may be performed at a receiver. In a time division duplex (TDD) system, because a channel from the transmitter to the receiver and a channel from the receiver to the transmitter are reciprocal, the transmitter may obtain channel information from the transmitter to the receiver by estimating channel information from the receiver to the transmitter. For example, in a cellular communication network, including LTE, NR, or the like, when an access network device sends downlink data to a terminal, the terminal may send a reference signal to the access

network device. For example, the reference signal may be an SRS. The access network device may obtain uplink channel information from the terminal to the access network device by measuring the reference signal. According to a principle of reciprocity between an uplink channel and a downlink channel, the access network device may obtain downlink channel information from the access network device to the terminal, to assist the access network device in sending the downlink data to the terminal.

[00131] At a receiver, to achieve correct reception and demodulation of data, the receiver needs to obtain channel information. In an implementation, a transmitter sends, to the receiver on a specific time-frequency resource, information known to the receiver. The information carried on the specific time-frequency resource may be referred to as a DMRS. The receiver compares a DMRS received from the transmitter with the known DMRS, to obtain channel information from the transmitter to the receiver, so as to assist the receiver in demodulating data information received from the transmitter.

[00132] Currently, there may be a plurality of types of common sequences used to generate a reference signal, for example, a W sequence, a Zadoff-Chu (Zadoff-Chu, ZC) sequence, a Golay (Golay) sequence, a Gold sequence, or an m sequence. How to resolve coexistence of a plurality of sequence types becomes an urgent problem to be resolved.

[00133] Based on this, this application provides a possible implementation. In this implementation, a resource may be associated with a sequence type. A communication apparatus (for example, a first communication apparatus and a second communication apparatus) may determine the sequence type associated with the resource, then generate a reference signal based on a sequence of the sequence type, and perform transmission of the reference signal on the resource. It can be learned that this solution provides a solution for coexistence of a plurality of sequence types.

[00134] In another possible implementation, because relatively strong interference may exist between different sequence types, embodiments of this application provide a possible implementation to reduce interference. In this implementation, sequences of different sequence types may be associated with different resources, so that interference between the different sequence types can be reduced.

[00135] Based on the foregoing content, FIG. 3 is an example schematic flowchart of a communication method according to an embodiment of this application. A transmitter may determine, by using a solution provided in this embodiment of this application, a sequence type associated with a resource, and generate a reference signal based on a sequence corresponding to the sequence type. The transmitter sends the reference signal. A receiver may determine, by using the solution provided in this embodiment of this application, the sequence type associated with the

resource, and receive the reference signal based on the sequence corresponding to the sequence type. In an uplink communication scenario, the transmitter may be a terminal, and the receiver may be an access network device. In a downlink communication scenario, the transmitter may be an access network device, and the receiver may be a terminal. In a sidelink communication scenario, the transmitter may be a terminal, and the receiver may be a terminal.

[00136] In this solution, a first communication apparatus and a second communication apparatus are used as execution bodies to describe the solution in this embodiment of this application. The first communication apparatus may be a reference signal transmitter, or may be a reference signal receiver. Correspondingly, the second communication apparatus may be a reference signal receiver, or may be a reference signal transmitter.

[00137] For example, the first communication apparatus may be the network device, a chip (or a circuit or a system on chip) inside the network device, the terminal, or a chip (or a circuit or a system on chip) inside the terminal in FIG. 2. The second communication apparatus may be the network device, a chip (or a circuit or a system on chip) inside the network device, the terminal, or a chip (or a circuit or a system on chip) inside the terminal in FIG. 2. The network device in this embodiment of this application is, for example, the access network device in FIG. 2.

[00138] The following provides descriptions with reference to FIG. 3.

[00139] Step 301: The first communication apparatus obtains a sequence type associated with a first resource.

[00140] Step 302: The second communication apparatus obtains the sequence type associated with the first resource.

[00141] Step 303: The first communication apparatus performs transmission of a first reference signal on the first resource based on the sequence type associated with the first resource.

[00142] Correspondingly, the second communication apparatus performs transmission of the first reference signal on the first resource based on the sequence type associated with the first resource. The first reference signal is generated based on a first sequence corresponding to the sequence type associated with the first resource.

[00143] In step 303, after obtaining the sequence type associated with the first resource, the first communication apparatus may obtain a sequence corresponding to the sequence type, and generate and send the first reference signal based on the sequence. After obtaining the sequence type associated with the first resource, the second communication apparatus obtains the sequence corresponding to the sequence type, and receives the first reference signal based on the sequence.

[00144] Alternatively, in step 303, after obtaining the sequence type associated with the first resource, the second communication apparatus may obtain a sequence corresponding to the sequence type, and generate and send the first reference signal based on the sequence. After

obtaining the sequence type associated with the first resource, the first communication apparatus obtains the sequence corresponding to the sequence type, and receives the first reference signal based on the sequence.

[00145] A reference signal (for example, the first reference signal or a subsequent second reference signal) in this embodiment of this application may be used for channel measurement, demodulation, and/or the like. For a related application scenario, refer to the foregoing descriptions. Details are not described again. For example, the reference signal may be an SRS, a DMRS, or the like. For related content, refer to the foregoing descriptions about the reference signal. Details are not described again.

[00146] Because the first resource may be associated with the sequence type, the first communication apparatus may determine the sequence type associated with the first resource, then generate a reference signal based on a sequence of the type, and perform transmission of the reference signal on the first resource. According to this solution, when a plurality of sequence types are configured for the first communication apparatus, the solution can enable the first communication apparatus to select a corresponding sequence type based on a resource. This solution provides a solution for coexistence of a plurality of sequence types.

[00147] In this embodiment of this application, the first resource may be associated with a plurality of sequence types. For example, the sequence type associated with the first resource includes a W sequence type, a Zadoff-Chu (Zadoff-Chu, ZC) sequence type, a Golay (Golay) sequence pair type, a Golay (Golay) sequence set type, a Gold sequence type, an m sequence type, or the like. The sequence type associated with the first resource may alternatively include a flexible type, and the flexible type includes at least one sequence type. A sequence of the ZC sequence type has a good correlation, but has time-frequency ambiguity and a small capacity. A sequence of the W sequence type has advantages of time-frequency joint ambiguity and a large capacity, but has a poorer correlation than the ZC sequence in some scenarios. A plurality of types are jointly used, so that more options can be provided for the communication apparatus in different scenarios. In another possible implementation, when a plurality of sequence types coexist, a better sequence type may be selected based on an actual situation, to further improve communication performance.

[00148] The following uses an example in which the sequence type associated with the first resource includes a first type, a second type, or a flexible type for description. The sequence type associated with the first resource may alternatively include another type, or include more or fewer sequence types. The following separately describes the sequence types by using a sequence type A1 (for describing the first type), a sequence type A2 (for describing the second type), and a sequence type A3 (for describing the flexible type) as examples.

[00149] The sequence type A1 is the first type.

[00150] For example, the first type may be a W sequence type, a ZC sequence type, a Golay (Golay) sequence pair type, a Golay (Golay) sequence set type, a Gold sequence type, an m sequence type, or the like.

[00151] When the sequence type associated with the first resource is the first type, the first resource supports a sequence of the first type, and the first communication apparatus sends a reference signal corresponding to the sequence of the first type on the first resource.

[00152] A W sequence may be an R^{th}-degree exponential sequence, and R is an integer greater than 2. In this way, an auto-ambiguity function of a sequence of the W sequence type within a specific time-frequency offset range satisfies Weil's exponential sum bound, and the sequence has good auto-correlation, so that better synchronization performance can be achieved when a frequency offset within a specific range exists.

[00153] In an implementation, an exponential sequence may be a complex exponential sequence. For example, terms of a complex number and π or 2π are extracted, and the remaining polynomial factors are written in a polynomial form. The W sequence provided in this embodiment of this application may be considered as a new sequence. For example, the W sequence may have another name, for example, may be referred to as a Weil exponential sum sequence (Weil exponential sum sequence). A specific name of the W sequence is not limited in this embodiment of this application.

[00154] The W sequence means that, in a group of sequences, an auto-ambiguity function of any sequence within a specific time-frequency offset range satisfies Weil's exponential sum bound, and a cross-ambiguity function between any two sequences satisfies Weil's exponential sum bound within a specific time-frequency offset range. That the auto-ambiguity function of the sequence within the specific time-frequency offset range satisfies Weil's exponential sum bound means that a maximum correlation value of the auto-ambiguity function of the sequence within the specific time-frequency offset range can reach a preset value. That the cross-ambiguity function between the two sequences satisfies Weil's exponential sum bound within the specific time-frequency offset range means that an energy peak of the cross-ambiguity function between the two sequences is not greater than a preset value within the specific time-frequency offset range.

[00155] For example, an expression $\mathrm{s}_1(\mathrm{n})$ of the W sequence satisfies Formula (1):

$$\mathrm{s}_1(\mathrm{n}) = \mathrm{e}^{-\mathrm{j}2\pi f(n)/\mathrm{N}_1} * \mathrm{e}^{-\mathrm{j}2\pi(\mathrm{k}_1 n)/\mathrm{P}_1} \quad \text{……Formula (1)}$$

[00156] In Formula (1), e is Euler's constant, N_1 is a length of the sequence (for example, a generation length of the sequence), N_1 may be a prime number, P_1 is a quantity of cyclic shifts supported by the sequence, k_1 is an identifier (or an index) of a used cyclic shift, and $0 \le n \le (L_1 - 1)$. $f(n)$ is an x^{th}-degree polynomial, and x is greater than 2. Using an example of x=3, $f(n) = (\lambda \mathrm{n}^3 + \mathrm{u}_1 \mathrm{n}^2 + \mathrm{vn})$. λ is referred to as a cubic term coefficient, u_1 is referred to as a

quadratic term coefficient, and v is referred to as a linear term coefficient. It may also be described as follows: An expression (or a general term) of the sequence corresponding to the W sequence type is Formula (1). Cross-correlation and cross-ambiguity of the W sequence and the ZC sequence are good, and satisfy Weil's exponential sum bound.

[00157] In Formula (1), N_1 may be determined based on L_1. N_1 is the generation length of the sequence. L_1 is a length of an actually sent sequence. For example, if L_1 is 12, the first communication apparatus needs to determine a value of N based on a value of L_1, and the first communication apparatus selects a maximum prime number less than L_1 as N_1, for example, selects 11 as N_1. In another possible implementation, N_1 is a minimum prime number greater than L_1, for example, 13 is selected as N_1. In another possible implementation, for some values of L_1, N_1 is a maximum prime number less than L_1; and for some other values of L_1, N_1 is a minimum prime number greater than L_1. For example, when $L_1 \leq \mathrm{C}_1$, N_1 is a minimum prime number greater than L_1; or when $L_1 > \mathrm{C}_1$, N_1 is a maximum prime number less than L_1, where C_1 is a constant, for example, C_1 may be 30, 24, 18, 12, 6, or the like.

[00158] For another example, the expression $\mathrm{s}_1(\mathrm{n})$ of the W sequence may alternatively satisfy Formula (2):

$$\mathrm{s}_1(\mathrm{n}) = \mathrm{e}^{-\mathrm{j}2\pi f(n)/\mathrm{N}_1} \ldots\ldots \text{Formula (2)}$$

[00159] In Formula (2), e is Euler's constant, N_1 is a length of the sequence (for example, a generation length of the sequence), and N_1 may be a prime number. $f(n)$ is an x^{th}-degree polynomial, and x is greater than 2. Using an example of x=3, $f(n) = (an^3 + bn^2 + cn + d)$, and $0 \leq n \leq (L_1 - 1)$. a is referred to as a cubic term coefficient, b is referred to as a quadratic term coefficient, and c is referred to as a linear term coefficient. It may also be described as follows: An expression (or a general term) of the sequence corresponding to the W sequence type is Formula (2). existing technology.

[00160] In a possible implementation, the ZC sequence may be a quadratic exponential sequence. For example, an expression $\mathrm{s}_2(n)$ of the ZC sequence satisfies Formula (3):

$$\mathrm{s}_2(n) = e^{-j2\pi(u_2 n^2 + u_2 n)/N} * e^{-j2\pi(k_2 n)/P_2} \ldots\ldots \text{Formula (3)}$$

[00161] In Formula (3), e is Euler's constant, P_2 is a quantity of cyclic shifts supported by the sequence, k_2 is an identifier (or an index) of a used cyclic shift, u_2 may be a root (root) of the sequence, n represents an index of an element in the ZC sequence, $0 \leq n \leq (L_2 - 1)$, and N_2 represents a generation length of the ZC sequence, and is an integer greater than zero. For example, a ZC sequence in one period includes N_2 elements, and a length of an actually sent pilot sequence is adjusted to L_2 through truncation, cyclic shift extension, or the like. For a related solution, refer to the foregoing descriptions about N_1 and L_1 in the W sequence. Optionally, in the ZC sequence,

a prime number may be selected as a value of N_2.

[00162] The sequence type A2 is the second type.

[00163] For example, the second type may be a W sequence type, a ZC sequence type, a Golay (Golay) sequence pair type, a Golay (Golay) sequence set type, a Gold sequence type, an m sequence type, or the like.

[00164] The first type and the second type may be a same type, or may be different types. In a possible implementation, the first type and the second type may be two different types. For example, the first type is a W sequence type, and the second type is a ZC sequence type.

[00165] When the sequence type associated with the first resource is the second type, the first resource supports a sequence of the second type, and the first communication apparatus sends a reference signal corresponding to the sequence of the second type on the first resource.

[00166] The sequence type A3 is the flexible type.

[00167] The flexible type may include at least two types. For example, the flexible type includes the first type and the second type. For example, the flexible type includes a W sequence type and a ZC sequence type. When sequence types associated with the first resource include the first type and the second type, the first resource supports a sequence of the first type and a sequence of the second type, and the first communication apparatus may send a reference signal corresponding to the sequence of the first type on the first resource, and may also send a reference signal corresponding to the sequence of the second type on the first resource. In this embodiment of this application, the flexible type may alternatively have another name, for example, may be referred to as a fifth type or a mixed type.

[00168] In this embodiment of this application, an example in which the sequence type associated with the first resource includes the first type, the second type, or the flexible type is used. In another possible implementation, the sequence type associated with the first resource may include more cases. For example, the sequence type associated with the first resource includes the first type, the second type, a third type, a fourth type, or the flexible type. In this embodiment of this application, an example in which the flexible type includes the first type and the second type is used for description. In another possible implementation, at least two types included in the flexible type may have another case. For example, the flexible type includes the first type, the second type, the third type, and the fourth type. For example, the third type is a Golay (Golay) sequence pair type, and the fourth type is a Golay (Golay) sequence set type.

[00169] In a possible implementation, the first communication apparatus may further obtain a sequence type associated with a second resource. The first communication apparatus performs transmission of a second reference signal on the second resource based on the sequence type associated with the second resource. The second reference signal is generated based on a second

sequence corresponding to the sequence type associated with the second resource. In another possible implementation, the second communication apparatus may further obtain the sequence type associated with the second resource. The second communication apparatus performs transmission of the second reference signal on the second resource based on the sequence type associated with the second resource. For example, the first communication apparatus sends the second reference signal, and the second communication apparatus receives the second reference signal. Alternatively, the second communication apparatus sends the second reference signal, and the first communication apparatus receives the second reference signal.

[00170] A plurality of resources, for example, the first resource and the second resource, may be configured for the first communication apparatus, and the second resource may also be associated with a sequence type. In this way, the first communication apparatus may generate the second reference signal based on a sequence corresponding to the sequence type associated with the second resource. In this implementation, sequence types corresponding to the plurality of resources may be the same or may be different. In this way, solution flexibility can be improved. In another possible implementation, when a plurality of sequence types coexist, better sequence types may be selected for different resources based on an actual situation, to further improve communication performance.

[00171] The second resource may be associated with a plurality of sequence types. For example, the sequence type associated with the second resource includes a W sequence type, a Zadoff-Chu (Zadoff-Chu, ZC) sequence type, a Golay (Golay) sequence pair type, a Golay (Golay) sequence set type, a Gold sequence type, an m sequence type, or the like. The sequence type associated with the second resource may alternatively include a flexible type, and the flexible type includes at least one sequence type. For example, the sequence type associated with the second resource includes the first type, the second type, or the flexible type. The first type is, for example, a W sequence type, the second type is, for example, a ZC sequence type, and the flexible type includes the first type and the second type. A sequence of the ZC sequence type has a good correlation, but has time-frequency ambiguity and a small capacity. A sequence of the W sequence type has advantages of time-frequency joint ambiguity and a large capacity, but has a poorer correlation than the ZC sequence in some scenarios. A plurality of types are jointly used, so that more options can be provided for the communication apparatus in different scenarios. In another possible implementation, when a plurality of sequence types coexist, a better sequence type may be selected based on an actual situation, to further improve communication performance. Cross-correlation and cross-ambiguity of the W sequence and the ZC sequence are good, and satisfy Weil's exponential sum bound. Therefore, the W sequence and the ZC sequence have weak mutual interference when used together. For related content, refer to the foregoing related descriptions of

the sequence type A1, the sequence type A2, and the sequence type A3. Details are not described again.

[00172] The first communication apparatus may support a plurality of sequence types. Because interference between different sequence types is strong, in a possible implementation, different resources may be configured for different sequences. In this way, interference between different sequence types can be reduced. Because the first communication apparatus may use a large quantity of resources, a same sequence type may correspond to a same resource, or may correspond to different resources. This is not limited in this embodiment of this application.

[00173] For example, the sequence type associated with the first resource is different from the sequence type associated with the second resource. For example, the sequence type associated with the first resource is the first type, and the sequence type associated with the second resource is the second type. For another example, the sequence type associated with the first resource is the first type, and the sequence type associated with the second resource is the flexible type. For another example, the sequence type associated with the first resource is the W sequence type, and the sequence type associated with the second resource is the ZC sequence type. In this case, the first resource is different from the second resource, and that the first resource is different from the second resource may include, for example, that time domain resources and/or frequency domain resources are different. In this embodiment of this application, that the first resource is different from the second resource may be alternatively described by using other names. For example, the first resource and the second resource may be referred to as different orthogonal resources. The following describes several different implementations of the first resource and the second resource by using an implementation B1, an implementation B2, and an implementation B3 as examples. In the implementation B1, an example in which the first resource and the second resource have different time domain resources is used for description. In the implementation B2, an example in which the first resource and the second resource have different frequency domain resources is used for description. In the implementation B3, an example in which the first reference signal and the second reference signal correspond to different frequency domain units is used for description.

[00174] Implementation B1: That the first resource is different from the second resource may include: A time domain resource of the first resource does not overlap with, or partially overlaps with, a time domain resource of the second resource.

[00175] In the implementation B1, the frequency domain resources of the first resource and the second resource may completely overlap, partially overlap, or not overlap.

[00176] For example, the time domain resource of the first resource is a time domain symbol 1, a time domain symbol 2, and a time domain symbol 3. The time domain resource of the second resource is the time domain symbol 3, a time domain symbol 4, and a time domain symbol 5. The

time domain resources of the first resource and the second resource partially overlap, that is, the time domain symbol 3 is an overlapping time domain resource.

[00177] For another example, the time domain resource of the first resource is a time domain symbol 1, a time domain symbol 2, and a time domain symbol 3. The time domain resource of the second resource is a time domain symbol 4, a time domain symbol 5, and a time domain symbol 6. The time domain resources of the first resource and the second resource do not overlap.

[00178] Implementation B2: That the first resource is different from the second resource may include: A frequency domain resource of the first resource does not overlap with, or partially overlaps with, a frequency domain resource of the second resource.

[00179] In the implementation B2, the time domain resources of the first resource and the second resource may completely overlap, partially overlap, or not overlap.

[00180] For example, PRBs occupied by the first resource and the second resource partially overlap or do not overlap. For another example, REs occupied by the first resource and the second resource partially overlap or do not overlap. The following uses an example in which the REs occupied by the first resource and the second resource partially overlap or do not overlap.

[00181] For example, the frequency domain resource of the first resource is an RE #1, an RE #2, and an RE #3. The frequency domain resource of the second resource is the RE #3, an RE #4, and an RE #5. The frequency domain resources of the first resource and the second resource partially overlap, that is, the RE #3 is an overlapping frequency domain resource.

[00182] For another example, the frequency domain resource of the first resource is an RE #1, an RE #2, and an RE #3. The frequency domain resource of the second resource is an RE #4, an RE #5, and an RE #6. The frequency domain resources of the first resource and the second resource do not overlap.

[00183] Implementation B3: That the first resource is different from the second resource may include: A bandwidth of the first resource is partially or completely the same as a bandwidth of the second resource, and a frequency domain unit to which the first reference signal is mapped on the bandwidth of the first resource is different from a frequency domain unit to which the second reference signal is mapped on the bandwidth of the first resource.

[00184] For example, the first reference signal is mapped to the frequency domain unit based on a first comb value, and the second reference signal is mapped to the frequency domain unit based on a second comb value. The first comb value may be the same as or different from the second comb value. The frequency domain unit to which the first reference signal is mapped on the bandwidth of the first resource is different from the frequency domain unit to which the second reference signal is mapped on the bandwidth of the first resource. For a concept of the frequency domain unit, refer to the foregoing content. For example, the frequency domain unit is an RE.

[00185] For another example, the bandwidth of the first resource is partially or completely the same as the bandwidth of the second resource, the first comb value is the same as the second comb value, and a comb offset value corresponding to the first reference signal is different from a comb offset value corresponding to the second reference signal. In this way, the frequency domain unit to which the first reference signal is mapped on the bandwidth of the first resource is different from the frequency domain unit to which the second reference signal is mapped on the bandwidth of the first resource.

[00186] In the implementation B3, the time domain resources of the first resource and the second resource may completely overlap, partially overlap, or not overlap.

[00187] For example, the bandwidth of the first resource is a segment of continuous frequency domain resource occupied by an RE #0 to an RE #11. Refer to the example of the frequency domain resource shown in FIG. 1C. The bandwidth of the second resource is a segment of continuous frequency domain resource occupied by the RE #0 to the RE #11. For example, with reference to FIG. 1C, the first reference signal and the second reference signal are separately mapped based on a comb value M, and M is 4. The comb offset value in this embodiment of this application may be replaced with a comb index, a comb index value, or the like. A comb index, or referred to as a comb offset value, corresponding to the first reference signal is 0, and indexes of REs to which the first reference signal is mapped are respectively RE #0, RE #4, and RE #8 (referring to (a) in FIG. 1C). A comb offset value corresponding to the second reference signal is 1, and indexes of REs to which the second reference signal is mapped are respectively RE #1, RE #5, and RE #9 (referring to (b) in FIG. 1C). It can be learned that although the bandwidth of the first resource is the same as the bandwidth of the second resource, the first comb value is the same as the second comb value, or comb quantities corresponding to the first comb value and the second comb value are the same, that is, both are 4. However, the comb offset value corresponding to the first reference signal is different from the comb offset value corresponding to the second reference signal. Therefore, the frequency domain unit (for example, an RE) to which the first reference signal is mapped on the bandwidth of the first resource is different from the frequency domain unit (for example, an RE) to which the second reference signal is mapped on the bandwidth of the first resource. This implementation is also an implementation in which the first resource is different from the second resource in this embodiment of this application.

[00188] In the implementation B3, the bandwidth of the first resource may be the same as or partially the same as the bandwidth of the second resource. For example, there is a partial intersection between the bandwidth of the first resource and the bandwidth of the second resource. For example, the bandwidth of the first resource is a segment of continuous frequency domain resource occupied by an RE #0 to an RE #11. The bandwidth of the second resource is a segment

of continuous frequency domain resource occupied by an RE #5 to an RE #16, or the bandwidth of the second resource is a segment of continuous frequency domain resource occupied by the RE #5 to the RE #11. It can be learned that in this example, the bandwidth of the second resource is partially the same as the bandwidth of the first resource.

[00189] The implementation B1, the implementation B2, and the implementation B3 may be used separately or in combination. For example, that the first resource is different from the second resource may include: The time domain resource of the first resource does not overlap with, or partially overlaps with, the time domain resource of the second resource, and the frequency domain resource of the first resource does not overlap with, or partially overlaps with, the frequency domain resource of the second resource.

[00190] FIG. 4 is an example diagram of association between resources and sequence types. Refer to FIG. 4. Time domain resources and/or frequency domain resources corresponding to a sequence of the first type and a sequence of the second type are different. For example, a resource #11 and a resource #12 have a same time domain resource but different frequency domain resources, the resource #11 is associated with the sequence of the first type, and the resource #12 is associated with the sequence of the second type. For another example, a resource #2, a resource #3, a resource #4, and a resource #5 have a same frequency domain resource but different time domain resources. The resource #4 is associated with the sequence of the first type, and the other resources are associated with the sequence of the second type. It can be learned that time domain resources in resources associated with the sequence of the first type and the sequence of the second type are different. For another example, in a resource #6, an RE associated with the sequence of the first type is different from an RE associated with the sequence of the second type.

[00191] The first communication apparatus or the second communication apparatus may obtain a sequence type associated with a resource, for example, the sequence type associated with the first resource or the sequence type associated with the second resource, in a plurality of implementations. The following uses an example in which the first communication apparatus obtains the sequence type associated with the first resource for description. A sequence type associated with another resource is similar to the sequence type associated with the first resource, and details are not described.

[00192] For example, the sequence type associated with the first resource may be preconfigured, or may be defined in a protocol, or may be indicated by another apparatus.

[00193] In this embodiment of this application, (pre)configuration includes (pre)configuration by a network device. The network device may perform (pre)configuration by using one or more of downlink control information (downlink control information, DCI), RRC signaling, and a medium access control (medium access control, MAC) control element (control element, CE).

[00194] For example, a first network apparatus sends first information, and the first communication apparatus may receive the first information. The first communication apparatus determines, based on the first information, the sequence type associated with the first resource. In this way, the first network apparatus may configure, for the first communication apparatus by using the first information, the sequence type associated with the first resource, and the first network apparatus may configure a more suitable sequence type for the first resource based on an actual situation, thereby further improving communication performance. In this example, the first communication apparatus may be a terminal or a chip (or a circuit or a system on chip) inside the terminal. The second communication apparatus may be a terminal or a chip (or a circuit or a system on chip) inside the terminal. In this case, for a manner in which the second communication apparatus obtains a sequence type associated with a resource, refer to the manner in which the first communication apparatus obtains the sequence type associated with the first resource. The manners are similar. Details are not described again. Alternatively, the second communication apparatus may be the first network apparatus. In this case, the second communication apparatus may configure, for the first communication apparatus, the sequence type associated with the first resource.

[00195] The first information may be carried in a plurality of types of information. This may be flexibly configured. For example, in a possible implementation, the first information is carried in an RRC message.

[00196] The first network apparatus may indicate, in an explicit manner, a sequence type associated with a resource, or may indicate, in some implicit manners, a sequence type associated with a resource. The following describes, by using an implementation C1 (an explicit manner) and an implementation C2 (an implicit manner) as examples, several implementations in which the first communication apparatus obtains the sequence type associated with the first resource.

[00197] Implementation C1: The first information includes indication information of the sequence type associated with the first resource, and/or an identifier of the first sequence. A type of the first sequence is the sequence type associated with the first resource, and the first sequence is used to generate the first reference signal.

[00198] In the implementation C1, the first network apparatus may indicate, in an explicit manner, a sequence type associated with a resource. In this way, the first communication apparatus may determine, based on these parameters, the sequence type associated with the first resource. This solution is simple and convenient and easy to implement. The following separately describes several possible implementations by using an implementation C1.1, an implementation C1.2, and an implementation C1.3 as examples. In the implementation C1.1, an example in which the first information includes the indication information of the sequence type associated with the first

resource is used for description. In the implementation C1.2, an example in which the first information includes the indication information of the sequence type associated with the first resource and the identifier of the first sequence is used for description. In the implementation C1.3, an example in which the first information includes the identifier of the first sequence is used for description.

[00199] Implementation C1.1: The first information includes the indication information of the sequence type associated with the first resource.

[00200] For example, the indication information of the sequence type associated with the first resource indicates the first type, and the first communication apparatus may determine the first sequence based on the sequence type, namely, the first type.

[00201] For another example, the indication information of the sequence type associated with the first resource indicates the second type, and the first communication apparatus may determine the first sequence based on the sequence type, namely, the second type.

[00202] For another example, the indication information of the sequence type associated with the first resource indicates the flexible type, and the first communication apparatus may determine the first sequence based on the sequence type, namely, the first type or the second type.

[00203] Implementation C1.2: The first information includes the indication information of the sequence type associated with the first resource and the identifier of the first sequence.

[00204] For example, the indication information of the sequence type associated with the first resource indicates the first type, and the first communication apparatus may search sequence identifiers corresponding to the first type for the identifier of the first sequence, and then determine the first sequence based on found information. For another example, the indication information of the sequence type associated with the first resource indicates the second type, and the first communication apparatus may search sequence identifiers corresponding to the second type for the identifier of the first sequence, and then determine the first sequence based on found information. For another example, the indication information of the sequence type associated with the first resource indicates the flexible type, and the first communication apparatus may search sequence identifiers corresponding to the flexible type for the identifier of the first sequence, and then determine the first sequence based on found information.

[00205] One sequence type corresponds to an identifier of at least one sequence. The identifier of the sequence may be stored in the form of table, text, or the like. An identifier of a sequence corresponding to one sequence type may be separately set, and identifiers of two sequences of different types may be the same or different. Alternatively, identifiers of sequences corresponding to a plurality of sequence types are set together, and a unique sequence may be found based on an identifier of one sequence.

[00206] For example, identifiers of sequences corresponding to the first type (for example, W sequence) include sequence #001, sequence #002, and sequence #003. Identifiers of sequences corresponding to the second type (for example, ZC sequence) include sequence #001, sequence #002, and sequence #003. Identifiers of sequences corresponding to the flexible type include sequence #001, sequence #002, sequence #003, sequence #004, sequence #005, and sequence #006. A sequence corresponding to an identifier of a sequence corresponding to the flexible type may belong to the first type or the second type. For example, sequences corresponding to sequence #001 and sequence #002 are sequences of the first type, and sequences corresponding to sequence #003, sequence #004, sequence #005, and sequence #006 are sequences of the second type.

[00207] When the indication information of the sequence type associated with the first resource indicates that the sequence type is the first type, the first information includes that the identifier of the first sequence is sequence #001. The first communication apparatus may search identifiers of sequences corresponding to the first type, and use a sequence corresponding to sequence #001 among the sequences corresponding to the first type as the first sequence.

[00208] When the indication information of the sequence type associated with the first resource indicates that the sequence type is the second type, the first information includes that the identifier of the first sequence is sequence #001. The first communication apparatus may search identifiers of sequences corresponding to the second type, and use a sequence corresponding to sequence #001 among the sequences corresponding to the second type as the first sequence.

[00209] When the indication information of the sequence type associated with the first resource indicates that the sequence type is the flexible type, the first information includes that the identifier of the first sequence is sequence #001. The first communication apparatus may search identifiers of sequences corresponding to the flexible type, and use a sequence corresponding to sequence #001 among the sequences corresponding to the flexible type as the first sequence.

[00210] Implementation C1.3: The first information includes the identifier of the first sequence.

[00211] One sequence type corresponds to an identifier of at least one sequence. The identifier of the sequence may be stored in the form of table, text, or the like. Identifiers of sequences corresponding to a plurality of sequence types are set together, and one (or a unique) sequence may be found based on an identifier of one sequence.

[00212] For example, identifiers of sequences corresponding to the first type (for example, W sequence) include sequence #001, sequence #002, and sequence #003. Identifiers of sequences corresponding to the second type (for example, ZC sequence) include sequence #004, sequence #005, and sequence #006. Identifiers of sequences corresponding to the flexible type include sequence #001, sequence #002, sequence #003, sequence #004, sequence #005, and sequence #006. The flexible type includes the first type and the second type.

[00213] When the identifier of the first sequence is sequence #001, the first communication apparatus uses a sequence corresponding to sequence #001 as the first sequence. A sequence type associated with sequence #001 is the first type.

[00214] When the identifier of the first sequence is sequence #004, the first communication apparatus uses a sequence corresponding to sequence #004 as the first sequence. A sequence type associated with sequence #004 is the second type.

[00215] In a possible implementation, the first network apparatus may configure one sequence type for one resource set of a user, or configure one sequence type for one resource.

[00216] For example, the resource is an SRS resource, and the first network apparatus may configure one sequence type for one SRS resource set (SRS resource set). One resource set includes configurations of one or more resources. For example, one SRS resource set includes configurations of one or more SRS resources. In this case, sequence types associated with all resources in the SRS resource set are a sequence type associated with the SRS resource set.

[00217] The following describes a possible SRS resource configuration manner by using an example:

SRS-resourceSet::= SEQUENCE{

srs-ResourceSetID INTEGER(0…maxNrofSRS-ResourceSets-1)// maxNrofSRS-ResourcesPerSet is the maximum value of SRS resource configuration

srs-ResourceIDList SEQUENCE(SIZE(1…maxNrofSRS-ResourcesPerSet)) of SRS-ResourceID// maxNrofSRS-ResourcesPerSet is the maximum value of SRS resource configuration

srs-SequenceType ENUMERATED{ZC, W, Mixed}//the sequence type associated with the SRS resource set includes a ZC sequence type, a W sequence type, or a flexible type (mixed); ENUMERATED means enumerated

}

[00218] It can be learned from the foregoing example that a parameter of the sequence type is configured in the SRS resource set. In this example, an example of the flexible type is mixed, and the flexible type may also be referred to as a mixed type.

[00219] In another possible implementation, the first network apparatus may alternatively configure one sequence type for one SRS resource. For example, one SRS resource configuration may include one sequence type. Two sequence types associated with two SRS resources included in one SRS resource set may be the same or may be different.

[00220] The following describes a possible SRS resource configuration manner by using an example:

SRS-resourceSet::= INTEGER(0…maxNrofSRS-ResourceSets-1)// maxNrofSRS-

ResourcesPerSet is the maximum value of SRS resource configuration

SRS-resource::= SEQUENCE{

srs-ResourceID INTEGER(0…maxNrofSRS-ResourceSets-1)// maxNrofSRS-ResourcesPerSet is the maximum value of SRS resource configuration

SequenceType ENUMERATED{ZC, W, Mixed}//the sequence type associated with the SRS resource set includes a ZC sequence type, a W sequence type, or a flexible type (mixed); ENUMERATED means enumerated

SequenceID BIT STRING(SIZE(10))//identifier of the sequence associated with the SRS resource

}

[00221] It can be learned from the foregoing example that a parameter of the sequence type is configured in one SRS resource in the SRS resource set. In this example, an example of the flexible type is mixed, and the flexible type may also be referred to as a mixed type. In this example, the SRS resource may be further associated with an identifier of a sequence, and based on this, the first communication apparatus may determine, based on the sequence type, the sequence associated with the resource. For related content, refer to the foregoing descriptions. Details are not described again.

[00222] In another possible implementation, the first information may further include some other content, for example, an index of a group to which the first sequence belongs and/or an identifier of the first sequence in the group. For example, the type of the first sequence is the first type, sequences corresponding to the first type may be divided into a plurality of groups, and the first information may include the index of the group to which the first sequence belongs, the identifier of the first sequence in the group, and/or the like, so that the first communication apparatus can more quickly find, based on the first information, the group to which the first sequence belongs, and then search the group for content associated with the identifier of the first sequence. Sequences corresponding to one type may be further divided into a plurality of groups, and a plurality of groups associated with one type may have same group identification information. Therefore, the first communication apparatus can find the first sequence based on a combination of the index of the group and the identifier of the first sequence in the group. In this solution, indexes of a plurality of sequences corresponding to one type can be maintained within a relatively small range, thereby reducing a search time.

[00223] Implementation C2: The first information includes some parameters, and these parameters are associated with the sequence type associated with the first resource.

[00224] In the implementation C2, the first network apparatus may indicate, in an implicit manner, a sequence type associated with a resource. In this way, the first communication apparatus

may infer, based on such information, the sequence type associated with the first resource. This solution can reduce signaling overheads.

[00225] For example, the first information includes information indicating a quantity of reference signal streams transmitted on the first resource. The information indicating the quantity of reference signal streams transmitted on the first resource may include, for example, a parameter indicating a quantity of layers (layer). The quantity of reference signal streams is associated with the sequence type associated with the first resource. For example, the information indicating the quantity of reference signal streams transmitted on the first resource indicates a single stream. In this case, the first communication apparatus may determine that the sequence type associated with the first resource is W sequence. For another example, the information indicating the quantity of reference signal streams transmitted on the first resource indicates dual streams. In this case, the first communication apparatus may determine that the sequence type associated with the first resource is ZC sequence.

[00226] For another example, the first information includes information indicating a power control parameter of a reference signal transmitted on the first resource, and the power control parameter is associated with the sequence type associated with the first resource. For example, a transmit power indicated by the information indicating the power control parameter of the reference signal transmitted on the first resource has a first transmit power value. The first transmit power value is greater than a second transmit power value. In this case, the first communication apparatus may determine that the sequence type associated with the first resource is W sequence. For another example, a transmit power indicated by the information indicating the power control parameter of the reference signal transmitted on the first resource has a second transmit power value. In this case, the first communication apparatus may determine that the sequence type associated with the first resource is ZC sequence.

[00227] For another example, the first information includes information indicating a scenario to which the first resource is applicable. For example, the information indicating the scenario to which the first resource is applicable indicates that the scenario to which the first resource is applicable is a scenario in which capacity expansion is needed. In this case, the first communication apparatus may determine that the sequence type associated with the first resource is W sequence. For another example, the information indicating the scenario to which the first resource is applicable indicates that the scenario to which the first resource is applicable is a scenario in which signal coverage is limited and capacity expansion is not needed. In this case, the first communication apparatus may determine that the sequence type associated with the first resource is ZC sequence. The signal coverage (for example, poor or good) may be indicated by using a power control parameter or signaling like downlink control information (downlink control

information, DCI).

[00228] In another possible implementation, when the sequence type associated with the first resource is the flexible type, the first communication apparatus may alternatively determine, in some other implementations, the sequence type associated with the first resource. It can be learned that in this solution, a resource may be alternatively associated with the flexible type, and the flexible type includes a plurality of types of sequences. Further, the first communication apparatus may determine, based on some information, a type associated with a specifically used sequence. This solution provides more options for configuring a sequence type for a resource, so that solution flexibility can be further improved. The following describes two possible implementations by using an implementation D1 and an implementation D2 as examples. In the implementation D1, an example in which another apparatus indicates a sequence type to the first communication apparatus is used for description. In the implementation D2, an example in which the first communication apparatus determines a sequence type based on the identifier of the first sequence is used for description.

[00229] Implementation D1: The first communication apparatus receives second information. The second information indicates that the flexible type is the first type or the second type.

[00230] The first network apparatus sends the second information, and the first communication apparatus may receive the second information. In this example, the first communication apparatus may be a terminal or a chip (or a circuit or a system on chip) inside the terminal. The second communication apparatus may be a terminal or a chip (or a circuit or a system on chip) inside the terminal. In this case, for a manner in which the second communication apparatus obtains a sequence type associated with a resource, refer to the manner in which the first communication apparatus obtains the sequence type associated with the first resource. The manners are similar. Details are not described again. Alternatively, the second communication apparatus may be the first network apparatus. In this case, the second communication apparatus may configure, for the first communication apparatus, the sequence type associated with the first resource.

[00231] The second information may be carried in a plurality of types of information. This may be flexibly configured. For example, in a possible implementation, the second information is carried in an RRC message.

[00232] Implementation D2: The first communication apparatus determines, based on the identifier of the first sequence, that the flexible type is the first type or the second type.

[00233] The first communication apparatus may obtain the identifier of the first sequence. For example, the first communication apparatus may obtain the identifier of the first sequence in a manner of preconfiguration or definition in a protocol. Alternatively, the first communication apparatus may receive the identifier of the first sequence from the first network apparatus.

[00234] An identifier of a sequence is associated with a sequence type of the sequence.

[00235] For example, identifiers of sequences corresponding to the flexible type include 001, 002, 003, 004, 005, and 006. The flexible type includes the first type and the second type. Sequence types associated with 001 and 002 indicate sequences of the first type, and sequence types associated with 003, 004, 0005, and 006 indicate sequences of the second type. The first communication apparatus may obtain an association relationship between identifiers and sequence types. For example, the association relationship may be obtained in a preconfiguration manner, or may be obtained according to a preset rule, or may be indicated by using the first network apparatus.

[00236] When the identifier of the first sequence is 001, the first communication apparatus determines, based on an association relationship between 001 and the first type, that the sequence type associated with the first resource is the first type.

[00237] When the identifier of the first sequence is 004, the first communication apparatus determines, based on an association relationship between 004 and the second type, that the sequence type associated with the first resource is the second type.

[00238] Based on the foregoing content, FIG. 5 is an example schematic flowchart of a communication method according to an embodiment of this application. In this solution, a first network apparatus and a second network apparatus are used as execution bodies to describe the solution in this embodiment of this application. The first network apparatus may be the network device, or a chip (or a circuit or a system on chip) inside the network device in FIG. 2. The second network apparatus may be the network device, a chip (or a circuit or a system on chip) inside the network device, the terminal, or a chip (or a circuit or a system on chip) inside the terminal in FIG. 2. The network device in this embodiment of this application is, for example, the access network device in FIG. 2.

[00239] The first communication apparatus in FIG. 3 may be the first network apparatus, and correspondingly, the second communication apparatus may be a terminal or a chip (or a circuit or a system on chip) inside the terminal. The second communication apparatus in FIG. 3 may be the first network apparatus, and correspondingly, the first communication apparatus may be a terminal or a chip (or a circuit or a system on chip) inside the terminal. Both the second communication apparatus and the first communication apparatus in FIG. 3 may be different from the first network apparatus. For example, the second communication apparatus and the first communication apparatus each may be a terminal or a chip (or a circuit or a system on chip) inside the terminal.

[00240] The following provides descriptions with reference to FIG. 5.

[00241] Step 501: The first network apparatus obtains a sequence type associated with a first resource.

[00242] For the sequence type associated with the first resource, refer to the related descriptions

in FIG. 3. For example, the sequence type associated with the first resource is a first type, a second type, or a flexible type. Related content is not described again.

[00243] Step 502: The first network apparatus sends third information to the second network apparatus.

[00244] Correspondingly, the second network apparatus receives the third information.

[00245] The third information indicates the sequence type associated with the first resource. Alternatively, the third information indicates the sequence type associated with the first resource corresponding to the first network apparatus.

[00246] In this embodiment of this application, the two network apparatuses may be configured with a same resource, which is alternatively referred to as an overlapping resource. The third information indicates the sequence type associated with the first resource corresponding to the first network apparatus. The sequence type associated with the first resource corresponding to the first network apparatus may alternatively be a sequence type associated with the first resource within a coverage area of the first network apparatus, or a sequence type associated with the first resource configured for the first network apparatus. When a communication apparatus (for example, the first communication apparatus) is located within a signal coverage area of the first network apparatus, or an association relationship between a resource of the first communication apparatus and a sequence type is an association relationship between a resource and a sequence corresponding to the first network apparatus, or is configured by the first network apparatus, the first communication apparatus determines, based on the association relationship between the resource and the sequence corresponding to the first network apparatus, a sequence type associated with a resource.

[00247] For example, a first resource corresponding to the first network apparatus is associated with the first type, and a first resource corresponding to the second network apparatus is associated with the second type. The first communication apparatus communicates with the first network apparatus, or an association relationship between a resource of the first communication apparatus and a sequence is configured by the first network apparatus, or the first communication apparatus is located within a coverage area of the first network apparatus, and the first communication apparatus needs to perform transmission of a corresponding reference signal on the first resource by using a sequence of the first type. For example, the first communication apparatus communicates with the second network apparatus, or an association relationship between a resource of the first communication apparatus and a sequence is configured by the second network apparatus, or the first communication apparatus is located within a coverage area of the second network apparatus, and the first communication apparatus needs to perform transmission of a corresponding reference signal on the first resource by using a sequence of the second type.

[00248] The first network apparatus may notify the second network apparatus of the sequence type associated with the first resource. Therefore, a parameter may be properly set between the two network apparatuses, to reduce interference on the first resource. For example, the second network apparatus may set a type associated with the first resource to be the same as the sequence type associated with the first resource corresponding to the first network apparatus, or the second network apparatus adjusts a parameter (for example, a power control parameter) associated with the first resource. In this way, communication performance can be further improved.

[00249] After step 502, the second network apparatus may perform step 503.

[00250] Step 503: The second network apparatus configures a sequence type associated with the first resource corresponding to the second network apparatus as the sequence type indicated by the third information.

[00251] For example, when the third information indicates that the sequence type associated with the first resource corresponding to the first network apparatus is the first type, the second network apparatus configures the sequence type associated with the first resource corresponding to the second network apparatus as the first type. For another example, when the third information indicates that the sequence type associated with the first resource corresponding to the first network apparatus is the second type, the second network apparatus configures the sequence type associated with the first resource corresponding to the second network apparatus as the second type.

[00252] FIG. 6A and FIG. 6B show examples of association relationships between resources and sequence types. FIG. 6A shows an example of an association relationship between resources and sequence types corresponding to the first network apparatus, and FIG. 6B shows an example of an association relationship between resources and sequence types corresponding to the second network apparatus. It can be learned from FIG. 6A and FIG. 6B that, after negotiation between the first network apparatus and the second network apparatus, a same sequence type may be configured for a same resource. For example, for a resource #1, the first network apparatus and the second network apparatus each associate a sequence of the second type with the resource #1.

[00253] According to the solution provided in FIG. 5, because the first network apparatus and the second network apparatus can transmit reference signals corresponding to sequences of a same type on a same resource (for example, the resource #1) after negotiation, interference on the resource can be reduced, and performance of detecting a channel state by using the reference signals transmitted on the resource can be improved.

[00254] Based on the foregoing content, FIG. 7 is an example schematic flowchart of a communication method according to an embodiment of this application. In this solution, a first network apparatus and a second network apparatus are used as execution bodies to describe the

solution in this embodiment of this application. For related descriptions of the first network apparatus and the second network apparatus, refer to the foregoing descriptions in FIG. 5. Details are not described again.

[00255] The following provides descriptions with reference to FIG. 7.

[00256] Step 701: The first network apparatus obtains a sequence type associated with a first resource.

[00257] For the sequence type associated with the first resource, refer to the related descriptions in FIG. 3. For example, the sequence type associated with the first resource is a first type, a second type, or a flexible type. Related content is not described again.

[00258] For content of step 701, refer to the content of step 501. Details are not described again.

[00259] Step 702: The first network apparatus sends third information to the second network apparatus.

[00260] Correspondingly, the second network apparatus receives the third information.

[00261] The third information indicates the sequence type associated with the first resource. Alternatively, the third information indicates the sequence type associated with the first resource corresponding to the first network apparatus.

[00262] For content of step 702 and the third information, refer to the content of step 502. Details are not described again.

[00263] After step 702, the second network apparatus performs step 703.

[00264] Step 703: The second network apparatus adjusts a power control parameter corresponding to the first resource.

[00265] In step 703, in a possible implementation, the sequence type indicated by the third information is different from a sequence type associated with the first resource corresponding to the second network apparatus. In this case, signals corresponding to two different types of sequences may be transmitted on the first resource. As a result, interference on the first resource may be strong.

[00266] Based on the foregoing problem, in a possible implementation, the second network apparatus adjusts the power control parameter corresponding to the first resource. The power control parameter may include, for example, parameters such as a transmit power and/or transmit power adjustment. That the second network apparatus adjusts the power control parameter corresponding to the first resource may include: The second network apparatus increases or decreases the power control parameter corresponding to the first resource. For example, the second network apparatus adjusts a transmit power corresponding to the first resource to a first transmit power threshold.

[00267] For example, the third information indicates that the sequence type associated with the

first resource is the first type (for example, W sequence), and the sequence type associated with the first resource corresponding to the second network apparatus is the second type (for example, ZC sequence). The second network apparatus may adjust the power control parameter corresponding to the first resource. For example, the second network apparatus may decrease or increase the transmit power corresponding to the first resource. For another example, the third information indicates that the sequence type associated with the first resource is the second type (for example, ZC sequence), and the sequence type associated with the first resource corresponding to the second network apparatus is the first type (for example, W sequence). The second network apparatus may adjust the power control parameter corresponding to the first resource. For example, the second network apparatus may decrease or increase the transmit power corresponding to the first resource.

[00268] Optionally, after step 703, step 704 may be further included.

[00269] Step 704: The second network apparatus adjusts a power control parameter corresponding to a third resource.

[00270] The third resource and the first resource overlap or partially overlap in time domain, and a sequence type associated with the third resource is the same as the sequence type associated with the first resource corresponding to the second network apparatus. An adjusted power control parameter (for example, a transmit power) of the third resource matches (or is the same as) a power control parameter (for example, a transmit power) corresponding to the first resource as adjusted by the second network apparatus.

[00271] Because time domain resources of the first resource and the third resource overlap or partially overlap, the first resource and the third resource correspond to a same sequence type. When the second network apparatus adjusts the power control parameter corresponding to the first resource, and the power control parameter corresponding to the first resource does not match (for example, differs from) the power control parameter corresponding to the third resource, interference is strong. In the solution provided in this embodiment of this application, the second network apparatus may adjust the power control parameter on the third resource, to reduce interference.

[00272] Optionally, after step 704, step 705 and/or step 706 may be further included.

[00273] Step 705: The second network apparatus sends fourth information.

[00274] Correspondingly, the first network apparatus receives the fourth information. The fourth information indicates the sequence type associated with the first resource corresponding to the second network apparatus.

[00275] Step 706: The second network apparatus sends fifth information.

[00276] Correspondingly, the first network apparatus receives the fifth information. The fifth

information indicates the power control parameter corresponding to the first resource as adjusted by the second network apparatus.

[00277] The fourth information and the fifth information may be carried in a same message, or may be respectively carried in two messages. For example, the fourth information and the fifth information may be carried in an RRC message.

[00278] Optionally, after step 705 or step 706, step 707 may be further included.

[00279] Step 707: The first network apparatus adjusts a power control parameter corresponding to a fourth resource.

[00280] The fourth resource and the first resource overlap or partially overlap in time domain, and a sequence type associated with the fourth resource is the same as the sequence type associated with the first resource corresponding to the second network apparatus. An adjusted power control parameter of the fourth resource matches (or is the same as) a power control parameter corresponding to the first resource as adjusted by the second network apparatus.

[00281] Because time domain resources of the first resource and the fourth resource overlap or partially overlap, a sequence type associated with the fourth resource corresponding to the first network apparatus is the same as the sequence type associated with the first resource corresponding to the second network apparatus. When the second network apparatus adjusts the power control parameter corresponding to the first resource, and the power control parameter corresponding to the first resource does not match (for example, differs from) the power control parameter corresponding to the fourth resource, interference is strong. In the solution provided in this embodiment of this application, the first network apparatus may adjust the power control parameter on the fourth resource, to reduce interference.

[00282] FIG. 8A and FIG. 8B show examples of association relationships between resources and sequence types. FIG. 8A shows an example of an association relationship between resources and sequence types corresponding to the first network apparatus, and FIG. 8B shows an example of an association relationship between resources and sequence types corresponding to the second network apparatus. Refer to FIG. 8A and FIG. 8B. For example, for a resource #11 (for example, the resource #11 is the first resource), the resource #11 corresponding to the first network apparatus is associated with a sequence of the first type (for example, a W sequence type), and the resource #11 (the first resource) corresponding to the second network apparatus is associated with a sequence of the second type (for example, a ZC sequence type). The second network apparatus may decrease (or increase) a power control parameter (for example, a transmit power) corresponding to the resource #11 (the first resource). In this way, interference between a reference signal sent on the resource #11 of the second network apparatus and a reference signal on the resource #11 of the first network apparatus can be reduced.

[00283] Further, the second network apparatus decreases (or increases) the power control parameter (for example, a transmit power) corresponding to the resource #11 (the first resource). Therefore, the second network apparatus may further decrease (or increase) a power control parameter (for example, a transmit power) corresponding to the resource #12 (the third resource). The power control parameter (for example, a transmit power) corresponding to the resource #12 (the third resource) matches (for example, is the same as) the power control parameter (for example, a transmit power) corresponding to the resource #11 (the first resource). In this way, interference between reference signals corresponding to the resource #12 (the third resource) and the resource #11 (the first resource) can be reduced.

[00284] Further, the second network apparatus decreases (or increases) the power control parameter (for example, a transmit power) corresponding to the resource #12 (the third resource). A sequence type associated with the resource #12 (the fourth resource) corresponding to the first network apparatus is also the second type (for example, ZC sequence). Therefore, the first network apparatus may further decrease (or increase) the power control parameter (for example, a transmit power) corresponding to the resource #12 (the fourth resource), and a decreased power control parameter (for example, a transmit power) corresponding to the resource #12 (the fourth resource) matches (for example, is the same as) a power control parameter (for example, a transmit power) corresponding to the resource #12 (the third resource) as adjusted by the second network apparatus. In this way, interference to a reference signal corresponding to the resource #12 can be reduced.

[00285] It may be understood that, to implement the functions in the foregoing embodiments, the first communication apparatus, the second communication apparatus, the first network apparatus, and the second network 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 the units and the method steps in the examples described in embodiments disclosed in this application, this application can be implemented by using hardware or a combination of hardware and computer software. Whether a function is performed by using hardware or hardware driven by computer software depends on particular application scenarios and design constraints of the technical solutions.

[00286] Based on the same concept, FIG. 9 and FIG. 10 are diagrams of structures of possible communication apparatuses according to an embodiment of this application. These communication apparatuses may be configured to implement functions of the first communication apparatus, the second communication apparatus, the first network apparatus, or the second network apparatus in the foregoing method embodiments, and therefore can also achieve the beneficial effects of the foregoing method embodiments. In embodiments of this application, the communication apparatus may be the terminal device, a chip (or a circuit or a system on chip)

inside the terminal device, the network device, or a chip (or a circuit or a system on chip) inside the network device shown in FIG. 2.

[00287] As shown in FIG. 9, a communication apparatus 1300 includes a processing unit 1310 and a transceiver unit 1320. The communication apparatus 1300 is configured to implement functions of the first communication apparatus, the second communication apparatus, the first network apparatus, or the second network apparatus in the method embodiment shown in FIG. 3, FIG. 5, or FIG. 7. The transceiver unit 1320 may also be referred to as a communication unit. The transceiver unit 1320 may include a sending unit and a receiving unit.

[00288] When the communication apparatus 1300 is configured to implement functions of the first communication apparatus or the second communication apparatus in the method embodiment shown in FIG. 3, in a possible implementation, the processing unit 1310 is configured to obtain a sequence type associated with a first resource. The processing unit 1310 is configured to perform transmission of a first reference signal on the first resource through the transceiver unit 1320 based on the sequence type associated with the first resource.

[00289] When the communication apparatus 1300 is configured to implement functions of the first communication apparatus or the second communication apparatus in the method embodiment shown in FIG. 3, in a possible implementation, the processing unit 1310 is configured to obtain a sequence type associated with a second resource. The processing unit 1310 is configured to perform transmission of a second reference signal on the second resource through the transceiver unit 1320 based on the sequence type associated with the second resource.

[00290] When the communication apparatus 1300 is configured to implement functions of the first communication apparatus or the second communication apparatus in the method embodiment shown in FIG. 3, in a possible implementation, the processing unit 1310 is configured to receive first information through the transceiver unit 1320. The processing unit 1310 is configured to determine, based on the first information, the sequence type associated with the first resource.

[00291] When the communication apparatus 1300 is configured to implement functions of the first communication apparatus or the second communication apparatus in the method embodiment shown in FIG. 3, in a possible implementation, if the sequence type associated with the first resource is a flexible type, the processing unit 1310 is configured to receive third information through the transceiver unit 1320. The processing unit 1310 is configured to determine, based on an identifier of the first sequence, that the flexible type is a first type or a second type.

[00292] In another possible implementation, when the communication apparatus 1300 is configured to implement functions of the second communication apparatus in the method embodiment shown in FIG. 3, in a possible implementation, the processing unit 1310 is configured to obtain a sequence type associated with a first resource. The processing unit 1310 is configured

to perform transmission of a first reference signal on the first resource through the transceiver unit 1320 based on the sequence type associated with the first resource.

[00293] When the communication apparatus 1300 is configured to implement functions of the first communication apparatus or the second communication apparatus in the method embodiment shown in FIG. 3, in a possible implementation, the processing unit 1310 is configured to obtain a sequence type associated with a second resource. The processing unit 1310 is configured to perform transmission of a second reference signal on the second resource through the transceiver unit 1320 based on the sequence type associated with the second resource.

[00294] When the communication apparatus 1300 is configured to implement functions of the first communication apparatus or the second communication apparatus in the method embodiment shown in FIG. 3, in a possible implementation, the processing unit 1310 is configured to send first information through the transceiver unit 1320. The processing unit 1310 is configured to determine, based on the first information, the sequence type associated with the first resource.

[00295] When the communication apparatus 1300 is configured to implement functions of the first communication apparatus or the second communication apparatus in the method embodiment shown in FIG. 3, in a possible implementation, the processing unit 1310 is configured to send third information through the transceiver unit 1320.

[00296] When the communication apparatus 1300 is configured to implement functions of the first network apparatus in the method embodiment shown in FIG. 5 or FIG. 7, in a possible implementation, the processing unit 1310 is configured to obtain a sequence type associated with a first resource. The transceiver unit 1320 is configured to send third information to a second network apparatus.

[00297] When the communication apparatus 1300 is configured to implement functions of the first network apparatus in the method embodiment shown in FIG. 5 or FIG. 7, in a possible implementation, the transceiver unit 1320 is configured to receive fourth information and/or fifth information.

[00298] When the communication apparatus 1300 is configured to implement functions of the first network apparatus in the method embodiment shown in FIG. 5 or FIG. 7, in a possible implementation, the processing unit 1310 is configured to adjust a power control parameter corresponding to a fourth resource.

[00299] When the communication apparatus 1300 is configured to implement functions of the second network apparatus in the method embodiment shown in FIG. 5 or FIG. 7, in a possible implementation, the processing unit 1310 is configured to receive third information. The processing unit 1310 is configured to obtain, based on the third information, a sequence type associated with a first resource corresponding to a first network apparatus.

[00300] When the communication apparatus 1300 is configured to implement functions of the second network apparatus in the method embodiment shown in FIG. 5 or FIG. 7, in a possible implementation, the processing unit 1310 is configured to configure a sequence type associated with the first resource as the sequence type indicated by the third information.

[00301] When the communication apparatus 1300 is configured to implement functions of the second network apparatus in the method embodiment shown in FIG. 5 or FIG. 7, in a possible implementation, the processing unit 1310 is configured to adjust a power control parameter corresponding to the first resource when the sequence type associated with the first resource corresponding to the second network apparatus is different from the sequence type indicated by the third information.

[00302] When the communication apparatus 1300 is configured to implement functions of the second network apparatus in the method embodiment shown in FIG. 5 or FIG. 7, in a possible implementation, the processing unit 1310 is configured to adjust a power control parameter corresponding to a third resource.

[00303] When the communication apparatus 1300 is configured to implement functions of the second network apparatus in the method embodiment shown in FIG. 5 or FIG. 7, in a possible implementation, the transceiver unit 1320 is configured to send fourth information and/or fifth information.

[00304] For more detailed descriptions about the processing unit 1310 and the transceiver unit 1320, refer to related descriptions in the method embodiment shown in FIG. 3, FIG. 5, or FIG. 7.

[00305] As shown in FIG. 10, a communication apparatus 1400 includes a processor 1410. Optionally, the communication apparatus 1400 further includes an interface circuit 1420. The processor 1410 and the interface circuit 1420 are coupled to each other. It may be understood that the interface circuit 1420 may be a transceiver or an input/output interface. The transceiver includes a transmitter and a receiver. The transmitter may be configured to send information, the receiver may be configured to receive information, and another function may be implemented by the processor. The input/output interface is configured to input and/or output information. Outputting may be understood as sending, inputting may be understood as receiving, and another function may be implemented by the processor. Optionally, the communication apparatus 1400 may further include a memory 1430, configured to: store instructions executed by the processor 1410, or store input data required for running instructions by the processor 1410, or store data generated after the processor 1410 runs instructions.

[00306] When the communication apparatus 1400 is configured to implement the method shown in FIG. 3, FIG. 5, or FIG. 7, the processor 1410 is configured to implement a function of the processing unit 1310, and the interface circuit 1420 is configured to implement a function of

the transceiver unit 1320.

[00307] When the communication apparatus is a chip (or a circuit or a system on chip) used in a terminal, the chip (or the circuit or the system on chip) in the terminal implements a function of a terminal apparatus in the foregoing method embodiments. That the chip (or the circuit or the system on chip) in the terminal receives information from a base station may be understood as that the information is first received by another module (for example, a radio frequency module or an antenna) in the terminal and then sent by the module to the chip (or the circuit or the system on chip) in the terminal. That the chip (or the circuit or the system on chip) in the terminal sends information to a base station may be understood as that the information is first sent to another module (for example, a radio frequency module or an antenna) in the terminal and then sent by the module to the base station.

[00308] When the communication apparatus is a chip (or a circuit or a system on chip) used in a base station, the chip (or the circuit or the system on chip) in the base station implements a function of a network apparatus in the foregoing method embodiments. That the chip (or the circuit or the system on chip) in the base station receives information from a terminal may be understood as that the information is first received by another module (for example, a radio frequency module or an antenna) in the base station and then sent by the module to the chip (or the circuit or the system on chip) in the base station. That the chip (or the circuit or the system on chip) in the base station sends information to a terminal may be understood as that the information is first sent to another module (for example, a radio frequency module or an antenna) in the base station and then sent by the module to the terminal.

[00309] In this application, that an entity A sends information to an entity B may be that A directly sends the information to B, or may be that A indirectly sends the information to B via another entity. Similarly, that an entity B receives information from an entity A may be that the entity B directly receives the information sent by the entity A, or may be that the entity B indirectly receives, via another entity, the information sent by the entity A. The entities A and B herein each may be a RAN node or a terminal, or may be a module inside a RAN node or a terminal. Information sending and receiving may be information exchange between a RAN node and a terminal, for example, information exchange between a base station and a terminal. Information sending and receiving may alternatively be information exchange between two RAN nodes, for example, information exchange between a CU and a DU. Information sending and receiving may alternatively be information exchange between different modules inside an apparatus, for example, information exchange between a chip (or a circuit or a system on chip) of a terminal and another module of the terminal, or information exchange between a chip (or a circuit or a system on chip) of a base station and another module of the base station.

[00310] It may be understood that, the processor in embodiments of this application may be a central processing unit (central processing unit, CPU), or may be another general-purpose processor, a digital signal processor (digital signal processor, DSP), an application-specific integrated circuit (application-specific integrated circuit, ASIC), a field programmable gate array (field programmable gate array, FPGA) or another programmable logic device, a transistor logic device, a hardware component, or any combination thereof. The general-purpose processor may be a microprocessor, or may be any conventional processor.

[00311] The method steps in embodiments of this application may be implemented in hardware, or may be implemented in software instructions that can be executed by a processor. The software instructions may be composed of corresponding software modules. The software module may be stored in a random access memory, a flash memory, a read-only memory, a programmable read-only memory, an erasable programmable read-only memory, an electrically erasable programmable read-only memory, a register, a hard disk, a removable hard disk, a compact disc read-only memory (compact disc read-only memory, CD-ROM), or any other form of storage medium well-known in the art. An example storage medium is coupled to a processor, so that the processor can read information from the storage medium and can write information into the storage medium. The storage medium may alternatively be a component of the processor. The processor and the storage medium may be located in an ASIC. In addition, the ASIC may be located in a base station or a terminal. The processor and the storage medium may exist in the base station or the terminal as discrete components.

[00312] All or some of the foregoing embodiments may be implemented by software, hardware, firmware, or any combination thereof. When software is used to implement the embodiments, all or some of the embodiments may be implemented in a form of a computer program product. The computer program product includes one or more computer programs or instructions. When the computer programs or the instructions are loaded and executed on a computer, all or some of the procedures or functions in embodiments of this application are executed. The computer may be a general-purpose computer, a dedicated computer, a computer network, a network device, user equipment, or another programmable apparatus. The computer programs or the instructions may be stored in a computer-readable storage medium or may be transmitted from a computer-readable storage medium to another computer-readable storage medium. For example, the computer programs or the instructions may be transmitted from a website, computer, server, or data center to another website, computer, server, or data center in a wired or wireless manner. The computer-readable storage medium may be any usable medium accessible by a computer, or a data storage device such as a server or a data center integrating one or more usable media. The usable medium may be a magnetic medium, for example, a floppy disk, a hard disk drive, or a magnetic tape; or

may be an optical medium, for example, a digital video disc; or may be a semiconductor medium, for example, a solid-state drive. The computer-readable storage medium may be a volatile or non-volatile storage medium, or may include two types of storage media: a volatile storage medium and a non-volatile storage medium.

[00313] In embodiments of this application, unless otherwise stated or there is a logic conflict, terms and/or descriptions between 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.

[00314] In this application, "at least one" means one or more, and "a plurality of" means two or more. The term "and/or" describes an association relationship of associated objects, and indicates that three relationships may exist. For example, A and/or B may indicate the following three cases: Only A exists, both A and B exist, and only B exists. A and B may be singular or plural. In the text descriptions of this application, the character "/" generally indicates an "or" relationship between the associated objects. In a formula in this application, the character "/" indicates a "division" relationship between the associated objects. "Including at least one of A, B, or C" may represent: including A; including B; including C; including A and B; including A and C; including B and C; and including A, B, and C.

[00315] It may be understood that various numbers (for example, numerical numbers "first" and "second" and letter numbers "A1 and A2", "B1 and B2", and "C1 and C2") in embodiments of this application are merely used for differentiation for ease of description, and are not used to limit the scope of embodiments of this application. Sequence numbers of the foregoing processes do not mean a sequence of execution. The sequence of execution of the processes should be determined according to functions and internal logic of the processes.

CLAIMS

1. A communication method, comprising:

obtaining a sequence type associated with a first resource; and

performing transmission of a first reference signal on the first resource based on the sequence type associated with the first resource, wherein the first reference signal is generated based on a first sequence, and a sequence type of the first sequence is the sequence type associated with the first resource.

2. The method according to claim 1, wherein the sequence type associated with the first resource comprises a first type, a second type, or a flexible type.

3. The method according to claim 2, wherein the first type is a W sequence type, the second type is a ZC sequence type, and the flexible type comprises the first type and the second type.

4. The method according to any one of claims 1 to 3, wherein an expression of a sequence corresponding to the W sequence type is $e^{-2\pi j\frac{(an^3+bn^2+cn+d)}{N}}$, wherein e is Euler's constant, $0\leq n\leq(L-1)$, a, b, c, and d are all constants, $j=\sqrt{-1}$, N is a prime number, and L is a constant.

5. The method according to any one of claims 1 to 4, wherein the method further comprises:

obtaining a sequence type associated with a second resource; and

performing transmission of a second reference signal on the second resource based on the sequence type associated with the second resource, wherein the second reference signal is generated based on a second sequence, and a sequence type of the second sequence is the sequence type associated with the second resource.

6. The method according to claim 5, wherein the sequence type associated with the second resource comprises the first type, the second type, or the flexible type.

7. The method according to claim 5 or 6, wherein the sequence type associated with the first resource is different from the sequence type associated with the second resource.

8. The method according to any one of claims 5 to 7, wherein the first resource and the second resource satisfy at least one of the following:

a time domain resource of the first resource does not overlap with, or partially overlaps with, a time domain resource of the second resource;

a frequency domain resource of the first resource does not overlap with, or partially overlaps with, a frequency domain resource of the second resource; and

a bandwidth of the first resource is partially or completely the same as a bandwidth of the second resource, and a frequency domain unit to which the first reference signal is mapped on the bandwidth of the first resource is different from a frequency domain unit to which the second

reference signal is mapped on the bandwidth of the first resource.

9. The method according to any one of claims 1 to 8, wherein the method further comprises:

receiving first information; and

determining, based on the first information, the sequence type associated with the first resource.

10. The method according to any one of claims 1 to 8, wherein the method further comprises:

sending first information.

11. The method according to claim 9 or 10, wherein the first information is carried in a radio resource control, RRC, message.

12. The method according to any one of claims 9 to 11, wherein the first information comprises:

indication information of the sequence type associated with the first resource; and/or

an identifier of the first sequence.

13. The method according to any one of claims 9 to 11, wherein the first information comprises:

information indicating a quantity of reference signal streams transmitted on the first resource, wherein the quantity of reference signal streams is associated with the sequence type associated with the first resource; and/or

information indicating a power control parameter of a reference signal transmitted on the first resource, wherein the power control parameter is associated with the sequence type associated with the first resource.

14. The method according to any one of claims 1 to 13, wherein when the sequence type associated with the first resource is the flexible type, the method further comprises:

receiving third information, wherein the third information indicates that the flexible type is the first type or the second type; or

determining, based on the identifier of the first sequence, that the flexible type is the first type or the second type.

15. The method according to any one of claims 1 to 13, wherein when the sequence type associated with the first resource is the flexible type, the method further comprises:

sending third information, wherein the third information indicates that the flexible type is the first type or the second type.

16. The method according to claim 14 or 15, wherein the third information is carried in an RRC message.

17. A communication method, wherein the method is applicable to a first network apparatus, and the method comprises:

obtaining a sequence type associated with a first resource; and

sending third information to a second network apparatus, wherein the third information indicates the sequence type associated with the first resource.

18. The method according to claim 17, wherein the method further comprises:

receiving fourth information and/or fifth information, wherein

the fourth information indicates that a sequence type associated with the first resource corresponding to the second network apparatus is a first type; and

the fifth information indicates a power control parameter corresponding to the first resource as adjusted by the second network apparatus.

19. A communication apparatus configured to perform the method according to any one of claims 1 to 16, or perform the method according to claim 17 or 18.

20. A computer program product, wherein the computer program product stores a computer program, and the computer program comprises program instructions, and when the program instructions are executed by a computer, the method according to any one of claims 1 to 16 is implemented, or the method according to claim 17 or 18 is implemented.