a, c, and m are particular parameters, and $x(0), x(1), ..., x(N-1)$ is the congruential sequence.

[0029] With reference to the fourth aspect and the foregoing implementation manners of the fourth aspect, in a third implementation manner of the fourth aspect, $a = 7^5$, $c = 0$, and $m = 2^{31} - 1$.

[0030] With reference to the fourth aspect and the foregoing implementation manners of the fourth aspect, in a fourth implementation manner of the fourth aspect, the control signaling includes but is not limited to one of the following control channels: a physical downlink control channel PDCCH, a physical broadcast channel PBCH, or a physical uplink control channel PUCCH.

[0031] With reference to the fourth aspect and the foregoing implementation manners of the fourth aspect, in a third implementation manner of the fourth aspect, when $N = 128$, the mapping function is:

{0, 112, 35, 14, 48, 1, 99, 54, 28, 120, 126, 46, 114, 110, 43, 32, 81, 18, 113, 63, 75, 38, 64, 7, 15, 37, 19, 70, 27, 12, 34, 50, 17, 86, 3, 68, 98, 23, 111, 62, 57, 61, 89, 59, 13, 56, 66, 107, 47, 41, 124, 30, 2, 49, 44, 88, 65, 45, 123, 104, 10, 85, 102, 103, 122, 91, 121, 58, 73, 60, 26, 8, 55, 105, 94, 82, 115, 69, 74, 83, 106, 95, 9, 108, 53, 90, 29, 11, 36, 42, 87, 39, 101, 76, 4, 67, 93, 31, 97, 119, 100, 72, 6, 5, 22, 118, 25, 117, 125, 92, 80, 77, 21, 79, 116, 33, 20, 71, 52, 109, 84, 51, 96, 24, 40, 78, 16, 127}.

[0032] With reference to the fourth aspect and the foregoing implementation manners of the fourth aspect, in a third implementation manner of the fourth aspect, when $N = 256$, the mapping function is:

{0, 188, 112, 128, 183, 35, 150, 14, 48, 149, 148, 154, 130, 1, 229, 152, 131, 197, 182, 248, 253, 99, 54, 245, 231, 165, 28, 226, 120, 132, 136, 185, 168, 196, 187, 200, 159, 211, 147, 126, 46, 157, 114, 110, 210, 43, 32, 81, 18, 113, 63, 158, 75, 222, 38, 170, 219, 208, 237, 220, 252, 64, 137, 230, 216, 133, 7, 192, 218, 15, 37, 217, 19, 70, 27, 173, 155, 12, 34, 239, 50, 207, 175, 169, 223, 242, 240, 17, 161, 86, 3, 68, 98, 23, 145, 111, 62, 189, 202, 57, 61, 89, 59, 13, 56, 66, 199, 167, 214, 179, 215, 221, 107, 47, 41, 124, 234, 30, 2, 49, 44, 88, 201, 65, 195, 205, 45, 123, 104, 10, 85, 193, 102, 177, 103, 122, 225, 241, 181, 227, 91, 172, 121, 58, 142, 174, 73, 134, 60, 250, 180, 26, 8, 55, 236, 105, 94, 235, 194, 82, 162, 160, 243, 115, 69, 74, 83, 106, 191, 95, 232, 9, 108, 206, 53, 212, 209, 90, 29, 11, 139, 36, 42, 87, 39, 178, 101, 144, 151, 138, 247, 76, 4, 238, 143, 67, 146, 93, 254, 31, 198, 97, 119, 100, 171, 163, 204, 72, 6, 5, 22, 118, 190, 233, 141, 213, 25, 117, 125, 92, 246, 153, 80, 186, 135, 77, 251, 21, 79, 249, 116, 203, 164, 129, 33, 20, 71, 184, 52, 244, 109, 84, 51, 96, 24, 255, 40, 224, 176, 78, 140, 228, 16, 127, 166, 156}.

[0033] Based on the foregoing technical solutions, when a broadcast signaling (such as a

DESCRIPTION OF EMBODIMENTS

[0044] The following clearly and completely describes the technical solutions in the embodiments of the present invention with reference to the accompanying drawings in the embodiments of the present invention. Apparently, the described embodiments are a part rather than all of the embodiments of the present invention. All other embodiments obtained by a person of ordinary skill in the art based on the embodiments of the present invention without creative efforts shall fall within the protection scope of the present invention.

[0045] Terminologies such as "component", "module", and "system" used in this specification are used to indicate computer-related entities, hardware, firmware, combinations of hardware and software, software, or software being executed. For example, a component may be, but is not limited to, a process that runs on a processor, a processor, an object, an executable file, a thread of execution, a program, and/or a computer. Both a computing device and an application that runs on the computing device may be components. One or more components may reside within a process and/or a thread of execution, and a component may be located on one computer and/or distributed between two or more computers. In addition, these components may be executed from various computer-readable media that store various data structures. For example, the components may communicate using a local and/or remote process and according to, for example, a signal having one or more data packets (for example, data from one component interacting with another component in a local system, a distributed system, and/or across a network such as the Internet interacting with other systems using the signal).

[0046] In addition, the embodiments are described with reference to an access terminal. An access terminal may also be referred to as a system, a subscriber unit, a subscriber station, a mobile station, a mobile, a remote station, a remote terminal, a mobile device, a user terminal, a terminal, a wireless communications device, a user agent, a user apparatus, or UE (User Equipment, user equipment). The access terminal may be a cellular phone, a cordless phone, a SIP (Session Initiation Protocol, Session Initiation Protocol) phone, a WLL (Wireless Local Loop, wireless local loop) station, a PDA (Personal Digital Assistant, personal digital assistant), a handheld device having a wireless communication function, a computing device, or another processing device connected to a wireless modem. In addition, the embodiments are described with reference to a base station. A base station can be used to communicate with a mobile device; and the base station may be a BTS (Base Transceiver Station, base transceiver station) in GSM (Global System for Mobile communication, Global System for Mobile Communications) or CDMA (Code Division Multiple Access, Code Division Multiple Access); or may be an NB (NodeB, NodeB) in WCDMA (Wideband Code Division Multiple Access, Wideband Code Division Multiple Access); or may further be an eNB or

eNodeB (evolved Node B, evolved NodeB) in LTE (Long Term Evolution, Long Term Evolution), a relay station or an access point, a base station device in a future 5G network, or the like.

[0047] In addition, aspects or features of the present invention may be implemented as a method, an apparatus or a product that uses standard programming and/or engineering technologies. The term "product" used in this application covers a computer program that can be accessed from any computer readable component, carrier or medium. For example, the computer readable medium may include but is not limited to: a magnetic storage component (for example, a hard disk, a floppy disk or a magnetic tape), an optical disc (for example, a CD (Compact Disk, compact disk), a DVD (Digital Versatile Disk, digital versatile disk), a smart card and a flash memory component (for example, EPROM (Erasable Programmable Read-Only Memory, erasable programmable read-only memory), a card, a stick, or a key drive). In addition, various storage media described in this specification may indicate one or more devices and/or other machine-readable media that is used to store information. The term "machine readable media" may include but is not limited to a radio channel, and various other media that can store, contain and/or carry an instruction and/or data.

[0048] FIG. 1 shows a wireless communications system 100 according to embodiments of this specification. The system 100 includes a base station 102. The base station 102 may include multiple antenna groups. For example, one antenna group may include an antenna 104 and an antenna 106, another antenna group may include an antenna 108 and an antenna 110, and an additional group may include an antenna 112 and an antenna 114. For each antenna group, two antennas are shown; however, more or fewer antennas may be used for each group. The base station 102 may additionally include a transmitter chain and a receiver chain, and a person of ordinary skill in the art may understand that both the transmitter chain and the receiver chain may include multiple components (for example, a processor, a modulator, a multiplexer, a demodulator, a demultiplexer, and an antenna) related to signal sending and receiving.

[0049] The base station 102 may communicate with one or more access terminals (for example, an access terminal 116 and an access terminal 122). However, it may be understood that the base station 102 may communicate with basically any quantity of access terminals similar to the access terminal 116 and the access terminal 122. The access terminal 116 and the access terminal 122 may be, for example, a cellular phone, a smartphone, a portable computer, a handheld communications device, a handheld computing device, a satellite radio apparatus, a global positioning system, a PDA, and/or any other suitable device configured to perform communication in the wireless communications system 100. As shown in the figure, the access terminal 116 communicates with the antenna 112 and the antenna 114, and the antenna 112 and the antenna 114 send information to

$N*N$ matrix, $G_{N.}=B_N F^{\otimes n}$, where N is a length of coded bits after encoding, and $n \geq 0$; and herein, $F=\begin{bmatrix}1 & 0\\ 1 & 1\end{bmatrix}$, B_N is a transposed matrix, $F^{\otimes n}$ is a kronecker power (kronecker power), and it is defined as: $F^{\otimes n}=F \otimes F^{\otimes(n-1)}$.

[0065] In a polar code encoding process, some bits in u_1^N are used to carry information (that is, information that needs to be sent to a receive end), where the bits are referred to as information bits, and an index set of the bits is denoted as A. Remaining bits have fixed values, and are referred to as frozen bits, and for example, usually may be set to 0.

[0066] According to the method in this embodiment of the present invention, reserved bits of a broadcast signaling are mapped, according to a length of the reserved bits, that is, a quantity M of the reserved bits, to M information bits with lowest reliability of a polar code, and remaining bits of the broadcast signaling are mapped to remaining information bits of the polar code. Then, a polar code after encoding may be obtained according to the encoding process shown in formula (1). That is, coded bits after encoding are obtained.

[0067] A polar code after encoding that is output after encoding processing performed by the polar code encoder may be simplified as: $x_1^N=u_A G_{N.}(A)$, where u_A is a set of information bits in u_1^N; u_A is a row vector with a length of K; K is a quantity of the information bits; $G_{N.}(A)$ is a submatrix that is formed by rows corresponding to indices in the set A and that is in $G_{N.}$; and $G_{N.}(A)$ is a K*N matrix.

[0068] Based on the foregoing technical solution, when a broadcast signaling is sent, mapping is first performed according to reliability of information bits in a polar code, and then polar code encoding is performed on bits after mapping. In this way, useful bits in the broadcast signaling can be prevented from being mapped to low-reliability information bits, thereby improving broadcast signaling transmission reliability.

[0069] Optionally, in an embodiment, the M low-reliability information bits include M information bits with reliability lower than a preset threshold, or the M low-reliability information bits include M information bits with lowest reliability in the K information bits.

[0070] Optionally, in another embodiment, before the M reserved bits of the broadcast signaling are respectively mapped to the M low-reliability information bits in the K information bits of the polar code, the K information bits may be sorted according to reliability of the K information bits. In this case, when the M reserved bits of the broadcast signaling are respectively mapped to the M low-reliability information bits in the K information bits of the polar code, the M reserved bits are

where N is the length of the coded bits of the polar code after encoding, x_0, a, c, and m are particular parameters, and $x(0), x(1), ..., x(N-1)$ is the congruential sequence.

[0120] It should be understood that, that N is the length of the coded bits of the polar code after encoding means that N is a code length of the polar code.

[0121] Specifically, it is assumed that Q is a given positive integer. If two integers A and B are divided by Q, and obtained remainders are the same, A and B are congruential to the modulus Q. Formula (2) represents a linear congruential method, m represents a modulus, and $m > 0$; a represents a multiplier; c represents an increment; and $x(0)$ represents an initial value.

[0122] Optionally, in another embodiment, $x_0 = 4831$, $a = 7^5$, $c = 0$, and $m = 2^{31} - 1$.

[0123] FIG. 5 is a schematic diagram of an access terminal helpful in performing the foregoing polar code encoding method in a wireless communications system. The access terminal 500 includes a receiver 502. The receiver 502 is configured to receive a signal from, for example, a receive antenna (which is not shown), perform a typical operation (for example, filtering, amplification, or down-conversion) on the received signal, and digitize an adjusted signal to obtain a sample. The receiver 502 may be, for example, a minimum mean square error (Minimum Mean Square Error, MMSE) receiver. The access terminal 500 may further include a demodulator 504. The demodulator 504 may be configured to demodulate received symbols and provide the symbols to a processor 506 for channel estimation. The processor 506 may be a processor dedicated for analyzing information received by the receiver 502 and/or generating information to be sent by the transmitter 516, a processor configured to control one or more components of the access terminal 500, and/or a controller configured to analyze information received by the receiver 502, generate information to be sent by the transmitter 516, and control one or more components of the access terminal 500.

[0124] The access terminal 500 may additionally include a memory 508. The memory 508 is operatively coupled to the processor 506, and stores the following data: data to be sent, received data, and any other suitable information related to execution of various operations and functions in this specification. The memory 508 may additionally store a protocol and/or an algorithm related to polar code processing.

[0125] It may be understood that a data storage apparatus (for example, the memory 508) described in this specification may be a volatile memory or a non-volatile memory, or may include both a volatile memory and a non-volatile memory. For example but not for limitation, the non-volatile memory may include: a read-only memory (Read-Only Memory, ROM), a programmable read-only memory (Programmable ROM, PROM), an erasable programmable

[0131] Optionally, in another embodiment, the reliability of one of the K information bits is determined according to a bit capacity, a Bhattacharyya parameter such as a Bhattacharyya distance, or an error probability.

[0132] Optionally, in another embodiment, the rate matching device 510 performs sorted congruential interleaving on the coded bits after encoding, to obtain coded bits after interleaving; and inputs, according to a preset value E, the first E bits of the coded bits after interleaving into a cyclic buffer.

[0133] Alternatively, the rate matching device 510 performs sorted congruential interleaving on the coded bits after encoding, to obtain coded bits after interleaving; and performs order-reversing processing on the coded bits after interleaving, and inputs, according to a preset value E, the first E bits of the coded bits after order-reversing processing into a cyclic buffer.

[0134] Optionally, in another embodiment, the rate matching device 510 obtains a congruential sequence according to a length of the coded bits after encoding; then, performs sorting processing on the congruential sequence according to a preset rule, to obtain a reference sequence; determines a mapping function according to the congruential sequence and the reference sequence; and finally, interleaves the coded bits after encoding according to the mapping function, to obtain the coded bits after interleaving.

[0135] Optionally, in another embodiment, the rate matching device 510 determines the congruential sequence according to the following formula (4):

$$x(0) = x_o \text{; and}$$

$$x(n+1) = [a * x(n) + c] \bmod m \text{, where } n = 0,1,\mathrm{K},(N-2) \qquad (4),$$

where N is the length of the coded bits of the polar code after encoding, x_0, a, c, and m are particular parameters, and $x(0), x(1), ..., x(N-1)$ is the congruential sequence.

[0136] It should be understood that, that N is the length of the coded bits of the polar code after encoding means that N is a code length of the polar code.

[0137] FIG. 6 is a schematic diagram of a system helpful in performing the foregoing polar code encoding method in a wireless communications environment. The system 600 includes a base station 602 (for example, an access point, a NodeB, or an eNB). The base station 602 has a receiver 610 that receives a signal from one or more access terminals 604 using multiple receive antennas 606, and a transmitter 624 that transmits a signal to the one or more access terminals 604 using a transmit antenna 608. The receiver 610 may receive information from the receive antennas 606, and is operatively associated to a demodulator 612 that demodulates the received information. A demodulated symbol is analyzed by a processor 614 similar to the processor described in FIG. 5,

the processor 614 is connected to a memory 616, and the memory 616 is configured to store data to be sent to the access terminal 604 (or a different base station (which is not shown)), or data received from the access terminal 604 (or a different base station (which is not shown)), and/or any other suitable information related to execution of various operations and functions in this specification. The processor 614 may be further coupled to a polar code encoder 618 and a rate matching device 620.

[0138] The polar code encoder 618 may be configured to: map M reserved bits of a broadcast signaling respectively to M low-reliability information bits in K information bits of a polar code, and map remaining bits of the broadcast signaling to remaining information bits of the K information bits, to obtain bits after mapping, where M<K, and both M and K are positive integers; and then perform polar code encoding on the bits after mapping, to obtain coded bits after encoding.

[0139] According to this embodiment of the present invention, when a broadcast signaling is sent, mapping is first performed according to reliability of information bits in a polar code, and then polar code encoding is performed on bits after mapping. In this way, useful bits in the broadcast signaling can be prevented from being mapped to low-reliability information bits, thereby improving broadcast signaling transmission reliability.

[0140] Optionally, in an embodiment, the M low-reliability information bits include M information bits with reliability lower than a preset threshold, or the M low-reliability information bits include M information bits with lowest reliability in the K information bits.

[0141] Optionally, in another embodiment, the polar code encoder 618 sorts the K information bits according to reliability of the K information bits. Then, the polar code encoder 618 maps, according to a sorting result, the M reserved bits respectively to the M low-reliability information bits in the K information bits.

[0142] Optionally, in another embodiment, the reliability of one of the K information bits is determined according to a bit capacity, a Bhattacharyya parameter such as a Bhattacharyya distance, or an error probability.

[0143] Optionally, in another embodiment, the rate matching device 620 performs sorted congruential interleaving on the coded bits after encoding, to obtain coded bits after interleaving; and inputs, according to a preset value E, the first E bits of the coded bits after interleaving into a cyclic buffer.

[0144] Alternatively, the rate matching device 620 performs sorted congruential interleaving on the coded bits after encoding, to obtain coded bits after interleaving; and performs order-reversing processing on the coded bits after interleaving, and inputs, according to a preset value E, the first E bits of the coded bits after order-reversing processing into a cyclic buffer.

[0145] Optionally, in another embodiment, the rate matching device 620 obtains a congruential sequence according to a length of the coded bits after encoding; then, performs sorting processing on the congruential sequence according to a preset rule, to obtain a reference sequence; determines a mapping function according to the congruential sequence and the reference sequence; and finally, interleaves the coded bits after encoding according to the mapping function, to obtain the coded bits after interleaving.

[0146] Optionally, in another embodiment, the rate matching device 620 determines the congruential sequence according to the following formula (5):

$$x(0) = x_o \text{; and}$$

$$x(n+1) = [a * x(n) + c] \bmod m \text{, where } n = 0,1,\mathrm{K},(N-2) \quad (5),$$

where N is the length of the coded bits of the polar code after encoding, x_0, a, c, and m are particular parameters, and $x(0), x(1), ..., x(N-1)$ is the congruential sequence. It should be understood that, that N is the length of the coded bits of the polar code after encoding means that N is a code length of the polar code.

[0147] In addition, in the system 600, a modulator 622 may multiplex a frame, so that the transmitter 624 sends information to the access terminal 604 using the antenna 608. Although it is shown that the polar code encoder 618, the rate matching device 620, and/or the modulator 622 are/is separated from the processor 614, it may be understood that the polar code encoder 618, the rate matching device 620, and/or the modulator 622 may be a part of the processor 614 or multiple processors (which are not shown).

[0148] It may be understood that the embodiments described in this specification may be implemented by hardware, software, firmware, middleware, microcode, or a combination thereof. For hardware implementation, a processing unit may be implemented in one or more application specific integrated circuits (Application Specific Integrated Circuits, ASIC), a digital signal processor (Digital Signal Processor, DSP), a digital signal processing device (DSP Device, DSPD), a programmable logic device (Programmable Logic Device, PLD), a field-programmable gate array (Field-Programmable Gate Array, FPGA), a processor, a controller, a microcontroller, a microprocessor, and other electronic units configured to perform the functions described in this application, or a combination thereof.

[0149] When the embodiments are implemented in software, firmware, middleware, microcode, program code, or a code segment, they may be stored in, for example, a machine-readable medium of a storage component. The code segment may indicate a process, a function, a subprogram, a program, a routine, a subroutine, a module, a software group, a type, or any combination of an

CLAIMS:

1. A polar code encoding method, **characterized in** comprising:

mapping M reserved bits of a broadcast signaling to M low-reliability information bits in K information bits of a polar code respectively, and mapping remaining bits of the broadcast signaling to remaining information bits of the K information bits, to obtain K bits after mapping, wherein M<K, and both M and K are positive integers (301), wherein the reserved bits carry no useful information; and

performing polar code encoding on the K bits after mapping, to obtain coded bits after encoding (302).

2. The encoding method according to claim 1, wherein the M low-reliability information bits comprise M information bits with reliability lower than a preset threshold, or the M low-reliability information bits comprise M information bits with lowest reliability in the K information bits.

3. The encoding method according to claim 1 or 2, wherein before the mapping M reserved bits of a broadcast signalling respectively to M low-reliability information bits in K information bits of a polar code, the encoding method further comprises:

sorting the K information bits according to reliability of the K information bits.

4. The encoding method according to claim 3, wherein the reliability of one of the K information bits is determined according to a bit capacity, a Bhattacharyya parameter, or an error probability.

5. The encoding method according to any one of claims 1 to 4, wherein after the performing polar code encoding on the K bits after mapping, the encoding method further comprises:

performing sorted congruential interleaving on the coded bits after encoding, to obtain coded bits after interleaving; and

inputting, according to a value E, the first E bits of the coded bits after interleaving into a cyclic buffer; or,

performing order-reversing processing on the coded bits after interleaving, and inputting, according to a value E, the first E bits of the coded bits after order-reversing processing into a cyclic buffer.

6. The method according to claim 5, wherein the performing sorted congruential interleaving on the coded bits after encoding, to obtain coded bits after interleaving comprises:

obtaining a congruential sequence according to a length of the coded bits after encoding;

performing sorting processing on the congruential sequence according to a rule, to obtain a reference sequence;

determining a mapping function according to the congruential sequence and the reference sequence; and

interleaving the coded bits after encoding according to the mapping function, to obtain the coded bits after interleaving.

7. The method according to claim 6, wherein the obtaining a congruential sequence according to a length of the coded bits after encoding comprises:

determining the congruential sequence according to the following formula:

$$x(0) = x_0;$$

and

$$x(n+1) = [a * x(n) + c] \bmod m,$$

wherein $n = 0,1,..., (N - 2)$, wherein N is the length of the coded bits of the polar code after encoding, $x0$, a, c, and m are particular parameters, and $x(0)$, $x(1)$, ..., $x(N-1)$ is the congruential sequence.

8. A polar code encoding apparatus, **characterized in** comprising:

a mapping unit (401), configured to: map M reserved bits of a broadcast signaling to M low-reliability information bits in K information bits of a polar code respectively, and map remaining bits of the broadcast signaling to remaining information bits of the K information bits, to obtain bits after mapping, wherein M<K, and both M and K are positive integers, wherein the reserved bits carry no useful information; and

an encoding unit (402), configured to perform polar code encoding on the K bits after mapping, to obtain coded bits after encoding.

9. The encoding apparatus according to claim 8, wherein the M low-reliability information bits comprise M information bits with reliability lower than a preset threshold, or the M low-reliability information bits comprise M information bits with lowest reliability in the K information bits.

10. The encoding apparatus according to claim 8 or 9, wherein the encoding apparatus further comprises a sorting unit (403), configured to sort the K information bits according to reliability of the K information bits.

11. The encoding apparatus according to claim 10, wherein the reliability of one of the K information bits is determined according to a bit capacity, a Bhattacharyya parameter, or an error probability.

12. The encoding apparatus according to any one of claims 8 to 11, wherein the encoding apparatus further comprises an interleaving unit (404) and a capturing unit (405), wherein the interleaving unit (404) is configured to perform sorted congruential interleaving on the coded bits after encoding, to obtain coded bits after interleaving; and

the capturing unit (405) is configured to input, according to a value E, the first E bits of the coded bits after interleaving into a cyclic buffer; or, configured to perform order-reversing processing on the coded bits after interleaving, and

input, according to a value E, the first E bits of the coded bits after order-reversing processing into a cyclic buffer.

13. The encoding apparatus according to claim 12, wherein the interleaving unit (404) is specifically configured to:

obtain a congruential sequence according to a length of the coded bits after encoding;

perform sorting processing on the congruential sequence according to a rule, to obtain a reference sequence;

determine a mapping function according to the congruential sequence and the reference sequence; and interleave the coded bits after encoding according to the mapping function, to obtain the coded bits after interleaving.

14. The encoding apparatus according to claim 13, wherein the interleaving unit (404) is specifically configured to determine the congruential sequence according to the following formula:

$$x(0) = x_o;$$

and

$$x(n+1) = [a * x(n) + c] \bmod m,$$

wherein $n = 0,1,...,(N - 2)$, wherein N is the length of the coded bits of the polar code after encoding, $x0$, a, c, and m are particular parameters, and $x(0)$, $x(1)$, ..., $x(N-1)$ is the congruential sequence.