

CLAIMS

What is claimed is:

1. A retransmission method, comprising:

obtaining, by a sending apparatus, a to-be-encoded bit sequence comprising K to-be-encoded
5 bits, wherein K is a positive integer;

performing polar encoding on the to-be-encoded sequence to obtain an encoded first bit
sequence, wherein a length of the first bit sequence is N_0 , and determining an initial transmission
version RV0;

determining a length E1 of a retransmission version RV1;

10 determining the retransmission version RV1 based on an initial transmission code rate R0;
and

sending the RV1,

wherein the determining the retransmission version RV1 based on an initial transmission code
rate R0 comprises:

15 when R0 is less than or equal to a preset code rate threshold R_threshold, determining that
the RV1 is E1 bits read from a first circular buffer for initial transmission; or

when R0 is greater than R_threshold, generating an encoded second bit sequence in an
incremental redundancy IR manner, and obtaining the RV1 based on the second bit sequence,
wherein a length of the second bit sequence is N_1 , and $N_1 = 2 * N_0$,

20 wherein the obtaining the RV1 based on the second bit sequence is:

obtaining a subchannel set Q1, wherein Q1 comprises K elements, and the K elements are
sequence numbers of K subchannels used to place the K to-be-encoded bits during initial
transmission;

25 obtaining a subchannel set Q2, wherein $Q2(i) = Q1(i) + N_0$, $i = 0, 1, \dots$, and $K-1$, and N_0 is
a mother code length of a polar code used during initial transmission;

obtaining a subchannel set Q3, wherein $Q3(i) < N_0$, or $Q3(i) \in Q2$; and $i = 0, 1, \dots$, and $K-1$;

determining an extended to-be-encoded bit set Qext, wherein an element in Qext is an element
that is in Q3 and that is less than N_0 ;

determining a replicated bit set $Qchk = Q2 \setminus (Q3 \setminus Qext)$; and

30 performing, based on Q2, Q3, Qext, and Qchk, polar code encoding with a mother code length

of N1 on the K to-be-encoded bits, to obtain the second bit sequence.

2. The method according to claim 1, wherein Q3 is determined based on a reliability ordering sequence whose length is N1 and a rate matching manner for retransmission.

3. The method according to claim 1 or 2, wherein the performing, based on the Q2, Q3, Qext, and Qchk, polar code encoding with a mother code length of N1 on the K to-be-encoded bits comprises:

selecting bit values on some or all subchannels in Qchk, and replicating the bit values to corresponding subchannels in Qext one by one.

4. The method according to any one of claims 1 to 3, wherein the obtaining the RV1 based on the second bit sequence is:

obtaining the RV1 from first N0 bits of the second bit sequence based on the rate matching manner for retransmission.

5. The method according to any one of claims 1 to 4, wherein before the obtaining, by a sending apparatus, a to-be-encoded bit sequence comprising K to-be-encoded bits, the method further comprises:

performing segmentation based on a transport block size TBS.

6. The method according to claim 5, wherein

a segment quantity C of the segmentation is:

$$C = \begin{cases} \lfloor (TBS + TBcrc)/K_threshold \rfloor & TBS > K_threshold \\ 1 & \text{else} \end{cases},$$

TBcrc is a quantity of cyclic redundancy check CRC bits at a transport block TB level, and K_threshold is a preset first threshold.

7. The method according to claim 6, wherein

$$K = \begin{cases} \lfloor (TBS + TBcrc)/C \rfloor + CBcrc & C > 1 \\ TBS + TBcrc & C = 1 \end{cases}, \text{ and}$$

CBcrc is a quantity of CRC bits at a code block CB level.

8. The method according to claim 6 or 7, wherein

$$TBS = 2^{n2} * C * \lfloor (N'_{info} + TBcrc)/(2^{n2} * C) \rfloor - TBcrc,$$

2^{n2} is a quantization unit, n2 is a positive integer, and N'_{info} is obtained by adjusting, based on a quantization level, a volume N_{info} of data that may be transmitted.

9. The method according to claim 8, wherein N'_{info} is:

$$N'_{info} = \max(TBSmin, 2^n * \text{round}((N_{info} - TBcrc)/2^n));$$

$n = \max(n_{min}, \lfloor \log_2(N_{info} - TBcrc) \rfloor - n_0)$; and

TBSmin is a minimum transport block size, round is a rounding operation, n is a quantization level of a to-be-transmitted transport block, n_{min} is a minimum quantization level, n_0 is a quantized adjustment value, and $\lfloor \cdot \rfloor$ is a rounding down operation.

10. The method according to any one of claims 1 to 9, wherein the method further comprises: inputting, by the sending apparatus, the RV0 and the RV1 in a cascading manner into a second circular buffer; and

performing, by the sending apparatus, retransmission based on the RV0 and the RV1.

11. A sending device, comprising:

an obtaining unit, configured to obtain a to-be-encoded bit sequence comprising K to-be-encoded bits, wherein K is a positive integer;

an encoding unit, configured to perform polar encoding on the to-be-encoded sequence to obtain an encoded first bit sequence, wherein a length of the first bit sequence is N_0 ; and

a determining unit, configured to: determine an initial transmission version RV0 and a length E1 of a retransmission version RV1, and determine the retransmission version RV1 based on an initial transmission bit rate R_0 ,

wherein the determining the retransmission version RV1 based on an initial transmission bit rate R_0 comprises:

when R_0 is less than or equal to a preset code rate threshold $R_{threshold}$, determining that the RV1 is E1 bits read from a first circular buffer for initial transmission; or

when R_0 is greater than $R_{threshold}$, generating an encoded second bit sequence in an incremental redundancy IR manner, and obtaining the RV1 based on the second bit sequence, wherein a length of the second bit sequence is N_1 , and $N_1 = 2 * N_0$,

wherein the obtaining the RV1 based on the second bit sequence is:

obtaining a subchannel set Q1, wherein Q1 comprises K elements, and the K elements are sequence numbers of K subchannels used to place the K to-be-encoded bits during initial transmission;

obtaining a subchannel set Q2, wherein $Q2(i) = Q1(i) + N_0$, $i = 0, 1, \dots, \text{and } K-1$, and N_0 is a mother code length of a polar code used during initial transmission;

obtaining a subchannel set Q3, wherein $Q3(i) < N0$, or $Q3(i) \in Q2$; and $i = 0, 1, \dots$, and $K-1$;
determining an extended to-be-encoded bit set Qext, wherein an element in Qext is an element that is in Q3 and that is less than N0;

determining a replicated bit set $Qchk = Q2 \setminus (Q3 \setminus Qext)$; and

5 performing, based on Q2, Q3, Qext, and Qchk, polar code encoding with a mother code length of N1 on the K to-be-encoded bits, to obtain the second bit sequence.

12. The device according to claim 11, wherein Q3 is determined based on a reliability ordering sequence whose length is N1 and a rate matching manner for retransmission.

13. The device according to claim 11 or 12, wherein the performing, based on Q2, Q3, Qext, and Qchk, polar code encoding with a mother code length of N1 on the K to-be-encoded bits
10 comprises:

selecting bit values on some or all subchannels in Qchk, and replicating the bit values to corresponding subchannels in Qext one by one.

14. The device according to any one of claims 11 to 13, wherein the obtaining the RV1 based
15 on the second bit sequence is:

obtaining the RV1 from first N0 bits of the second bit sequence based on the rate matching manner for retransmission.

15. The device according to any one of claims 11 to 14, wherein the device further comprises: a segmenting unit, configured to perform segmentation based on a transport block size TBS.

20 16. The device according to claim 15, wherein a segment quantity C of the segmentation is:

$$C = \begin{cases} \lfloor (TBS + TBcrc)/K_threshold \rfloor & TBS > K_threshold \\ 1 & \text{else} \end{cases},$$

TBcrc is a quantity of cyclic redundancy check CRC bits at a transport block TB level, and K_threshold is a preset first threshold.

25 17. The device according to claim 16, wherein

$$K = \begin{cases} \lfloor (TBS + TBcrc)/C \rfloor + CBcrc & C > 1 \\ TBS + TBcrc & C = 1 \end{cases}, \text{ and}$$

CBcrc is a quantity of CRC bits at a code block CB level.

18. The device according to claim 16 or 17, wherein

$$TBS = 2^{n2} * C * \lfloor (N'_{info} + TBcrc)/(2^{n2} * C) \rfloor - TBcrc, \text{ wherein}$$

30 2^{n2} is a quantization unit, n2 is a positive integer, and N'_{info} is obtained by adjusting, based

on a quantization level, a volume N_{info} of data that may be transmitted.

19. The device according to claim 18, wherein N'_{info} is:

$$N'_{info} = \max(TBSmin, 2^n * \text{round}((N_{info} - TBcrc)/2^n));$$

$n = \max(n_{min}, \lfloor \log_2(N_{info} - TBcrc) \rfloor - n_0)$; and

5 TBSmin is a minimum transport block size, round is a rounding operation, n is a quantization level of a to-be-transmitted transport block, n_{min} is a minimum quantization level, n_0 is a quantized adjustment value, and $\lfloor \cdot \rfloor$ is a rounding down operation.

20. The device according to any one of claims 11 to 19, wherein the determining unit is further configured to:

10 input the RV0 and the RV1 in a cascading manner into a second circular buffer.

21. A sending apparatus, comprising:

an input interface circuit, configured to obtain a to-be-transmitted transport block;

a logic circuit, configured to obtain an encoded sequence or a retransmitted sequence based on the to-be-transmitted transport block according to the method according to any one of claims 1

15 to 10; and

an output interface circuit, configured to output the encoded sequence or the retransmitted sequence.

22. A retransmission method, comprising:

20 receiving, by a receiving apparatus, a received signal comprising information of K to-be-encoded bits, wherein a mother code length corresponding to the received signal is N_0 , and determining an initial transmission version RV0;

determining a length E1 of a retransmission version RV1;

determining the retransmission version RV1 based on an initial transmission code rate R0;

and

25 performing decoding based on the RV0 and the RV1,

wherein the determining the retransmission version RV1 based on an initial transmission code rate R0 comprises:

when R0 is less than or equal to a preset code rate threshold $R_{threshold}$, determining that the RV1 is E1 bits read from a first circular buffer for initial transmission; or

30 when R0 is greater than $R_{threshold}$, the RV1 is obtained based on an encoded second bit

sequence generated in an incremental redundancy IR manner, wherein a length of the second bit sequence is N1, and $N1 = 2 \cdot N0$,

wherein the second bit sequence is obtained based on a subchannel Q1, a subchannel set Q2, a subchannel set Q3, an extended to-be-encoded bit set Qext, and a replicated bit set Qchk, where

5 Q1 comprises K elements, and the K elements are sequence numbers of K subchannels used to place the K to-be-encoded bits during initial transmission;

$Q2(i) = Q1(i) + N0$, $i = 0, 1, \dots, \text{and } K-1$, and N0 is a mother code length of a polar code used during initial transmission;

$Q3(i) < N0$, or $Q3(i) \in Q2$; and $i = 0, 1, \dots, \text{and } K-1$;

10 For Qext, an element in Qext is an element that is in Q3 and that is less than N0; and

$Qchk = Q2 \setminus (Q3 \setminus Qext)$.

23. The method according to claim 22, wherein Q3 is determined based on a reliability ordering sequence whose length is N1 and a rate matching manner for retransmission.

24. The method according to claim 22 or 23, wherein the second bit sequence is obtained
15 based on a subchannel Q1, a subchannel set Q2, a subchannel set Q3, an extended to-be-encoded bit set Qext, and a replicated bit set Qchk comprises:

selecting bit values on some or all subchannels in Qchk, and replicating the bit values to corresponding subchannels in Qext one by one.

25. The method according to any one of claims 22 to 24, wherein that the RV1 is obtained
20 based on an encoded second bit sequence generated in an incremental redundancy IR manner is:

obtaining the RV1 from first N0 bits of the second bit sequence based on the rate matching manner for retransmission.

26. The method according to any one of claims 22 to 25, further comprising segmenting a received to-be-decoded transport block based on a transport block size TBS.

25 27. The method according to claim 26, wherein a segment quantity C of the segmentation is:

$$C = \begin{cases} \lceil (TBS + TB_{crc}) / K_threshold \rceil & TBS > K_threshold \\ 1 & \text{else} \end{cases},$$

TB_{crc} is a quantity of cyclic redundancy check CRC bits at a transport block TB level, and K_{threshold} is a preset first threshold.

30 28. The method according to claim 33, wherein

$$K = \begin{cases} \lceil (TBS + TBcrc)/C \rceil + CBcrc & C > 1, \text{ and} \\ TBS + TBcrc & C=1 \end{cases}$$

CBcrc is a quantity of CRC bits at a code block CB level.

29. The method according to claim 27 or 28, wherein

$$TBS = 2^{n2} * C * \lceil (N'_{info} + TBcrc)/(2^{n2} * C) \rceil - TBcrc,$$

5 2^{n2} is a quantization unit, $n2$ is a positive integer, and N'_{info} is obtained by adjusting, based on a quantization level, a volume N_{info} of data that may be transmitted.

30. The method according to claim 29, wherein N'_{info} is:

$$N'_{info} = \max(TBSmin, 2^n * \text{round}((N_{info} - TBcrc)/2^n));$$

$n = \max(n_{min}, \lfloor \log_2(N_{info} - TBcrc) \rfloor - n0)$; and

10 TBSmin is a minimum transport block size, round is a rounding operation, n is a quantization level of a to-be-transmitted transport block, n_{min} is a minimum quantization level, $n0$ is a quantized adjustment value, and $\lfloor \cdot \rfloor$ is a rounding down operation.

31. A receiving device comprising:

an obtaining unit, configured to: receive a received signal comprising information about K to-be-encoded bits, wherein a mother code length corresponding to the received signal is $N0$; and determine an initial transmission version $RV0$;

a determining unit, configured to: determine a length $E1$ of a retransmission version $RV1$, and determine the retransmission version $RV1$ based on an initial transmission bit rate $R0$; and

a decoding unit, configured to perform decoding based on the $RV0$ and the $RV1$,

20 wherein the determining the retransmission version $RV1$ based on an initial transmission bit rate $R0$ comprises:

when $R0$ is less than or equal to a preset code rate threshold $R_threshold$, determining that the $RV1$ is $E1$ bits read from a first circular buffer for initial transmission; or

when $R0$ is greater than $R_threshold$, the $RV1$ is obtained based on an encoded second bit sequence generated in an incremental redundancy IR manner, wherein a length of the second bit sequence is $N1$, and $N1 = 2 * N0$,

wherein the second bit sequence is obtained based on a subchannel $Q1$, a subchannel set $Q2$, a subchannel set $Q3$, an extended to-be-encoded bit set $Qext$, and a replicated bit set $Qchk$, where:

$Q1$ comprises K elements, and the K elements are sequence numbers of K subchannels used

to place the K to-be-encoded bits during initial transmission;

$Q2(i) = Q1(i) + N0$, $i = 0, 1, \dots$, and $K-1$, and $N0$ is a mother code length of a polar code used during initial transmission;

$Q3(i) < N0$, or $Q3(i) \in Q2$; and $i = 0, 1, \dots$, and $K-1$;

5 for Q_{ext} , an element in Q_{ext} is an element that is in $Q3$ and that is less than $N0$; and

$Q_{chk} = Q2 \setminus (Q3 \setminus Q_{ext})$.

32. The device according to claim 31, wherein $Q3$ is determined based on a reliability ordering sequence whose length is $N1$ and a rate matching manner for retransmission.

33. The device according to claim 31 or 32, wherein the second bit sequence is obtained based
10 on a subchannel $Q1$, a subchannel set $Q2$, a subchannel set $Q3$, an extended to-be-encoded bit set Q_{ext} , and a replicated bit set Q_{chk} comprises:

selecting bit values on some or all subchannels in Q_{chk} , and replicating the bit values to corresponding subchannels in Q_{ext} one by one.

34. The method according to any one of claims 31 to 33, wherein that the $RV1$ is obtained
15 based on an encoded second bit sequence generated in an incremental redundancy IR manner is:

obtaining the $RV1$ from first $N0$ bits of the second bit sequence based on the rate matching manner for retransmission.

35. The device according to any one of claims 31 to 34, further comprising a segmenting unit,
configured to segment a received to-be-decoded transport block based on a transport block size
20 TBS.

36. The device according to claim 35, wherein

a segment quantity C of the segmentation is:

$$C = \begin{cases} \lceil (TBS + TB_{crc}) / K_{threshold} \rceil & TBS > K_{threshold} \\ 1 & \text{else} \end{cases},$$

TB_{crc} is a quantity of cyclic redundancy check CRC bits at a transport block TB level, and

25 $K_{threshold}$ is a preset first threshold.

37. The device according to claim 36, wherein

$$K = \begin{cases} \lceil (TBS + TB_{crc}) / C \rceil + CB_{crc} & C > 1 \\ TBS + TB_{crc} & C = 1 \end{cases}, \text{ and}$$

CB_{crc} is a quantity of CRC bits at a code block CB level.

38. The device according to claim 36 or 37, wherein

30 $TBS = 2^{n2} * C * \lceil (N'_{info} + TB_{crc}) / (2^{n2} * C) \rceil - TB_{crc}$,

2^{n2} is a quantization unit, $n2$ is a positive integer, and N'_{info} is obtained by adjusting, based on a quantization level, a volume N_{info} of data that may be transmitted.

39. The device according to claim 38, wherein N'_{info} is:

$$N'_{info} = \max(TBSmin, 2^n * \text{round}((N_{info} - TBcrc)/2^n));$$

5 $n = \max(n_{min}, \lfloor \log_2(N_{info} - TBcrc) \rfloor - n0)$; and

TBSmin is a minimum transport block size, round is a rounding operation, n is a quantization level of a to-be-transmitted transport block, n_{min} is a minimum quantization level, $n0$ is a quantized adjustment value, and $\lfloor \cdot \rfloor$ is a rounding down operation.

40. A receiving apparatus, comprising:

10 an input interface circuit, configured to obtain a received signal;

a logic circuit, configured to obtain a decoding result based on the received signal according to the method according to any one of claims 22 to 30; and

an output interface circuit, configured to output the decoding result.

41. A communication apparatus, comprising a processor, configured to perform, when
15 executing program instructions, the method according to any one of claims 1 to 12 or according to any one of claims 22 to 30.

42. The apparatus according to claim 41, further comprising a memory, configured to store the program instructions.

43. A computer-readable medium, storing computer program instructions, wherein when the
20 computer program instructions are executed by a computer, the method according to any one of claims 1 to 12 or the method according to any one of claims 22 to 30 is performed.

44. A computer program product, comprising instructions, wherein when the instructions are executed by a computer, the method according to any one of claims 1 to 10 or the method according to any one of claims 22 to 30 is performed.

25 45. A communication system, comprising a sending apparatus and a receiving apparatus, wherein the sending apparatus is configured to perform the method according to any one of claims 1 to 10, and the receiving apparatus is configured to perform the method according to any one of claims 22 to 30.