CLAIMS

1. A method of sending information in a communication system, comprising:

mapping first information to M most significant bits (MSBs) of a message, where M is one or greater;

mapping second information to N least significant bits (LSBs) of the message if the second information is sent, where N is one or greater; and

encoding the message with a block code, wherein the first information is sent alone or with the second information in the message, and wherein the second information is sent with the first information or not sent in the message.

2. The method of claim 1, wherein the block code comprises a plurality of basis sequences for a plurality of information bits, and wherein the encoding the message with the block code comprises

encoding the M MSBs of the message with first M basis sequences of the block code, and

encoding the N LSBs of the message with next N basis sequences of the block code if the second information is sent.

3. The method of claim 1, wherein the first information comprises channel quality indicator (CQI) information and the second information comprises acknowledgement (ACK) information.

4. The method of claim 1, further comprising:

setting each of N acknowledgement (ACK) bits to a first value for an ACK or to a second value for a negative acknowledgement (NACK), wherein the second value is also used for discontinuous transmission (DTX) of the ACK information, and wherein the second information comprises the N ACK bits.

5. The method of claim 1, wherein the block code is derived based on a Reed-Muller code.

6. An apparatus for communication, comprising:

at least one processor configured to map first information to M most significant bits (MSBs) of a message, where M is one or greater, to map second information to N least significant bits (LSBs) of the message if the second information is sent, where N is one or greater, and to encode the message with a block code, wherein the first information is sent alone or with the second information in the message, and wherein the second information is sent with the first information or not sent in the message.

7. The apparatus of claim 6, wherein the block code comprises a plurality of basis sequences for a plurality of information bits, and wherein the at least one processor is configured to encode the M MSBs of the message with first M basis sequences of the block code, and to encode the N LSBs of the message with next N basis sequences of the block code if the second information is sent.

8. The apparatus of claim 6, wherein the at least one processor is configured to set each of N acknowledgement (ACK) bits to a first value for an ACK or to a second value for a negative acknowledgement (NACK), wherein the second value is also used for discontinuous transmission (DTX) of the ACK information, and wherein the second information comprises the N ACK bits.

9. An apparatus for communication, comprising:

means for mapping first information to M most significant bits (MSBs) of a message, where M is one or greater;

means for mapping second information to N least significant bits (LSBs) of the message if the second information is sent, where N is one or greater; and

means for encoding the message with a block code, wherein the first information is sent alone or with the second information in the message, and wherein the second information is sent with the first information or not sent in the message.

10. The apparatus of claim 9, wherein the block code comprises a plurality of basis sequences for a plurality of information bits, and wherein the means for encoding the message with the block code comprises

means for encoding the M MSBs of the message with first M basis sequences of the block code, and

means for encoding the N LSBs of the message with next N basis sequences of the block code if the second information is sent.

11. The apparatus of claim 9, further comprising:

means for setting each of N acknowledgement (ACK) bits to a first value for an ACK or to a second value for a negative acknowledgement (NACK), wherein the second value is also used for discontinuous transmission (DTX) of the ACK information, and wherein the second information comprises the N ACK bits.

12. A method of sending information in a communication system, comprising:

mapping channel quality indicator (CQI) information to M most significant bits (MSBs) of a message, where M is one or greater;

mapping acknowledgement (ACK) information to N least significant bits (LSBs) of the message if the ACK information is sent, where N is one or greater;

encoding the M MSBs of the message with first M basis sequences of a block code; and

encoding the N LSBs of the message with next N basis sequences of the block code if the ACK information is sent.

13. The method of claim 12, wherein the message comprises M bits and is encoded with the first M basis sequences of the block code if only CQI information is sent, and wherein the message comprises M plus N bits and is encoded with the first M plus N basis sequences of the block code if both CQI and ACK information are sent.

14. The method of claim 12, further comprising:

setting each of N ACK bits to a first value for an ACK or to a second value for a negative acknowledgement (NACK), wherein the second value is also used for discontinuous transmission (DTX) of the ACK information, and wherein the ACK information comprises the N ACK bits.

15. The method of claim 12, further comprising:

obtaining an output bit sequence from encoding the M MSBs and the N LSBs of the message; and

sending the output bit sequence on a physical uplink control channel (PUCCH).

16. A method of sending information in a communication system, comprising:

encoding first information based on a first block code if only the first information is sent; and

encoding the first information and second information based on a second block code if both the first and second information are sent, the second block code comprising a first sub-code for the first information and a second sub-code for the second information, the first sub-code corresponding to the first block code.

17. The method of claim 16, further comprising:

setting each of N bits to a first value for an acknowledgement (ACK) or to a second value for a negative acknowledgement (NACK), where N is one or greater, the second value also being used for discontinuous transmission (DTX) of the second information, and the second information comprising the N bits.

18. A method of receiving information in a communication system, comprising:

decoding a received transmission based on a block code to obtain a decoded message comprising multiple bits;

providing M most significant bits (MSBs) of the decoded message as first information, where M is one or greater; and

providing N least significant bits (LSBs) of the decoded message as second information, where N is one or greater, wherein the received transmission comprises only the first information or both the first and second information.

19. The method of claim 18, wherein the decoding the received transmission comprises decoding the received transmission based on first M plus N basis sequences of the block code to obtain the decoded message, wherein the M MSBs of the decoded message are obtained based on the first M basis sequences of the block code, and wherein the N LSBs of the decoded message are obtained based on the next N basis sequences of the block code.

20. The method of claim 18, wherein the first information comprises channel quality indicator (CQI) information and the second information comprises acknowledgement (ACK) information.

21. The method of claim 18, wherein the block code is derived based on a Reed-Muller code.

22. An apparatus for communication, comprising:

at least one processor configured to decode a received transmission based on a block code to obtain a decoded message comprising multiple bits, to provide M most significant bits (MSBs) of the decoded message as first information, where M is one or greater, and to provide N least significant bits (LSBs) of the decoded message as second information, where N is one or greater, wherein the received transmission comprises only the first information or both the first and second information.

23. The apparatus of claim 22, wherein the at least one processor is configured to decode the received transmission based on first M plus N basis sequences of the block code to obtain the decoded message, wherein the M MSBs of the decoded message are obtained based on the first M basis sequences of the block code, and wherein the N LSBs of the decoded message are obtained based on the next N basis sequences of the block code.

24. The apparatus of claim 22, wherein for each bit among the N LSBs of the decoded message, the at least one processor is configured to provide an acknowledgement (ACK) if the bit has a first value, and to provide a negative acknowledgement (NACK) if the bit has a second value, the second value also being used for discontinuous transmission (DTX) of the ACK information.

25. A method of receiving information in a communication system, comprising:

decoding a received transmission based on multiple basis sequences of a block code to obtain a decoded message comprising multiple bits;

providing M most significant bits (MSBs) of the decoded message, obtained based on the first M basis sequences of the block code, as channel quality indicator (CQI) information, where M is one or greater, and

providing N least significant bits (LSBs) of the decoded message, obtained based on the next N basis sequences of the block code, as acknowledgement (ACK) information, where N is one or greater.

26. The method of claim 25, wherein the received transmission comprises a first output bit sequence if only CQI information is sent and comprises a second output bit sequence if both CQI and ACK information are sent, the first output bit sequence being obtained by encoding M bits of the CQI information with the first M basis sequences of the block code, and the second output bit sequence being obtained by encoding M bits of the CQI information with the first M basis sequences of the block code and encoding N bits of the ACK information with the next N basis sequences of the block code.

27. The method of claim 25, further comprising:

for each bit among the N LSBs of the decoded message,

providing an ACK if the bit has a first value, and

providing a negative acknowledgement (NACK) if the bit has a second value, the second value also being used for discontinuous transmission (DTX) of the ACK information.

28. A method of receiving information in a communication system, comprising:

decoding a received transmission based on a first block code if only first information is expected from the received transmission; and

decoding the received transmission based on a second block code if both the first information and second information are expected from the received transmission, the second block code comprising a first sub-code for the first information and a second sub-code for the second information, the first sub-code corresponding to the first block code.

29. The method of claim 28, further comprising:

if the second information is expected from the received transmission, for each bit among at least one decoded bit for the second information,

providing an acknowledgement (ACK) if the bit has a first value, and

providing a negative acknowledgement (NACK) if the bit has a second value, the second value also being used for discontinuous transmission (DTX) of the second information.

CLAIMS

1. A method of sending information in a communication system, comprising:

mapping first information to M most significant bits (MSBs) of a message, where M is one or greater;

mapping second information to N least significant bits (LSBs) of the message when the second information is to be sent with the first information, where N is one or greater;

encoding the message with a block code to obtain an output bit sequence, wherein encoding the message comprises:

encoding K bits of the message with K basis sequences of the block code to obtain K encoded basis sequences, where K equals M plus N; and

combining the K encoded basis sequences using modulo-**2** addition to obtain the output bit sequence; and

sending the output bit sequence on a channel.

2. The method of claim **1**, wherein encoding the message with the block code comprises

encoding the M MSBs of the message with first M basis sequences of the K basis sequences; and

encoding the N LSBs of the message with next N basis sequences of the K basis sequences.

3. The method of claim **1**, wherein the first information comprises channel quality indicator (CQI) information and the second information comprises acknowledgement (ACK) information.

4. The method of claim **1**, further comprising:

setting each of N acknowledgement (ACK) bits to a first value for an ACK or to a second value for a negative acknowledgement (NACK), wherein the second value is

also used for discontinuous transmission (DTX) of the ACK information, and wherein the second information comprises the N ACK bits.

5. The method of claim **1**, wherein the block code is derived based on a Reed-Muller code.

6. An apparatus for communication, comprising:

at least one processor configured to:

map first information to M most significant bits (MSBs) of a message, where M is one or greater;

map second information to N least significant bits (LSBs) of the message when the second information is to be sent with the first information, where N is one or greater;

encode the message with a block code to obtain an output bit sequence, wherein the message is encoded by:

encoding K bits of the message with K basis sequences of the block code to obtain K encoded basis sequences, where K equals M plus N; and

combining the K encoded basis sequences using modulo-2 addition to obtain the output bit sequence; and

send the output bit sequence over a channel; and

a memory coupled to the at least one processor.

7. The apparatus of claim **6**, wherein the at least one processor is configured to encode the M MSBs of the message with first M basis sequences of the K basis sequences, and to encode the N LSBs of the message with next N basis sequences of the K basis sequences.

8. The apparatus of claim **6**, wherein the at least one processor is configured to set each of N acknowledgement (ACK) bits to a first value for an ACK or to a second value for a negative acknowledgement (NACK), wherein the second

value is also used for discontinuous transmission (DTX) of the ACK information, and wherein the second information comprises the N ACK bits.

9. An apparatus for communication, comprising:

means for mapping first information to M most significant bits (MSBs) of a message, where M is one or greater;

means for mapping second information to N least significant bits (LSBs) of the message when the second information is to be sent with the first information, where N is one or greater;

means for encoding the message with a block code to obtain an output bit sequence, wherein the means for encoding the message comprises:

means for encoding K bits of the message with K basis sequences of the block code to obtain K encoded basis sequences, where K equals M plus N; and

means for combining the K encoded basis sequences using modulo-**2** addition to obtain the output bit sequence; and

means for sending the output bit sequence on a channel.

10. The apparatus of claim **9**, wherein the means for encoding the message with the block code comprises

means for encoding the M MSBs of the message with first M basis sequences of the K basis sequences, and

means for encoding the N LSBs of the message with next N basis sequences of the K basis sequences.

11. The apparatus of claim **9**, further comprising:

means for setting each of N acknowledgement (ACK) bits to a first value for an ACK or to a second value for a negative acknowledgement (NACK), wherein the second value is also used for discontinuous transmission (DTX) of the ACK information, and wherein the second information comprises the N ACK bits.

12. A computer program product, comprising:

a non-transitory computer-readable medium comprising:

code for causing the at least one computer to map first information to M most significant bits (MSBs) of a message, where M is one or greater;

code for causing the at least one computer to map second information to N least significant bits (LSBs) of the message when the second information is to be sent with the first information, where N is one or greater;

code for causing the at least one computer to encode the message with a block code to obtain an output bit sequence, wherein the code for causing the at least one computer to encode the message comprises:

code for causing the at least one computer to encode K bits of the message K basis sequences of the block code to obtain K encoded basis sequences, where K equals M plus N; and

code for causing the at least one computer to combine the K encoded basis sequences using modulo-**2** addition to obtain the output bit sequence; and

code for causing the at least one computer to send the output bit sequence on a channel.

13. The computer program product of claim **12**, wherein the computer-readable medium further comprises code for causing the at least one computer to set each of N acknowledgement (ACK) bits to a first value for an ACK or to a second value for a negative acknowledgement (NACK), wherein the second value is also used for discontinuous transmission (DTX) of the ACK information, and wherein the second information comprises the N ACK bits.

14. A method of sending information in a communication system, comprising:

mapping channel quality indicator (CQI) information to M most significant bits (MSBs) of a message, where M is one or greater;

mapping acknowledgement (ACK) information to N least significant bits (LSBs) of the message when the ACK information is to be sent with the CQI information, where N is one or greater;

encoding the message with a block code to obtain an output bit sequence, wherein encoding the message comprises:

encoding the M MSBs of the message with first M basis sequences of the block code to obtain M encoded basis sequences;

encoding the N LSBs of the message with next N basis sequences of the block code when the ACK information is to be sent with the CQI information to obtain N encoded basis sequences; and

combining the M and N encoded basis sequences to obtain the output bit sequence; and

sending the output bit sequence on a channel.

15. The method of claim **14**, wherein the message comprises M plus N bits and is encoded with the first M plus N basis sequences of the block code if both CQI and ACK information are sent.

16. The method of claim **14**, further comprising:

setting each of N ACK bits to a first value for an ACK or to a second value for a negative acknowledgement (NACK), wherein the second value is also used for discontinuous transmission (DTX) of the ACK information, and wherein the ACK information comprises the N ACK bits.

17. The method of claim **14**, wherein the channel is a physical uplink control channel (PUCCH).

18. A method of receiving information in a communication system, comprising:

receiving a transmission comprising an encoded message, wherein the encoded message is encoded by:

encoding K bits of a message with K basis sequences of a block code to obtain K encoded basis sequences; and

combining the K encoded basis sequences using modulo-2 addition to obtain an output bit sequence of the encoded message;

decoding the received transmission based on the block code to obtain a decoded message comprising multiple bits;

providing M most significant bits (MSBs) of the decoded message as first information when at least the first information is expected, where M is one or greater; and

providing N least significant bits (LSBs) of the decoded message as second information when at least the second information is expected with the first information, where N is one or greater and K equals M plus N.

19. The method of claim **18**, wherein the decoding the received transmission comprises decoding the received transmission based on first M plus N basis sequences of the block code to obtain the decoded message, wherein the M MSBs of the decoded message are obtained based on the first M basis sequences of the block code, and wherein the N LSBs of the decoded message are obtained based on the next N basis sequences of the block code.

20. The method of claim **18**, wherein the first information comprises channel quality indicator (CQI) information and the second information comprises acknowledgement (ACK) information.

21. The method of claim **18**, wherein the block code is derived based on a Reed-Muller code.

22. An apparatus for communication, comprising:
at least one processor configured to:
receive a transmission comprising an encoded message, wherein the encoded message is encoded by:
encoding K bits of a message with K basis sequences of a block code to obtain K encoded basis sequences; and
combining the K encoded basis sequences using modulo-**2** addition to obtain an output bit sequence of the encoded message;
decode the received transmission based on the block code to obtain a decoded message comprising multiple bits;
provide M most significant bits (MSBs) of the decoded message as first information when at least the first information is expected, where M is one or greater; and
provide N least significant bits (LSBs) of the decoded message as second information when at least the second information is expected with the first information, where N is one or greater and K equals M plus N; and
a memory coupled to the at least one processor.

23. The apparatus of claim **22**, wherein the at least one processor is configured to decode the received transmission based on first M plus N basis sequences of the block code to obtain the decoded message, wherein the M MSBs of the decoded message are obtained based on the first M basis sequences of the block code, and wherein the N LSBs of the decoded message are obtained based on the next N basis sequences of the block code.

24. The apparatus of claim **22**, wherein for each bit among the N LSBs of the decoded message, the at least one processor is configured to provide an acknowledgement (ACK) if the bit has a first value, and to provide a negative acknowledgement (NACK) if the bit has a second value, the second value also

being used for discontinuous transmission (DTX) of the ACK information.

25. A method of receiving information in a communication system, comprising:

receiving a transmission comprising an encoded message, wherein the encoded message is encoded by:

encoding K bits of a message with K basis sequences of a block code to obtain K encoded basis sequences; and

combining the K encoded basis sequences using modulo-**2** addition to obtain an output bit sequence of the encoded message;

decoding the received transmission based on the K basis sequences of the block code to obtain a decoded message comprising multiple bits;

providing M most significant bits (MSBs) of the decoded message, obtained based on the first M basis sequences of the block code, as channel quality indictor (CQI) information when at least the CQI information is expected, where M is one or greater; and

providing N least significant bits (LSBs) of the decoded message, obtained based on the next N basis sequences of the block code, as acknowledgement (ACK) information when at least the ACK information is expected with the CQI information, where N is one or greater and K equals M plus N.

26. The method of claim **25**, wherein the received transmission comprises a first output bit sequence if only CQI information is sent and comprises a second output bit sequence if both CQI and ACK information are sent, the first output bit sequence being obtained by encoding M bits of the CQI information with the first M basis sequences of the block

code, and the second output bit sequence being obtained by encoding M bits of the CQI information with the first M basis sequences of the block code and encoding N bits of the ACK information with the next N basis sequences of the block code.

27. The method of claim **25**, further comprising:

for each bit among the N LSBs of the decoded message,

providing an ACK if the bit has a first value, and

providing a negative acknowledgement (NACK) if the bit has a second value, the second value also being used for discontinuous transmission (DTX) of the ACK information.

28. An apparatus for communication, comprising:

means for receiving a transmission comprising an encoded message, wherein the encoded message is encoded by:

encoding K bits of a message with K basis sequences of a block code to obtain K encoded basis sequences; and

combining the K encoded basis sequences using modulo-2 addition to obtain an output bit sequence of the encoded message;

means for decoding the received transmission based on the block code to obtain a decoded message comprising multiple bits;

means for providing M most significant bits (MSBs) of the decoded message as first information when at least the first information is expected, where M is one or greater; and

means for providing N least significant bits (LSBs) of the decoded message as second information when at least the second information is expected with the first information, where N is one or greater and K equals M plus N.

29. The apparatus of claim **28**, wherein the means for decoding decodes the received transmission based on first M plus N basis sequences of the block code to obtain the decoded message, wherein the M MSBs of the decoded message are obtained based on the first M basis sequences of the

block code, and wherein the N LSBs of the decoded message are obtained based on the next N basis sequences of the block code.

30. A computer program product, comprising:

a non-transitory computer-readable medium comprising:

code for causing the at least one computer to receive a transmission comprising an encoded message, wherein the encoded message is encoded by:

encoding K bits of a message with K basis sequences of a block code to obtain K encoded basis sequences; and

combining the K encoded basis sequences using modulo-**2** addition to obtain an output bit sequence of the encoded message;

code for causing the at least one computer to decode the received transmission based on the block code to obtain a decoded message comprising multiple bits;

code for causing the at least one computer to provide M most significant bits (MSBs) of the decoded message as first information when at least the first information is expected, where M is one or greater; and

code for causing the at least one computer to provide N least significant bits (LSBs) of the decoded message as second information when at least the second information is expected with the first information, where N is one or greater and K equals M plus N.

31. The computer program product of claim **30**, wherein the code for causing the at least one computer to decode decodes the received transmission based on first M plus N basis sequences of the block code to obtain the decoded message, wherein the M MSBs of the decoded message are obtained based on the first M basis sequences of the block code, and wherein the N LSBs of the decoded message are obtained based on the next N basis sequences of the block code.