CLAIMS

1. A method of transmitting data in a transport block (TB) in wireless communication, comprising:

determining ~~a maximum code block size;~~

~~determining a transport block level cyclic redundancy check size;~~

~~determining a code block level cyclic redundancy check size;~~

an intermediate value based on a number of resource elements, a modulation order, a code rate, and a number of MIMO layers for transmitting the TB; selecting a maximum code block size from a plurality of maximum code block sizes; determining a number of code blocks associated with the TB based on the intermediate value and the selected maximum code block size~~, the transport block level cyclic redundancy check size, and the code block level cyclic redundancy check size~~; determining a code block size based on the number of code blocks;

determining a transport block size (TBS) for the TB ~~in a single pass~~ as a function of the ~~determined maximum~~ code block size, the ~~transport block level cyclic redundancy check size, the code block level cyclic redundancy check size, the~~ number of code blocks, and ~~the code block size~~a rate back-off factor; and

transmitting the TB ~~with the data based on~~ using the determined TBS~~.~~, wherein the rate back-off factor has a value dependent at least on Qm, R, and v, where Qm is a modulation order, R is a code rate, and v is a number of multiple-input multiple-output MIMO layers.

2. The method of claim 1, wherein the determining the code block size comprises determining a ~~byte-aligned code block size.~~code block (CB) level cyclic redundancy check (CRC) size by selecting the CB level CRC size from a plurality of predetermined CRC sizes based on the intermediate value.

~~3.~~ 3. The method of claim 2, wherein the ~~transmitted TB has no padding bits.~~determining the code block size further comprises determining a byte-aligned code block size.

4. The method of claim 1, wherein the determining the ~~maximum code block size~~TBS further comprises~~:~~

determining a ~~base graph for encoding a code block based on at least one of a code rate or an intermediate number of information bits; and~~

~~determining the maximum code block~~TB level cyclic redundancy check (CRC) size ~~based on the determined base graph.~~

~~5. The method of claim 4, wherein the determining the maximum code block size based on the determined base graph, comprises:~~

by selecting the ~~maximum code block~~TB level CRC size from a plurality of ~~values.~~predetermined CRC sizes based on the intermediate value.

~~6.~~ 5. The method of claim 1, wherein the determining the ~~transport block level cyclic redundancy check size~~ TBS further comprises~~:~~

~~if $N_{RE} \cdot Q_m \cdot R \cdot v$ is less than a predetermined value, setting the transport block level cyclic redundancy check size to a first value; and~~

~~otherwise, setting the transport block level cyclic redundancy check size to a second value that is greater than the first value, wherein v is a number of MIMO layers, Q_m is a modulation order, R is a code rate, and N_{RE} is a number of resource elements.~~ determining the TBS without cyclic dependencies between the TBS, a selected base graph, and the code block size.

6. The method of claim 5, further comprising: selecting the base graph based on at least one of the code rate or the intermediate value; and determining the maximum code block size based on the selected base graph.

~~7.~~ 7. The method of claim 1, wherein the ~~determining~~transmitting the ~~code block level cyclic redundancy check size~~TB comprises~~:~~

~~if~~ transmitting the ~~condition $N_{RE} \cdot Q_m \cdot R \cdot v - X + L_{TB,CRC}$ is less than or equal to the maximum code block size, setting the code block level cyclic redundancy check size to a first value; and~~

~~otherwise, setting the code block level cyclic redundancy check size to a second value that is greater than the first value,~~

~~wherein v is a number of MIMO layers, Q_m is a modulation order, R is a code rate, N_{RE} is a number of resource elements, X is a rate back-off factor, $L_{TB,CRC}$ is the transport block level cyclic redundancy check size.~~TB with no padding bits.

8.~~——~~ The method of claim 1, wherein the determining the TBS comprises:

~~determining a plurality of intermediate values for use with the function in one or more lookup tables, based on $N_{RE} \cdot Q_m \cdot R \cdot v$, wherein v is a number of MIMO layers, Q_m is a modulation order, R is a code rate, and N_{RE} is a number of resource elements.~~

~~9. The method of claim 1, wherein the function determines the TBS based on $N_{RE} \cdot Q_m \cdot R \cdot v - X$, where X is a rate back-off factor that has a value equal to or greater than zero, v is a number of MIMO layers, Q_m is a modulation order, R is a code rate, and N_{RE} is a number of resource elements.~~

~~10. The method of claim 9, wherein the function comprises:~~

$$TBS = \left\lceil \frac{1}{8} \left\lceil \frac{L_{TB,CRC} + N_{RE} \cdot Q_m \cdot R \cdot v - X}{K_{cb} - L_{CB,CRC}} \right\rceil \right\rceil 8 \left\lceil \frac{L_{TB,CRC} + N_{RE} \cdot Q_m \cdot R \cdot v - X}{K_{cb} - L_{CB,CRC}} \right\rceil - L_{TB,CRC},$$

~~wherein K_{cb} is the maximum code block size, $L_{TB,CRC}$ is the transport block level cyclic redundancy check size, and $L_{CB,CRC}$ is the code block level cyclic redundancy check size.~~

~~11. The method of claim 9, wherein X comprises a predetermined value based on the values of N_{RE}, Q_m, R, and v.~~

~~12. A method of transmitting data in a transport block (TB) in wireless communication, comprising:~~

~~determining a transport block size (TBS) for the TB in a~~ determining the TBS using a non-recursive ~~procedure using a~~ function ~~including a plurality~~ of ~~parameters,~~

~~wherein~~ the ~~plurality of parameters comprise a maximum~~ code block size~~, a transport block level cyclic redundancy check size, a code block level cyclic redundancy check size, a~~ and the number of code blocks ~~associated with the TB, and a code block size K.; and~~

~~transmitting the TB with the data based on the determined TBS.~~

~~13. The method of claim 12, wherein the determining the TBS for the TB in the non-recursive procedure is based on $N_{RE} \cdot Q_m \cdot R \cdot v - X$, wherein X is a rate back-off factor that has a value equal to or greater than zero, v is a number of MIMO layers, Q_m is a modulation order, R is a code rate, and N_{RE} is a number of resource elements.~~

~~14. The method of claim 13, wherein the determining the TBS for the TB in the non-recursive procedure determines:~~

$$TBS = \left\lceil \frac{1}{8} \frac{L_{TB,CRC} + N_{RE} \cdot Q_m \cdot R \cdot v - X}{\left\lceil \frac{L_{TB,CRC} + N_{RE} \cdot Q_m \cdot R \cdot v - X}{K_{cb} - L_{CB,CRC}} \right\rceil} \right\rceil 8 \left\lceil \frac{L_{TB,CRC} + N_{RE} \cdot Q_m \cdot R \cdot v - X}{K_{cb} - L_{CB,CRC}} \right\rceil - L_{TB,CRC},$$

~~wherein K_{cb} is the maximum code block size, $L_{TB,CRC}$ is the transport block level cyclic redundancy check size, $L_{CB,CRC}$ is the code block level cyclic redundancy check size, X is a rate back-off factor that has a value equal to or greater than zero, v is a number of MIMO layers, Q_m is a modulation order, R is a code rate, and N_{RE} is a number of resource element.~~

~~15. The method of claim 13, wherein X comprises a predetermined value based on the values of N_{RE}, Q_m, R, and v.~~

~~16.~~ 9. An apparatus of wireless communication, comprising:

a communication interface configured to transmit data in a transport block (TB);

a memory ~~stored with executable code~~; and

a processor ~~operatively~~ coupled with the communication interface and the memory,

wherein the processor ~~is~~and the memory are configured ~~by the executable code~~ to:

determine ~~a maximum code block size;~~

~~determine a transport block level cyclic redundancy check size;~~

~~determine a code block level cyclic redundancy check size;~~

an intermediate value based on a number of resource elements, a modulation order, a code rate, and a number of MIMO layers for transmitting the TB; select a maximum code block size from a plurality of maximum code block sizes; determine a number of code blocks associated with the TB based on the ~~maximum code block size, the transport block level cyclic redundancy check size, and the code block level cyclic redundancy check size;~~

intermediate value; determine a code block size based on the number of code blocks;

determine a transport block size (TBS) for the TB ~~in a single pass~~ as a function of the ~~determined maximum~~ code block size~~, the transport block level cyclic redundancy check size, the code block level cyclic redundancy check size~~, the number of code blocks, and ~~the code block size~~a rate back-off factor; and

transmit the TB ~~with the data based on~~ using the determined TBS~~.~~, wherein the rate back-off factor has a value dependent at least on Qm, R, and v, where Qm is a modulation order, R is a code rate, and v is a number of multiple-input multiple-output MIMO layers.

~~17.~~ 10. The apparatus of claim ~~16~~9, wherein, to determine the code block size, the processor ~~is~~and the memory are further configured to: determine ~~the~~a code block ~~size by determining a byte-aligned code block size.~~

~~18. The apparatus of claim 16, wherein the transmitted TB has no padding bit.~~

~~19. The apparatus of claim 16, wherein the processor is further configured to determine the maximum code block~~(CB) level cyclic redundancy check (CRC) size by~~:~~

~~determining a base graph for encoding a code block based on at least one of a code rate or an intermediate number of information bits; and~~

~~determining the maximum code block size based on the determined base graph.~~

~~20. The apparatus of claim 19, wherein the processor is further configured to determine the maximum code block size based on the determined base graph by selecting the maximum code block~~ selecting the CB level CRC size from a plurality of ~~values.~~predetermined CRC sizes based on the intermediate value.

~~21.~~ 11. The apparatus of claim ~~16~~10, wherein, to determine the code block size, the processor ~~is~~and the memory are further configured to: determine ~~the transport block level cyclic redundancy check size by:~~

~~if $N_{RE} \cdot Q_m \cdot R \cdot v$ is less than~~ a ~~predetermined value, setting the transport block level cyclic redundancy check~~ byte-aligned code block size ~~to a first value; and~~

~~otherwise, setting the transport block level cyclic redundancy check size to a second value that is greater than the first value, wherein v is a number of MIMO layers, Q_m is a modulation order, R is a code rate, N_{RE} is a number of resource elements~~.

~~22.~~ 12. The apparatus of claim ~~16, wherein the processor is further configured to determine the code block level cyclic redundancy check size by:~~

~~if the condition $N_{RE} \cdot Q_m \cdot R \cdot v - X + L_{TB,CRC}$ is less than or equal to the maximum code block size, setting the code block level cyclic redundancy check size to a first value; and~~

~~otherwise, setting the code block level cyclic redundancy check size to a second value that is greater than the first value,~~

~~wherein v is a number of MIMO layers, Q_m is a modulation order, R is a code rate, N_{RE} is a number of resource elements, X is a rate back-off factor, $L_{TB,CRC}$ is the transport block level cyclic redundancy check size, and K_{cb} is the maximum code block size.~~

~~23. The apparatus of claim 16, wherein the processor is further configured~~9, wherein, to determine the TBS ~~by:~~

~~determining~~, the processor and the memory are further configured to: determine a TB level cyclic redundancy check (CRC) size by selecting the TB level CRC size from a plurality of predetermined CRC sizes based on the intermediate ~~values for use with the function in one or more lookup tables, based on $N_{RE} \cdot Q_m \cdot R \cdot v$, wherein v is a number of MIMO layers, Q_m is a modulation order, R is a code rate, and N_{RE} is a number of resource elements.~~value.

~~24.~~ 13. The apparatus of claim ~~16~~9, wherein ~~the function determines~~, to determine the TBS ~~based on $N_{RE} \cdot Q_m \cdot R \cdot v - X$, wherein X is a rate back-off factor that has a value equal to or greater than zero, v is a number of MIMO layers, Q_m is a modulation order, R is a code rate~~, the processor and the memory are further configured to: determine the TBS without cyclic dependencies between the TBS, a selected base graph, and ~~N_{RE} is a number of resource elements.~~the code block size.

~~25.~~ 14. The apparatus of claim ~~24, wherein the function comprises:~~

$$TBS = \left\lceil \frac{1}{8} \frac{L_{TB,CRC} + N_{RE} \cdot Q_m \cdot R \cdot v - X}{\left\lceil \frac{L_{TB,CRC} + N_{RE} \cdot Q_m \cdot R \cdot v - X}{K_{cb} - L_{CB,CRC}} \right\rceil} \right\rceil 8 \left\lceil \frac{L_{TB,CRC} + N_{RE} \cdot Q_m \cdot R \cdot v - X}{K_{cb} - L_{CB,CRC}} \right\rceil - L_{TB,CRC},$$

wherein K_{cb} is13, wherein the processor and the memory are further configured to: select the base graph based on at least one of the code rate or the intermediate value; and determine the maximum code block size, $L_{TB,CRC}$ is the transport block level cyclic redundancy check size, $L_{CB,CRC}$ is the code block level cyclic redundancy check size, X is a rate back-off factor that has a value equal to or greater than zero, v is a number of MIMO layers, Q_m is a modulation order, R is a code rate, and N_{RE} is a number of resource elements. based on the selected base graph.

26. 15. The apparatus of claim 24,

wherein X comprises a predetermined value based on the values of N_{RE}, Q_m, R, and v.

27. An apparatus of wireless communication, comprising:

a communication interface configured to9, wherein, to transmit data in a transport block (the TB);

a memory; and

a, the processor coupled with the communication interface and memory,

whereinand the processor ismemory are further configured to:

determine a transport block size (TBS) for the TB in a non-recursive procedure using a function including a plurality of parameters,

wherein the plurality of parameters comprise a maximum code block size, a transport block level cyclic redundancy check size, a code block level cyclic redundancy check size, a number of code blocks associated with the TB, and a code block size; and

transmit the TB with the data based on the determined TBS.no padding bits.

28. 16. The apparatus of claim 279, wherein in the non-recursive procedure, the processor is further configured, to determine the TBS based on $N_{RE} \cdot Q_m \cdot R \cdot v - X$, wherein X is a rate back-off factor that has a value equal to or greater than zero, v is a number of MIMO layers, Q_m is a modulation order, R is a code rate,, the processor and N_{RE} is a number of resource elements.

29. The apparatus of claim 28, wherein the the memory are further configured to: determine the TBS as a non-recursive procedure comprises:

$$TBS = \left\lceil \frac{1}{8} \frac{L_{TB,CRC} + N_{RE} \cdot Q_m \cdot R \cdot v - X}{\left\lceil \frac{L_{TB,CRC} + N_{RE} \cdot Q_m \cdot R \cdot v - X}{K_{cb} - L_{CB,CRC}} \right\rceil} \right\rceil 8 \left\lceil \frac{L_{TB,CRC} + N_{RE} \cdot Q_m \cdot R \cdot v - X}{K_{cb} - L_{CB,CRC}} \right\rceil - L_{TB,CRC},$$

wherein K_{cb} is the maximum code block size, $L_{TB,CRC}$ is the transport block level cyclic redundancy check size, $L_{CB,CRC}$ is function of the code block level cyclic redundancy check size, X is a rate back-off factor that has a value equal to or greater than zero, v is a number of MIMO layers, Q_m is a modulation order, R is a code rate,size and N_{RE} is a number of resource elements.

30. The apparatus of claim 28, wherein X comprises a predetermined value based on the values of N_{RE}, Q_m, R, and v.number of code blocks.

31. 17. An apparatus of wireless communication, comprising:

means for determining a maximum code block size of a transport block (TB);

means for determining a transport block level cyclic redundancy check size;

means for determining a code block level cyclic redundancy check size;

an intermediate value based on a number of resource elements, a modulation order, a code rate, and a number of MIMO layers for transmitting a transport block (TB); means for selecting a maximum code block size from a plurality of maximum code block sizes; means for determining a number of code blocks associated with the TB based on the intermediate value and the selected maximum code block size, the transport block level cyclic redundancy check size, and the code block level cyclic redundancy check size;

; means for determining a code block size based on the number of code blocks;

means for determining a transport block size (TBS) for the TB in a single pass as a function of the determined maximum code block size, the transport block level cyclic redundancy check size, the code block level cyclic redundancy check size, the number of code blocks, and the code block sizea rate back-off factor; and

means for transmitting the TB with the data based onusing the determined TBS.

32. The apparatus of claim 31, wherein the means for determining the code block size is configured to determine a byte-aligned code block size.

33. The apparatus of claim 31, wherein the transmitted TB has no padding bit.

34. The apparatus of claim 31, wherein the means for determining the maximum code block size comprises:

means for determining a base graph for encoding a code block based on at least one of a code rate or an intermediate number of information bits; and

means for determining the maximum code block size based on the determined base graph.

35. The apparatus of claim 34, wherein the means for determining the maximum code block size based on the determined base graph is configured to select the maximum code block size from a plurality of values.

36. The apparatus of claim 31, wherein the means for determining the transport block level cyclic redundancy check size is configured to:

if $N_{RE} \cdot Q_m \cdot R \cdot v$ is less than a predetermined value, set the transport block level cyclic redundancy check size to a first value; and

otherwise, set the transport block level cyclic redundancy check size to a second value that is greater than the first value, wherein v is a number of MIMO layers, Q_m is a modulation order, R is a code rate, and N_{RE} is a number of resource elements.

37. The apparatus of claim 31, wherein the means for determining the code block level cyclic redundancy check size comprises:

if the condition $N_{RE} \cdot Q_m \cdot R \cdot v - X + L_{TB,CRC}$ is less than or equal to the maximum code block size, setting the code block level cyclic redundancy check size to a first value; and

otherwise, setting the code block level cyclic redundancy check size to a second value that is greater than the first value,

wherein v is a number of MIMO layers, Q_m is a modulation order, R is a code rate, N_{RE} is a number of resource elements, X is a rate back-off factor, $L_{TB,CRC}$ is the transport block level cyclic redundancy check size, and K_{cb} is the maximum code block size.

~~38. The apparatus of claim 31, wherein the means for determining the~~ TBS ~~comprises:~~

~~determining a plurality of intermediate values for use with the function in one or more lookup tables, based on $N_{RE} \cdot Q_m \cdot R \cdot v$, wherein v is a number of MIMO layers, Q_m is a modulation order, R is a code rate, and N_{RE} is a number of resource elements.~~

~~39. The apparatus of claim 31, wherein the function determines the~~ , wherein the rate back-off factor has a value dependent at least on Qm, R, and v, where Qm is a modulation order, R is a code rate, and v is a number of multiple-input multiple-output MIMO layers.

18. A non-transitory computer-readable medium comprising executable code stored thereon which, when executed by a processor, causes an apparatus for wireless communication to: determine an intermediate value based on a number of resource elements, a modulation order, a code rate, and a number of MIMO layers for transmitting a transport block (TB); selecting a maximum code block size from a plurality of maximum code block sizes; determine a number of code blocks associated with the TB based on the intermediate value and the selected maximum code block size; determine a code block size based on the number of code blocks; determine a transport block size (TBS ~~based on $N_{RE} \cdot Q_m \cdot R \cdot v - X$, wherein X is~~) for the TB as a function of the code block size, the number of code blocks, and a rate back-off factor ~~that~~ ; and transmit the TB using the determined TBS, wherein the rate back-off factor has a value ~~equal to or greater than zero, v is a number of MIMO layers, Q_m~~dependent at least on Qm, R, and v, where Qm is a modulation order, ~~R~~R is a code rate, and ~~N_{RE}~~v is a number of ~~resource elements.~~

~~40. The apparatus of claim 39, wherein the function comprises:~~

$$TBS = \left\lceil \frac{1}{8} \frac{L_{TB,CRC} + N_{RE} \cdot Q_m \cdot R \cdot v - X}{\left\lceil \frac{L_{TB,CRC} + N_{RE} \cdot Q_m \cdot R \cdot v - X}{K_{cb} - L_{CB,CRC}} \right\rceil} \right\rceil 8 \left\lceil \frac{L_{TB,CRC} + N_{RE} \cdot Q_m \cdot R \cdot v - X}{K_{cb} - L_{CB,CRC}} \right\rceil - L_{TB,CRC},$$

~~wherein K_{cb} is the maximum code block size, $L_{TB,CRC}$ is the transport block level cyclic redundancy check size, $L_{CB,CRC}$ is the code block level cyclic redundancy check size, X is a rate back-off factor that has a value equal to or greater than zero, v is a number of MIMO layers, Q_m is a modulation order, R is a code rate, and N_{RE} is a number of resource elements.~~

~~41. The apparatus of claim 39, wherein X comprises a predetermined value based on the values of N_{RE}, Q_m, R, and v~~multiple-input multiple-output MIMO layers.