

WHAT IS CLAIMED IS:

1. A physical-layer resource mapping method, ~~applied to~~implemented by user equipment (UE), the method comprising:

in response to hybrid automatic repeat request acknowledgement (HARQ-ACK) information and uplink data being multiplexed in transmission, determining a frequency-domain offset and a starting position for each of physical-layer resources that a HARQ-ACK modulation symbol is mapped to, wherein the frequency-domain offset is for one of a plurality of resource elements (REs) that different HARQ-ACK modulation symbols are mapped to; and

mapping each HARQ-ACK modulation symbol to ~~an corresponding~~an RE of an orthogonal frequency division multiplexing (OFDM) symbol by a same interval in frequency domain according to the starting position and the frequency-domain offset,

wherein the frequency-domain offset for each of physical-layer resources that the HARQ-ACK modulation symbol is mapped to is at least determined by following parameters: the number N of OFDM symbols mappable for the HARQ-ACK modulation symbols, the number K of REs occupied by the HARQ-ACK modulation symbols, and the number M of REs in each OFDM symbol, wherein $N=1$, $K < M$.

2. The method of claim 1, wherein the determining a ~~frequency-domain offset and a starting position~~ for each of physical-layer resources that a HARQ-ACK modulation symbol is mapped to comprises:

determining a lowest frequency-domain position of an orthogonal frequency division multiplexing (OFDM) symbol next to a demodulation reference signal (DMRS) of the uplink data as the starting position; or,

determining a lowest frequency-domain position of a first OFDM symbol other than a DMRS of the uplink data as the starting position.

3. The method of claim 1, wherein the determining a frequency-domain offset and a starting

position for each of physical-layer resources that a HARQ-ACK modulation symbol is mapped to comprises:

determining the frequency-domain offset for each of REs based on the number N of OFDM symbols mappable for the HARQ-ACK modulation symbols, the number K of REs occupied by the HARQ-ACK modulation symbols and the number M of REs in each OFDM symbol.

4. The method of claim 3, wherein the mapping each HARQ-ACK modulation symbol to a corresponding RE according to the starting position and the frequency-domain offset comprises:

mapping a first HARQ-ACK modulation symbol to an RE where the starting position is;
and

mapping, in a frequency-domain-first manner, each of remaining HARQ-ACK modulation symbols to different REs according to the frequency-domain offset; and

in response to the frequency-domain offset exceeds a frequency-domain range of an OFDM symbol, mapping the remaining HARQ-ACK modulation symbols to REs of a next OFDM symbol sequentially.

5. The method of claim 3, wherein the mapping each HARQ-ACK modulation symbol to a corresponding RE according to the starting position and the frequency-domain offset comprises:

dividing the HARQ-ACK modulation symbols into P symbol groups, wherein each symbol group comprises at most N HARQ-ACK modulation symbols;

mapping each of HARQ-ACK modulation symbols in a first group of HARQ-ACK modulation symbols to different REs at a frequency-domain position where the starting position is;

determining a frequency-domain position, to which each group of HARQ-ACK modulation symbols in remaining groups of HARQ-ACK modulation symbols are mapped, based on the frequency-domain position where the starting position is and the

frequency-domain offset; and

mapping, in a time-domain-first manner, the remaining groups of HARQ-ACK modulation symbols to different REs at frequency-domain positions of corresponding groups.

6. The method of claim 1, wherein the determining a frequency-domain offset for each of physical-layer resources that a HARQ-ACK modulation symbol is mapped to comprises:

determining the frequency-domain offset based on the number K of REs occupied by the HARQ-ACK modulation symbols and the number M of REs in each OFDM symbol.

7. The method of claim 6, wherein the mapping each HARQ-ACK modulation symbol to a corresponding RE according to the starting position and the frequency-domain offset comprises:

mapping, in a time-domain-first manner, Q HARQ-ACK modulation symbols to different REs being with the same frequency-domain position, wherein the REs start from a frequency-domain position where the starting position is, then offsetting the Q HARQ-ACK modulation symbols based on the frequency-domain offset, and then mapping next Q HARQ-ACK modulation symbols to different REs, wherein Q is calculated based on K and M .

8. The method of claim 1, wherein the determining a frequency-domain offset for each of physical-layer resources that a HARQ-ACK modulation symbol is mapped to comprises:

in a case that K is not greater than M , determining a first frequency-domain offset corresponding to first R HARQ-ACK modulation symbols by a first algorithm, and determining a second frequency-domain offset corresponding to remaining HARQ-ACK modulation symbols other than the first R HARQ-ACK modulation symbols by a second algorithm, wherein R is calculated based on a third algorithm, K is the number K of REs occupied by the HARQ-ACK modulation symbols and M is the number of REs in each OFDM symbol; or

in a case that K is greater than M , determining, by a fourth algorithm, a first count

corresponding to REs that the HARQ-ACK modulation symbols are mapped to at each frequency-domain position during first S offsetting of the HARQ-ACK modulation symbols, and determining, by a fifth algorithm, a second count corresponding to REs that the HARQ-ACK modulation symbols are mapped to at each frequency-domain position during offsetting of remaining HARQ-ACK modulation symbols other than the first S offsetting, wherein S is calculated based on a sixth algorithm, a frequency-domain offset corresponding to the first S offsetting is a first preset value, and a frequency-domain offset corresponding to frequency-domain offsetting other than the first S offsetting is a second set value.

9. The method of claim 8, wherein the mapping each HARQ-ACK modulation symbol to a corresponding RE according to the starting position and the frequency-domain offset comprises:

in a case that K is not greater than M, mapping, in a time-domain-first manner, each of the first R HARQ-ACK modulation symbols to different REs being with the same frequency-domain position according to the first frequency-domain offset, wherein the REs start from a frequency-domain position where the starting position is;

determining an RE that an (R+1)th HARQ-ACK modulation symbol is mapped to based on a frequency-domain position of an Rth HARQ-ACK modulation symbol and the second frequency-domain offset; and

mapping, in a time-domain-first manner, each of remaining HARQ-ACK modulation symbols other than the first R HARQ-ACK modulation symbols to different REs at different frequency-domain positions starting from the RE, that the (R+1)th HARQ-ACK modulation symbol is mapped to, according to the second frequency-domain offset.

10. The method of claim 8, wherein the mapping each HARQ-ACK modulation symbol to a corresponding RE according to the starting position and the frequency-domain offset comprises:

in a case that K is greater than M, performing, in a time-domain-first manner, the first S frequency-domain offsetting starting from the frequency-domain position where the starting

position is according to the first preset value, and continuously mapping the first count of HARQ-ACK modulation symbols at each frequency-domain position;

based on the frequency-domain position where the starting position is, the first preset value and the second set value, determining a starting position of (S+1)th offsetting; and

after completing the first S offsetting, performing, in a time-domain-first manner, frequency-domain offsetting starting from the starting position of (S+1)th offsetting according to the first preset value, and continuously mapping the second count of HARQ-ACK modulation symbols at each frequency-domain position.

11. The method of claim 1, further comprising:

in response to Channel State Information (CSI), the HARQ-ACK information and the uplink data being multiplexed in transmission, determining REs that CSI modulation symbols are mapped to; and

determining REs, other than the REs that the CSI modulation symbols are mapped to, as mappable REs for the HARQ-ACK modulation symbols, or determining REs, other than OFDM symbols comprising the REs that the CSI modulation symbols are mapped to, as mappable REs for the HARQ-ACK modulation symbols,

wherein the mapping each HARQ-ACK modulation symbol to a corresponding RE according to the starting position and the frequency-domain offset comprises:

mapping the HARQ-ACK modulation symbols to the mappable REs according to the starting position and the frequency-domain offset.

12. The method of claim 1, in response to CSI, the HARQ-ACK information and the uplink data being multiplexed in transmission, after mapping each HARQ-ACK modulation symbol to the corresponding RE, the method further comprising:

determining REs, other than the REs that the HARQ-ACK modulation symbols are mapped to, as mappable REs for CSI modulation symbols; and

mapping the CSI modulation symbols to the mappable REs for the CSI modulation symbols according to a preset mapping rule of the CSI modulation symbols.

13. A physical-layer resource mapping method, ~~applied to~~implemented by a base station, the method comprising:

receiving coded data from user equipment (UE), wherein the coded data comprises hybrid automatic repeat request acknowledgement (HARQ-ACK) modulation symbols and data modulation symbols;

determining resource elements (REs) comprising the HARQ-ACK modulation symbols mapped to an orthogonal frequency division multiplexing (OFDM) symbol by a same interval in frequency domain and REs comprising the data modulation symbols based on a starting position and a frequency-domain offset for each of physical-layer resources that a HARQ-ACK modulation symbol is mapped to, wherein the frequency-domain offset is for one of a plurality of REs that different HARQ-ACK modulation symbols are mapped to; and

acquiring HARQ-ACK information and uplink data based on the REs comprising the HARQ-ACK modulation symbols and the REs comprising the data modulation symbols,

wherein the frequency-domain offset for each of physical-layer resources that the HARQ-ACK modulation symbol is mapped to is at least determined by following parameters: the number N of OFDM symbols mappable for the HARQ-ACK modulation symbols, the number K of REs occupied by the HARQ-ACK modulation symbols, and the number M of REs in each OFDM symbol, wherein $N=1$, $K < M$.

14. The method of claim 13, wherein

the starting position of the physical-layer resources that HARQ-ACK modulation symbols mapped to is a lowest frequency-domain position of an orthogonal frequency division multiplexing (OFDM) symbol next to a demodulation reference signal (DMRS) of the uplink data; or,

the starting position of the physical-layer resources that HARQ-ACK modulation symbols mapped to is a lowest frequency-domain position of a first OFDM symbol other than a DMRS of the uplink data.

15. The method of claim 13, wherein the frequency-domain offset for one of a plurality of REs that different HARQ-ACK modulation symbols are mapped to is obtained based on the number K of the REs occupied by the HARQ-ACK modulation symbols and the number M of REs in each OFDM symbol.

16. The method of claim 13, wherein the frequency-domain offset for one of a plurality of REs that different HARQ-ACK modulation symbols are mapped to is obtained based on the number N of OFDM symbols mappable for the HARQ-ACK modulation symbols, the number K of the REs occupied by the HARQ-ACK modulation symbols and the number M of the REs in each OFDM symbol.

~~17. A physical layer resource mapping device, applied to user equipment (UE), the device comprising:~~

~~a first determination module, configured to, in response to hybrid automatic repeat request acknowledgement (HARQ-ACK) information and uplink data being multiplexed in transmission, determine a frequency domain offset and a starting position for each of physical layer resources that a HARQ-ACK modulation symbol is mapped to, wherein the frequency domain offset is for one of a plurality of resource elements (REs) that different HARQ-ACK modulation symbols are mapped to; and~~

~~a first mapping module, configured to map each HARQ-ACK modulation symbol to a corresponding RE according to the starting position and the frequency domain offset.~~

~~18. The device of claim 17, wherein the first determination module comprises:~~

~~a first determination submodule, configured to determine a lowest frequency domain position of an orthogonal frequency division multiplexing (OFDM) symbol next to a demodulation reference signal (DMRS) of the uplink data as the starting position; or,~~

~~a second determination submodule, configured to determine a lowest frequency domain position of a first OFDM symbol other than a DMRS of the uplink data as the starting position.~~

19. ~~The device of claim 17, wherein the first determination module comprises:~~

~~a third determination submodule, configured to determine the frequency domain offset for each of REs based on the number N of OFDM symbols mappable for the HARQ ACK modulation symbols, the number K of REs occupied by the HARQ ACK modulation symbols and the number M of REs in each OFDM symbol.~~

20. ~~The device of claim 19, wherein the first mapping module comprises:~~

~~a first mapping submodule, configured to map a first HARQ ACK modulation symbol to an RE where the starting position is; and~~

~~a second mapping submodule, configured to map, in a frequency domain first manner, each of remaining HARQ ACK modulation symbols to different REs according to the frequency domain offset; and in response to the frequency domain offset exceeds a frequency domain range of an OFDM symbol, mapping the remaining HARQ ACK modulation symbols to REs of a next OFDM symbol sequentially.~~

21. ~~The device of claim 19, wherein the first mapping module comprises:~~

~~a division submodule, configured to divide the HARQ ACK modulation symbols into P symbol groups, wherein each symbol group comprises at most N HARQ ACK modulation symbols;~~

~~a third mapping submodule, configured to map each of HARQ ACK modulation symbols in a first group of HARQ ACK modulation symbols to different REs at a frequency domain position where the starting position is;~~

~~a fourth determination submodule, configured to determine a frequency domain position that each group of HARQ ACK modulation symbols in remaining groups of HARQ ACK modulation symbols are mapped to based on the frequency domain position where the starting position is and the frequency domain offset; and~~

~~a fourth mapping submodule, configured to map, in a time domain first manner, the remaining groups of HARQ ACK modulation symbols to different REs at frequency domain~~

positions of corresponding groups.

22.— The device of claim 17, wherein the first determination module comprises:

~~a fifth determination submodule, configured to determine the frequency domain offset based on the number K of REs occupied by the HARQ ACK modulation symbols and the number M of REs in each OFDM symbol.~~

23.— The device of claim 22, wherein the first mapping module comprises:

~~a fifth mapping submodule, configured to map, in a time domain first manner, Q HARQ ACK modulation symbols to different REs being with the same frequency domain position, wherein the REs start from a frequency domain position where the starting position is, then offset the Q HARQ ACK modulation symbols based on the frequency domain offset, and then map next Q HARQ ACK modulation symbols to different REs, wherein Q is calculated based on K and M.~~

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24.— The device of claim 17, wherein the first determination module comprises:

~~a sixth determination submodule, configured to, in a case that K is not greater than M, determine a first frequency domain offset corresponding to first R HARQ ACK modulation symbols by a first algorithm and determine a second frequency domain offset corresponding to remaining HARQ ACK modulation symbols other than the first R HARQ ACK modulation symbols by a second algorithm, wherein R is calculated based on a third algorithm, K is the number K of REs occupied by the HARQ ACK modulation symbols and M is the number of REs in each OFDM symbol; and~~

~~a seventh determination submodule, configured to, in a case that K is greater than M, determine a first count corresponding to REs that the HARQ ACK modulation symbols are mapped to at each frequency domain position during first S offsetting of the HARQ ACK modulation symbols by a fourth algorithm and determine a second count corresponding to REs that the HARQ ACK modulation symbols are mapped to at each frequency domain position during offsetting of remaining HARQ ACK modulation symbols other than the first~~

~~S offsetting by a fifth algorithm, wherein S is calculated based on a sixth algorithm, a frequency domain offset corresponding to the first S offsetting is a first preset value, and a frequency domain offset corresponding to frequency domain offsetting other than the first S offsetting is a second set value.~~

25. ~~The device of claim 24, wherein the first mapping module comprises:~~

~~a sixth mapping submodule, configured to, in a case that K is not greater than M, map, in a time domain first manner, each of the first R HARQ-ACK modulation symbols to different REs being with the same frequency domain position according to the first frequency domain offset, wherein the REs start from a frequency domain position where the starting position is;~~

~~an eighth determination submodule, configured to determine an RE that an (R+1)th HARQ-ACK modulation symbol is mapped to based on a frequency domain position of an Rth HARQ-ACK modulation symbol and the second frequency domain offset; and~~

~~a seventh mapping submodule, configured to map, in a time domain first manner, each of remaining HARQ-ACK modulation symbols other than the first R HARQ-ACK modulation symbols to different REs at different frequency domain positions starting from the RE, that the (R+1)th HARQ-ACK modulation symbol is mapped to, according to the second frequency domain offset.~~

26. ~~The device of claim 24, wherein the first mapping module comprises:~~

~~an eighth mapping submodule, configured to, in a case that K is greater than M, perform, in a time domain first manner, the first S frequency domain offsetting starting from the frequency domain position where the starting position is according to the first preset value and continuously map the first count of HARQ-ACK modulation symbols at each frequency domain position;~~

~~a ninth determination submodule, configured to determine, based on the frequency domain position where the starting position is, the first preset value and the second set value, a starting position of (S+1)th offsetting; and~~

~~a ninth mapping submodule, configured to, after the first S offsetting is completed, perform, in a time-domain first manner, frequency-domain offsetting starting from the starting position of (S+1)th offsetting according to the first preset value and continuously map the second count of HARQ-ACK modulation symbols at each frequency-domain position.~~

~~27. The device of claim 17, further comprising:~~

~~a second determination module, configured to, in response to Channel State Information (CSI), the HARQ-ACK information and the uplink data being multiplexed in transmission, determining REs that CSI modulation symbols are mapped to; and~~

~~a third determination module, configured to determine REs, other than the REs that the CSI modulation symbols are mapped to, to be mappable REs for the HARQ-ACK modulation symbols or determine REs, other than OFDM symbols comprising the REs that the CSI modulation symbols are mapped to, as mappable REs for the HARQ-ACK modulation symbols;~~

~~wherein the first mapping module comprises:~~

~~a tenth mapping submodule, configured to map the HARQ-ACK modulation symbols to the mappable REs according to the starting position and the frequency-domain offset.~~

~~28. The device of claim 17, further comprising:~~

~~a fourth determination module, configured to determine REs, other than the REs that the HARQ-ACK modulation symbols are mapped to, as mappable REs for CSI modulation symbols; and~~

~~a second mapping module, configured to map the CSI modulation symbols to the mappable REs for the CSI modulation symbols according to a preset mapping rule.~~

~~29. A physical-layer resource mapping device, applied to a base station, the device comprising:~~

~~a receiving module, configured to receive coded data from user equipment (UE);~~

~~wherein the coded data comprises hybrid automatic repeat request acknowledgement (HARQ-ACK) modulation symbols and data modulation symbols;~~

~~a fifth determination module, configured to determine resource elements (REs) comprising the HARQ-ACK modulation symbols and REs comprising the data modulation symbols based on a starting position and a frequency domain offset for each of physical layer resources that each HARQ-ACK modulation symbol is mapped to, wherein the frequency domain offset is for one of a plurality of REs that different HARQ-ACK modulation symbols are mapped to; and~~

~~a data acquisition module, configured to acquire HARQ-ACK information and uplink data based on the REs comprising the HARQ-ACK modulation symbols and the REs comprising the data modulation symbols.~~

~~30. The device of claim 29, wherein~~

~~the starting position of the physical layer resources that HARQ-ACK modulation symbols mapped to is a lowest frequency domain position of an orthogonal frequency division multiplexing (OFDM) symbol next to a demodulation reference signal (DMRS) of the uplink data; or,~~

~~the starting position of the physical layer resources that HARQ-ACK modulation symbols mapped to is a lowest frequency domain position of a first OFDM symbol other than a DMRS of the uplink data.~~

~~31. The device of claim 29, wherein the frequency domain offset for one of a plurality of REs that different HARQ-ACK modulation symbols are mapped to is obtained based on the number K of the REs occupied by the HARQ-ACK modulation symbols and the number M of REs in each OFDM symbol.~~

~~32. The device of claim 29, wherein the frequency domain offset for one of a plurality of REs that different HARQ-ACK modulation symbols are mapped to is obtained based on the number N of OFDM symbols mappable for the HARQ-ACK modulation symbols, the number K of the REs occupied by the HARQ-ACK modulation symbols and the number M~~

~~of the REs in each OFDM symbol.~~

3317. User equipment (UE), comprising:

a processor; and

a memory configured to store instructions executable by the processor,

wherein the processor is configured to:

in response to hybrid automatic repeat request acknowledgement (HARQ-ACK) information and uplink data being multiplexed in transmission, determine a frequency-domain offset and a starting position for each of physical-layer resources that a HARQ-ACK modulation symbol is mapped to, wherein the frequency-domain offset is for one of a plurality of resource elements (REs) that different HARQ-ACK modulation symbols are mapped to; and

map each HARQ-ACK modulation symbol to a corresponding RE of an orthogonal frequency division multiplexing (OFDM) symbol by a same interval in frequency domains according to the starting position and the frequency-domain offset,

wherein the frequency-domain offset for each of physical-layer resources that the HARQ-ACK modulation symbol is mapped to is at least determined by following parameters: the number N of OFDM symbols mappable for the HARQ-ACK modulation symbols, the number K of REs occupied by the HARQ-ACK modulation symbols, and the number M of REs in each OFDM symbol, wherein $N=1$, $K < M$.

3418. A base station, comprising:

a processor; and

a memory configured to store instructions executable by the processor,

wherein the processor is configured to:

~~receive coded data from user equipment (UE), wherein the coded data comprises hybrid automatic repeat request acknowledgement (HARQ-ACK) modulation symbols and data modulation symbols;~~

~~determine resource elements (REs) comprising the HARQ-ACK modulation symbols~~

~~and REs comprising the data modulation symbols based on a starting position and a frequency domain offset for each of physical layer resources that each HARQ ACK modulation symbol is mapped to, wherein the frequency domain offset is for one of a plurality of REs that different HARQ ACK modulation symbols are mapped to; and~~

~~acquire HARQ ACK information and uplink data based on the REs comprising the HARQ ACK modulation symbols and the REs comprising the data modulation symbols~~implement steps of the method of claim 13.

~~3519. A non-transitory computer-readable storage medium, having computer instructions stored thereon that, when executed by a processor, cause the processor to implement steps of:~~
~~in response to hybrid automatic repeat request acknowledgement (HARQ ACK) information and uplink data being multiplexed in transmission, determining a frequency domain offset and a starting position for each of physical layer resources that a HARQ ACK modulation symbol is mapped to, wherein the frequency domain offset is for one of a plurality of resource elements (REs) that different HARQ ACK modulation symbols are mapped to; and~~
~~mapping each HARQ ACK modulation symbol to a corresponding REs according to the starting position and the frequency domain offset~~the method of claim 1.

~~3620. A non-transitory computer-readable storage medium, having computer instructions stored thereon that, when executed by a processor, cause the processor to implement steps of~~
the method of claim 13:

~~receiving coded data from user equipment (UE), wherein the coded data comprises hybrid automatic repeat request acknowledgement (HARQ ACK) modulation symbols and data modulation symbols;~~

~~determining resource elements (REs) comprising the HARQ ACK modulation symbols and REs comprising the data modulation symbols based on a starting position and a frequency domain offset for each of physical layer resources that each HARQ ACK modulation symbol is mapped to, wherein the frequency domain offset is for one of a plurality of REs that different HARQ ACK modulation symbols are mapped to; and~~

acquiring HARQ-ACK information and uplink data based on the REs comprising the HARQ-ACK modulation symbols and the REs comprising the data modulation symbols.