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CERTIFICATE

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Title of the Invention-Creation: DATA TRANSMISSION METHOD AND APPARATUS

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Applicant: Institute of Telecommunications Science and Technology

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Claims

1. A data transmission method, characterized by comprising:
allocating downlink (DL) regions in a time unit, wherein the time unit comprises at least two DL regions; and
notifying a terminal of the allocated DL regions by means of configuration signaling.
2. The method according to claim 1, wherein notifying the terminal of the allocated DL regions by means of the configuration signaling specifically comprises:
notifying the terminal of lengths and positions of the DL regions in the time unit; or
notifying the terminal of one of a plurality of predetermined patterns, each pattern comprising an allocation of lengths and positions of the DL regions in the time unit; or
notifying the terminal of start or end positions of the DL regions in the time unit.
3. The method according to in claim 1, wherein an uplink (UL) region and/or a guard period (GP) region in the time unit are/is further indicated by means of the configuration signaling, specifically comprising:
notifying the terminal of a length and a position of the UL region in the time unit; or
notifying the terminal of one of a plurality of predetermined patterns, each pattern comprising an allocation of a length and a position of the UL region in the time unit; or
notifying the terminal of a start or end position of the UL region in the time unit; or
notifying the terminal of indication information so that the terminal determines the UL region in the time unit according to the indication information under a predefined rule.
4. The method according to claim 1, further comprising:
determining a UL region in the time unit according to uplink scheduling signaling, or according to a position at which ACK/NACK for downlink transmission is fed back.
5. The method according to any one of claims 1 to 4, wherein the configuration signaling is indicated by means of higher-layer signaling or physical downlink control signaling in a unicast or broadcast or multicast form.
6. The method according to any one of claims 1 to 4, further comprising:





transmitting a downlink control channel to the terminal in at least one DL region in the time unit.

7. The method according to claim 6, wherein before the downlink control channel is transmitted to the terminal in the at least one DL region in the time unit, the method further comprises:

determining a detection DL region of the terminal in the time unit, and notifying the terminal of the detection DL region by means of configuration information, or determining a detection DL region in the time unit according to a pre-definition, wherein the detection DL region may be a part or all of the DL regions in the time unit; and

when the detection DL region is configured or defined, transmitting the downlink control channel to the terminal in at least one DL region in the detection DL region corresponding to the terminal.

8. The method according to claim 6 or 7, further comprising:

when a downlink downlink control information (DCI) format is used for the downlink control channel, receiving ACK/NACK feedback for the downlink control channel, and/or ACK/NACK feedback for a downlink shared channel corresponding to the downlink control channel, in a UL region corresponding to a DL region in which the downlink control channel is transmitted; or

when an uplink DCI format is used for the downlink control channel, receiving an uplink shared channel corresponding to the downlink control channel in the UL region corresponding to the DL region in which the downlink control channel is transmitted.

9. The method according to claim 8, wherein the UL region corresponding to the DL region is determined according to one or a combination of the following schemes:

a region spaced from the DL region by a length T after an end position of the DL region is the UL region corresponding to the DL region, or a first UL region spaced from the DL region by the length T after the end position of the DL region is a UL feedback region corresponding to the DL region, wherein T is predefined or configured; or

the UL region corresponding to the DL region is indicated by means of indication information in the downlink control channel; or

a UL region corresponding to a part of the DL regions in the time unit is predefined or configured as a UL region in a current time unit, and if there are a plurality of UL regions in the current time unit, then the UL region corresponding to the part of the DL regions is one or more defined or configured UL regions in the current time unit; or





a UL region corresponding to a part of the DL regions in the time unit is predefined or configured as a UL region in a next time unit, and if there are a plurality of UL regions in the next time unit, then the UL region corresponding to the part of the DL regions is one or more defined or configured UL regions in the next time unit; or

the UL region corresponding to the DL region in the time unit is predefined or configured as a UL region in the current time unit, and if there are a plurality of DL regions and a plurality of UL regions in the current time unit, then each DL region corresponds to one or more defined or configured UL regions.

10. The method according to any one of claims 1 to 9, wherein the time unit is one or more slots, or one or more subframes.

11. A data transmission method, characterized by comprising:

receiving configuration signaling; and

determining DL regions allocated in a time unit according to the configuration signaling, wherein the time unit comprises at least two DL regions.

12. The method according to claim 11, wherein determining the DL regions allocated in the time unit according to the configuration signaling specifically comprises:

notifying lengths and positions of the DL regions in the time unit by means of the configuration signaling; or

notifying one of a plurality of predetermined patterns by means of the configuration signaling, each pattern comprising an allocation of lengths and positions of the DL regions in the time unit; or

notifying start or end positions of the DL regions in the time unit by means of the configuration signaling.

13. The method according to claim 11, wherein when determining the DL regions allocated in the time unit according to the configuration signaling, the method further comprises:

determining a UL region and/or a GP region in the time unit according to the configuration signaling, wherein

a length and a position of the UL region in the time unit are indicated by means of the configuration signaling; or





one of a plurality of predetermined patterns is indicated by means of the configuration signaling, each pattern comprising an allocation of a length and a position of the UL region in the time unit; or

a start or end position of the UL region in the time unit is indicated by means of the configuration signaling; or

indication information is indicated by means of the configuration signaling so that the terminal determines the UL region in the time unit according to the indication information under a predefined rule.

14. The method according to claim 11, further comprising:

determining, by the terminal, a UL region in the time unit according to uplink scheduling signaling, or determining, by the terminal, the UL region in the time unit according to a position at which ACK/NACK for downlink transmission is fed back.

15. The method according to any one of claims 11 to 14, wherein the configuration signaling is indicated by means of higher-layer signaling or physical downlink control signaling in a unicast or broadcast or multicast form.

16. The method according to any one of claims 11 to 14, further comprising:

detecting a downlink control channel in each DL region or each detection DL region in the time unit.

17. The method according to claim 16, wherein before detection of a downlink control channel is performed in each detection DL region in the time unit, the method further comprises:

receiving configuration information, and determining a detection DL region in the time unit according to the configuration information, or determining a detection DL region in the time unit according to a pre-definition, wherein the detection DL region may be a part or all of the DL regions in the time unit.

18. The method according to claim 16 or 17, further comprising:

when a downlink DCI format is used for the downlink control channel, transmitting ACK/NACK feedback for the downlink control channel, and/or ACK/NACK feedback for a downlink shared channel corresponding to the downlink control channel, in a UL region corresponding to a DL region in which the downlink control channel is received; or

when an uplink DCI format is used for the downlink control channel, transmitting an uplink shared channel corresponding to the downlink control channel in the UL region corresponding to the DL region in which the downlink control channel is received.





19. The method according to claim 18, wherein the UL region corresponding to the DL region is determined according to one or a combination of the following schemes:

a region spaced from the DL region by a length T after an end position of the DL region is the UL region corresponding to the DL region, or a first UL region spaced from the DL region by the length T after the end position of the DL region is a UL feedback region corresponding to the DL region, wherein T is predefined or configured; or

the UL region corresponding to the DL region is determined according to indication information in the downlink control channel; or

a UL region corresponding to a part of the DL regions in the time unit is predefined or configured as a UL region in a current time unit, and if there are a plurality of UL regions in the current time unit, then the UL region corresponding to the part of the DL regions is one or more defined or configured UL regions in the current time unit; or

a UL region corresponding to a part of the DL regions in the time unit is predefined or configured as a UL region in a next time unit, and if there are a plurality of UL regions in the next time unit, then the UL region corresponding to the part of the DL regions is one or more defined or configured UL regions in the next time unit; or

the UL region corresponding to the DL region in the time unit is predefined or configured as a UL region in the current time unit, and if there are a plurality of DL regions and a plurality of UL regions in the current time unit, then each DL region corresponds to one or more defined or configured UL regions.

20. The method according to any one of claims 11 to 19, wherein the time unit is one or more slots, or one or more subframes.

21. A data transmission apparatus, characterized by comprising:

an allocating module configured to allocate DL regions in a time unit, wherein the time unit comprises at least two DL regions; and

a notifying module configured to notify a terminal of the allocated DL regions by means of configuration signaling.

22. The apparatus according to claim 21, wherein the notifying module is further configured to notify the terminal of the allocated DL regions by means of the configuration signaling, specifically comprising:

notifying the terminal of lengths and positions of the DL regions in the time unit; or





notifying the terminal of one of a plurality of predetermined patterns, each pattern comprising an allocation of lengths and positions of the DL regions in the time unit; or

notifying the terminal of start or end positions of the DL regions in the time unit.

23. The apparatus according to claim 21, wherein the notifying module is further configured to further notify, in the configuration signaling,

a UL region and/or a GP region in the time unit, specifically comprising:

notifying the terminal of a length and a position of the UL region in the time unit; or

notifying the terminal of one of a plurality of predetermined patterns, each pattern comprising an allocation of a length and a position of the UL region in the time unit; or

notifying the terminal of a start or end position of the UL region in the time unit; or

notifying the terminal of indication information so that the terminal determines the UL region in the time unit according to the indication information under a predefined rule.

24. The apparatus according to claim 21, further comprising:

determining a UL region in the time unit according to uplink scheduling signaling, or according to a position at which ACK/NACK for downlink transmission is fed back.

25. The apparatus according to any one of claims 21 to 24, wherein the notifying module is further configured to transmit the configuration signaling by means of higher-layer signaling or physical downlink control signaling in a unicast or broadcast or multicast form.

26. The apparatus according to any one of claims 21 to 24, further comprising:

a transmitting module configured to transmit a downlink control channel to the terminal in at least one DL region in the time unit.

27. The apparatus according to claim 26, wherein the transmitting module is further configured to, before the downlink control channel is transmitted to the terminal in at least one DL region in the time unit, perform operations further comprising:

determining a detection DL region of the terminal in the time unit, and notifying the terminal of the detection DL region by means of configuration information, or determining a detection DL region in the time unit according to a pre-definition, wherein the detection DL region may be a part or all of the DL regions in the time unit; and





when the detection DL region is configured or defined, transmitting the downlink control channel to the terminal in at least one DL region in the detection DL region corresponding to the terminal.

28. The apparatus according to claim 26 or 27, wherein the transmitting module is further configured to: when a downlink DCI format is used for the downlink control channel, receive ACK/NACK feedback for the downlink control channel, and/or ACK/NACK feedback for a downlink shared channel corresponding to the downlink control channel, in a UL region corresponding to a DL region in which the downlink control channel is transmitted; or

when an uplink DCI format is used for the downlink control channel, receive an uplink shared channel corresponding to the downlink control channel in the UL region corresponding to the DL region in which the downlink control channel is transmitted.

29. The apparatus according to claim 28, wherein the UL region corresponding to the DL region is determined according to one or a combination of the following schemes:

a region spaced from the DL region by a length T after an end position of the DL region is the UL region corresponding to the DL region, or a first UL region spaced from the DL region by the length T after the end position of the DL region is a UL feedback region corresponding to the DL region, wherein T is predefined or configured; or

the UL region corresponding to the DL region is indicated by means of indication information in the downlink control channel; or

a UL region corresponding to a part of the DL regions in the time unit is predefined or configured as a UL region in a current time unit, and if there are a plurality of UL regions in the current time unit, then the UL region corresponding to the part of the DL regions is one or more defined or configured UL regions in the current time unit; or

a UL region corresponding to a part of the DL regions in the time unit is predefined or configured as a UL region in a next time unit, and if there are a plurality of UL regions in the next time unit, then the UL region corresponding to the part of the DL regions is one or more defined or configured UL regions in the next time unit; or

the UL region corresponding to the DL region in the time unit is predefined or configured as a UL region in the current time unit, and if there are a plurality of DL regions and a plurality of UL regions in the current time unit, then each DL region corresponds to one or more defined or configured UL regions.

30. The apparatus according to any one of claims 21 to 29, wherein the time unit is one or more slots, or one or more subframes.





31. A data transmission apparatus, characterized by comprising:

a receiving module configured to receive configuration signaling; and

a determining module configured to determine DL regions allocated in a time unit according to the configuration signaling, wherein the time unit comprises at least two DL regions.

32. The apparatus according to claim 31, wherein the determining module is configured to, when determining the DL regions allocated in the time unit according to the configuration signaling, perform operations specifically comprising:

determining lengths and positions of the DL regions in the time unit indicated by means of the configuration signaling; or

determining one of a plurality of predetermined patterns indicated by means of the configuration signaling, each pattern comprising an allocation of lengths and positions of the DL regions in the time unit; or

determining start or end positions of the DL regions in the time unit indicated by means of the configuration signaling.

33. The apparatus according to claim 31, wherein the determining module is further configured to:

determine a UL region and/or a GP region in the time unit according to the configuration signaling, wherein

a length and a position of the UL region in the time unit are indicated by means of the configuration signaling; or

one of a plurality of predetermined patterns is indicated by means of the configuration signaling, each pattern comprising an allocation of a length and a position of the UL region in the time unit; or

a start or end position of the UL region in the time unit is indicated by means of the configuration signaling; or

indication information is indicated by means of the configuration signaling so that the terminal determines the UL region in the time unit according to the indication information under a predefined rule.

34. The apparatus according to claim 31, wherein the determining module is further configured to:





determine a UL region in the time unit according to uplink scheduling signaling, or determine the UL region in the time unit according to a position at which ACK/NACK for downlink transmission is fed back.

35. The apparatus according to any one of claims 31 to 34, wherein the receiving module is further configured to receive the configuration signaling indicated by means of higher-layer signaling or physical downlink control signaling in a unicast or broadcast or multicast form.

36. The apparatus according to any one of claims 31 to 34, further comprising:

a detecting module configured to detect a downlink control channel in each DL region or each detection DL region in the time unit.

37. The apparatus according to claim 36, wherein before detection of a downlink control channel is performed in each detection DL region in the time unit, the detecting module is further configured to perform operations further comprising:

receiving configuration information, and determining a detection DL region in the time unit according to the configuration information, or determining a detection DL region in the time unit according to a pre-definition, wherein the detection DL region may be a part or all of the DL regions in the time unit.

38. The apparatus according to claim 36 or 37, wherein the detecting module is further configured to, when a downlink DCI format is used for the downlink control channel, transmit ACK/NACK feedback for the downlink control channel, and/or ACK/NACK feedback for a downlink shared channel corresponding to the downlink control channel, in a UL region corresponding to a DL region in which the downlink control channel is received; or

when an uplink DCI format is used for the downlink control channel, transmit an uplink shared channel corresponding to the downlink control channel in the UL region corresponding to the DL region in which the downlink control channel is received.

39. The apparatus according to claim 38, wherein the UL region corresponding to the DL region is determined according to one or a combination of the following schemes:

a region spaced from the DL region by a length T after an end position of the DL region is the UL region corresponding to the DL region, or a first UL region spaced from the DL region by the length T after the end position of the DL region is a UL feedback region corresponding to the DL region, wherein T is predefined or configured; or

the UL region corresponding to the DL region is determined according to indication information in the downlink control channel; or





a UL region corresponding to a part of the DL regions in the time unit is predefined or configured as a UL region in a current time unit, and if there are a plurality of UL regions in the current time unit, then the UL region corresponding to the part of the DL regions is one or more defined or configured UL regions in the current time unit; or

a UL region corresponding to a part of the DL regions in the time unit is predefined or configured as a UL region in a next time unit, and if there are a plurality of UL regions in the next time unit, then the UL region corresponding to the part of the DL regions is one or more defined or configured UL regions in the next time unit; or

the UL region corresponding to the DL region in the time unit is predefined or configured as a UL region in the current time unit, and if there are a plurality of DL regions and a plurality of UL regions in the current time unit, then each DL region corresponds to one or more defined or configured UL regions.

40. The apparatus according to any one of claims 31 to 39, wherein the time unit is one or more slots, or one or more subframes.





Description

DATA TRANSMISSION METHOD AND APPARATUS

Technical Field

The present invention relates to the technical field of wireless communications, and relates in particular to a data transmission method and apparatus.

Background Art

The following frame structure is defined for a time division duplex (TDD) mode in an existing long term evolution (LTE) system.

FIG. 1 is a schematic diagram of a frame structure type 2 for an LTE TDD system. As shown in the figure, the LTE TDD system uses the frame structure type 2 (FS2), and different subframes or slots at the same frequency are used for uplink and downlink transmission. Each 10 ms radio frame is composed of two 5 ms half-frames, and each half-frame includes five subframes with a length of 1 ms. The subframes in the FS2 are divided into three classes: downlink subframes, uplink subframes and special subframes, wherein each special subframe is composed of three parts, i.e., a downlink pilot time slot (DwPTS), a guard period (GP), and an uplink pilot time slot (UpPTS). Each half-frame includes at least one downlink subframe, at least one uplink subframe, and at most one special subframe. Seven TDD uplink-downlink configurations as shown in Table 1, and ten special subframe structures as shown in Table 2 are defined according to different downlink-to-uplink switch-point periodicities and uplink-downlink allocation proportions.

Table 1: Uplink-downlink configurations

Uplink-downlink configuration	Downlink-to-Uplink Switch-point periodicity	Subframe number									
		0	1	2	3	4	5	6	7	8	9
0	5 ms	D	S	U	U	U	D	S	U	U	U
1	5 ms	D	S	U	U	D	D	S	U	U	D
2	5 ms	D	S	U	D	D	D	S	U	D	D
3	10 ms	D	S	U	U	U	D	D	D	D	D
4	10 ms	D	S	U	U	D	D	D	D	D	D
5	10 ms	D	S	U	D	D	D	D	D	D	D
6	5 ms	D	S	U	U	U	D	S	U	U	D

Table 2: Special subframe configurations (DwPTS/GP/UpPTS lengths).





Special subframe configuration	Normal cyclic prefix in downlink			Extended cyclic prefix in downlink		
	DwPTS	UpPTS		DwPTS	UpPTS	
		Normal cyclic prefix in uplink	Extended cyclic prefix in uplink		Normal cyclic prefix in uplink	Extended cyclic prefix in uplink
0	$6592 \cdot T_s$	$(1+X) \cdot 2192 \cdot T_s$	$(1+X) \cdot 2560 \cdot T_s$	$7680 \cdot T_s$	$(1+X) \cdot 2192 \cdot T_s$	$(1+X) \cdot 2560 \cdot T_s$
1	$19760 \cdot T_s$			$20480 \cdot T_s$		
2	$21952 \cdot T_s$			$23040 \cdot T_s$		
3	$24144 \cdot T_s$			$25600 \cdot T_s$		
4	$26336 \cdot T_s$			$7680 \cdot T_s$		
5	$6592 \cdot T_s$	$(2+X) \cdot 2192 \cdot T_s$	$(2+X) \cdot 2560 \cdot T_s$	$20480 \cdot T_s$	$(2+X) \cdot 2192 \cdot T_s$	$(2+X) \cdot 2560 \cdot T_s$
6	$19760 \cdot T_s$			$23040 \cdot T_s$		
7	$21952 \cdot T_s$			$12800 \cdot T_s$		
8	$24144 \cdot T_s$			-	-	-
9	$13168 \cdot T_s$			-	-	-

T_s is an interval of time used in the system, and X is a predefined or preconfigured value.

In the LTE system, uplink and downlink resources are allocated by defining the above TDD frame structure. Therefore, for an LTE cell, only one TDD frame structure can be configured, and only a fixed allocation of the uplink and downlink resources is supported. The allocation is indicated by means of system information broadcast in the cell, and it is thus fixed and shared among all terminals in the cell.

Furthermore, in the LTE system, a GP needs to be arranged between an uplink resource and a downlink resource to avoid interference between the uplink and the downlink in the same cell, and to switch from the downlink to the uplink. A GP only exists in a special subframe in each TDD uplink-downlink configuration described above, and the length of the GP is determined by a special subframe configuration corresponding to an allocation of lengths of a downlink resource (a DwPTS part), an uplink resource (an UpPTS part), and a GP part in the special subframe. The special subframe configuration is also indicated in a cell by means of system information broadcasted in the cell, and it is thus fixed and shared among all terminals in the cell.

A shortcoming in the prior art is that with a current 5G system as an example, a solution that can use dynamic allocations of uplink and downlink resources to perform data transmission has not existed yet.

Summary of the Invention





Embodiments of the present invention provide a data transmission method and apparatus so as to provide a solution capable of dynamically allocating uplink and downlink resources for data transmission.

The embodiments of the present invention provide a data transmission method, comprising:

allocating DL regions in a time unit, wherein the time unit comprises at least two DL regions; and

notifying a terminal of the allocated DL regions by means of configuration signaling.

Preferably, notifying the terminal of the allocated DL regions by means of the configuration signaling specifically comprises:

notifying the terminal of lengths and positions of the DL regions in the time unit; or

notifying the terminal of one of a plurality of predetermined patterns, each pattern comprising an allocation of lengths and positions of the DL regions in the time unit; or

notifying the terminal of start or end positions of the DL regions in the time unit.

Preferably, a UL region and/or GP region in the time unit are/is further indicated by means of the configuration signaling, specifically comprising:

notifying the terminal of a length and a position of the UL region in the time unit; or

notifying the terminal of one of a plurality of predetermined patterns, each pattern comprising an allocation of a length and a position of the UL region in the time unit; or

notifying the terminal of a start or end position of the UL region in the time unit; or

notifying the terminal of indication information so that the terminal determines the UL region in the time unit according to the indication information under a predefined rule.

Preferably, the method further comprises:

determining the UL region in the time unit according to uplink scheduling signaling, or according to a position at which ACK/NACK for downlink transmission is fed back.

Preferably, the configuration signaling is indicated by means of higher-layer signaling or physical downlink control signaling in a unicast or broadcast or multicast form.

Preferably, the method further comprises:

transmitting a downlink control channel to the terminal in at least one DL region in the time unit.





Preferably, before the downlink control channel is transmitted to the terminal in the at least one DL region in the time unit, the method further comprises:

determining a detection DL region of the terminal in the time unit, and notifying the terminal of the detection DL region by means of configuration information, or determining a detection DL region in the time unit according to a pre-definition, wherein the detection DL region may be a part or all of the DL regions in the time unit; and

when the detection DL region is configured or defined, transmitting the downlink control channel to the terminal in at least one DL region in the detection DL region corresponding to the terminal.

Preferably, the method further comprises:

when a downlink DCI format is used for the downlink control channel, receiving ACK/NACK feedback for the downlink control channel, and/or ACK/NACK feedback for a downlink shared channel corresponding to the downlink control channel, in a UL region corresponding to a DL region in which the downlink control channel is transmitted; or

when an uplink DCI format is used for the downlink control channel, receiving an uplink shared channel corresponding to the downlink control channel in the UL region corresponding to the DL region in which the downlink control channel is transmitted.

Preferably, a UL region corresponding to a DL region is determined according to one or a combination of the following schemes:

a region spaced from the DL region by a length T after an end position of the DL region is the UL region corresponding to the DL region, or a first UL region spaced from the DL region by the length T after the end position of the DL region is a UL feedback region corresponding to the DL region, wherein T is predefined or configured; or

the UL region corresponding to the DL region is indicated by means of indication information in the downlink control channel; or

a UL region corresponding to a part of DL regions in a time unit is predefined or configured as a UL region in a current time unit, and if there are a plurality of UL regions in the current time unit, then the UL region corresponding to the part of the DL regions is one or more defined or configured UL regions in the current time unit; or

a UL region corresponding to a part of DL regions in a time unit is predefined or configured as a UL region in a next time unit, and if there are a plurality of UL regions in the next time unit, then the UL region corresponding to the part of the DL regions is one or more defined or configured UL regions in the next time unit; or





a UL region corresponding to a DL region in a time unit is predefined or configured as a UL region in the current time unit, and if there are a plurality of DL regions and a plurality of UL regions in the current time unit, then each DL region corresponds to one or more defined or configured UL regions.

Preferably, the time unit is one or more slots, or one or more subframes.

The embodiments of the present invention provide a data transmission method, comprising:

receiving configuration signaling; and

determining DL regions allocated in a time unit according to the configuration signaling, wherein the time unit comprises at least two DL regions.

Preferably, determining the DL regions allocated in the time unit according to the configuration signaling specifically comprises:

notifying lengths and positions of the DL regions in the time unit by means of the configuration signaling; or

notifying one of a plurality of predetermined patterns by means of the configuration signaling, each pattern comprising an allocation of lengths and positions of the DL regions in the time unit; or

notifying start or end positions of the DL regions in the time unit by means of the configuration signaling.

Preferably, when determining the DL regions allocated in the time unit according to the configuration signaling, the method further comprises:

determining a UL region and/or a GP region in the time unit according to the configuration signaling, wherein

a length and a position of the UL region in the time unit are indicated by means of the configuration signaling; or

one of a plurality of predetermined patterns is indicated by means of the configuration signaling, each pattern comprising an allocation of a length and a position of the UL region in the time unit; or

a start or end position of the UL region in the time unit is indicated by means of the configuration signaling; or





indication information is indicated by means of the configuration signaling so that the terminal determines the UL region in the time unit according to the indication information under a predefined rule.

Preferably, the method further comprises:

determining, by the terminal, the UL region in the time unit according to uplink scheduling signaling, or determining, by the terminal, the UL region in the time unit according to a position at which ACK/NACK for downlink transmission is fed back.

Preferably, the configuration signaling is indicated by means of higher-layer signaling or physical downlink control signaling in a unicast or broadcast or multicast form.

Preferably, the method further comprises:

detecting a downlink control channel in each DL region or each detection DL region in the time unit.

Preferably, before detection of a downlink control channel is performed in each detection DL region in the time unit, the method further comprises:

receiving configuration information, and determining a detection DL region in the time unit according to the configuration information, or determining a detection DL region in the time unit according to a pre-definition, wherein the detection DL region may be a part or all of the DL regions in the time unit.

Preferably, the method further comprises:

when a downlink DCI format is used for the downlink control channel, transmitting ACK/NACK feedback for the downlink control channel, and/or ACK/NACK feedback for a downlink shared channel corresponding to the downlink control channel, in a UL region corresponding to a DL region in which the downlink control channel is received; or

when an uplink DCI format is used for the downlink control channel, transmitting an uplink shared channel corresponding to the downlink control channel in the UL region corresponding to the DL region in which the downlink control channel is received.

Preferably, a UL region corresponding to a DL region is determined according to one or a combination of the following schemes:

a region spaced from the DL region by a length T after an end position of the DL region is the UL region corresponding to the DL region, or a first UL region spaced from the DL region by the length T after the end position of the DL region is a UL feedback region corresponding to the DL region, wherein T is predefined or configured; or





the UL region corresponding to the DL region is determined according to indication information in the downlink control channel; or

a UL region corresponding to a part of DL regions in a time unit is predefined or configured as a UL region in a current time unit, and if there are a plurality of UL regions in the current time unit, then the UL region corresponding to the part of the DL regions is one or more defined or configured UL regions in the current time unit; or

a UL region corresponding to a part of DL regions in a time unit is predefined or configured as a UL region in a next time unit, and if there are a plurality of UL regions in the next time unit, then the UL region corresponding to the part of the DL regions is one or more defined or configured UL regions in the next time unit; or

a UL region corresponding to a DL region in a time unit is predefined or configured as a UL region in the current time unit, and if there are a plurality of DL regions and a plurality of UL regions in the current time unit, then each DL region corresponds to one or more defined or configured UL regions.

Preferably, the time unit is one or more slots, or one or more subframes.

The embodiments of the present invention provide a data transmission apparatus, comprising:

an allocating module configured to allocate DL regions in a time unit, wherein the time unit comprises at least two DL regions; and

a notifying module configured to notify a terminal of the allocated DL regions by means of configuration signaling.

Preferably, the notifying module is further configured to notify the terminal of the allocated DL regions by means of configuration signaling, specifically comprising:

notifying the terminal of lengths and positions of the DL regions in the time unit; or

notifying the terminal of one of a plurality of predetermined patterns, each pattern comprising an allocation of lengths and positions of the DL regions in the time unit; or

notifying the terminal of start or end positions of the DL regions in the time unit.

Preferably, the notifying module is further configured to further notify, in the configuration signaling,

a UL region and/or a GP region in the time unit, specifically comprising:

notifying the terminal of a length and a position of the UL region in the time unit; or





notifying the terminal of one of a plurality of predetermined patterns, each pattern comprising an allocation of a length and a position of the UL region in the time unit; or

notifying the terminal of a start or end position of the UL region in the time unit; or

notifying the terminal of indication information so that the terminal determines the UL region in the time unit according to the indication information under a predefined rule.

Preferably, notifying the UL region and/or the GP region in the time unit further comprises:

determining the UL region in the time unit according to uplink scheduling signaling, or according to a position at which ACK/NACK for downlink transmission is fed back.

Preferably, the notifying module is further configured to transmit the configuration signaling by means of higher-layer signaling or physical downlink control signaling in a unicast or broadcast or multicast form.

Preferably, the apparatus further comprises:

a transmitting module configured to transmit a downlink control channel to the terminal in at least one DL region in the time unit.

Preferably, the transmitting module is further configured to, before the downlink control channel is transmitted to the terminal in at least one DL region in the time unit, perform operations further comprising:

determining a detection DL region of the terminal in the time unit, and notifying the terminal of the detection DL region by means of configuration information, or determining a detection DL region in the time unit according to a pre-definition, wherein the detection DL region may be a part or all of the DL regions in the time unit; and

when the detection DL region is configured or defined, transmitting the downlink control channel to the terminal in at least one DL region in the detection DL region corresponding to the terminal.

Preferably, the transmitting module is further configured to: when a downlink DCI format is used for the downlink control channel, receive ACK/NACK feedback for the downlink control channel, and/or ACK/NACK feedback for a downlink shared channel corresponding to the downlink control channel, in a UL region corresponding to a DL region in which the downlink control channel is transmitted; or

when an uplink DCI format is used for the downlink control channel, receiving an uplink shared channel corresponding to the downlink control channel in the UL region corresponding to the DL region in which the downlink control channel is transmitted.





Preferably, a UL region corresponding to a DL region is determined according to one or a combination of the following schemes:

a region spaced from the DL region by a length T after an end position of the DL region is the UL region corresponding to the DL region, or a first UL region spaced from the DL region by the length T after the end position of the DL region is a UL feedback region corresponding to the DL region, wherein T is predefined or configured; or

the UL region corresponding to the DL region is indicated by means of indication information in the downlink control channel; or

a UL region corresponding to a part of DL regions in a time unit is predefined or configured as a UL region in a current time unit, and if there are a plurality of UL regions in the current time unit, then the UL region corresponding to the part of the DL regions is one or more defined or configured UL regions in the current time unit; or

a UL region corresponding to a part of DL regions in a time unit is predefined or configured as a UL region in a next time unit, and if there are a plurality of UL regions in the next time unit, then the UL region corresponding to the part of the DL regions is one or more defined or configured UL regions in the next time unit; or

a UL region corresponding to a DL region in a time unit is predefined or configured as a UL region in the current time unit, and if there are a plurality of DL regions and a plurality of UL regions in the current time unit, then each DL region corresponds to one or more defined or configured UL regions.

Preferably, the time unit is one or more slots, or one or more subframes.

The embodiments of the present invention provide a data transmission apparatus, comprising:

a receiving module configured to receive configuration signaling; and

a determining module configured to determine DL regions allocated in a time unit according to the configuration signaling, wherein the time unit comprises at least two DL regions.

Preferably, the determining module is configured to, when determining the DL regions allocated in the time unit according to the configuration signaling, perform operations specifically comprising:

determining lengths and positions of the DL regions in the time unit indicated by means of the configuration signaling; or





determining one of a plurality of predetermined patterns indicated by means of the configuration signaling, each pattern comprising an allocation of lengths and positions of the DL regions in the time unit; or

determining start or end positions of the DL regions in the time unit indicated by means of the configuration signaling.

Preferably, the determining module is further configured to:

determine a UL region and/or a GP region in the time unit according to the configuration signaling, wherein

a length and a position of the UL region in the time unit are indicated by means of the configuration signaling; or

one of a plurality of predetermined patterns is indicated by means of the configuration signaling, each pattern comprising an allocation of a length and a position of the UL region in the time unit; or

a start or end position of the UL region in the time unit is indicated by means of the configuration signaling; or

indication information is indicated by means of the configuration signaling so that the terminal determines the UL region in the time unit according to the indication information under a predefined rule.

Preferably, the determining module is further configured to:

determine the UL region in the time unit according to uplink scheduling signaling, or determine the UL region in the time unit according to a position at which ACK/NACK for downlink transmission is fed back.

Preferably, the receiving module is further configured to receive the configuration signaling indicated by means of higher-layer signaling or physical downlink control signaling in a unicast or broadcast or multicast form.

Preferably, the apparatus further comprises:

a detecting module configured to detect a downlink control channel in each DL region or each detection DL region in the time unit.

Preferably, before detection of a downlink control channel is performed in each detection DL region in the time unit, the detecting module is further configured to perform operations further comprising:





receiving configuration information, and determining a detection DL region in the time unit according to the configuration information, or determining a detection DL region in the time unit according to a pre-definition, wherein the detection DL region may be a part or all of the DL regions in the time unit.

Preferably, the detecting module is further configured to, when a downlink DCI format is used for the downlink control channel, transmit ACK/NACK feedback for the downlink control channel, and/or ACK/NACK feedback for a downlink shared channel corresponding to the downlink control channel, in a UL region corresponding to a DL region in which the downlink control channel is received; or

when an uplink DCI format is used for the downlink control channel, transmit an uplink shared channel corresponding to the downlink control channel in the UL region corresponding to the DL region in which the downlink control channel is received.

Preferably, a UL region corresponding to a DL region is determined according to one or a combination of the following schemes:

a region spaced from the DL region by a length T after an end position of the DL region is the UL region corresponding to the DL region, or a first UL region spaced from the DL region by the length T after the end position of the DL region is a UL feedback region corresponding to the DL region, wherein T is predefined or configured; or

the UL region corresponding to the DL region is determined according to indication information in the downlink control channel; or

a UL region corresponding to a part of DL regions in a time unit is predefined or configured as a UL region in a current time unit, and if there are a plurality of UL regions in the current time unit, then the UL region corresponding to the part of the DL regions is one or more defined or configured UL regions in the current time unit; or

a UL region corresponding to a part of DL regions in a time unit is predefined or configured as a UL region in a next time unit, and if there are a plurality of UL regions in the next time unit, then the UL region corresponding to the part of the DL regions is one or more defined or configured UL regions in the next time unit; or

a UL region corresponding to a DL region in a time unit is predefined or configured as a UL region in the current time unit, and if there are a plurality of DL regions and a plurality of UL regions in the current time unit, then each DL region corresponds to one or more defined or configured UL regions.

Preferably, the time unit is one or more slots, or one or more subframes.





Beneficial effects of the present Invention are as follows:

in the technical solutions according to the embodiments of the present invention, at least two DL regions are defined in a time unit, the terminal detects downlink transmission in each DL region or a part of DL regions, and when the downlink transmission is detected, the terminal feeds back ACK/NACK in an uplink region corresponding to the downlink region. Since a time unit can be divided into a plurality of downlink regions, and each downlink region can separately define feedback and scheduling relationships, the flexibility of scheduling and the utilization ratio of system resources can be improved.

Brief Description of the Drawings

The drawings described here are used to provide further understanding of the present invention, and constitute a part of the present invention, and the exemplary embodiments of the present invention and the description thereof are used to explain the present invention, but not to limit the present invention unduly. In the drawings:

FIG. 1 is a schematic diagram of a frame structure type 2 used in an LTE TDD system in the background art;

FIG. 2 is a schematic flow chart of an implementation of a data transmission method at a base station side in an embodiment of the present invention;

FIG. 3 is a schematic flow chart of an implementation of a data transmission method at a terminal side in an embodiment of the present invention;

FIG. 4 is a schematic diagram of an allocation of and a correspondence relationship between uplink and downlink resources of a system with a TA and/or a switching time according to Embodiment 1 of the present invention;

FIG. 5 is a schematic diagram of an allocation of and a correspondence relationship between uplink and downlink resources of a system without any TA and/or switching time according to Embodiment 1 of the present invention;

FIG. 6 is a schematic diagram of scenario 1 or 3 at a terminal side with a TA and/or a switching time in Embodiment 1 of the present invention;

FIG. 7 is a schematic diagram of scenario 1 or 3 at a terminal side without any TA and/or switching time in Embodiment 1 of the present invention;

FIG. 8 is a schematic diagram of scenario 2 or 4 at a terminal side with a TA and/or a switching time in Embodiment 1 of the present invention;





FIG. 9 is a schematic diagram of scenario 2 or 4 at a terminal side without any TA and/or switching time in Embodiment 1 of the present invention;

FIG. 10 is a schematic diagram of an allocation of and a correspondence relationship between uplink and downlink resources of a system with a TA and/or a switching time in Embodiment 1 of the present invention when being in different services;

FIG. 11 is a schematic diagram of an allocation of and a correspondence relationship between uplink and downlink resources of a system without any TA and/or switching time in Embodiment 1 of the present invention when being in different services;

FIG. 12 is a schematic diagram of an allocation of and a correspondence relationship between uplink and downlink resources of a system with a TA and/or a switching time according to Embodiment 2 of the present invention;

FIG. 13 is a schematic diagram of an allocation of and a correspondence relationship between uplink and downlink resources of a system without any TA and/or switching time according to Embodiment 2 of the present invention;

FIG. 14 is a schematic diagram of a first or third instance at a terminal side with a TA and/or a switching time in Embodiment 2 of the present invention;

FIG. 15 is a schematic diagram of scenario 1 or 3 at a terminal side without any TA and/or switching time in Embodiment 2 of the present invention;

FIG. 16 is a schematic diagram of scenario 2 or 4 at a terminal side with a TA and/or a switching time in Embodiment 2 of the present invention;

FIG. 17 is a schematic diagram of scenario 2 or 4 at a terminal side without any TA and/or switching time in Embodiment 2 of the present invention;

FIG. 18 is a schematic diagram of an allocation of and a correspondence relationship between uplink and downlink resources of a system with a TA and/or a switching time in Embodiment 2 of the present invention when being in different services;

FIG. 19 is a schematic diagram of an allocation of and a correspondence relationship between uplink and downlink resources of a system without any TA and/or switching time in Embodiment 2 of the present invention when being in different services;

FIG. 20 is a schematic structural diagram of a data transmission apparatus at a base station side in an embodiment of the present invention;

FIG. 21 is a schematic structural diagram of a data transmission apparatus at a terminal side in an embodiment of the present invention;





FIG. 22 is a schematic structural diagram of a base station in an embodiment of the present invention; and

FIG. 23 is a schematic structural diagram of a terminal in an embodiment of the present invention.

Detailed Description of the Preferred Embodiments

The inventors have noticed during making of the invention that:

with the development and changes in the demand for mobile communication services, the International Telecommunication Union (ITU), the 3rd Generation Partnership Project (3GPP), and other organizations have begun to carry out research on a new wireless communication system (e.g., a 5G system). The new wireless communication system can support various coexisting types of services, e.g., an enhanced mobile broadband (eMBB) service, an ultra-reliable & low latency communication (URLLC) service, a massive machine type communication (mMTC) service, etc., and the amount of traffic of the same service may also vary. When uplink and downlink traffic shares the same frequency resource in a time division multiplexing (TDM) mode, in order to support different types of services and demands for the amount of traffic, a flexible and varying allocation of resources shall be supported, but a related solution that can use dynamically allocated uplink and downlink resources to perform data transmission has not existed yet.

Based on the foregoing, an embodiment of the present invention provides a solution to transmit data, wherein at least two DL detection regions are defined in a time unit, a terminal detects downlink transmission in each detection region, and when downlink transmission is detected, the terminal feeds back ACK/NACK in an uplink region corresponding to the downlink region. Specific implementations of the present invention will be described below with reference to the drawings.

In the following description, implementations at a base station side and a terminal side will be described separately, and then an example of an implementation in which both of them cooperate will be further given for better understanding of the implementations of the solutions given in the embodiments of the present invention. However, such a description does not mean that both of them must cooperate in an implementation, or they must operate separately in an implementation. In practice, respective problems at the base station side and the terminal side can also be addressed when they operate separately in an implementation, although a better technical effect can be achieved when both of them are used in combination.





It should further be noted that since the behaviors on the base station side generally correspond to those on the terminal side, for the sake of conciseness, one of the sides will be mainly described, but it does not mean that there is no corresponding implementation at the other side which is not described. Those skilled in the art should be able to understand the implementation of the corresponding side according to common sense.

FIG. 2 is a schematic flow chart of an implementation of a data transmission method at the base station side, and as shown in the figure, the method may include:

step 201, allocating DL regions in a time unit, wherein the time unit includes at least two DL regions; and

step 202, notifying a terminal of the allocated DL regions by means of configuration signaling.

FIG. 3 is a schematic flow chart of an implementation of a data transmission method at the terminal side, and as shown in the figure, the method may include:

step 301, receiving configuration signaling; and

step 302, determining DL regions allocated in a time unit according to the configuration signaling, wherein the time unit includes at least two DL regions.

The base station side will be mainly described below.

In an implementation, notifying the terminal of the allocated DL regions by means of the configuration signaling may specifically include:

notifying the terminal of lengths and positions of the DL regions in the time unit; or

notifying the terminal of one of a plurality of predetermined patterns, each pattern comprising an allocation of lengths and positions of the DL regions in the time unit; or

notifying the terminal of start or end positions of the DL regions in the time unit.

Specifically, an allocation of DL regions in a time unit is determined, and the terminal is indicated of an allocation result by means of configuration signaling.

Lengths and positions of the DL regions in the time unit are directly indicated by means of configuration signaling; or a plurality of patterns of combinations of lengths and positions of the DL regions in the time unit are predefined, and one of the patterns is indicated by means of configuration signaling; or start positions of the DL regions in the time unit are directly indicated by means of configuration signaling, and lengths of the DL regions can be obtained otherwise, e.g., through energy detection, or the lengths or end positions of the DL regions are directly





indicated by means of other configuration signaling; or end positions of the DL regions in the time unit are directly indicated by means of configuration signaling, and start positions of the DL regions can be determined through energy detection or in a predefined manner or according to a UL region and/or a GP region.

In an implementation, a UL region and/or a GP region in the time unit is further indicated by means of configuration signaling.

Specifically, if the DL and UL regions are determined, then the GP region may also be determined by itself according to the sizes of the DL and UL regions instead of being indicated. Similarly, if the DL and GP regions are determined, then the UL region may also be determined by itself according to the sizes of the DL and GP regions instead of being indicated.

In an implementation, a UL region and/or GP region in the time unit are/is further indicated by means of the configuration signaling, which specifically includes:

- notifying the terminal of a length and a position of the UL region in the time unit;

- or notifying the terminal of one of a plurality of predetermined patterns, each pattern comprising an allocation of a length and a position of the UL region in the time unit;

- or notifying the terminal of start or end positions of the UL regions in the time unit;

- or notifying the terminal of indication information so that the terminal determines the UL region in the time unit according to the indication information under a predefined rule.

In an implementation, an allocation of UL regions and and/or a GP allocation in the time unit may further be indicated by means of the configuration signaling, which may be as follows:

- lengths and positions of uplink regions in the time unit are directly indicated by means of configuration signaling;

- or a plurality of patterns of combinations of lengths and positions of the uplink regions in the time unit are predefined, and one of the patterns is indicated by means of configuration signaling;

- or start or end positions of the uplink regions in the time unit are directly indicated by means of configuration signaling, and lengths of the uplink regions can be obtained otherwise, e.g., through scheduling signaling, or the start or end positions of the uplink regions are indicated by means of other configuration signaling.

As another implementation, the UL region in the time unit is determined according to uplink scheduling signaling, or according to a position at which ACK/NACK for downlink transmission is fed back. That is, the uplink region is obtained implicitly, and for example, a scheduled uplink





region is determined according to uplink scheduling signaling, an uplink region for carrying ACK/NACK is determined according to the position at which the ACK/NACK for downlink transmission is fed back, etc., or the GP region is indicated by means of configuration signaling, and the uplink region is determined according to the GP region and the downlink region.

In an implementation, the method may further include:

determining the UL region in the time unit according to uplink scheduling signaling, or according to a position at which ACK/NACK for downlink transmission is fed back.

In an implementation, the configuration signaling may be indicated by means of higher-layer signaling or physical downlink control signaling in a unicast or broadcast or multicast form.

Specifically, the configuration signaling may be transmitted in a unicast or broadcast or multicast form, e.g., at some periodicity, and different configuration signaling may be transmitted in different periodicities; or the configuration signaling may be transmitted by means of higher-layer signaling or over a downlink control channel; and the downlink control channel may be transmitted in a UE-specific search space (USS), or may be transmitted in a cell-specific search space (CSS).

In an implementation, the method may further include:

transmitting a downlink control channel to the terminal in at least one DL region in the time unit.

In an implementation, before the downlink control channel is transmitted to the terminal in the at least one DL region in the time unit, the method further include:

determining a detection DL region of the terminal in the time unit, and notifying the terminal of the detection DL region by means of configuration information, or determining a detection DL region in the time unit according to a pre-definition, wherein the detection DL region may be a part or all of the DL regions in the time unit; and

when the detection DL region is configured or defined, transmitting the downlink control channel to the terminal in at least one DL region in the detection DL region corresponding to the terminal.

Specifically, a downlink control channel is transmitted to the terminal in at least one DL region in a time unit; a detection DL region of the terminal is preconfigured, wherein the detection DL region may be a part or all of the DL regions; and when the detection DL region is configured, a downlink control channel is transmitted to the terminal in the detection DL region corresponding to the terminal.





Correspondingly, at the terminal side, the method is correspondingly as follows:

In an implementation, the method may further include:

detecting a downlink control channel in each DL region or each detection DL region in the time unit.

In an implementation, before detection of a downlink control channel is performed in each detection DL region in the time unit, the method further includes:

receiving configuration information, and determining a detection DL region in the time unit according to the configuration information, or determining a detection DL region in the time unit according to a pre-definition, wherein the detection DL region may be a part or all of the DL regions in the time unit.

In an implementation, the method may further include:

when a downlink DCI format is used for the downlink control channel, receiving ACK/NACK feedback for the downlink control channel, and/or ACK/NACK feedback for a downlink shared channel corresponding to the downlink control channel, in a UL region corresponding to a DL region in which the downlink control channel is transmitted; or

when an uplink DCI format is used for the downlink control channel, receiving an uplink shared channel corresponding to the downlink control channel in the UL region corresponding to the DL region in which the downlink control channel is transmitted.

Specifically, when a downlink DCI format is used for the downlink control channel, ACK/NACK feedback for the downlink control channel, and/or ACK/NACK feedback for a downlink shared channel corresponding to the downlink control channel is received in a UL region corresponding to the DL region in which the downlink control channel is transmitted; and when an uplink DCI format is used for the downlink control channel, an uplink shared channel corresponding to the downlink control channel is received in a UL region corresponding to the DL region in which the downlink control channel is transmitted.

Correspondingly, at the terminal side, the method is correspondingly as follows:

In an implementation, the method may further include:

when a downlink DCI format is used for the downlink control channel, transmitting ACK/NACK feedback for the downlink control channel, and/or ACK/NACK feedback for a downlink shared channel corresponding to the downlink control channel, in a UL region corresponding to a DL region in which the downlink control channel is received; or





when an uplink DCI format is used for the downlink control channel, transmit an uplink shared channel corresponding to the downlink control channel in the UL region corresponding to the DL region in which the downlink control channel is received.

Specifically, when the terminal detects downlink transmission (including a downlink control channel and a downlink shared channel, for which ACK/NACK is to be fed back; wherein the downlink shared channel includes a downlink shared channel with a corresponding downlink control channel, and a downlink shared channel without any corresponding downlink control channel) in a DL region, the terminal feeds back ACK/NACK for the downlink transmission, in a UL region corresponding to the DL region; and when the terminal detects a downlink control channel in an uplink DCI format in a DL region, the terminal transmits an uplink shared channel corresponding to the downlink control channel in a UL region corresponding to the DL region.

In an implementation, a UL region corresponding to a DL region may be determined according to one or a combination of the following schemes:

a region spaced from the DL region by a length T after an end position of the DL region is the UL region corresponding to the DL region, or a first UL region spaced from the DL region by the length T after the end position of the DL region is a UL feedback region corresponding to the DL region; wherein T is predefined or configured.

Specifically, a region spaced from a DL region by a length T after an end position of the DL region is a UL region corresponding to the DL region, or the first UL region spaced from a DL region by a length T after an end position of the DL region is a UL feedback region corresponding to the DL region, wherein lengths T corresponding to respective DL regions may be the same or different, and a sum of a length of a DL region, a length T , and a length of a corresponding UL region may be less than or equal to or greater than a length of a time unit; and T is predefined or configured; and when T is configured, it may be configured semi-statically by means of higher-layer signaling, or may be indicated in the downlink control channel (e.g., as a feedback time sequence or a feedback delay or a scheduling time sequence or a scheduling delay).

Alternatively, the UL region corresponding to the DL region is indicated by means of indication information in the downlink control channel.

Specifically, a UL region corresponding to a DL region is determined according to indication information in the downlink control channel, and for example, the indication information indicates a time domain position of the UL region directly, e.g., the number of a symbol, a micro-slot, a slot, a subframe, etc., or may also indicate a delay on the basis of a predefined processing delay, wherein a region or the first UL region satisfying the processing delay and the





delay after the end position of the downlink region is determined as a UL region corresponding to the DL region according to the delay and the processing delay.

Alternatively, a UL region corresponding to a part of DL regions in a time unit is predefined or configured as a UL region in a current time unit, and if there are a plurality of UL regions in the current time unit, then the UL region corresponding to the part of the DL regions is one or more defined or configured UL regions in the current time unit.

Alternatively, a UL region corresponding to a part of DL regions in a time unit is predefined or configured as a UL region in a next time unit, and if there are a plurality of UL regions in the next time unit then the UL region corresponding to the part of the DL regions is one or more defined or configured UL regions in the next time unit.

Specifically, a UL region corresponding to the first a DL regions in a time unit can be predefined or configured as a UL region in the current time unit, that is, ACK/NACK for downlink transmission in the first a DL regions in the time unit is fed back in a UL region in the time unit, that is, a downlink control channel in an uplink DCI format in the first a DL regions in the time unit schedules an uplink shared channel to be transmitted in a UL region in the time unit. If there are a plurality of UL regions in the time unit, then a UL region corresponding to the first a DL regions in the time unit will be a UL region predefined or configured in the current time unit, and for example, defined or configured as the last UL region in the current time unit. A UL region corresponding to the last b DL regions in a time unit is predefined or configured as a UL region in the next time unit, that is, ACK/NACK for downlink transmission in the last b DL regions in the time unit is fed back in a UL region in the next time unit, that is, a downlink control channel in an uplink DCI format in the last b DL regions in the time unit schedules an uplink shared channel to be transmitted in a UL region in the next time unit. If there are a plurality of UL regions in the next time unit, then a UL region corresponding to the last b DL regions in the time unit will be a UL region predefined or configured in the next time unit, and for example, predefined or configured as the first UL region in the next time unit.

For example, when there are two DL regions and one UL region in a time unit, the first DL region in the first time unit may be defined to correspond to a UL region in the time unit, and the second DL region in the first time unit may be defined to correspond to a UL region in the next time unit; and in another example, when there are two DL regions and two UL regions in a time unit, the first DL region in a time unit may be defined to correspond to the second UL region in the time unit, and the second DL region in a time unit may be defined to correspond to the first UL region in the next time unit.

Other definitions will not be precluded, and when there are more DL and UL regions in a time unit, a similar definition will apply.





Alternatively, a UL region corresponding to a DL region in a time unit is predefined or configured as a UL region in the current time unit, and if there are a plurality of DL regions, and a plurality of UL regions in the current time unit, then each DL region will correspond to one or more predefined or configured UL regions.

Specifically, for example, when there are two DL regions and two UL regions in a time unit, then a first DL region may be defined to correspond to a first UL region, and a second DL region may be defined to correspond to a second UL region. The same will apply to other numbers of DL regions and UL regions.

In an implementation, the method may further include:

indicating a feedback delay or a feedback time sequence or a feedback position index in the downlink control channel for the terminal to determine a resource for feeding back ACK/NACK in a corresponding UL region;

and/or, indicating a scheduling delay or a scheduling time sequence or a scheduling position index in the downlink control channel for the terminal to determine a resource for transmitting an uplink shared channel in a corresponding UL region.

Specifically, the downlink control channel may indicate a feedback delay or a feedback time sequence or a feedback position index for the terminal to determine a resource (e.g., a symbol or a mini-slot) for feeding back ACK/NACK in a corresponding UL region.

and the downlink control channel can indicate a scheduling delay or a scheduling time sequence or a scheduling position index for the terminal to determine a resource (e.g., a symbol or a mini-slot) for transmitting an uplink shared channel in a corresponding UL region.

In an implementation, a time unit may be one or more slots, or one or more subframes.

In a specific implementation, a plurality of DL regions in a time unit may or may not be adjacent (they are spaced by a GP between the current downlink transmission and uplink feedback of the current terminal, and there may also be DL or UL transmission of another terminal in the GP).

The sizes of respective DL regions in a time unit may be the same or different. For example, there are two symbols in the first DL region, and three symbols in the second DL region.

For different services, there may be different numbers of DL region and UL regions in a time unit. For example, there are one DL region and one UL region in a time unit for an eMBB service, and two DL regions and two UL regions in a time unit for a URLLC service. For different services, a correspondence relationship between a DL region and a UL region may be the same or different.



There may be one or more slots, or one or more subframes in a time unit.

For a specific implementation, reference may be made to the description of the implementation at the base station side.

Specific examples of an implementation in which the base station side and the terminal side cooperate with each other will be further described below.

In the drawings in the embodiments, "AN" refers to Acknowledgement/Negative Acknowledgement (ACK/NACK).

Embodiment 1:

FIG. 4 is a schematic diagram of an allocation of and a correspondence relationship between uplink and downlink resources of a system with a TA and/or a switching time in Embodiment 1, and FIG. 5 is a schematic diagram of an allocation of and a correspondence relationship between uplink and downlink resources of a system without any TA and/or switching time in Embodiment 1. As shown in FIG. 4, it is assumed that a base station determines to divide a time unit into two DL regions and one UL region, and there is such a blank region or a GP region between a DL region and the UL region that is a reserved region determined to satisfy a timing advance (TA) demand of the UL, a switching time from the DL to the UL, etc., possibly taking into account interference between adjacent cells, and other factors. Of course, if a TA or a switching time or anti-interference is not required, then there may be no blank part or GP part, as shown in FIG. 5. A correspondence relationship between the DL regions and the UL region may be predefined or configured directly. For example, the first DL region in a time unit is defined or configured to schedule uplink transmission in the UL region in the time unit (wherein uplink transmission in the UL region may occupy only a part of orthogonal frequency division multiplexing (OFDM) or single-carrier frequency division multiple access (SC-FDMA) symbols or a part of mini-slots in the UL region, so a plurality of uplink shared channels of the same or different terminals may be transmitted in a UL region in a time division multiplexing (TDM) mode, or uplink transmission in the UL region may occupy the length of the entire UL region, and the same will apply hereinafter). The second DL region in a time unit is scheduled to perform uplink transmission in the UL region in the next time unit, ACK/NACK for downlink transmission in the first DL region in a time unit (wherein downlink transmission in the DL region may occupy only a part of OFDM symbols or a part of mini-slots in the DL region, so a plurality of downlink transmission TDMs of the same or different terminals may be transmitted in a DL region, or downlink transmission in the DL region may occupy the length of the entire DL region) is fed back in the UL region in the time unit (an uplink channel carrying ACK/NACK feedback information for downlink transmission may occupy only a part of OFDM or SC-OFDM symbols or a part of mini-slots in the UL region, so a plurality of uplink channels, carrying ACK/NACK, of the same or different terminals may be transmitted in a UL region, or



the uplink channel may occupy the length of the entire UL region, and the same will apply hereinafter). ACK/NACK for downlink transmission in the second DL region in a time unit is fed back in the UL region in the next time unit, as shown in FIGS. 4 and 5. Of course, the value of T may also be defined or configured, and a UL region spaced from a DL region by a period T of time after the DL region may be defined as a corresponding UL region. The same effect of the correspondence relationship predefined or configured as above may also be achieved, as shown in FIGS. 4 and 5. T lengths of different DL regions may be different, and the value of T for defining a scheduling relationship may be the same as or different from the value of T for defining a feedback relationship. When DL and UL regions is differently allocated in a time unit, the corresponding value of T will also be different, and for example, there are different allocations of DL and UL regions for different services. In the present embodiment, a time unit may be a slot or a subframe. Of course, other manners of defining the length of the time unit are not excluded.

The base station notifies a terminal of the above allocation, which may be in the following implementations.

In an implementation, the base station notifies the terminal by means of higher-layer signaling.

In another implementation, the base station transmits configuration signaling over a specific resource in a defined DL region in each time unit, or one of a plurality of time units (e.g., the first N OFDM symbols in a time unit), wherein the configuration signaling may be transmitted over a data channel (e.g., like a system information block (SIB)), or may be transmitted in a control channel (e.g., in a preset downlink control information (DCI) format in a common search space).

The terminal may be indicated directly of the size and the position of each DL region, and the size of the UL region may be determined implicitly according to whether there is a demand for feedback or uplink transmission; or the terminal may be indicated of the size and the position of each DL region, and the size and the position of the UL region, or may be indicated of the size and the position of each DL region, and the size and the position of the GP; or the terminal may be indicated of the size and the position of the UL region, and the size and the position of the GP. Of course, a plurality of modes of combinations of the sizes and the positions of DL regions, a UL region, and a GP region in a time unit may be predefined, and one of the modes may be indicated by means of signaling.

The terminal receives the configuration signaling, and determines a corresponding allocation of DL regions in a time unit to determine a specific part for starting to detect a downlink control channel, wherein according to different configuration modes of the above base station, an





allocation of UL regions may be further determined according to the notification content, or the UL regions may be implicitly determined directly according to the scheduling relationship.

When the base station needs to schedule the terminal, the base station selects at least one DL region in a time unit, and transmits a downlink control channel to the terminal in a downlink control channel search space of the selected DL region to schedule the terminal to receive a downlink shared channel in the selected DL region, or to transmit an uplink shared channel in a corresponding UL region.

For example, in scenario 1, the base station transmits a downlink control channel 1 in a downlink DCI format in a DL region 1 to schedule a terminal 1 to receive a downlink shared channel 1 in the DL region 1, and transmits a downlink control channel 2 in the downlink DCI format in a DL region 2 to schedule a terminal 2 to receive a downlink shared channel 2 in the DL region 2.

For another example, in scenario 2, the base station transmits a downlink control channel 1-1 in a downlink DCI format in a DL region 1 to schedule a terminal 1 to receive a downlink shared channel 1-1 in the DL region 1, transmits a downlink control channel 2-1 in the downlink DCI format in the DL region 1 to schedule a terminal 2 to receive a downlink shared channel 2-1 in the DL region 1, transmits a downlink control channel 1-2 in the downlink DCI format in a DL region 2 to schedule the terminal 1 to receive a downlink shared channel 1-2 in the DL region 2, and transmits a downlink control channel 2-2 in the downlink DCI format in the DL region 2 to schedule the terminal 2 to receive a downlink shared channel 2-2 in the DL region 2.

For another example, in scenario 3, the base station transmits a downlink control channel 1 in an uplink DCI format in a DL region 1 to schedule a terminal 1 to transmit an uplink shared channel 1 in the UL region in the time unit, and transmits a downlink control channel 2 in the uplink DCI format in a DL region 2 to schedule a terminal 2 to transmit an uplink shared channel 2 in the UL region in the next time unit.

For another example, in scenario 4, the base station transmits a downlink control channel 1-1 in an uplink DCI format in a DL region 1 to schedule a terminal 1 to transmit an uplink shared channel 1-1 in the UL region in the time unit, transmits a downlink control channel 2-1 in the uplink DCI format in the DL region 1 to schedule a terminal 2 to transmit an uplink shared channel 2-1 in the UL region in the time unit, transmits a downlink control channel 1-2 in the uplink DCI format in a DL region 2 to schedule the terminal 1 to transmit an uplink shared channel 1-2 in the UL region in the next time unit, and transmits a downlink control channel 2-2 in the uplink DCI format in the DL region 2 to schedule the terminal 2 to transmit an uplink shared channel 2-2 in the UL region in the next time unit.





Of course, the scenarios above may exist in combination. For example, for each terminal, there may be both uplink and downlink scheduled transmission, that is, there may be both scenarios 1 and 3, or both scenarios 2 and 4. For another example, for a terminal, the base station may transmit a downlink control channel (which includes a downlink control channel in an uplink or downlink DCI format, and the same will apply hereafter) thereto in only one DL region in a time unit, and transmit downlink control channels thereto in both of two DL regions in another time unit.

Of course, the base station may further pre-configure a DL region to be detected by the terminal, and this configuration may be made semi-statically by means of radio resource control (RRC) signaling, or may be made by transmitting configuration signaling periodically, wherein the periodicity may be changed according to actual needs. For example, a part of terminals are configured to detect a downlink control channel only in the DL region 1, and another part of terminals are configured to detect a downlink control channel only in the DL region 2. Therefore, if the base station is intended to schedule uplink or downlink transmission of the terminals, then it will transmit downlink control channels of these terminals only in the DL detection regions configured for these terminals.

The terminal detects blindly a downlink control channel in each DL region in a time unit according to the determined allocation of DL and UL regions. When a downlink control channel of the terminal in a downlink DCI format is detected, the terminal receives a corresponding downlink shared channel in the DL region, generates ACK/NACK feedback information (AN feedback in the figure) for the downlink shared channel, and makes ACK/NACK feedback in a UL region corresponding to the DL region. If ACK/NACK feedback is made for a plurality of DL regions in the same corresponding UL region, then ACK/NACK feedback information in the plurality of DL regions may be fed back over the same uplink channel in the UL region, or may be fed back over different uplink channels, wherein if there are different uplink channels, then they may be uplink channels transmitted at different times, or may be uplink channels transmitted over different frequency resources at the same time, or may be uplink channels transmitted over the same time and frequency resource in a code division mode. When a downlink control channel of the terminal in an uplink DCI format is detected, the terminal transmits a corresponding uplink shared channel in a UL region corresponding to the DL region.

For example, in correspondence to scenario 1 at the base station side, the terminal 1 detects a downlink control channel in a downlink DCI format in the DL regions 1 and 2, and only detects a downlink control channel 1 in the downlink DCI format in the DL region 1. Then, the terminal 1 receives a corresponding downlink shared channel 1 in the DL region 1 according to scheduling information carried over the downlink control channel 1, generates ACK/NACK feedback information, and makes ACK/NACK feedback in the UL region in the time unit. The terminal 2 detects a downlink control channel in a downlink DCI format in the DL regions 1 and





2, and only detects a downlink control channel 2 in the downlink DCI format in the DL region 2. Then, the terminal 2 receives a corresponding downlink shared channel 2 in the DL region 2 according to scheduling information carried over the downlink control channel 2, generates ACK/NACK feedback information, and makes ACK/NACK feedback in the UL region in the next time unit. At this time, transmission structures of the terminal 1 and the terminal 2 are as shown in the AN feedback relationships in FIGS. 6 and 7. FIG. 6 is a schematic diagram of scenario 1 or 3 at a terminal side with a TA and/or a switching time in Embodiment 1, and FIG. 7 is a schematic diagram of scenario 1 or 3 at a terminal side without any TA and/or switching time in Embodiment 1.

For example, in correspondence to scenario 2 at the base station side, the terminal 1 detects a downlink control channel in a downlink DCI format in the DL regions 1 and 2, and detects a downlink control channel 1-1 in the downlink DCI format in the DL region 1. Then, the terminal 1 receives a corresponding downlink shared channel 1-1 in the DL region 1 according to scheduling information carried over the downlink control channel 1-1, generates ACK/NACK feedback information, and makes ACK/NACK feedback in the UL region in the time unit. The terminal 1 detects a downlink control channel 1-2 in the downlink DCI format in the DL region 2. Then, the terminal 2 receives a corresponding downlink shared channel 1-2 in the DL region 2 according to scheduling information carried over the downlink control channel 1-2, generates ACK/NACK feedback information, and makes ACK/NACK feedback in the UL region in the next time unit. The terminal 2 detects a downlink control channel in a downlink DCI format in the DL regions 1 and 2, and detects a downlink control channel 2-1 in the downlink DCI format in the DL region 1. Then, the terminal 2 receives a corresponding downlink shared channel 2-1 in the DL region 1 according to scheduling information carried over the downlink control channel 2-1, generates ACK/NACK feedback information, and makes ACK/NACK feedback in the UL region in the time unit. The terminal 2 detects a downlink control channel 2-2 in the downlink DCI format in the DL region 2. Then, the terminal 2 receives a corresponding downlink shared channel 2-2 in the DL region 2 according to scheduling information carried over the downlink control channel 2-2, generates ACK/NACK feedback information, and makes ACK/NACK feedback in the UL region in the next time unit. At this time, transmission structures of the terminal 1 and the terminal 2 are as shown in the AN feedback relationships in FIGS. 8 and 9. FIG. 8 is a schematic diagram of scenario 2 or 4 at a terminal side with a TA and/or a switching time in Embodiment 1, and FIG. 9 is a schematic diagram of scenario 2 or 4 at a terminal side without any TA and/or switching time in Embodiment 1.

For example, in correspondence to scenario 3 at the base station side, the terminal 1 detects a downlink control channel in an uplink DCI format in the DL regions 1 and 2, and detects a downlink control channel 1 in the uplink DCI format only in the DL region 1. Then, the terminal 1 transmits a corresponding uplink shared channel 1 in the UL region in the time unit according to scheduling information carried over the downlink control channel 1. The terminal 2 detects a





downlink control channel in an uplink DCI format in the DL regions 1 and 2, and detects a downlink control channel 2 in the uplink DCI format only in the DL region 2. Then, the terminal 2 transmits a corresponding uplink shared channel 2 in the UL region in the next time unit according to scheduling information carried over the downlink control channel 2. At this time, transmission structures of the terminal 1 and the terminal 2 are as shown in the UL scheduling relationships in FIGS. 6 and 7.

For example, in correspondence to scenario 4 at the base station side, the terminal 1 detects a downlink control channel in an uplink DCI format in the DL regions 1 and 2, and detects a downlink control channel 1-1 in the uplink DCI format in the DL region 1. Then, the terminal 1 transmits a corresponding uplink shared channel 1-1 in the UL region in the time unit according to scheduling information carried over the downlink control channel 1-1. The terminal 1 detects a downlink control channel 1-2 in the uplink DCI format in the DL region 2. Then, the terminal 1 transmits a corresponding uplink shared channel 1-2 in the UL region in the next time unit according to scheduling information carried over the downlink control channel 1-2. The terminal 2 detects a downlink control channel in an uplink DCI format in the DL regions 1 and 2, and detects a downlink control channel 2-1 in the uplink DCI format in the DL region 1. Then, the terminal 2 transmits a corresponding uplink shared channel 2-1 in the UL region in the time unit according to scheduling information carried over the downlink control channel 2-1. The terminal 2 detects a downlink control channel 2-2 in the uplink DCI format in the DL region 2. Then, the terminal 2 transmits a corresponding uplink shared channel 2-2 in the UL region in the next time unit according to scheduling information carried over the downlink control channel 2-2. At this time, transmission structures of the terminal 1 and the terminal 2 are as shown in the UL scheduling relationships in FIGS. 8 and 9.

Of course, specific reception at the terminal depends upon real scheduling by the base station, and there may be a combination of the scenarios above. For example, for each terminal, there may be both uplink and downlink scheduled transmission, that is, there may be both scenarios 1 and 3, or both scenarios 2 and 4. For another example, a terminal may detect a downlink control channel only in one DL region (which includes a downlink control channel in an uplink or downlink DCI format, and the same will apply hereinafter) in a time unit, and detect a downlink control channel in each of two DL regions in another time unit.

Of course, if the base station pre-configures a DL region to be detected by the terminal, then the terminal may detect a downlink control channel only in the configured DL region, and then make ACK/NACK feedback and/or transmit an uplink shared channel in a UL region corresponding to the DL region according to the detected downlink control channel. For example, the terminal 1 is configured to detect a downlink control channel only in the DL region 1. Then, the terminal 1 detects a downlink control channel only in the DL region 1, and determines to make ACK/NACK feedback and/or to transmit an uplink shared channel in the UL region in the





time unit according to the detected downlink control channel. The terminal 2 is configured to detect a downlink control channel only in the DL region 2. Then, the terminal 2 detects a downlink control channel only in the DL region 2, and determines to make ACK/NACK feedback and/or to transmit an uplink shared channel in the UL region in the next time unit according to the detected downlink control channel.

The base station side receives ACK/NACK feedback information corresponding to downlink transmission in a DL region, and/or an uplink shared channel, scheduled by a downlink control channel in an uplink DCI format, transmitted in the DL region, in a corresponding UL region according to the downlink control channel transmitted by the base station.

FIG. 10 is a schematic diagram of an allocation of and a correspondence relationship between the uplink and downlink resources of the system with a TA and/or a switching time in Embodiment 1 when being in different services, and FIG. 11 is a schematic diagram of an allocation of and a correspondence relationship between the uplink and downlink resources of the system without any TA and/or switching time in Embodiment 1 when being in different services. It is assumed that, when the structure in the present embodiment is defined for a corresponding eMBB service, if there is also a URLLC service in the system, then the structures as shown in FIGS. 10 and 11 may be defined for the URLLC service, that is, only one DL region and one UL region are defined only in a time unit, wherein the DL region is the entire set of DL regions of the eMBB service, or a subset thereof, and the UL is the entire set of eMBB ULs, or a subset thereof, or more than the eMBB UL regions, dependent upon feedback, a scheduling delay, a real demand, etc., in the URLLC service as long as feedback may be made, or an uplink shared channel may be transmitted, in the UL region in the current time unit for the last downlink scheduling unit, so that uplink scheduling or downlink feedback may be made in one time unit for the URLLC service. Of course, a uniform allocation of DL and UL regions may also be defined for eMBB and URLLC in the system, so that the eMBB service operates according to the feedback and scheduling relationships corresponding to the process above, and downlink transmission of URLLC in respective DL regions in a time unit may be feedback in the UL region in the current time unit, or downlink control channels in an uplink DCI format in all DL regions in a time unit may schedule uplink shared channels to be transmitted in the UL region in the current time unit. That is, at this time, the relationship between a DL end position and a UL start position in a time unit of URLLC is required to satisfy the demands for feedback and a scheduling delay, thereby ensuring that feedback and uplink scheduling may be made in the current time unit for all the DL regions to shorten the scheduling and feedback delays. There is the same operating flow of the URLLC service as described above according to the DL regions and the feedback/scheduling relationship defined for the URLLC service except that different feedback and scheduling delays are defined, so a specific process will not be repeated here.

Embodiment 2:



FIG. 12 is a schematic diagram of an allocation of and a correspondence relationship between uplink and downlink resources of a system with a TA and/or a switching time in Embodiment 2, and FIG. 13 is a schematic diagram of an allocation of and a correspondence relationship between uplink and downlink resources of a system without any TA and/or switching time in Embodiment 2. As shown in FIG. 12, it is assumed that a base station determines to divide a time unit into two DL regions and two UL region, and there is such a blank region or a GP region between a DL region and the UL region that is a reserved region determined to satisfy a TA demand of the UL, a switching time from the DL to the UL, etc., possibly taking into account interference between adjacent cells, and other factors. Of course, if a TA or a switching time or anti-interference is not required, then there may be no blank part or GP part, as shown in FIG. 13. A correspondence relationship between the DL regions and the UL region may be predefined or configured directly. For example, the first DL region in a time unit is defined or configured to schedule uplink transmission in the second (last) UL region in the time unit (wherein uplink transmission in the UL region may occupy only a part of OFDM or SC-FDMA symbols or a part of mini-slots in the UL region. Then, a plurality of uplink shared channels of the same or different terminals may be transmitted in a UL region, or uplink transmission in the UL region may occupy the length of the entire UL region, and the same will apply hereinafter). The second (last) DL region in a time unit is scheduled to perform uplink transmission in the UL region in the next time unit, ACK/NACK for downlink transmission in the first DL region in a time unit (wherein downlink transmission in the DL region may occupy only a part of OFDM symbols or a part of mini-slots in the DL region, so a plurality of downlink transmission TDMs of the same or different terminals may be transmitted in a DL region, or downlink transmission in the DL region may occupy the length of the entire DL region) is fed back in the UL region in the time unit (an uplink channel carrying ACK/NACK feedback information for downlink transmission may occupy only a part of OFDM or SC-OFDM symbols or a part of mini-slots in the UL region, so a plurality of uplink channels, carrying ACK/NACK, of the same or different terminals may be transmitted in a UL region, or the uplink channel may occupy the length of the entire UL region, and the same will apply hereinafter). The ACK/NACK of the downlink transmission in the second DL region in one time unit is fed back in the first UL region in the next time unit, as shown in FIGS. 5-1 and 5-2. Of course, the value of T may be also defined or configured, and a UL region spaced from a DL region by a period T of time after the DL region may be defined as a corresponding UL region. The same effect of the correspondence relationship predefined or configured as above may also be achieved, as shown in FIGS. 5-1 and 5-2. T lengths of different DL regions may be different, and the value of T for defining a scheduling relationship may be the same as or different from the value of T for defining a feedback relationship. When DL and UL regions is differently allocated in a time unit, the corresponding value of T will also be different, and for example, there are different allocations of DL and UL regions for different services, which correspond to different T values.

In the present embodiment, a time unit may be a slot or a subframe. Of course, other manners of defining the length of a time unit are not excluded.

The base station notifies a terminal of the above allocation, specifically as described in Embodiment 1, so it will not be repeated here.

The terminal receives the configuration signaling, and determines a corresponding allocation of DL regions in a time unit to determine a specific part for starting to detect a downlink control channel, wherein according to different configuration modes of the above base station, an allocation of UL regions may be further determined according to the notification content, or the UL regions may be implicitly determined directly according to the scheduling relationship.

When the base station needs to schedule the terminal, the base station selects at least one DL region in a time unit, and transmits a downlink control channel to the terminal in a downlink control channel search space of the selected DL region to schedule the terminal to receive a downlink shared channel in the selected DL region, or to transmit an uplink shared channel in a corresponding UL region.

For example, in scenario 1, the base station transmits a downlink control channel 1 in a downlink DCI format in a DL region 1 to schedule a terminal 1 to receive a downlink shared channel 1 in the DL region 1, and transmits a downlink control channel 2 in the downlink DCI format in a DL region 2 to schedule a terminal 2 to receive a downlink shared channel 2 in the DL region 2.

For another example, in scenario 2, the base station transmits a downlink control channel 1-1 in a downlink DCI format in a DL region 1 to schedule a terminal 1 to receive a downlink shared channel 1-1 in the DL region 1, transmits a downlink control channel 2-1 in the downlink DCI format in the DL region 1 to schedule a terminal 2 to receive a downlink shared channel 2-1 in the DL region 1, transmits a downlink control channel 1-2 in the downlink DCI format in a DL region 2 to schedule the terminal 1 to receive a downlink shared channel 1-2 in the DL region 2, and transmits a downlink control channel 2-2 in the downlink DCI format in the DL region 2 to schedule the terminal 2 to receive a downlink shared channel 2-2 in the DL region 2.

For another example, in scenario 3, the base station transmits a downlink control channel 1 in an uplink DCI format in a DL region 1 to schedule a terminal 1 to transmit an uplink shared channel 1 in the UL region 2 in the time unit, and transmits a downlink control channel 2 in the uplink DCI format in a DL region 2 to schedule a terminal 2 to transmit an uplink shared channel 2 in the UL region 1 in the next time unit.

For another example, in scenario 4, the base station transmits a downlink control channel 1-1 in an uplink DCI format in a DL region 1 to schedule a terminal 1 to transmit an uplink shared channel 1-1 in the UL region in the time unit, transmits a downlink control channel 2-1 in the



uplink DCI format in the DL region 1 to schedule a terminal 2 to transmit an uplink shared channel 2-1 in the UL region in the time unit, transmits a downlink control channel 1-2 in the uplink DCI format in a DL region 2 to schedule the terminal 1 to transmit an uplink shared channel 1-2 in the UL region in the next time unit, and transmits a downlink control channel 2-2 in the uplink DCI format in the DL region 2 to schedule the terminal 2 to transmit an uplink shared channel 2-2 in the UL region in the next time unit.

Of course, the scenarios above may exist in combination. For example, for each terminal, there may be both uplink and downlink scheduled transmission, that is, there may be both scenarios 1 and 3, or both scenarios 2 and 4. For another example, for a terminal, the base station may transmit a downlink control channel (which includes a downlink control channel in an uplink or downlink DCI format, and the same will apply hereafter) thereto in only one DL region in a time unit, and transmit downlink control channels thereto in both of two DL regions in another time unit.

Of course, the base station may further pre-configure a DL region to be detected by the terminal, and this configuration may be made semi-statically by means of RRC signaling, or may be made by transmitting configuration signaling periodically, wherein the periodicity may be changed according to actual needs. For example, a group of terminals are configured to detect a downlink control channel only in the DL region 1, and another group of terminals are configured to detect a downlink control channel only in the DL region 2. Therefore, if the base station is intended to schedule uplink or downlink transmission of this part of terminals, then it will transmit downlink control channels of these terminals only in the DL detection regions configured for these terminals.

The terminal detects blindly a downlink control channel in each DL region in a time unit according to the determined allocation of DL and UL regions. When a downlink control channel of the terminal in a downlink DCI format is detected, the terminal receives a corresponding downlink shared channel in the DL region, generates ACK/NACK feedback information (AN feedback in the figure) for the downlink shared channel, and makes ACK/NACK feedback in a UL region corresponding to the DL region. If ACK/NACK feedback is made for a plurality of DL regions in the same corresponding UL region, then ACK/NACK feedback information in the plurality of DL regions may be fed back over the same uplink channel in the UL region, or may be fed back over different uplink channels, wherein if there are different uplink channels, then they may be uplink channels transmitted at different times, or may be uplink channels transmitted over different frequency resources at the same time, or may be uplink channels transmitted over the same time and frequency resource in a code division mode. When a downlink control channel of the terminal in an uplink DCI format is detected, the terminal transmits a corresponding uplink shared channel in a UL region corresponding to the DL region.





For example, in correspondence to scenario 1 at the base station side, the terminal 1 detects a downlink control channel in a downlink DCI format in the DL regions 1 and 2, and detects a downlink control channel 1 in the downlink DCI format only in the DL region 1. Then, the terminal 1 receives a corresponding downlink shared channel 1 in the DL region 1 according to scheduling information carried over the downlink control channel 1, generates ACK/NACK feedback information, and makes ACK/NACK feedback in the UL region 2 in the time unit. The terminal 2 detects a downlink control channel in the downlink DCI format in the DL regions 1 and 2, and detects a downlink control channel 2 in the downlink DCI format only in the DL region 2. Then, the terminal 2 receives a corresponding downlink shared channel 2 in the DL region 2 according to scheduling information carried over the downlink control channel 2, generates ACK/NACK feedback information, and makes ACK/NACK feedback in the UL region 1 in the next time unit. At this time, transmission structures of the terminal 1 and the terminal 2 are as shown in the AN feedback relationships in FIGS. 14 and 15. FIG. 14 is a schematic diagram of scenario 1 or 3 at a terminal side with a TA and/or a switching time in Embodiment 2, and FIG. 15 is a schematic diagram of scenario 1 or 3 at a terminal side without any TA and/or switching time in Embodiment 2.

For example, in correspondence to scenario 2 at the base station side, the terminal 1 detects a downlink control channel in a downlink DCI format in the DL regions 1 and 2, and detects a downlink control channel 1-1 in the downlink DCI format in the DL region 1. Then, the terminal 1 receives a corresponding downlink shared channel 1-1 in the DL region 1 according to scheduling information carried over the downlink control channel 1-1, generates ACK/NACK feedback information, and makes ACK/NACK feedback in the UL region in the time unit. The terminal 1 detects a downlink control channel 1-2 in the downlink DCI format in the DL region 2. Then, the terminal 2 receives a corresponding downlink shared channel 1-2 in the DL region 2 according to scheduling information carried over the downlink control channel 1-2, generates ACK/NACK feedback information, and makes ACK/NACK feedback in the UL region 1 in the next time unit. The terminal 2 detects a downlink control channel in a downlink DCI format in the DL regions 1 and 2, and detects a downlink control channel 2-1 in the downlink DCI format in the DL region 1. Then, the terminal 2 receives a corresponding downlink shared channel 2-1 in the DL region 1 according to scheduling information carried over the downlink control channel 2-1, generates ACK/NACK feedback information, and makes ACK/NACK feedback in the UL region in the time unit. The terminal 2 detects a downlink control channel 2-2 in the downlink DCI format in the DL region 2. Then, the terminal 2 receives a corresponding downlink shared channel 2-2 in the DL region 2 according to scheduling information carried over the downlink control channel 2-2, generates ACK/NACK feedback information, and makes ACK/NACK feedback in the UL region in the next time unit. At this time, transmission structures of the terminal 1 and the terminal 2 are as shown in the AN feedback relationship in FIG. 8. FIG. 16 is a schematic diagram of scenario 2 or 4 at a terminal side with a TA and/or a



switching time in Embodiment 2, and FIG. 17 is a schematic diagram of scenario 2 or 4 at a terminal side without any TA and/or switching time in Embodiment 2.

For example, in correspondence to scenario 3 at the base station side, the terminal 1 detects a downlink control channel in an uplink DCI format in the DL regions 1 and 2, and only detects a downlink control channel 1 in the uplink DCI format in the DL region 1. Then, the terminal 1 transmits a corresponding uplink shared channel 1 in the UL region 2 in the time unit according to scheduling information carried over the downlink control channel 1. The terminal 2 detects a downlink control channel in an uplink DCI format in the DL regions 1 and 2, and detects a downlink control channel 2 in the uplink DCI format only in the DL region 2. Then, the terminal 2 transmits a corresponding uplink shared channel 2 in the UL region in the next time unit according to scheduling information carried over the downlink control channel 2. At this time, transmission structures of the terminal 1 and the terminal 2 are as shown in the UL scheduling relationships in FIGS. 14 and 15.

For example, in correspondence to scenario 4 at the base station side, the terminal 1 detects a downlink control channel in an uplink DCI format in the DL regions 1 and 2, and detects a downlink control channel 1-1 in the uplink DCI format only in the DL region 1. Then, the terminal 1 transmits a corresponding uplink shared channel 1-1 in the UL region 2 in the time unit according to scheduling information carried over the downlink control channel 1-1. The terminal 2 detects a downlink control channel 1-2 in an uplink DCI format in the DL region 2. Then, the terminal 2 transmits a corresponding uplink shared channel 1-2 in the UL region 1 in the next time unit according to scheduling information carried over the downlink control channel 1-2. The terminal 2 detects a downlink control channel in an uplink DCI format in the DL regions 1 and 2, and detects a downlink control channel 2-1 in the uplink DCI format in the DL region 1. Then, the terminal 2 transmits a corresponding uplink shared channel 2-1 in the UL region 2 in the time unit according to scheduling information carried over the downlink control channel 2-1. The terminal 2 detects a downlink control channel 2-2 in the uplink DCI format in the DL region 2. Then, the terminal 2 transmits a corresponding uplink shared channel 2-2 in the UL region 1 in the next time unit according to scheduling information carried over the downlink control channel 2-2. At this time, transmission structures of the terminal 1 and the terminal 2 are as shown in the UL scheduling relationships in FIGS. 16 and 17.

Of course, specific reception at the terminal depends upon real scheduling by the base station, and there may be a combination of the scenarios above. For example, for each terminal, there may be both uplink and downlink scheduled transmission, that is, there may be both scenarios 1 and 3, or both scenarios 2 and 4. For another example, a terminal may detect a downlink control channel only in one DL region (which includes a downlink control channel in an uplink or downlink DCI format, and the same will apply hereinafter) in a time unit, and detect a downlink control channel in each of two DL regions in another time unit.



Of course, if the base station pre-configures a DL region to be detected by the terminal, then the terminal may detect a downlink control channel only in the configured DL region, and then make ACK/NACK feedback and/or transmit an uplink shared channel in a UL region corresponding to the DL region according to the detected downlink control channel. For example, the terminal 1 is configured to detect a downlink control channel only in the DL region 1. Then, the terminal 1 detects a downlink control channel only in the DL region 1, and determines to make ACK/NACK feedback and/or to transmit an uplink shared channel in the UL region in the time unit according to the detected downlink control channel. The terminal 2 is configured to detect a downlink control channel only in the DL region 2. Then, the terminal 2 detects a downlink control channel only in the DL region 2, and determines to make ACK/NACK feedback and/or to transmit an uplink shared channel in the UL region in the next time unit according to the detected downlink control channel.

The base station side receives ACK/NACK feedback information corresponding to downlink transmission in a DL region, and/or an uplink shared channel, scheduled by a downlink control channel in an uplink DCI format, transmitted in the DL region, in a corresponding UL region according to the downlink control channel transmitted by the base station.

FIG. 18 is a schematic diagram of an allocation of and a correspondence relationship between the uplink and downlink resources of the system with a TA and/or a switching time in Embodiment 2 when being in different services, and FIG. 19 is a schematic diagram of an allocation of and a correspondence relationship between the uplink and downlink resources of the system without any TA and/or switching time in Embodiment 2 when being in different services. It is assumed that, when the structure in the present embodiment is defined for a corresponding eMBB service, if there is also a URLLC service in the system, then the structures as shown in FIGS. 18 and 19 may be defined for the URLLC service, that is, only one DL region and one UL region are defined only in a time unit, wherein the DL region is the entire set of DL regions of the eMBB service, or a subset thereof, and the UL is the entire set of eMBB ULs, or a subset thereof, or more than the eMBB UL regions, dependent upon feedback, a scheduling delay, a real demand, etc., in the URLLC service as long as feedback may be made, or an uplink shared channel may be transmitted, in the UL region in the current time unit for the last downlink scheduling unit, so that uplink scheduling or downlink feedback may be made in one time unit for the URLLC service. Of course, a uniform allocation of DL and UL regions may also be defined for eMBB and URLLC in the system, so that the eMBB service operates according to the feedback and scheduling relationships corresponding to the process above, and downlink transmission of URLLC in respective DL regions in a time unit may be feedback in the UL region in the current time unit, or downlink control channels in an uplink DCI format in all DL regions in a time unit may schedule uplink shared channels to be transmitted in the UL region in the current time unit. That is, at this time, the relationship between a DL end position and a UL start position in a time unit of URLLC is required to satisfy the demands for feedback and a





scheduling delay, thereby ensuring that feedback and uplink scheduling may be made in the current time unit for all the DL regions to shorten the scheduling and feedback delays. There is the same operating flow of the URLLC service as described above according to the DL regions and the feedback/scheduling relationship defined for the URLLC service except that different feedback and scheduling delays are defined, so a specific process will not be repeated here.

Based on the same concept of invention, the embodiments of the present invention further provide apparatuses for transmitting data, and since these apparatuses address the problem under a similar principle to the methods for transmitting data, reference may be made to the implementations of the methods for implementations of these apparatuses, and a repeated description will be omitted here.

FIG. 20 is a schematic structural diagram of a data transmission apparatus at a base station side, and as shown in the figure, the apparatus may include:

an allocating module 2001 configured to allocate DL regions in a time unit, where the time unit includes at least two DL regions; and

a notifying module 2002 configured to notify a terminal of the allocated DL regions by means of configuration signaling.

In an implementation, the notifying module is further configured to notify the terminal of the allocated DL regions by means of configuration signaling, which specifically includes:

notifying the terminal of lengths and positions of the DL regions in the time unit; or

notifying the terminal of one of a plurality of predetermined patterns, each pattern comprising an allocation of lengths and positions of the DL regions in the time unit; or

notifying the terminal of start or end positions of the DL regions in the time unit.

In an implementation, the notifying module is further configured to further notify, in the configuration signaling,

a UL region and/or a GP region in the time unit, which specifically includes:

notifying the terminal of a length and a position of the UL region in the time unit; or

notifying the terminal of one of a plurality of predetermined patterns, each pattern comprising an allocation of a length and a position of the UL region in the time unit; or

notifying the terminal of a start or end position of the UL region in the time unit; or





notifying the terminal of indication information so that the terminal determines the UL region in the time unit according to the indication information under a predefined rule.

In an implementation, notifying the UL region and/or the GP region in the time unit further includes:

determining the UL region in the time unit according to uplink scheduling signaling, or according to a position at which ACK/NACK for downlink transmission is fed back.

In an implementation, the notifying module is further configured to transmit the configuration signaling by means of higher-layer signaling or physical downlink control signaling in a unicast or broadcast or multicast form.

In an implementation, the apparatus further includes:

a transmitting module configured to transmit a downlink control channel to the terminal in at least one DL region in the time unit.

In an implementation, the transmitting module is further configured to, before the downlink control channel is transmitted to the terminal in at least one DL region in the time unit, perform operations further including:

determining a detection DL region of the terminal in the time unit, and notifying the terminal of the detection DL region by means of configuration information, or determining a detection DL region in the time unit according to a pre-definition, wherein the detection DL region may be a part or all of the DL regions in the time unit; and

when the detection DL region is configured or defined, transmitting the downlink control channel to the terminal in at least one DL region in the detection DL region corresponding to the terminal.

In an implementation, the transmitting module is further configured to: when a downlink DCI format is used for the downlink control channel, receive ACK/NACK feedback for the downlink control channel, and/or ACK/NACK feedback for a downlink shared channel corresponding to the downlink control channel, in a UL region corresponding to a DL region in which the downlink control channel is transmitted; or

when an uplink DCI format is used for the downlink control channel, receive an uplink shared channel corresponding to the downlink control channel in the UL region corresponding to the DL region in which the downlink control channel is transmitted.

In an implementation, a UL region corresponding to a DL region is determined according to one or a combination of the following schemes:



a region spaced from the DL region by a length T after an end position of the DL region is the UL region corresponding to the DL region, or a first UL region spaced from the DL region by the length T after the end position of the DL region is a UL feedback region corresponding to the DL region, wherein T is predefined or configured; or

the UL region corresponding to the DL region is indicated by means of indication information in the downlink control channel; or

a UL region corresponding to a part of DL regions in a time unit is predefined or configured as a UL region in a current time unit, and if there are a plurality of UL regions in the current time unit, then the UL region corresponding to the part of the DL regions is one or more defined or configured UL regions in the current time unit; or

a UL region corresponding to a part of DL regions in a time unit is predefined or configured as a UL region in a next time unit, and if there are a plurality of UL regions in the next time unit, then the UL region corresponding to the part of the DL regions is one or more defined or configured UL regions in the next time unit; or

a UL region corresponding to a DL region in a time unit is predefined or configured as a UL region in the current time unit, and if there are a plurality of DL regions and a plurality of UL regions in the current time unit, then each DL region corresponds to one or more defined or configured UL regions.

In an implementation, a time unit is one or more slots, or one or more subframes.

FIG. 21 is a schematic structural diagram of a data transmission apparatus at a terminal side, and as shown in the figure, the apparatus may include:

a receiving module 2101 configured to receive configuration signaling; and

a determining module 2102 configured to determine DL regions allocated in a time unit according to the configuration signaling, where the time unit includes at least two DL regions.

In an implementation, the determining module is configured to, when determining the DL regions allocated in the time unit according to the configuration signaling, perform operations specifically including:

determining lengths and positions of the DL regions in the time unit indicated by means of the configuration signaling; or

determining one of a plurality of predetermined patterns indicated by means of the configuration signaling, each pattern comprising an allocation of lengths and positions of the DL regions in the time unit; or



determining start or end positions of the DL regions in the time unit indicated by means of the configuration signaling.

In an implementation, the determining module is further configured to:

determine a UL region and/or a GP region in the time unit according to the configuration signaling, wherein

a length and a position of the UL region in the time unit are indicated by means of the configuration signaling; or

one of a plurality of predetermined patterns is indicated by means of the configuration signaling, each pattern comprising an allocation of a length and a position of the UL region in the time unit; or

a start or end position of the UL region in the time unit is indicated by means of the configuration signaling; or

indication information is indicated by means of the configuration signaling so that the terminal determines the UL region in the time unit according to the indication information under a predefined rule.

In an implementation, the determining module is further configured to:

determine the UL region in the time unit according to uplink scheduling signaling, or determine the UL region in the time unit according to a position at which ACK/NACK for downlink transmission is fed back.

In an implementation, the receiving module is further configured to receive the configuration signaling indicated by means of higher-layer signaling or physical downlink control signaling in a unicast or broadcast or multicast form.

In an implementation, the apparatus further includes:

a detecting module configured to detect a downlink control channel in each DL region or each detection DL region in the time unit.

In an implementation, before detection of a downlink control channel is performed in each detection DL region in the time unit, the detecting module is further configured to perform operations further including:

receiving configuration information, and determining a detection DL region in the time unit according to the configuration information, or determining a detection DL region in the time unit





according to a pre-definition, wherein the detection DL region may be a part or all of the DL regions in the time unit.

In an implementation, the detecting module is further configured to, when a downlink DCI format is used for the downlink control channel, transmit ACK/NACK feedback for the downlink control channel, and/or ACK/NACK feedback for a downlink shared channel corresponding to the downlink control channel, in a UL region corresponding to a DL region in which the downlink control channel is received; or

when an uplink DCI format is used for the downlink control channel, transmit an uplink shared channel corresponding to the downlink control channel in the UL region corresponding to the DL region in which the downlink control channel is received.

In an implementation, a UL region corresponding to a DL region is determined according to one or a combination of the following schemes:

a region spaced from the DL region by a length T after an end position of the DL region is the UL region corresponding to the DL region, or a first UL region spaced from the DL region by the length T after the end position of the DL region is a UL feedback region corresponding to the DL region, wherein T is predefined or configured; or

the UL region corresponding to the DL region is determined according to indication information in the downlink control channel; or

a UL region corresponding to a part of DL regions in a time unit is predefined or configured as a UL region in a current time unit, and if there are a plurality of UL regions in the current time unit, then the UL region corresponding to the part of the DL regions is one or more defined or configured UL regions in the current time unit; or

a UL region corresponding to a part of DL regions in a time unit is predefined or configured as a UL region in a next time unit, and if there are a plurality of UL regions in the next time unit, then the UL region corresponding to the part of the DL regions is one or more defined or configured UL regions in the next time unit; or

a UL region corresponding to a DL region in a time unit is predefined or configured as a UL region in the current time unit, and if there are a plurality of DL regions and a plurality of UL regions in the current time unit, then each DL region corresponds to one or more defined or configured UL regions.

In an implementation, a time unit is one or more slots, or one or more subframes.

For the sake of a convenient description, the respective parts of the above apparatuses have been functionally described as respective modules or units, respectively. Of course, the functions





of the respective modules or units may be performed in the same one or more pieces of software or hardware when the present invention is implemented.

The technical solutions provided by the embodiments of the present invention may be implemented as follows when they are implemented.

FIG. 22 is a schematic structural diagram of a base station, and as shown in the figure, the base station includes:

a processor 2200 configured to read a program in a memory 2220 to perform the following process:

allocating DL regions in a time unit, wherein the time unit comprises at least two DL regions; and

a transceiver 2210 configured to receive and transmit data under the control of the processor 2200 to perform the following process:

notifying a terminal of the allocated DL regions by means of configuration signaling.

In an implementation, notifying the terminal of the allocated DL regions by means of the configuration signaling specifically includes:

notifying the terminal of lengths and positions of the DL regions in the time unit; or

notifying the terminal of one of a plurality of predetermined patterns, each pattern comprising an allocation of lengths and positions of the DL regions in the time unit; or

notifying the terminal of start or end positions of the DL regions in the time unit.

In an implementation, a UL region and/or GP region in the time unit are/is further indicated by means of the configuration signaling, which specifically includes:

notifying the terminal of a length and a position of the UL region in the time unit; or

notifying the terminal of one of a plurality of predetermined patterns, each pattern comprising an allocation of a length and a position of the UL region in the time unit; or

notifying the terminal of a start or end position of the UL region in the time unit; or

notifying the terminal of indication information so that the terminal determines the UL region in the time unit according to the indication information under a predefined rule.

In an implementation, notifying the terminal of the allocated DL regions by means of the configuration signaling further includes:





determining the UL region in the time unit according to uplink scheduling signaling, or according to a position at which ACK/NACK for downlink transmission is fed back.

In an implementation, the configuration signaling is indicated by means of higher-layer signaling or physical downlink control signaling in a unicast or broadcast or multicast form.

In an implementation, notifying the terminal of the allocated DL regions by means of the configuration signaling further includes:

transmitting a downlink control channel to the terminal in at least one DL region in the time unit.

In an implementation, before the downlink control channel is transmitted to the terminal in the at least one DL region in the time unit, notifying the terminal of the allocated DL regions by means of the configuration signaling further include:

determining a detection DL region of the terminal in the time unit, and notifying the terminal of the detection DL region by means of configuration information, or determining a detection DL region in the time unit according to a pre-definition, wherein the detection DL region may be a part or all of the DL regions in the time unit; and

when the detection DL region is configured or defined, transmitting the downlink control channel to the terminal in at least one DL region in the detection DL region corresponding to the terminal.

In an implementation, notifying the terminal of the allocated DL regions by means of the configuration signaling further includes:

when a downlink DCI format is used for the downlink control channel, receiving ACK/NACK feedback for the downlink control channel, and/or ACK/NACK feedback for a downlink shared channel corresponding to the downlink control channel, in a UL region corresponding to a DL region in which the downlink control channel is transmitted; or

when an uplink DCI format is used for the downlink control channel, receiving an uplink shared channel corresponding to the downlink control channel in the UL region corresponding to the DL region in which the downlink control channel is transmitted.

In an implementation, a UL region corresponding to a DL region is determined according to one or a combination of the following schemes:

a region spaced from the DL region by a length T after an end position of the DL region is the UL region corresponding to the DL region, or a first UL region spaced from the DL region





by the length T after the end position of the DL region is a UL feedback region corresponding to the DL region, wherein T is predefined or configured; or

the UL region corresponding to the DL region is indicated by means of indication information in the downlink control channel; or

a UL region corresponding to a part of DL regions in a time unit is predefined or configured as a UL region in a current time unit, and if there are a plurality of UL regions in the current time unit, then the UL region corresponding to the part of the DL regions is one or more defined or configured UL regions in the current time unit; or

a UL region corresponding to a part of DL regions in a time unit is predefined or configured as a UL region in a next time unit, and if there are a plurality of UL regions in the next time unit, then the UL region corresponding to the part of the DL regions is one or more defined or configured UL regions in the next time unit; or

a UL region corresponding to a DL region in a time unit is predefined or configured as a UL region in the current time unit, and if there are a plurality of DL regions and a plurality of UL regions in the current time unit, then each DL region corresponds to one or more defined or configured UL regions.

In an implementation, a time unit is one or more slots, or one or more subframes.

In FIG. 22, the bus architecture may include any number of interconnected buses and bridges. Specifically, one or more processors represented by the processor 2200 and various circuits of the memory represented by the memory 2220 are linked together. The bus architecture may also link various other circuits such as peripheral devices, voltage regulators, and power management circuits, etc., which are well known in the art, and therefore will not be further described herein. The bus interface provides an interface. The transceiver 2210 may be a plurality of elements, that is, it includes a transmitter and a transceiver, providing units for communication with various other apparatuses on a transmission medium. The processor 2200 is responsible for managing the bus architecture and general processing, and the memory 2220 may store data used by the processor 2200 when performing operations.

FIG. 23 is a schematic structural diagram of a terminal, and as shown in the figure, the terminal includes:

a processor 2300 configured to read a program in a memory 2320 to perform the following process:

determining DL regions allocated in a time unit according to configuration signaling, wherein the time unit includes at least two DL regions; and





a transceiver 2310 configured to receive and transmit data under the control of the processor 2300 to perform the following process:

receiving the configuration signaling.

In an implementation, determining the DL regions allocated in the time unit according to the configuration signaling specifically includes:

notifying lengths and positions of the DL regions in the time unit by means of the configuration signaling; or

notifying one of a plurality of predetermined patterns by means of the configuration signaling, each pattern comprising an allocation of lengths and positions of the DL regions in the time unit; or

notifying start or end positions of the DL regions in the time unit by means of the configuration signaling.

In an implementation, determining the DL regions allocated in the time unit according to the configuration signaling further includes:

determining a UL region and/or a GP region in the time unit according to the configuration signaling, wherein

a length and a position of the UL region in the time unit are indicated by means of the configuration signaling; or

one of a plurality of predetermined patterns is indicated by means of the configuration signaling, each pattern comprising an allocation of a length and a position of the UL region in the time unit; or

a start or end position of the UL region in the time unit is indicated by means of the configuration signaling; or

indication information is indicated by means of the configuration signaling so that the terminal determines the UL region in the time unit according to the indication information under a predefined rule.

In an implementation, determining the DL regions allocated in the time unit according to the configuration signaling further includes:

determining, by the terminal, the UL region in the time unit according to uplink scheduling signaling, or determining, by the terminal, the UL region in the time unit according to a position at which ACK/NACK for downlink transmission is fed back.





In an implementation, the configuration signaling is indicated by means of higher-layer signaling or physical downlink control signaling in a unicast or broadcast or multicast form.

In an implementation, determining the DL regions allocated in the time unit according to the configuration signaling further includes:

detecting a downlink control channel in each DL region or each detection DL region in the time unit.

In an implementation, before detection of a downlink control channel is performed in each detection DL region in the time unit, determining the DL regions allocated in the time unit according to the configuration signaling further includes:

receiving configuration information, and determining a detection DL region in the time unit according to the configuration information, or determining a detection DL region in the time unit according to a pre-definition, wherein the detection DL region may be a part or all of the DL regions in the time unit.

In an implementation, determining the DL regions allocated in the time unit according to the configuration signaling further includes:

when a downlink DCI format is used for the downlink control channel, transmitting ACK/NACK feedback for the downlink control channel, and/or ACK/NACK feedback for a downlink shared channel corresponding to the downlink control channel, in a UL region corresponding to a DL region in which the downlink control channel is received; or

when an uplink DCI format is used for the downlink control channel, transmitting an uplink shared channel corresponding to the downlink control channel in the UL region corresponding to the DL region in which the downlink control channel is received.

In an implementation, a UL region corresponding to a DL region is determined according to one or a combination of the following schemes:

a region spaced from the DL region by a length T after an end position of the DL region is the UL region corresponding to the DL region, or a first UL region spaced from the DL region by the length T after the end position of the DL region is a UL feedback region corresponding to the DL region, wherein T is predefined or configured; or

the UL region corresponding to the DL region is determined according to indication information in the downlink control channel; or

a UL region corresponding to a part of DL regions in a time unit is predefined or configured as a UL region in a current time unit, and if there are a plurality of UL regions in the current time





unit, then the UL region corresponding to the part of the DL regions is one or more defined or configured UL regions in the current time unit; or

a UL region corresponding to a part of DL regions in a time unit is predefined or configured as a UL region in a next time unit, and if there are a plurality of UL regions in the next time unit, then the UL region corresponding to the part of the DL regions is one or more defined or configured UL regions in the next time unit; or

a UL region corresponding to a DL region in a time unit is predefined or configured as a UL region in the current time unit, and if there are a plurality of DL regions and a plurality of UL regions in the current time unit, then each DL region corresponds to one or more defined or configured UL regions.

In an implementation, a time unit is one or more slots, or one or more subframes.

In FIG. 23, the bus architecture may include any number of interconnected buses and bridges. Specifically, one or more processors represented by the processor 2300 and various circuits of the memory represented by the memory 2320 are linked together. The bus architecture may also link various other circuits such as peripheral devices, voltage regulators, and power management circuits, etc., which are well known in the art, and therefore will not be further described herein. The bus interface provides an interface. The transceiver 2310 may be a plurality of elements, that is, it includes a transmitter and a receiver, providing units for communication with various other apparatuses on a transmission medium. For different user equipment, a user interface 2330 may also be an interface by means of which devices are connected internally and externally as needed, and the connected devices include but will not be limited to a keypad, a display, a speaker, a microphone, a joystick, etc.

The processor 2300 is responsible for managing the bus architecture and general processing, and the memory 2320 may store data used by the processor 2300 when performing operations.

In summary, in the technical solutions according to the embodiments of the present invention, at least two DL regions are defined in a time unit, the terminal detects downlink transmission in each detection region, and when the downlink transmission is detected, the terminal feeds back ACK/NACK in an uplink region corresponding to the downlink region. The embodiments of the present invention provide a solution for transmitting data, wherein a time unit may be divided into a plurality of downlink regions, and each downlink region separately defines feedback and scheduling relationships, improving the flexibility of scheduling and the utilization ratio of system resources.

It should be understood by those skilled in the art that the embodiments of the present invention may be provided as methods, systems, or computer program products. Therefore, the present invention can take the form of an entirely hardware embodiment, an entirely software





embodiment, or an embodiment combining software and hardware aspects. Furthermore, the present invention may take the form of a computer program product embodied on one or more computer-usable storage media (including but not limited to disk storage and optical storage, etc.) having computer-usable program code embodied therein.

The present invention is described with reference to flowcharts and/or block diagrams of methods, devices (systems), and computer program products according to embodiments of the present invention. It should be understood that each procedure and/or block in the flowcharts and/or block diagrams/ and combinations of procedures and/or blocks in the flowcharts and/or block diagrams can be implemented by computer program instructions. These computer program instructions may be supplied to a general purpose computer, a special purpose computer, an embedded processor, or a processor of other programmable data processing equipment to produce a machine, so that the instructions executed by the computer or the processor of other programmable data processing equipment produce means for implementing the function(s) specified in one or more steps of the flowcharts and/or one or more blocks of the block diagrams.

These computer program instructions may also be stored in a computer-readable memory capable of directing a computer or other programmable data processing equipment to operate in a specific manner, so that the instructions stored in the computer-readable memory produce an article of manufacture comprising instruction means. The instruction means implement the function(s) specified in one or more procedures of the flowcharts and/or one or more blocks of the block diagrams.

These computer program instructions may also be loaded onto a computer or other programmable data processing equipment, causing a series of operation steps to be performed on the computer or other programmable equipment to produce a computer-implemented process, so that the instructions executed on the computer or other programmable equipment provide steps for implementing the function(s) specified in one or more procedures of the flowcharts and/or one or more blocks of the block diagrams.

Obviously, those skilled in the art can make various changes and modifications to the present invention without departing from the spirit and scope of the present invention. Thus, if these modifications and variations of the present invention fall within the scope of the claims of the present invention and equivalent technologies thereof, the present invention is also intended to comprise these modifications and variations.





Drawings

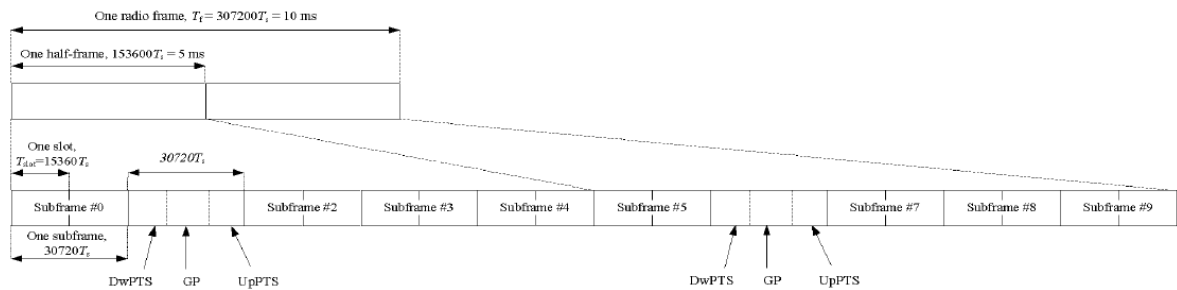


FIG. 1

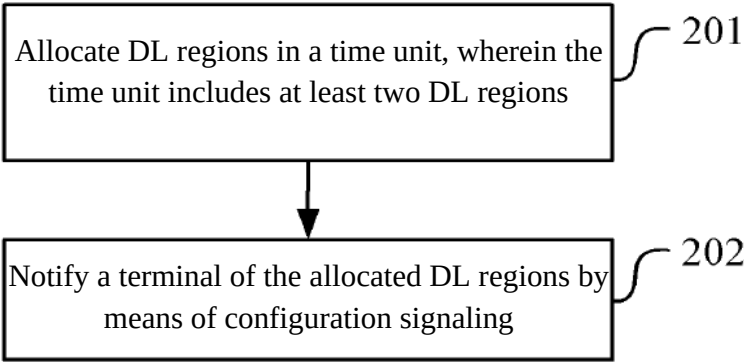


FIG. 2

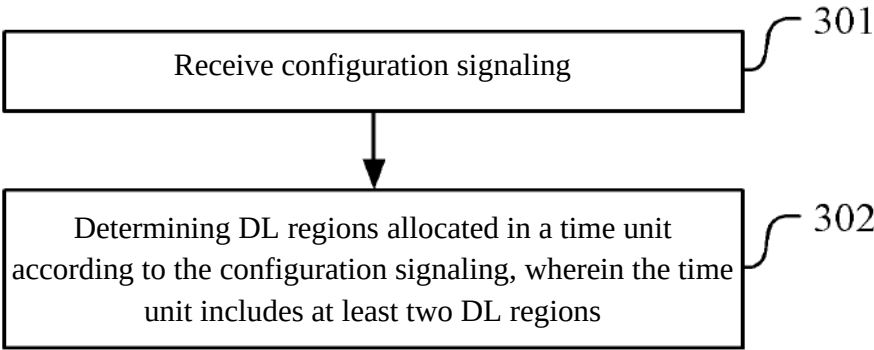


FIG. 3



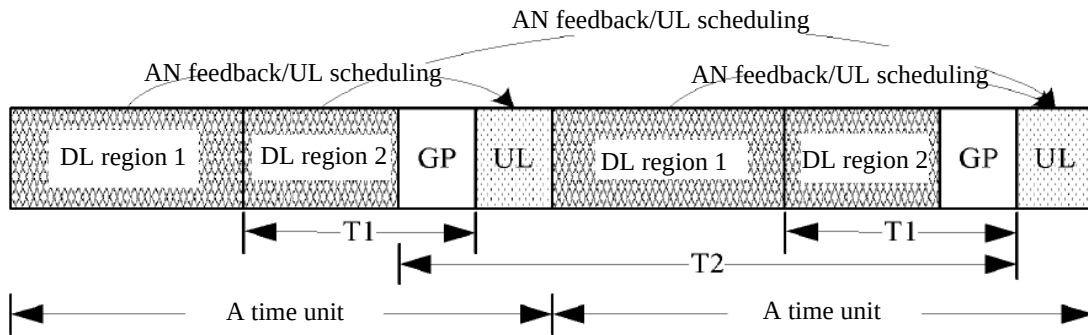


FIG. 4

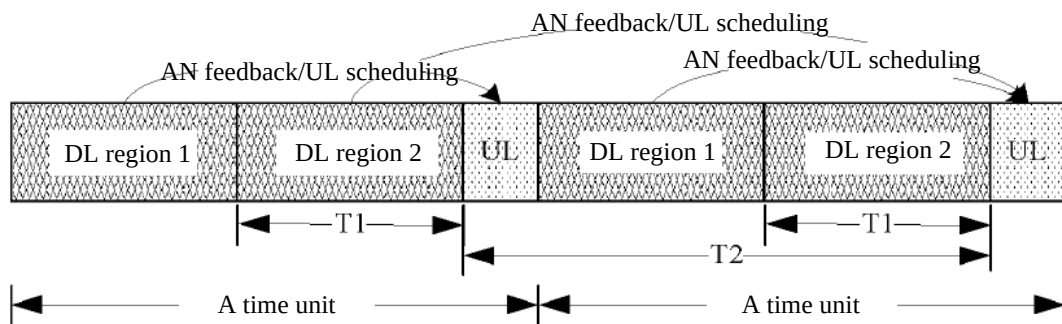


FIG. 5

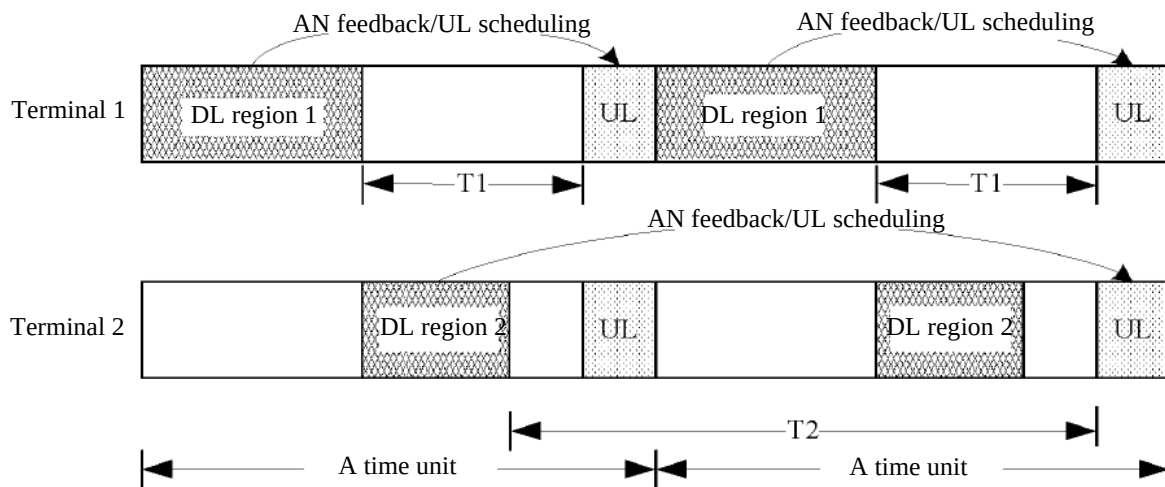


FIG. 6

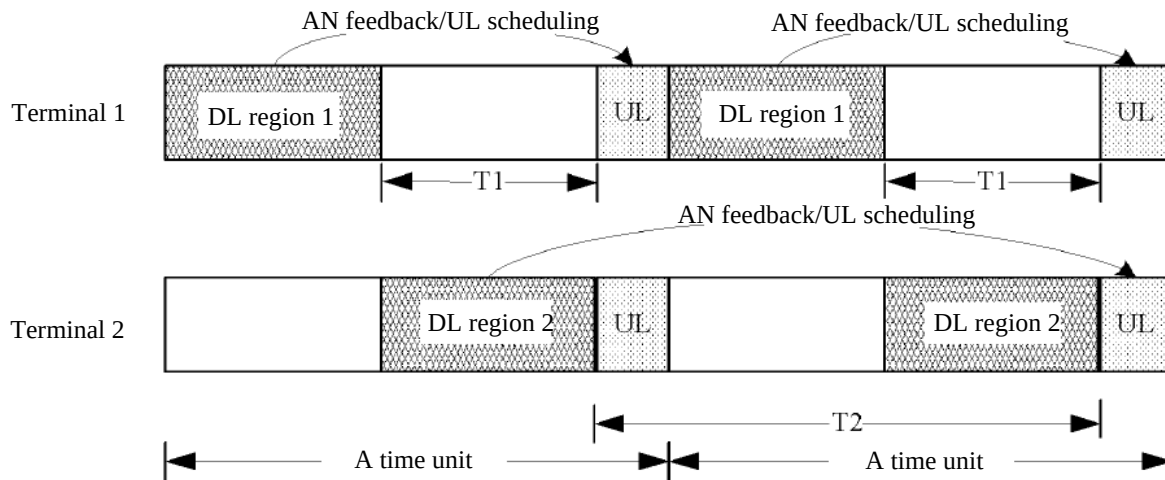


FIG. 7

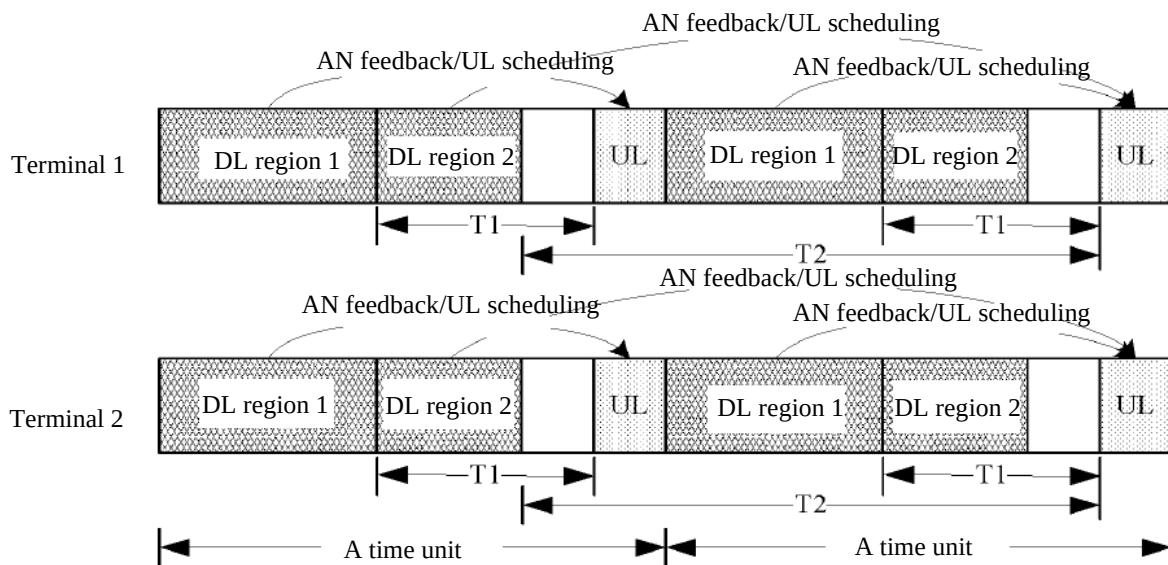


FIG. 8

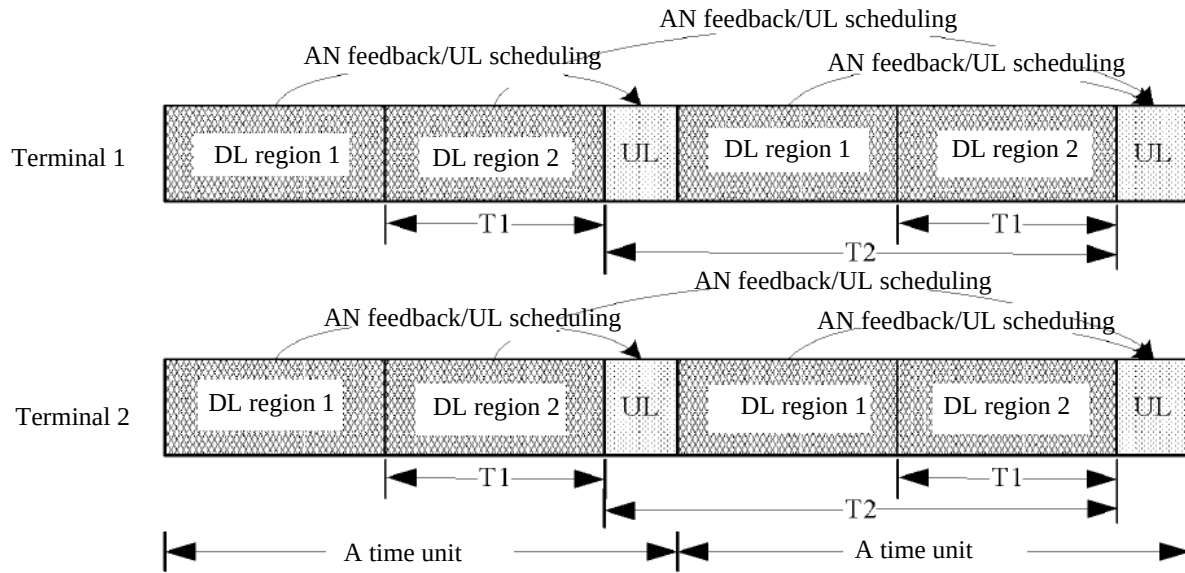


FIG. 9

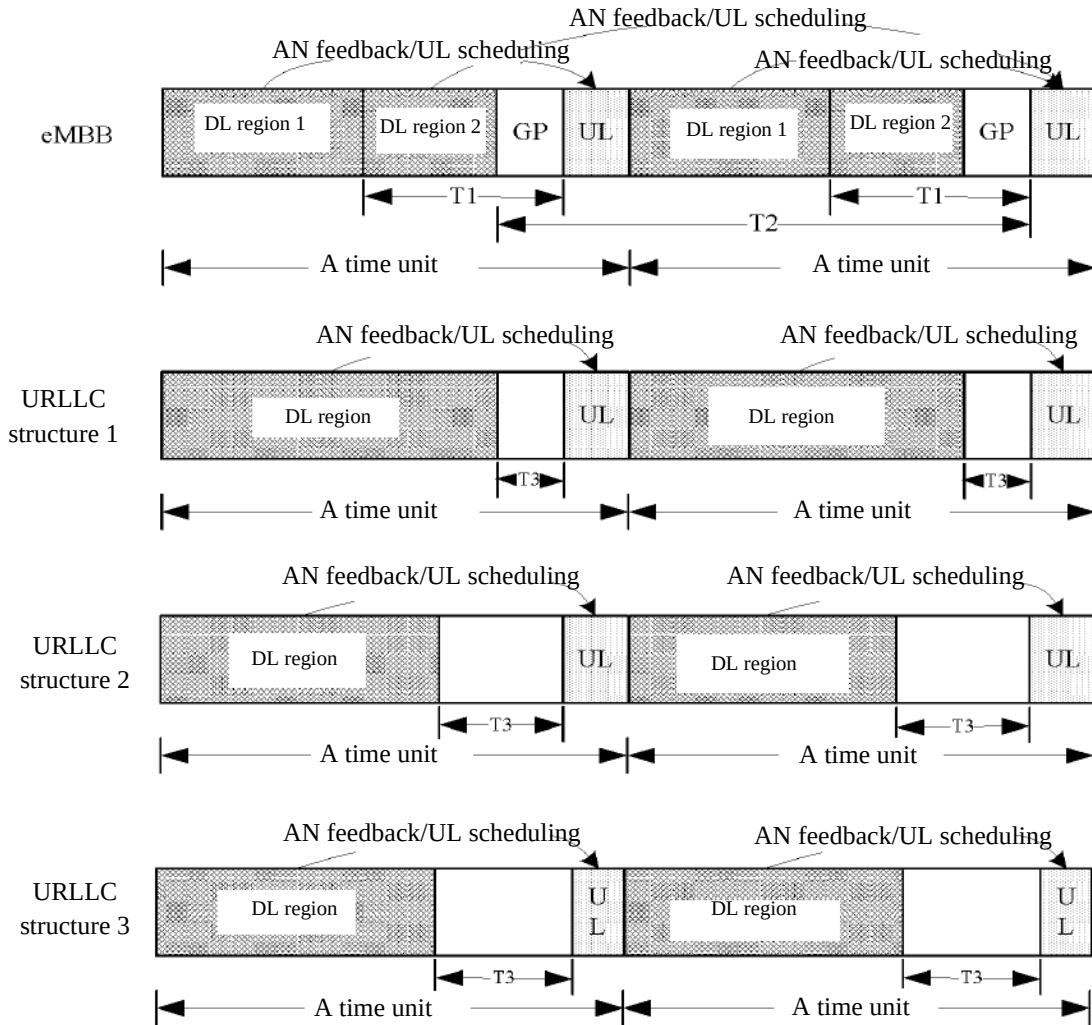


FIG. 10

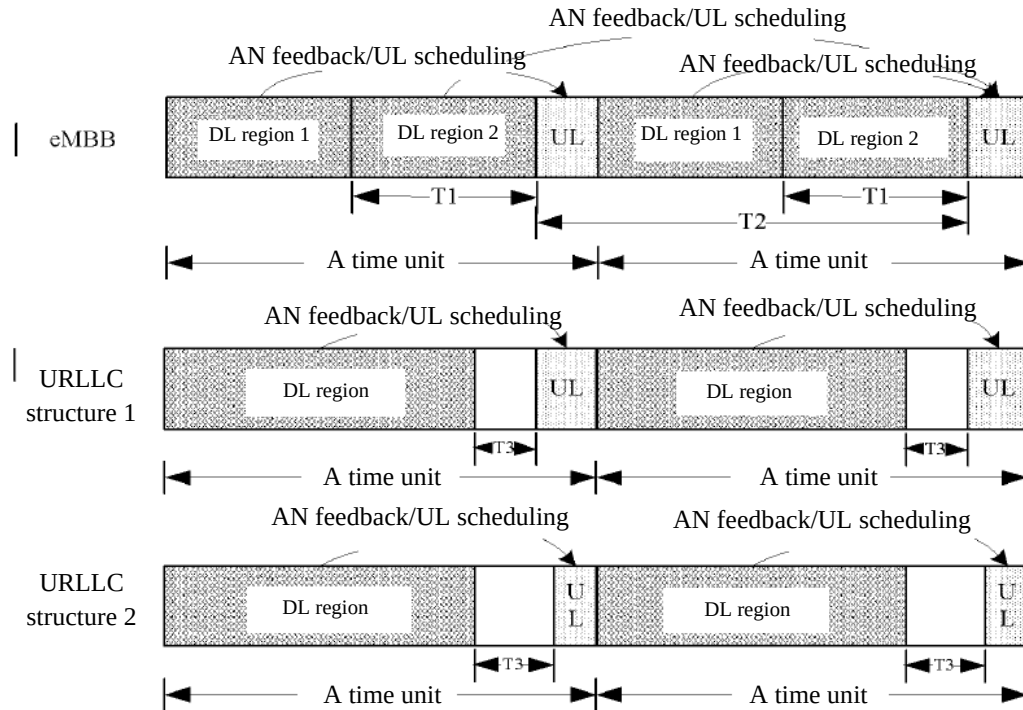


FIG. 11

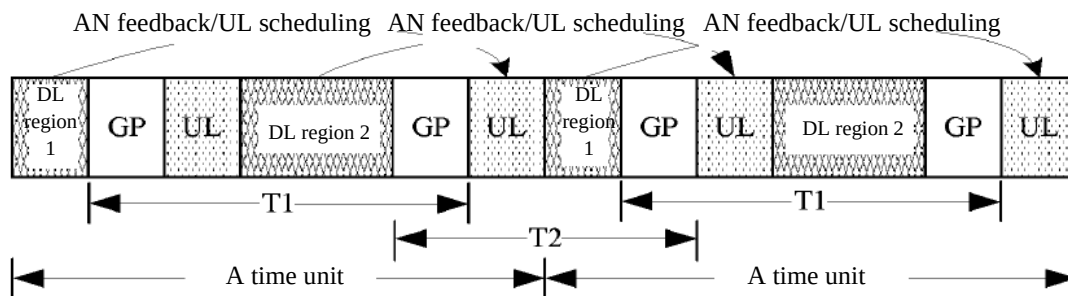


FIG. 12

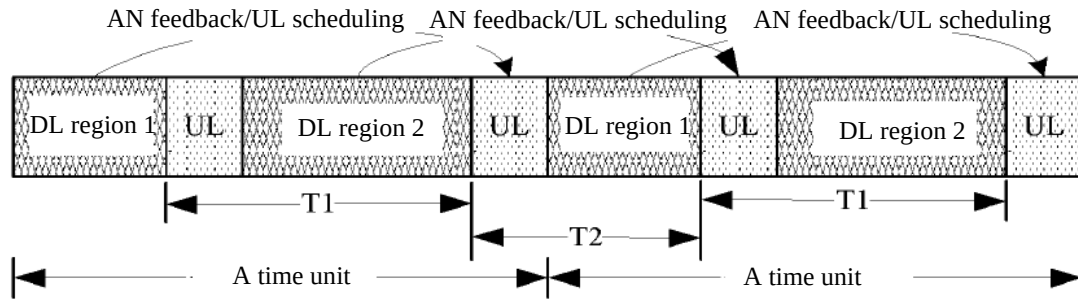


FIG. 13

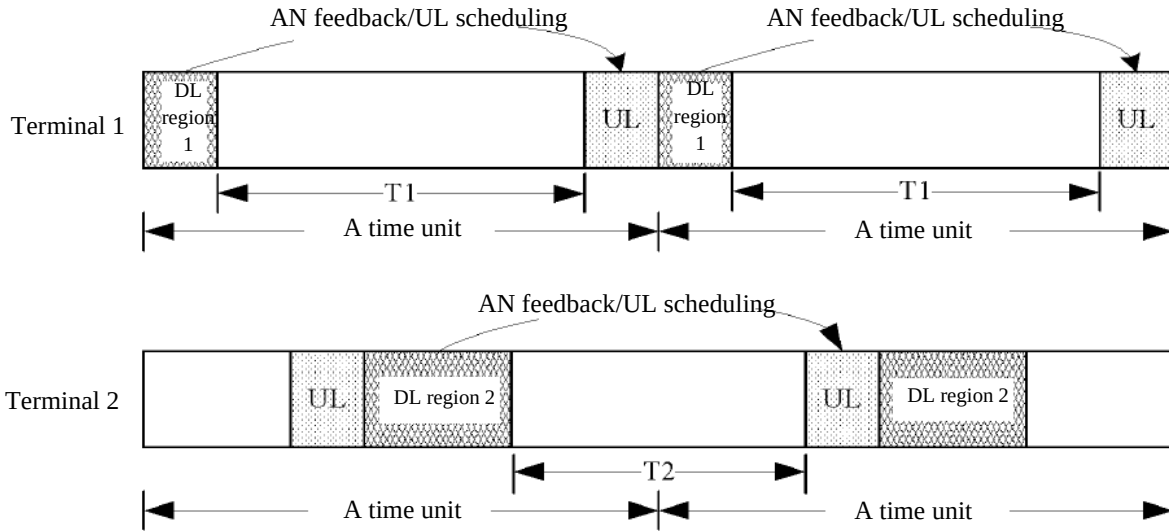


FIG. 14

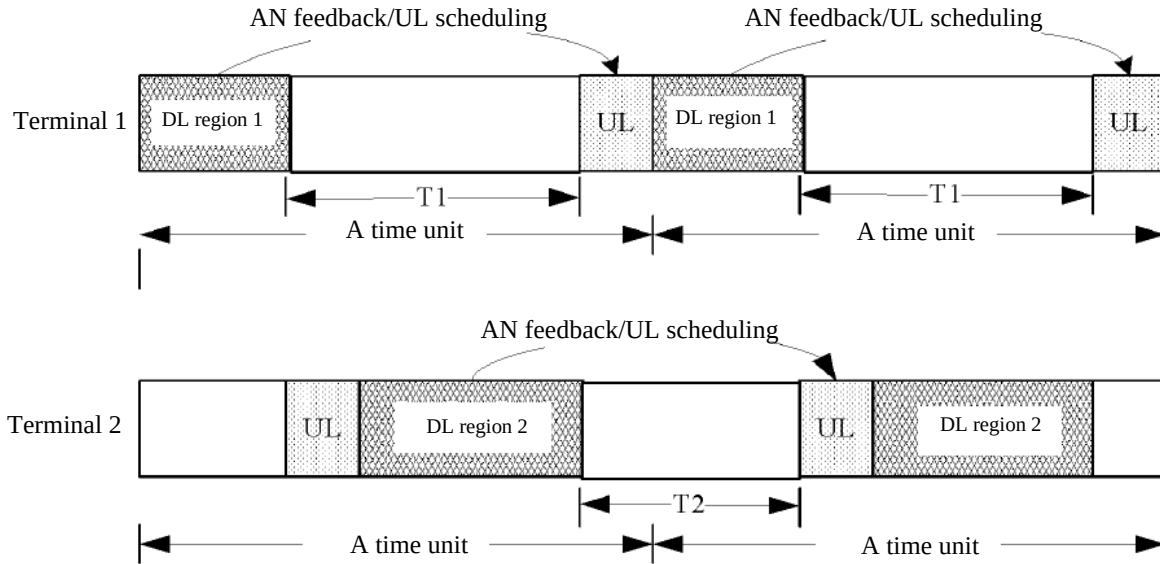


FIG. 15

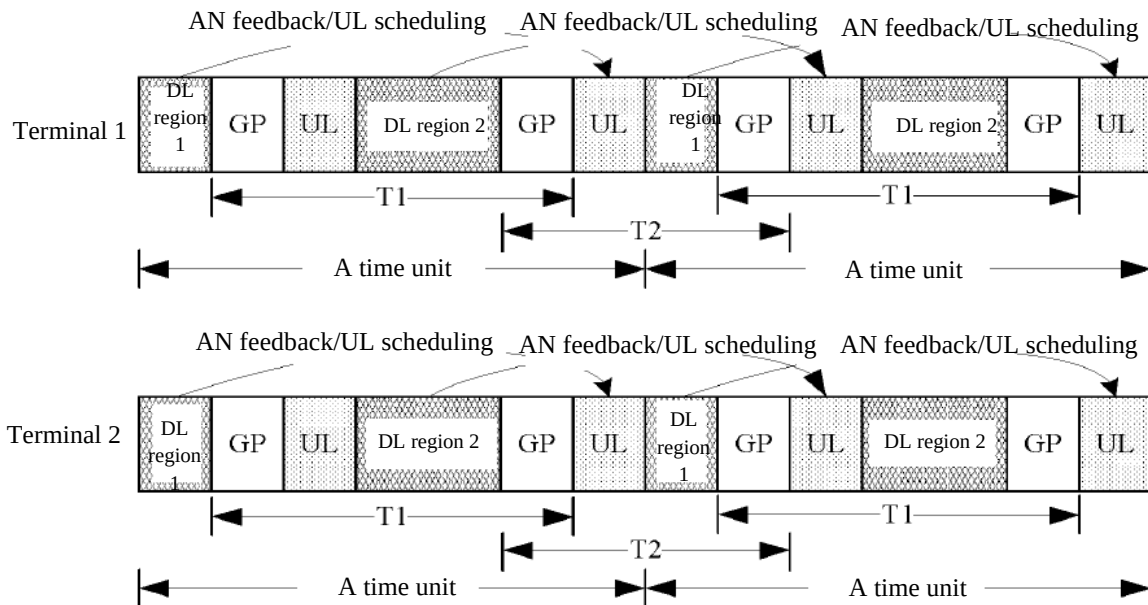




FIG. 16

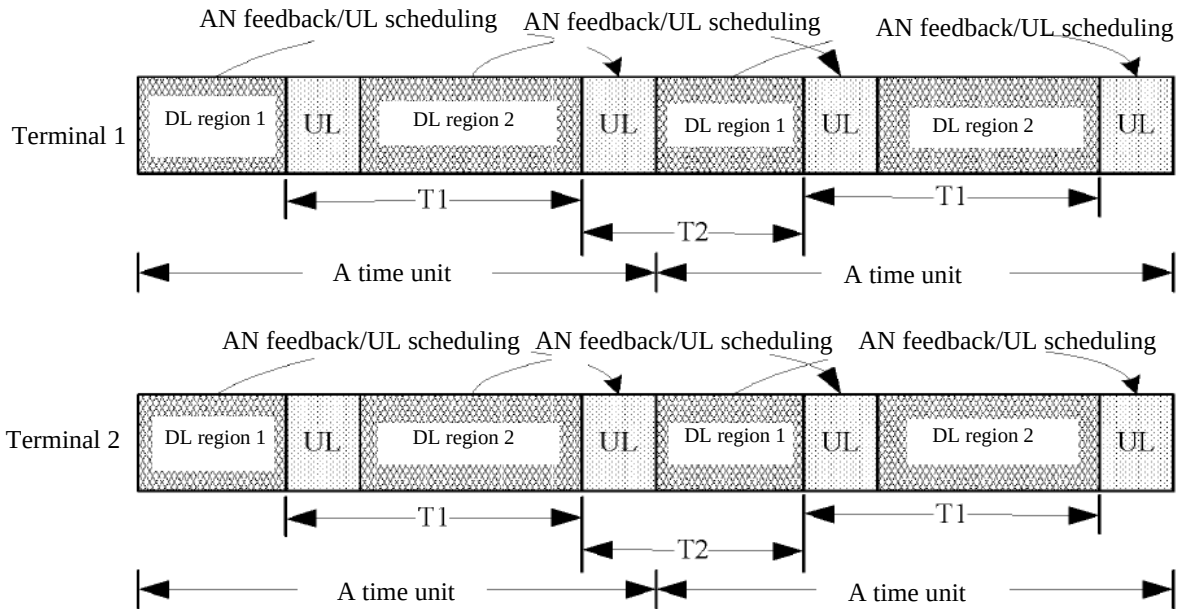


FIG. 17



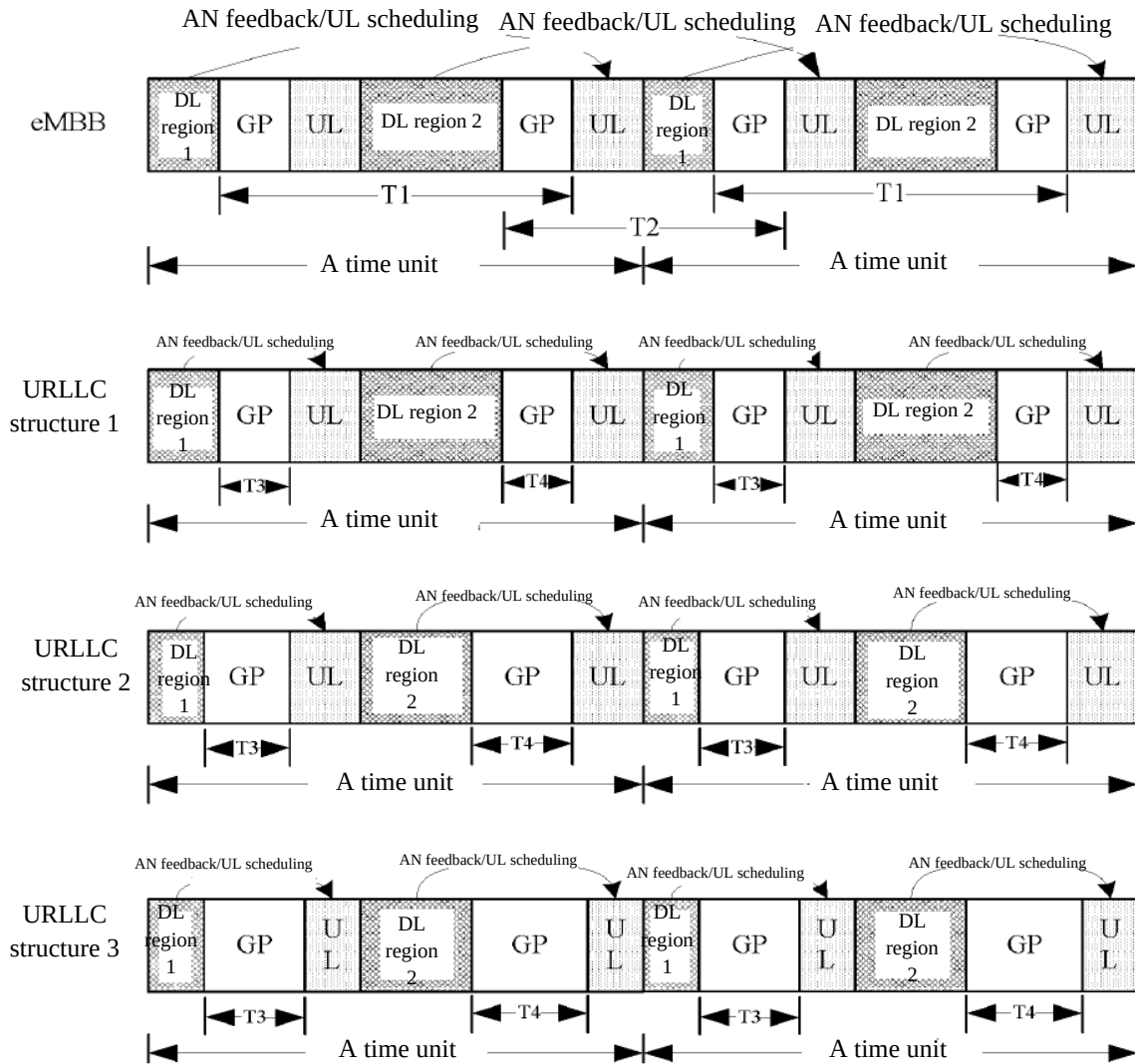


FIG. 18

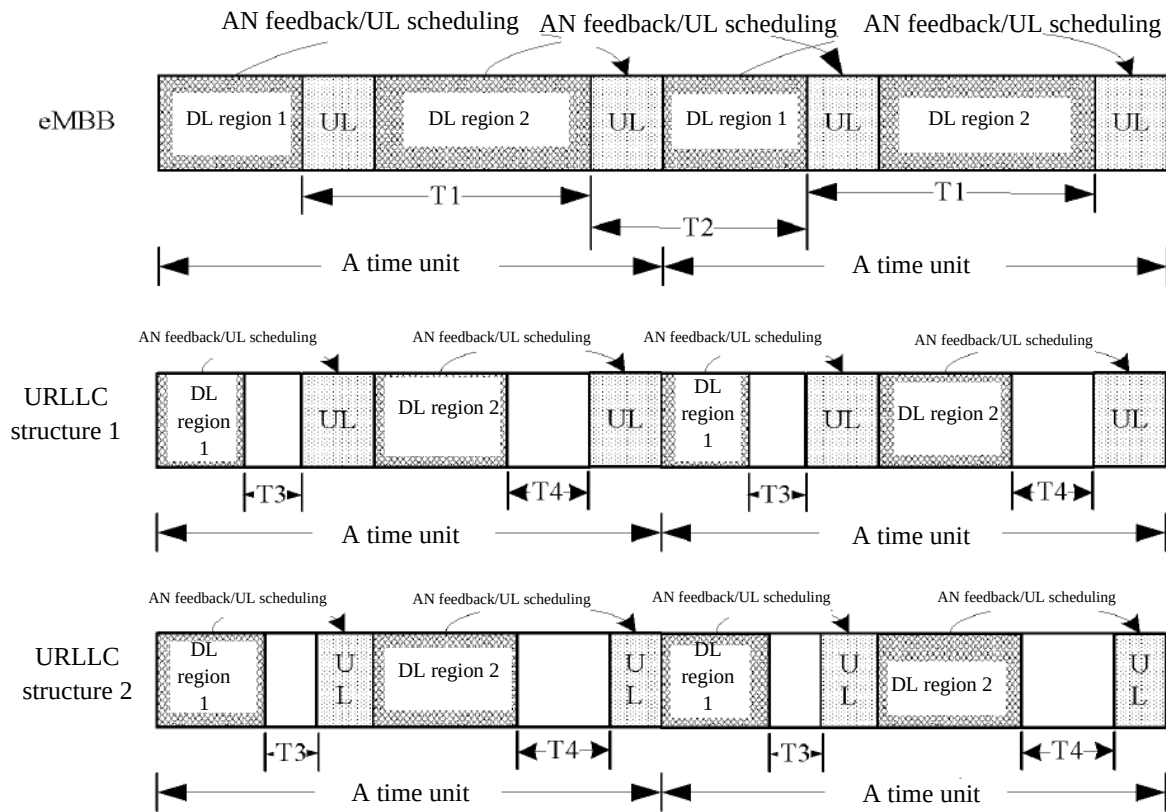


FIG. 19

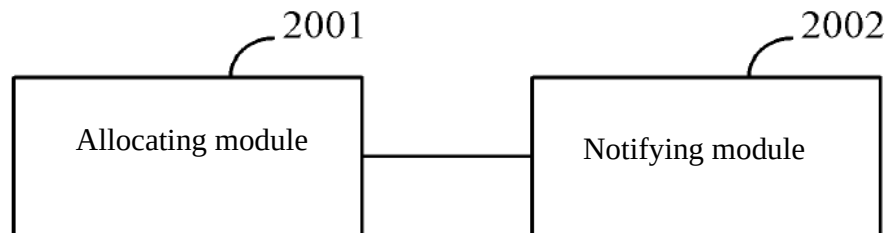


FIG. 20

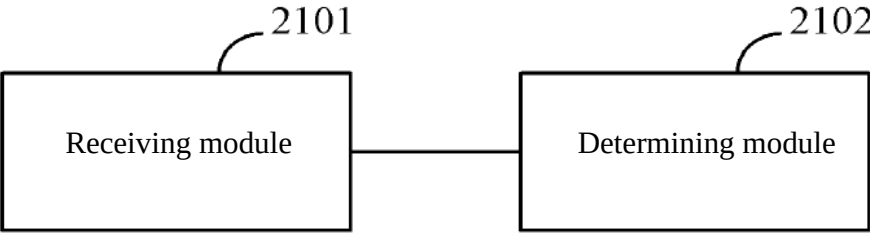


FIG. 21

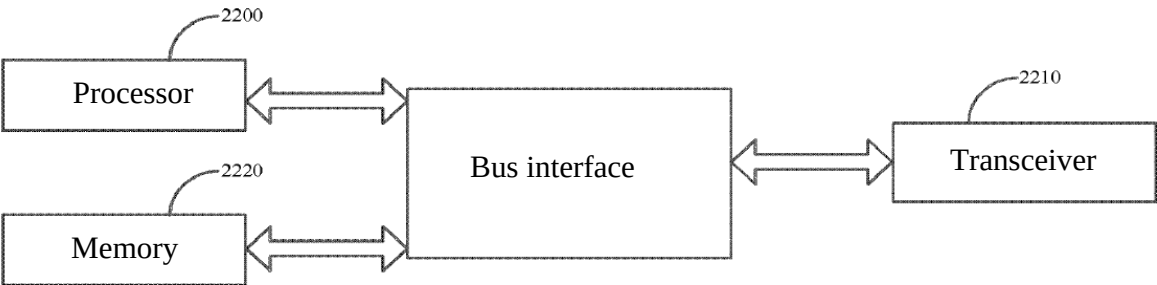


FIG. 22

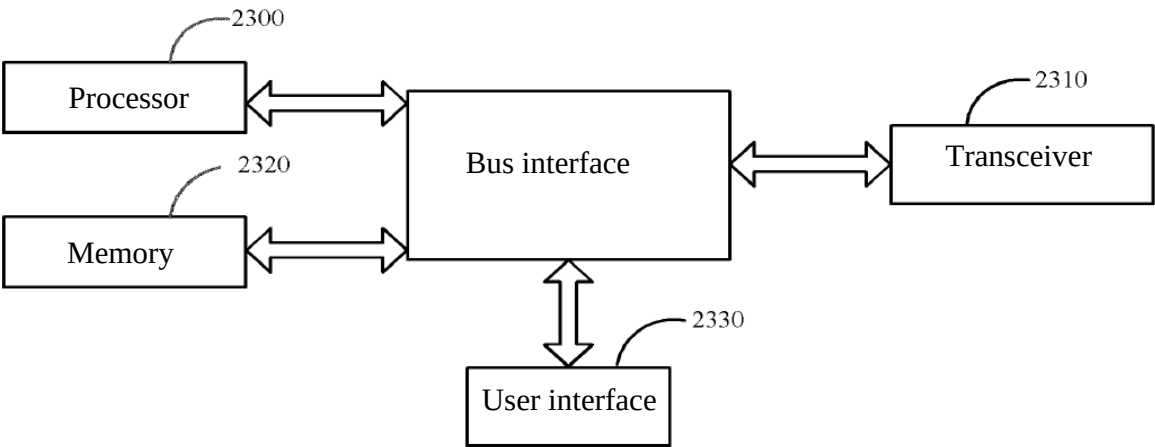


FIG. 23
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