

SCHEDULING INDICATION METHOD AND APPARATUS, AND STORAGE MEDIUM

This application claims priority to Chinese Patent Application No. 201910718562.2 filed Aug. 5, 2019, the disclosure of which is incorporated herein by reference in its entirety.

5 FIELD

The present disclosure relates to wireless communication networks, for example, to a scheduling indication method, a scheduling indication apparatus, and a storage medium.

BACKGROUND

10 In a multiple transport block (TB) scheduling scenario, since hybrid transport is supported, in a case where lots of processes are scheduled, for supporting the highest flexibility, downlink control information (DCI) overhead is significantly increased due to indications for process scheduling, resulting in degrading of performance of physical downlink control channels (PDCCH).

SUMMARY

15 A scheduling indication method, a scheduling indication apparatus, and a storage medium are provided according to the present disclosure to ensure that multiple TB scheduling would not bring too much DCI overhead.

A scheduling indication method is provided according to embodiments of the present disclosure, which includes:

20 scheduling multiple shared channels through a single physical downlink control channel (PDCCH);

where, scheduling information is carried in the single PDCCH, and is used to indicate scheduling for processes corresponding to the multiple shared channels, and the multiple shared channels include a physical uplink shared channel (PUSCH) and/or a physical downlink shared channel (PDSCH);

25 wherein the scheduling information comprises process identification information and new data indication (NDI) information corresponding to processes;

wherein the process identification information is used to indicate index information of scheduled processes, or is used to indicate a start position of indexes of scheduled processes and process number information;

wherein the maximum number of processes scheduled through downlink control information (DCI) is H , the scheduling information is X bits, and the scheduling information is used to indicate an index M of scheduling state; and

5 wherein values of M are determined according to at least process identification information of scheduled processes and NDI information corresponding to the scheduled processes.

A scheduling indication apparatus is provided according to embodiments of the present application, which includes:

a scheduling module configured to schedule multiple shared channels through a single physical downlink control channel (PDCCH);

5 where, scheduling information is carried in the single PDCCH, and is used to indicate scheduling for processes corresponding to the multiple shared channels, and the multiple shared channels include a physical uplink shared channel (PUSCH) and/or a physical downlink shared channel (PDSCH);

wherein the scheduling information comprises process identification information and new data indication (NDI) information corresponding to processes;

10 wherein the process identification information is used to indicate index information of scheduled processes, or is used to indicate a start position of indexes of scheduled processes and process number information;

wherein the maximum number of processes scheduled through downlink control information (DCI) is H, the scheduling information is X bits, and the scheduling information is used to indicate an index M of scheduling state; and

15 wherein values of M are determined according to at least process identification information of scheduled processes and NDI information corresponding to the scheduled processes.

A storage medium is provided according to embodiments of the present application, which stores a computer program, and the computer program, when being executed by a processor, implements the scheduling indication method according to any embodiment of the present disclosure.

20 BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is a flowchart of a scheduling indication method according to an embodiment of the present disclosure;

FIG. 2 is a structural block diagram of a scheduling indication apparatus according to an embodiment of the present disclosure; and

25 FIG. 3 is a schematic structural diagram of a device according to an embodiment of the present disclosure.

DETAILED DESCRIPTION

Embodiments of the present disclosure are described below in detail with reference to the drawings.

Based on the phase of version Release-16, with respect to multiple TB scheduling in scheduling enhancement in enhanced machine type communication (eMTC), hybrid transport and non-hybrid transport are supported when multiple TB scheduling is supported. Based on the scheduling enhancement, indications of process scheduling include information about process identifiers of scheduled processes and new data indication (NDI) corresponding to the scheduled processes. Since in the case of multiple TB scheduling, DCI overhead may be increased significantly due to the process scheduling indications. In view of this, in the embodiments of the present disclosure, reducing the DCI overhead as much as possible is implemented from three aspects: indications for processes scheduling, modulation and coding scheme (MCS) domain compression, and

What is claimed is:

1. A scheduling indication method, comprising:

scheduling a plurality of shared channels through a single physical downlink control channel (PDCCH);

wherein scheduling information is carried in the single PDCCH, and is used to indicate scheduling for processes corresponding to the plurality of shared channels, the plurality of shared channels comprise at least one of a physical uplink shared channel (PUSCH) and a physical downlink shared channel (PDSCH);

wherein the scheduling information comprises process identification information and new data indication (NDI) information corresponding to processes;

wherein the process identification information is used to indicate index information of scheduled processes, or is used to indicate a start position of indexes of scheduled processes and process number information;

wherein the maximum number of processes scheduled through downlink control information (DCI) is H, the scheduling information is X bits, and the scheduling information is used to indicate an index M of scheduling state; and

wherein values of M are determined according to at least process identification information of scheduled processes and NDI information corresponding to the scheduled processes.

2. The method according to claim 1, wherein the scheduling information comprises information for indicating scheduling for a single process or for a plurality of processes, process identification information, and NDI information corresponding to processes;

wherein the process identification information is used to indicate index information of scheduled processes, or is used to indicate a start position of indexes of scheduled processes and process number information.

3. The method according to claim 1, wherein the scheduling information comprises process number identification information, process identification information and NDI information corresponding to processes, and wherein the process number identification information is used to indicate that a number of scheduled processes is greater than a threshold z or a number of scheduled process is less than or equal to a threshold z, and the process identification information is used to indicate index information of scheduled processes, or a start position of indexes of scheduled processes and process number information.

4. The method according to claim 1, wherein the scheduling information comprises

information for indicating scheduling for a hybrid transport or a non-hybrid transport, process identification information and NDI information corresponding to processes, and wherein the non-hybrid transport scheduling refers to that scheduled processes correspond to same NDI information, and the hybrid transport scheduling refers to that the NDI information corresponding to the scheduled processes is not completely the same; the process identification information is used to indicate index information of scheduled processes, or a start position of indexes of scheduled processes and process number information.

5. The method according to claim 1, wherein the value of M is determined according to at least process identification information of scheduled processes and NDI information corresponding to the scheduled processes, comprising:

the value of M is increased in accordance with the number of scheduled processes increasing; or, the value of M is increased in accordance with a start position of scheduled processes increasing.

6. The method according to claim 2, wherein the scheduling information comprises 1 bit information for indicating scheduling for a single process or for a plurality of processes; and

wherein the 1 bit information indicates scheduling for a plurality of processes, j bits in $X-1$ bits are used to indicate NDI information corresponding to j processes, $X-1-j$ bits in the $X-1$ bits are used to indicate process identification information, X is a number of bits of the scheduling information, and j is a number of scheduled processes.

7. The method according to claim 6, wherein in a case of $X=10$, the scheduling state indicated comprises one of:

a number of scheduled processes is 8, 1 bit, for process identification information, in 9 bits is indicated as x , and 8bits for NDI correspond to 8 processes, the 8 processes comprising $x_0x_1x_2x_3x_4x_5x_6x_7$;

a number of scheduled processes is 7, 2 bits for process identification information in the 9 bits are indicated as $\sim x$, x , and 7bits for NDI correspond to 7 processes, the 7 processes comprising $x_0x_1x_2x_3x_4x_5x_6$ or $x_1x_2x_3x_4x_5x_6x_7$;

a number of scheduled processes is 6, 3 bits, for process identification information, in the 9 bits are indicated as $\sim x$, $\sim x$, x , and 6bits for NDI correspond to 6 processes, the 6 processes comprising $x_0x_1x_2x_3x_4x_5$, $x_1x_2x_3x_4x_5x_6$ or $x_2x_3x_4x_5x_6x_7$;

a number of scheduled processes is 5, 4 bits, for process identification information, in the 9

bits are indicated as $\sim x$, $\sim x$, $\sim x$, x , and 5bits for NDI correspond to 5 processes, the 5 processes comprising: $x_0x_1x_2x_3x_4$, $x_1x_2x_3x_4x_5$, $x_2x_3x_4x_5x_6$ or $x_3x_4x_5x_6x_7$;

a number of scheduled processes is 4, 5 bits, for process identification information, in the 9 bits are indicated as $\sim x$, $\sim x$, $\sim x$, $\sim x$, x , and 4bits for NDI correspond to 4 processes, the 4 processes comprising: $x_0x_1x_2x_3$, $x_1x_2x_3x_4$, $x_2x_3x_4x_5$, $x_3x_4x_5x_6$ or $x_4x_5x_6x_7$;

a number of scheduled processes is 3, 6 bits, for process identification information, in the 9 bits are indicated as $\sim x$, $\sim x$, $\sim x$, $\sim x$, $\sim x$, x , and 3bits for NDI correspond to 3 processes, the 3 processes comprising: $x_0x_1x_2$, $x_1x_2x_3$, $x_2x_3x_4$, $x_3x_4x_5$, $x_4x_5x_6$ or $x_5x_6x_7$;

a number of scheduled processes is 2, 7 bits, for process identification information, in the 9 bits are indicated as $\sim x$, $\sim x$, $\sim x$, $\sim x$, $\sim x$, $\sim x$, x , or $\sim x$, $\sim x$, $\sim x$, $\sim x$, $\sim x$, $\sim x$, and 2bits for NDI correspond to 2 processes, the 2 processes comprising: x_0x_1 , x_1x_2 , x_2x_3 , x_3x_4 , x_4x_5 , x_5x_6 or x_6x_7 ; and

wherein $x \in \{0,1\}$, $\sim x$ denotes a negative x , $x_0, x_1, x_2, x_3, x_4, x_5, x_6, x_7$ respectively correspond to NDI information corresponding to a process with a process identifier as 0, NDI information corresponding to a process with a process identifier as 1, NDI information corresponding to a process with a process identifier as 2, NDI information corresponding to a process with a process identifier as 3, NDI information corresponding to a process with a process identifier as 4, NDI information corresponding to a process with a process identifier as 5, NDI information corresponding to a process with a process identifier as 6, and NDI information corresponding to a process with a process identifier as 7, and each of $x_0, x_1, x_2, x_3, x_4, x_5, x_6, x_7 \in \{0,1\}$.

8. The method according to claim 6, wherein the maximum number of processes scheduled through DCI is 4, the scheduling information is 6 bits, and wherein 5 bits in the 6 bits are used to indicate process identification information of scheduling for a plurality of processes and NDI information corresponding to processes, the scheduling state indicated by the 5 bits comprises at least one of:

a number of scheduled processes is 4, 1 bit, for process identification information, in the 5 bits is indicated as x , 4bits for NDI correspond to 4 processes, the 4 processes comprising $x_0x_1x_2x_3$;

a number of scheduled processes is 3, 2 bits, for process identification information, in the 5 bits are indicated as $\sim x$, x , 3bits for NDI correspond to 3 processes, the 3 processes

comprising $x_0x_1x_2$ or $x_1x_2x_3$;

a number of scheduled processes is 2, 3 bits, for process identification information, in the 5 bits are indicated as $\sim x$, $\sim x \sim x$ or $\sim x$, $\sim x$, x , 2bits for NDI correspond to 2 processes, the 2 processes comprising x_0x_1 , x_1x_2 or x_2x_3 ;

wherein, $x \in \{0,1\}$, $\sim x$ denotes negative x , x_0 , x_1 , x_2 and x_3 respectively correspond to NDI information corresponding to a process with a process identifier as 0, NDI information corresponding to a process with a process identifier as 1, NDI information corresponding to a process with a process identifier as 2 and NDI information corresponding to a process with a process identifier as 3, each of x_0 , x_1 , x_2 , $x_3 \in \{0,1\}$.

9. The method according to claim 2, wherein the scheduling information indicates scheduling for a plurality of process, and the scheduling information further comprises information used to indicate scheduling for a hybrid transport scheduling or a non-hybrid transport scheduling; or, wherein the scheduling information further comprises process number identification information, and the process number identification information is used to indicate that a number of scheduled processes is greater than a threshold z or a number of scheduled processes is less than or equal to the threshold z .

10. The method according to claim 1, further comprising:

indicating an MCS domain of the plurality of shared channels, wherein an MCS domain corresponding to a case of scheduling for the plurality of shared channels enabled is 2 bits less than an MCS domain corresponding to a case of scheduling for the plurality of shared channels disabled; and

indexes of the MCS domain corresponding to a case of scheduling for the plurality of shared channels enabled are selected from indexes of an MCS domain corresponding to a case of scheduling for the plurality of shared channels disabled, wherein a selection principle is $I_{MCS} = P * n + Q$, P , Q and n are all integers, and I_{MCS} is an integer with a value range from 0 to 15.

11. The method according to claim 10, wherein

$P=2$, $I_{MCS} = 2n + Q$, and Q is at least one of 1, 3, 5, 7, 9; or,

$P=3$, $I_{MCS} = 3n + Q$, and Q is at least one of -3, 0, 3, 6, 9; or,

P=4, $I_{MCS} = 4n + Q$, and Q is at least one of -1, 3, 7; or,

P=5, Q is 0, and $I_{MCS} = 5n$.

12. The method according to claim 1, further comprising:

indicating a resource allocation domain of the plurality of shared channels; wherein a first mode is adopted, and the resource allocation domain occupies 1 bit, and comprises a state in which the number of corresponding physical resource blocks (PRB) is 6 and a state in which the number of corresponding PRBs is 4.

13. The method according to claim 1, further comprising:

determining positions of gaps, wherein, a gap is inserted every first preset subframes, a number of the first preset subframes is determined according to an interleaving granularity of transport blocks (TB), a number of scheduled TBs, and a preset threshold value, and the number of the first preset subframes is calculated through the following formular:

$$G * N_{TB} * \left\lceil \frac{\Theta}{G * N_{TB}} \right\rceil, \text{ or } G * N_{TB} * \left\lfloor \frac{\Theta}{G * N_{TB}} \right\rfloor;$$

wherein, G is the interleaving granularity, N_{TB} represents a number of scheduled TBs, Θ is the preset threshold, $\lceil \rceil$ is round up, and $\lfloor \rfloor$ is round down.

14. The method according to claim 1, further comprising:

determining positions of gaps, wherein a gap is inserted every second preset subframes, a number of the second preset subframes is determined according to a number of scheduled TBs, a number of repeat times of TBs, and a number of the inserted gaps, the number of the second preset subframes is calculated through the following formular:

$$N_{TB} * \frac{R}{2^n},$$

wherein, N_{TB} represents a number of scheduled TBs, R is a number of repeat times of TBs,

$2^n - 1 \leq \frac{R * N_{TB}}{\Theta} \leq 2^{n+1} - 1$, Θ is a preset threshold, the number of the inserted gaps is $2^n - 1$, and n is an integer.

15. The method according to claim 1, further comprising:

determining positions of gaps, wherein, a number of the inserted gaps is configured through a radio resource control (RRC) signal, and the positions of the gaps are obtained according to the configured number of the inserted gaps.

16. A scheduling indication apparatus, comprising:

a scheduling module configured to schedule a plurality of shared channels through a single physical downlink control channel (PDCCH);

wherein the scheduling information is carried in the single PDCCH to indicate scheduling for processes corresponding to the plurality of shared channels, the plurality of shared channels comprise at least one of a physical uplink shared channel (PUSCH) and a physical downlink shared channel (PDSCH);

wherein the scheduling information comprises process identification information and new data indication (NDI) information corresponding to processes;

wherein the process identification information is used to indicate index information of scheduled processes, or is used to indicate a start position of indexes of scheduled processes and process number information;

wherein the maximum number of processes scheduled through downlink control information (DCI) is H , the scheduling information is X bits, and the scheduling information is used to indicate an index M of scheduling state; and

wherein values of M are determined according to at least process identification information of scheduled processes and NDI information corresponding to the scheduled processes.

17. A non-transitory computer-readable storage medium storing a computer program, wherein the computer program, when executed by a processor, implements:

scheduling a plurality of shared channels through a single physical downlink control channel (PDCCH);

wherein the scheduling information is carried in the single PDCCH to indicate scheduling for processes corresponding to the plurality of shared channels, the plurality of shared channels comprise at least one of a physical uplink shared channel (PUSCH) and a physical downlink shared channel (PDSCH);

wherein the scheduling information comprises process identification information and new data indication (NDI) information corresponding to processes;

wherein the process identification information is used to indicate index information of scheduled processes, or is used to indicate a start position of indexes of scheduled processes and process number information;

wherein the maximum number of processes scheduled through downlink control information (DCI) is H , the scheduling information is X bits, and the scheduling information is used to indicate an index M of scheduling state; and

wherein values of M are determined according to at least process identification information of scheduled processes and NDI information corresponding to the scheduled processes.