

DETERMINING A FEEDBACK CODEBOOK

TECHNICAL FIELD

This patent document is directed generally to wireless communications.

BACKGROUND

5 Mobile communication technologies are moving the world toward an increasingly connected and networked society. The rapid growth of mobile communications and advances in technology have led to greater demand for capacity, connectivity, and reliability. Other aspects, such as energy consumption, device cost, spectral efficiency, and latency are also important to meeting the needs of various communication scenarios. Various techniques, including new ways
10 to provide higher quality of service, longer battery life, and improved performance are being discussed.

SUMMARY

 This document discloses methods, systems, apparatuses, and computer readable media related to wireless communication, and in particular to a method and apparatus for
15 scheduling in a 5G system and determining a feedback codebook size.

 In one aspect, a method of wireless communication is disclosed. The method includes sending, from a first radio terminal to a second radio terminal, a grant message to allow transmission in a future time slot, wherein the future timeslot corresponds to resources of a dummy shared channel in a first direction corresponding to uplink. The method includes
20 scheduling one or more resources of a shared channel in a second direction corresponding to downlink with corresponding acknowledgement that overlaps in time with the dummy shared channel in the first direction wherein no uplink data is transmitted on the dummy shared channel. The following examples are not intended to be limiting. Although specific communications equipment is listed, other equipment may be used in their place. In some example embodiments,
25 the first radio terminal is a base station such as an enhanced node B (eNB) or a next generation node B (gNB) or another base station. The second radio terminal may be a user equipment, mobile terminal, handset, smartphone, cell phone, or other mobile device. The dummy shared channel in the first direction may be a dummy physical uplink shared channel (PUSCH) or

another communications resource. The shared channel in the second direction may be a physical downlink shared channel (PDSCH)

or another communications resource. The acknowledgement message may be a hybrid automatic repeat request acknowledgement (HARQ-ACK) or another acknowledgement or ACK/NACK message. The assignment indicator may be a downlink assignment indicator (DAI) or other assignment message or indicator. The first direction may correspond to an uplink and the second
5 direction may correspond to a downlink.

In another aspect, another method for wireless communication is disclosed. The method includes sending, from a first radio terminal to a second radio terminal, a grant to allow transmission in a future time slot, wherein the future timeslot corresponds to resources of a non-dummy shared channel in a first direction corresponding to uplink. The method further includes
10 forbidding the scheduling of one or more resources of a shared channel in the second direction corresponding to downlink with corresponding acknowledgement that overlaps in time with the non-dummy shared channel in the first direction wherein uplink data is transmitted on the non-dummy shared channel.

In another aspect, another method for wireless communication is disclosed. The method includes sending, from a first radio terminal to a second radio terminal, a grant message to allow transmission in a future time slot, wherein the future timeslot corresponds to resources of a dummy shared channel in a first direction corresponding to uplink. The method further includes sending one or more subsequent grants to schedule resources of a shared channel in a second direction corresponding to downlink with an acknowledgement that overlaps in time with
15 the dummy shared channel in the first direction, and receiving a feedback acknowledgement codebook with a number of bits determined by an assignment indicator in a last sent grant wherein no uplink data is transmitted on the dummy shared channel.

In another aspect, another method for wireless communication is disclosed. The method includes sending, from a first radio terminal to a second radio terminal, a grant message to allow transmission in a future time slot, wherein the future timeslot corresponds to resources of a dummy shared channel in a first direction corresponding to uplink. The method further includes receiving a feedback acknowledgement codebook with a number of bits determined by an assignment indicator in a last sent grant when the first radio terminal does not send one or more subsequent grants to schedule resources of the shared channel in a second direction
25 corresponding to downlink with an acknowledgement that overlaps in time with the dummy shared channel in the first direction wherein no uplink data is transmitted on the dummy shared

channel.

In another aspect, another method for wireless communication is disclosed. The method includes receiving, at a second radio terminal from a first radio terminal, a grant message to allow transmission in a future time slot, wherein the future timeslot corresponds to resources

of a dummy shared channel in a first direction corresponding to uplink. The method includes receiving one or more resources of a shared channel in a second direction corresponding to downlink with corresponding acknowledgement that overlaps in time with the dummy shared channel in the first direction wherein no uplink data is transmitted on the dummy shared channel.

5 In another aspect, another method for wireless communication is disclosed. The method includes receiving, at a first radio from to a second radio terminal, a grant to allow transmission in a future time slot, wherein the future timeslot corresponds to resources of a non-dummy shared channel in a first direction corresponding to uplink. The method further includes failing to receive via one or more resources of a shared channel in the second direction
10 corresponding to downlink with corresponding acknowledgement that overlaps in time with the non-dummy shared channel in the first direction wherein uplink data is transmitted on the non-dummy shared channel.

 In another aspect, another method for wireless communication is disclosed. The method includes receiving, at a first radio terminal from a second radio terminal, a grant message
15 to allow transmission in a future time slot, wherein the future timeslot corresponds to resources of a dummy shared channel in a first direction corresponding to uplink. The method further includes receiving one or more subsequent grants to schedule resources of a shared channel in a second direction corresponding to downlink with an acknowledgement that overlaps in time with the dummy shared channel in the first direction. The method further includes sending feedback
20 acknowledgement codebook with a number of bits determined by an assignment indicator in a last received grant wherein no uplink data is transmitted on the dummy shared channel.

 In another aspect, another method for wireless communication is disclosed. The method includes receiving, at a first radio terminal from a second radio terminal, a grant message to allow transmission in a future time slot, wherein the future timeslot corresponds to resources
25 of a dummy shared channel in a first direction corresponding to uplink. The method further includes sending a feedback acknowledgement codebook with a number of bits determined by an assignment indicator in a last received grant when the second radio terminal does not receive one or more subsequent grants to schedule resources of the shared channel in a second direction corresponding to downlink with an acknowledgement that overlaps in time with the dummy
30 shared channel in the first direction wherein no uplink data is transmitted on the dummy shared channel.

The details of one or more implementations are set forth in the accompanying attachments, the drawings, and the description below. Other features will be apparent from the description and drawings, and from the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

5 FIGs. 1-7 depict various allocations of communications resources, in accordance with

CLAIMS

1. A wireless communications method, comprising:
sending, from a first radio terminal to a second radio terminal, a grant message to allow
5 transmission in a future time slot, wherein the future timeslot corresponds to resources of a
dummy shared channel in a first direction corresponding to uplink; and
scheduling one or more resources of a shared channel in a second direction corresponding
to downlink with a corresponding acknowledgement that overlaps in time with the dummy
shared channel in the first direction;
10 wherein no uplink data is transmitted on the dummy shared channel.
2. A wireless communications method, comprising:
sending, from a first radio terminal to a second radio terminal, a grant to allow
transmission in a future time slot, wherein the future timeslot corresponds to resources of a non-
15 dummy shared channel in a first direction corresponding to uplink; and
forbidding the scheduling of one or more resources of a shared channel in a second
direction corresponding to downlink with a corresponding acknowledgement that overlaps in
time with the non-dummy shared channel in the first direction;
wherein uplink data is transmitted on the non-dummy shared channel.
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3. The method of claim 2, wherein a last message received at the second radio terminal is
the grant message.
4. A wireless communications method, comprising:
25 sending, from a first radio terminal to a second radio terminal, a grant message to allow
transmission in a future time slot, wherein the future timeslot corresponds to resources of a
dummy shared channel in a first direction corresponding to uplink;
sending one or more subsequent grants to schedule resources of a shared channel in a
second direction corresponding to downlink with an acknowledgement that overlaps in time with
30 the dummy shared channel in the first direction; and

receiving a feedback acknowledgement codebook with a number of bits determined by an assignment indicator in a last sent grant;

wherein no uplink data is transmitted on the dummy shared channel.

5 5. A wireless communications method, comprising:

sending, from a first radio terminal to a second radio terminal, a grant message to allow transmission in a future time slot, wherein the future timeslot corresponds to resources of a dummy shared channel in a first direction corresponding to uplink; and

10 receiving a feedback acknowledgement codebook with a number of bits determined by an assignment indicator in a last sent grant when the first radio terminal does not send one or more subsequent grants to schedule resources of the shared channel in a second direction corresponding to downlink with an acknowledgement that overlaps in time with the dummy shared channel in the first direction;

wherein no uplink data is transmitted on the dummy shared channel.

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6. The method of claim 5, wherein a last message received at the second radio terminal is the grant message.

7. A wireless communications method, comprising:

20 receiving, at a second radio terminal from a first radio terminal, a grant message to allow transmission in a future time slot, wherein the future timeslot corresponds to resources of a dummy shared channel in a first direction corresponding to uplink; and

25 receiving one or more resources of a shared channel in a second direction corresponding to downlink with corresponding acknowledgement that overlaps in time with the dummy shared channel in the first direction;

wherein no uplink data is transmitted on the dummy shared channel.

8. The method of claim 1 or 7, wherein one or more intervening messages comprising one or more resources of the shared channel in the second direction are sent between the grant message and the corresponding acknowledgement.

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9. A wireless communications method, comprising:
receiving, at a first radio terminal from a second radio terminal, a grant to allow transmission in a future time slot, wherein the future timeslot corresponds to resources of a non-dummy shared channel in a first direction corresponding to uplink; and
5 failing to receive via one or more resources of a shared channel in a second direction corresponding to downlink with corresponding acknowledgement that overlaps in time with the non-dummy shared channel in the first direction;
wherein uplink data is transmitted on the non-dummy shared channel.
10. A wireless communications method, comprising:
receiving, at a first radio terminal from a second radio terminal, a grant message to allow transmission in a future time slot, wherein the future timeslot corresponds to resources of a dummy shared channel in a first direction corresponding to uplink;
receiving one or more subsequent grants to schedule resources of a shared channel in a
15 second direction corresponding to downlink with an acknowledgement that overlaps in time with the dummy shared channel in the first direction; and
sending feedback acknowledgement codebook with a number of bits determined by an assignment indicator in a last received grant;
wherein no uplink data is transmitted on the dummy shared channel.
- 20 11. The method of claim 1, 4, 7 or 10, wherein a last message received at the second radio terminal is a last scheduled resource of the shared channel in the second direction, or the grant message.
- 25 12. A wireless communications method, comprising:
receiving, at a first radio terminal from a second radio terminal, a grant message to allow transmission in a future time slot, wherein the future timeslot corresponds to resources of a dummy shared channel in a first direction corresponding to uplink; and
sending a feedback acknowledgement codebook with a number of bits determined by an
30 assignment indicator in a last received grant when the second radio terminal does not receive one or more subsequent grants to schedule resources of the shared channel in a second direction

corresponding to downlink with an acknowledgement that overlaps in time with the dummy shared channel in a first direction;

wherein no uplink data is transmitted on the dummy shared channel.

- 5 13. The method of claim 9 or 12, wherein a last message received at the second radio terminal is the grant message.

14. A wireless communication apparatus, comprising a processor configured to implement a method recited in any one or more of claims 1 to 13.

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15. A computer program product having code stored thereon, the code, when executed by a processor, causing the processor to implement a method recited in any one or more of claims 1 to 13.